# An Analysis of the Effects of State Financial Aid Policy on the Timing of Postsecondary Enrollment: A Focus on Income and Race Differences

by

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ABSTRACT

An Analysis of the Effects of State Financial Aid Policy on the Timing of Postsecondary Enrollment: A Focus on Income and Race Differences

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The driving force behind the recent increase in financial aid for college education is the rapid growth of state merit-based grant programs that provide scholarships to students who meet predefined standards of academic preparation at the state level, and this trend represents one of the most pronounced policy shifts away from a long tradition of need-based aid. Despite the existing literature on the role of financial aid policies in college-choice decisions for students from different backgrounds, researchers have paid limited attention to exploring socioeconomic and race/ethnic differences as well as the role of financial aid associated with the *timing* of student enrollment. Given that high school graduates enroll in college at different time points and financial aid is an important predictor of *whether* and *where* a student enrolls as well as *when* a student enrolls in college, this study explores the effects that state financial aid policies have on the

occurrence as well as the timing of postsecondary enrollment for high school graduates (or equivalent diploma holders).

Utilizing event history modeling on a nationally representative sample from the National Education Longitudinal Study (NELS:88/2000) in addition to state-level policy variables, this study examined how state aid policies differentially affect students' postsecondary enrollment depending on their family income and race/ethnicity between the years 1992 through 2000. The findings demonstrate that there is a clear and consistent gap in college enrollment for students who are from different income and race/ethnic groups, and that state financial aid significantly affects students' enrollment probabilities. The results also indicate that the effects of state financial aid vary by income and racial/ethnic backgrounds. The series of simulations conducted revealed that low-income students had enrollment propensities that were more responsive to changes in state aid policy for every racial group, but high increases in the provision of state financial aid do not appear to benefit all race/ethnic groups equally in terms of college participation. The study findings have important implications for state aid policy as well as future research on the role of public financial aid policies in college choice of students from different income and racial/ethnic backgrounds.

# Chapter I

## INTRODUCTION

The transition from secondary school to a college is a complex multistage process situated in one's social, psychological, and economic contexts, and the choices students make are constrained and enabled by financial means and incentives (Hossler, Braxton, & Coopersmith, 1989; St. John, Asker, & Hu, 2001). Since the first Higher Education Act in 1965 formalized the system of student aid programs, it has traditionally been a goal of financial aid policy to break the link between family socioeconomic background and college opportunities (McPherson & Schapiro, 2006). The rise in broad-based state merit aid programs since the early 1990s, however, represents one of the most pronounced policy shifts away from a long tradition of need-based aid (McPherson & Schapiro, 1998). The first of its kind, the Georgia HOPE (Helping Outstanding Pupils Educationally) scholarship began in 1993, and since then fourteen more states have adopted state merit aid programs modeled after HOPE (Heller & Marin, 2002). Spending on these state-sponsored scholarship programs grew 348 percent during the past decade (compared to 99 percent growth in need-based programs), and provided a "combined $1.2 billion yearly for college students on the basis of academic qualifications, over three times the $350 million provided in need-based aid by the states" (Heller & Rogers, 2006, p. 105). This statewide shift in financial aid policy translates into an overall decline in need-based aid, having negative implications for college opportunities of low-income students.

The changes in financial aid policies pose particular barriers to postsecondary choices of underrepresented student populations, resulting in widening income and racial/ethnic gaps in college attendance over time (Ellwood & Kane, 2000). Despite rapid increases in college costs at rates far in excess of inflation, college enrollments have continued to grow since the 1970s, what Heller (2001) called a "contradictory" phenomenon (p. 13). Numerous studies, however, have found that the enrollment growth has been mostly attributable to students from middle- and upper-income families rather than those from lower-income families (Belley & Lochner, 2007; Carneiro & Heckman, 2003; Kane, 2006). In terms of race/ethnic disparities, African American and Hispanic students continue to be underrepresented in colleges and universities compared to their White and Asian counterparts (Perna, 2000; Tierney, 1999). Consequently, disparities in college attendance rates by family income and race/ethnicity have persisted over time, and the gaps are particularly pronounced in four-year college participation rates, with low income and minority students concentrated in lower-priced, non-selective institutions, such as public two-year colleges (Ellwood & Kane, 2000; Hearn, 2001; Kane, 2004; McPherson & Schapiro, 1998, 2006; Perna, 2002, 2006b).

Although students from disadvantaged backgrounds enroll in postsecondary institutions, these students are more likely to experience transitional difficulties. Studies have further revealed that a growing population of low-income students who eventually get to college are disposed towards nontraditional forms of attendance by postponing college enrollment after high school completion (Goldrick-Rab, 2006; Hearn, 1992; Rowan-Kenyon, 2007). Delaying college enrollment poses a clear disadvantage for these students because it is likely to lower postsecondary educational attainment. Studies

demonstrate that the delayed time between high school graduation and college enrollment substantially increases the chances of attending less-than-four-year institutions and increases college dropout rates, while decreasing the chances of a bachelor's degree attainment (Ahlburg, McCall, & Na, 2002; Bozick & DeLuca, 2005).

## Objective of the Study

Given the tightening relationship between family financial resources and postsecondary opportunities, a large body of research indicates that college costs and financial aid have a direct effect on college enrollment and the choice of institutions, and that low-income and underrepresented minority students are more responsive to tuition and financial aid in the form of grants (Heller, 1997; Leslie & Brinkman, 1987; B. T. Long, 2004; Manski & Wise, 1983). Despite the large body of existing literature on the role of financial aid policies in enrollment decisions for students from different backgrounds, researchers have paid limited attention to exploring socioeconomic and race/ethnic differences as well as the role of financial aid associated with the *timing* of student enrollment.

Given that high school graduates enroll in college at different time points and financial aid is an important predictor of *whether* and *where* a student enrolls as well as *when* a student enrolls in college, this study will fill the void in the research by exploring the effects that state financial aid policies have on the occurrence as well as the timing of initial enrollment for high school graduates (or equivalent diploma holders). This study focuses on whether and how state aid policies differentially affect students' time to initial postsecondary enrollment depending on their family income and race/ethnicity. Using a large national dataset of high school completers in addition to state-level data that contain

state financial aid policies and other variables, this study utilizes a longitudinal research method that enables considering the choice of students who enrolled in college at different time points. Based on understanding the different timing of students' enrollment decisions over an extended time period, this study investigates students' enrollment behavior as well as their timing of enrollment among different income and race/ethnic groups in response to changes in state financial aid policies that may vary over time. In modeling this longitudinal process of college enrollment, I also accounts for clustered data structures in which students are nested within states that have very different policies as well as socio-demographic and economic context.

## Research Questions

Given the importance of considering differences in the timing of enrollment in college choice research and the need to explore whether and how state financial aid can remedy the persistent socioeconomic and race/ethnic gaps in enrollment at different types of postsecondary institutions, the purpose of this study is to investigate the following questions:

1. Do time-to-enrollment trajectories differ for high school graduates who are from different income and race/ethnic groups, and how do these enrollment trajectories vary for those enrolling in institutions of varying levels of selectivity?
2. Do state-level financial aid policies influence a student's decision of whether and when to enroll in college after completing high school?
3. Does state financial aid influence a student's decision of enrolling in more selective institutions after completing high school?

4. Does the effect of state financial aid policies differ by the type of aid (e.g., need-based and non-need based aid)?
5. Does the effect of state financial aid on college enrollment vary for students from different income and race/ethnic groups? (i.e., Do state-level financial aid policies reduce or increase enrollment gaps between low-income and high-income students?)

To address these questions, this study employs the longitudinal method called event history analysis that has been "used to analyze not only the occurrence but also the timing of events" (college enrollment in this study) (DesJardins, 2003, p. 423).

## Significance of the Study

Given the growing nontraditional student population in higher education due to delayed enrollment, the study's longitudinal modeling of college enrollment will provide insights into identifying the temporal aspects of college enrollment and the role that state financial aid policy plays in promoting postsecondary enrollment. Enhanced understanding of the temporal process of postsecondary enrollment and the effects that state financial aid policy have on students' enrollment decisions will assist policymakers to design public financial aid policies in a way that promote timely enrollment decisions after high school completion.

This study will further contribute to investigating the differential impact of state financial aid on college enrollment for students from different income and racial/ethnic groups, and will provide better understanding of income and racial gaps in postsecondary enrollment and the effectiveness of financial aid policy in reducing such gaps. By identifying which types and how much investment in state financial aid matter for on-

time postsecondary enrollment of students from disadvantaged background, this dissertation will offer empirical evidence that can support low-income and/or underrepresented minority students' immediate and successful transition to higher education.

## Organization of the Dissertation

This introductory chapter discussed the context for understanding why it is important to examine the role that state financial aid policy plays in college enrollment for students from different socioeconomic and race/ethnic groups. Chapter 2 reviews research literature relevant to college choice theory and research, which lays the foundation for establishing a conceptual framework for the present study. Chapter 3 discusses the methodology employed to address the research questions posed in this chapter, including data sources and sample, research variables, analytic methods, and model specifications. Chapter 4 presents findings from the data analysis and Chapter 5 discusses conclusions and implications for policy practice and future research.

# Chapter II

# LITERATURE REVIEW

This section examines the theoretical and empirical literature regarding students' college choice processes. The section begins by discussing theories and conceptualizations of college choice that have guided scholars to identify the critical factors and processes through which a high school student decides to attend a particular college. Then I review empirical literature based on the theories and present a conceptual framework that will serve as the basis for answering the research questions posed in the previous chapter.

## Theoretical and Conceptual Models of College Choice

Researchers have investigated college choice utilizing economic and sociological frameworks to address both economic and social forces affecting a student's college choice process (Hossler, et al., 1989; Jackson, 1982). Economic concepts and theories have been useful in conceptualizing the role of finances in college choice (Paulsen, 2001a), while sociological approaches, including status attainment and social/cultural capital, focus on the impact of social class on shaping college opportunities (Hossler, Schmit, & Vesper, 1999; McDonough, 1997). This section provides an overview of the two different theoretical approaches, respectively, concentrating on their contributions to conceptualizing college choice models, and then introducing combined models that synthesize these two approaches.

## The Economic Approach

### *Liquidity Constraints and the Need for Financial Aid*

Economists have stressed that the opportunity to attend college can be constrained by imperfections in the capital market that limit access to funds in the market for financing college education (Becker, 1960; Kane, 2004). As a form of imperfection in the capital market, a liquidity (or borrowing) constraint refers to a limit on the amount an individual can borrow to pay for their educational investments. As Becker (1993) pointed out, it is difficult to borrow large sums of money for college education because post-higher education level of human capital, embodied in a person and thus "a very illiquid asset, cannot be offered as collateral" (p. 91).

In the presence of the borrowing constraints facing families, parental income and wealth become important determinants in financing children's college education (Kane, 2006; Paulsen, 2001b). In other words, parents have substantial influences on the levels of schooling attained by children, operating mainly through parental monetary transfers of resources to their children (Becker, 1993; Belley & Lochner, 2007; Haveman & Wolfe, 1995). Faced with liquidity constraints, students from poorer families often have difficulty financing their college education because alternative sources of funds to supplement limited financial resources are not readily available for them (Becker & Tomes, 1986). The presence of borrowing constraints has therefore provided the justification for the use of governmental subsidies in the form of direct financial aid to help needy students make their optimal college choices less constrained by financial resources (B. T. Long & Riley, 2007; McPherson & Schapiro, 2006).

*The Human Capital Approach*

The primary economic theory applied to the study of college choice is the human capital model. Human capital theory began to receive much attention when the idea of education as an investment in human capital emerged in the late 1950s, and Shultz and Becker were among the pioneers who conceptualized the relationships between investment in education, human capital formation, and economic development (Cohn & Geske, 1990). Researchers have defined human capital as productive capacities, such as knowledge, talent, and skills possessed by individuals acquired through formal schooling and on-the-job training (Paulsen, 1998, 2001a). As a major form of investment in human capital, additional years of education are assumed to improve labor productivity, which is rewarded by increased future earnings of an individual. i.e., returns to education (Schultz, 1961; Weisbrod, 1962).

The application of human capital theory to college-choice research has been useful to examine how students make a series of college-related choices. This approach views college choice as a form of rational investment in the acquisition of human capital that maximizes expected utility (Catsiapis, 1987; Hossler, et al., 1989; Manski & Wise, 1983; Paulsen, 1990, 2001a). According to human capital theory, students act as "adolescent econometricians" who compare the expected benefits of a college education with expected costs to choose the best available postsecondary option (Manski, 1993, p. 43). The theory predicts that prospective students decide whether to attend college and select among a range of institutions only if the expected current and future benefits (e.g., financial aid, future earnings) outweigh the anticipated costs of their choice (e.g., tuition

and fees, living expenses, and foregone earnings as opportunity costs) (DesJardins & Toutkoushian, 2005; Fuller, Manski, & Wise, 1982).

Student behavior in response to financial costs and benefits is also predicted by applying the economic concepts of price and enrollment demand. Tuition is a price charged to students and financial aid, especially in the form of grants or scholarships, has the effect of discounting the net price of college attendance (Catsiapis, 1987; DesJardins, 2001). A basic principle of this theory is that student enrollment in college is negatively associated with direct costs of college (e.g., tuition) and positively associated with financial aid (Fuller, et al., 1982; Jackson & Weathersby, 1975; Kane, 1999).

The calculation of benefits and costs regarding college-choice decisions may vary substantially across individuals because the college choice process cannot be detached from social, economic, and cultural influences. Given the multifaceted aspects of college choice, the human capital model has been refined to incorporate individual differences, such as socioeconomic backgrounds, academic ability, access to college-related information, and financial opportunities in the credit market, into the traditional cost-benefit framework (Heckman, 2000; Kane, 2006; Paulsen, 2001a).

As the human capital model was extended to consider individual variations in college-choice decisions, criticisms have been raised regarding the assumption that students act in a rational manner. The traditional human capital model rested on the rationality assumption that students make college choice under certainty, calculating costs and benefits of college education based on perfect information about all possible alternatives. In response to this traditional view, Jongbloed (2004) writes the risk and

uncertainties that may deter prospective students from acting as rational decision-makers regarding college choice:

> First, students may be unsure about the effect of higher education on their human capital due to the uncertainty about their own probability of degree attainment and about the quality of educational services offered by higher education providers. Second, students may be unsure about the effects of human capital accumulation on their prospective income and employment opportunities. This is caused by the uncertainty about the future demand for labor (p. 268).

These uncertainties regarding college choice suggest that in reality, students rely on imperfect information with limited cognitive capacity to evaluate all possible alternatives. Given the scenario of uncertainty, subjective evaluation of the costs and benefits of college education based on available information shapes student decisions differently. For example, two individuals can make different college choices depending on differences in their preferences, tolerance for risk, and uncertainties even if the expected benefits and costs are calculated as being the same (DesJardins & Toutkoushian, 2005). This indicates that the concept of rationality in the human capital approach has been extended to incorporating subjective rationality, suggesting that an individual's college-choice decision is presumed to be rational when based on information about the benefits and costs available to them and consistent with their preferences (DesJardins & Toutkoushian, 2005).

Although the economic approach has made strides in incorporating the independent role of finances in college attendance, it has been criticized for overlooking the indirect role that financial aid and college costs plays prior to enrollment, such as "concerns about finances on college preparation, aspirations, and applications for college and financial aid" (St. John, 2006, p. 1607). In other words, the approach fails to consider the possibility that concerns about college costs and financial aid can negatively influence

decisions regarding how to prepare for college especially for students with limited financial resources. An exceptional study, however, expands the scope of the economic approach by investigating how concerns about finances differentially affect students' predisposition to attend college among different subgroups (Bell, 2011). Bell's (2011) analysis revealed that concerns about college costs and financial aid negatively influenced plans for attending college among students from low-income families, Whites, males, and low academic performers because these students were more likely than others to give up college aspirations because of financial concerns.

In addition to financial concerns, the expectation of financial aid may also influence a student's decision to apply to and enroll in a college (DesJardins, Ahlburg, & McCall, 2006). For instance, investigating how the expectations of different types of financial aid affect the college choice process, Kim, DesJardins, and McCall (2009) find that students from different race and income groups respond differentially to aid packages in their application and enrollment decisions depending on their levels of aid expectations. The expectations of financial aid as well as concerns about college affordability may indirectly influence students' college choice process, and thus should not be overlooked in examining the comprehensive role of finances.

### The Sociological Approach

Whereas economic approaches have focused on the independent effects of finances isolated from other student characteristics, sociological approaches explore how a variety of interrelated family social class, individual, and contextual factors jointly structure college opportunity. The theoretical lenses of sociology used to understand college choice have evolved initially from status attainment theory developed in the

1970s and 1980s to the models that emphasize the constructs of social and cultural capital (McDonough, 1997; Perna, 2006b).

*The Status Attainment Theory*

The status attainment theory illuminates how parents' socioeconomic backgrounds and students' academic ability interact to influence educational aspirations and attainment of their child (Hossler, et al., 1999; 1997; Sewell, 1971). Blau and Duncan (1967) developed the initial status attainment model that delineates the occupational attainment processes of males. Their model proposed that father's educational attainment and occupational status predict the son's future educational and occupational attainment. Later, Sewell and colleagues (Sewell, Haller, & Portes, 1969; Sewell & Hauser, 1972; Sewell & Shah, 1967) expanded the Blau and Duncan's model to better explain the processes by which a parent's socioeconomic background influences the status attainment of their children (Carter, 2002). In a study of Wisconsin high school students, Sewell and Shah (1967) examined the effects of SES and intelligence (as measured by a mental ability test) on a student's college plans, college attendance, and graduation. They found that SES and intelligence had strong direct effects on college plans, college attendance and graduation and that SES and intelligence also had considerable indirect effects on degree attainment mediated through students' college plans (or aspirations).

In a series of subsequent studies using the Wisconsin data, Sewell and colleagues further refined their model of the status attainment process utilizing social psychological variables that mediate the relationship between socioeconomic origins and educational and occupational attainment. These social psychological variables include academic performance, the influence of significant others (e.g., parents, peers, and teachers), and

educational and occupational aspirations, the combination of which accounts for a large portion of the effects of socioeconomic status variable on postsecondary educational attainment (Sewell & Hauser, 1972). With regard to the relationship between variables, their social psychological model revealed that the socioeconomic status and ability of the student affect their academic performance and the influences that significant others have on them, which in turn, affect the student's aspirations as well as educational attainment (Sewell, Haller, & Ohlendorf, 1970; Sewell, et al., 1969).

Although the status attainment model illuminates the process by which the effects of socioeconomic background on educational and occupational attainments are mediated by various social psychological factors, it is subject to criticism. One of the main criticisms is that it does not sufficiently explain differences across gender and racial/ethnic groups because status attainment research has been found to work well solely for White males (Carter, 2002). Furthermore, status attainment theory has been criticized for ignoring class as a structural impediment to attainment and social mobility in part because the theory was developed at a time when the rate of upward mobility was high, suggesting a greater number of individuals were moving up the socioeconomic ladder by means of education (Kerckhoff, 1976; Knottnerus, 1987).

*The Theories of Cultural and Social Capital*

*Cultural Capital and Habitus.* Initially developed by Pierre Bourdieu, the concepts of cultural capital and habitus assist us to understand the role of social class in college choice in ways that transcend the status attainment model. Focusing on the role of capital formation within families, cultural capital theory illuminates how students from different social classes make varied educational choices constrained by their habitus (St.

John, 2006). Bourdieu's notion of habitus describes the ways in which individual actions and social context in which those actions occur are inextricably linked. Shared by the members of the same social-class, habitus refers to "a common set of subjective, internalized, class-based, and enduring socially-constructed dispositions that shape individual expectations, attitudes, and aspirations" (McDonough & Calderone, 2006, p. 1704). The habitus reflects the internalization of structural boundaries and constraints and determines the range of possible action in social settings (Horvat, 2001).

In a broad sense, cultural capital refers to the system of cultural resources, such as language skills, cultural knowledge, or mannerisms and practices that define an individual's class status (Horvat, 2001; Perna, 2006a). Cultural capital involves the accumulation of credentials, skills, and knowledge, which are transmitted from middle- and upper-class parents to their children to maintain class status and privilege across generations (Bourdieu, 1990; McDonough, 1997). In light of cultural capital theory, college education becomes a valuable means of acquiring the credentials and knowledge that ensure continuing social and economic security of a family. Relative to lower-class parents who lack cultural capital, upper-class parents are better positioned to "transmit cultural capital by informing their children of the value and process for securing college education" (McDonough, 1997, p. 9), thereby encouraging children's aspirations and preparation for college. Types of cultural capital relevant to college choice include parental knowledge and experience of college preparation, application, admission requirements, and information about college costs and financial aid availability (DiMaggio, 1982; McDonough, 1994, 2004).

Increasingly, researchers examining the sources of race-based differences in educational outcomes have extended this argument by noting that each race/ethnic group may differ in their ability or opportunity to activate their cultural capital in different educational settings (Lareau & Horvat, 1999; Nora, 2004; Tierney, 1999). Minority students are reported to possess fewer educational resources and less cultural capital that promote postsecondary attainment relative to their White counterparts (Roscigno & Ainsworth-Darnell, 1999). This suggests significant racial gaps between Whites and minorities in their possession of cultural capital as well as the ability to convert this capital into educational attainment (Eitle & Eitle, 2002; Perna, 2000; Roscigno & Ainsworth-Darnell, 1999).

*Social Capital Theory*. Social capital theory has been considered a useful tool in explaining the role of social networks and connections in providing access to information and resources critical for college choice and educational attainment (Lin, 2000; Vryonides, 2007). Social capital is acquired through a form of a social relationship or a network of relationships that can be converted to socially valued resources and opportunities including emotional support and privileged information (Lin, 1999; Portes, 1998; Stanton-Salazar, 1997). Although many scholars have contributed to the development of social capital theory, the initial theoretical elaboration of social capital is attributed to Bourdieu and Coleman (Dika & Singh, 2002).

Bourdieu (1986) defines social capital as "the aggregate of actual or potential resources linked to possession of a durable network of institutionalized relationship of mutual acquaintance and recognition." (p. 248). According to Bourdieu, the volume of social capital to which an individual may gain access through social networks and

relationships depends on the size and strength of the networks as well as the availability of different types of capital resources (e.g., economic, cultural capital) that individuals in the network possess (Bourdieu, 1986; Lin, 1999). Focusing on the way in which some individuals are advantaged because of their membership in particular groups, Bourdieu views social capital as the power and investment of the dominant class and being accumulated and reproduced (through its linkages with other forms of capital) to perpetuate social class inequalities depending on gender, socioeconomic status, or race/ethnicity (Lin, 1999; Vryonides, 2007).

Emphasizing how social capital relates to educational attainment, Coleman (1988) defines social capital as a set of resources available to both "within" the family (e.g., relations between parents and children) and "outside" the family (e.g., relations between parents, children, and social ties outside the family) that frame appropriate social behaviors. Coleman's approach to social capital focuses on an individual's connection to a social structure such as a family, community, or school and on the information and resources that one can gain from participation in these networks. Coleman proposes that social capital inheres in the social structure and relations with others, and depends on trustworthiness, information channels, norms accompanied by sanctions, and social networks of support involving family members and school personnel (Coleman, 1988). Among types of social structures and relations, Coleman highlights the importance of intergenerational closure (i.e., relations between parents whose children are friends) as a social structure that facilitates the formation of social capital through institutionalizing effective norms and reinforcing trustworthiness. The idea that intergenerational closure facilitates the emergence of positive norms has been influential in educational research

and boosted policies promoting parental involvement and cohesive communities to increase educational attainment of children (Puyosa, 2009).

While Bourdieu's approach focuses on the restrictions imposed by structural barriers such as class, gender, and race, Coleman's view suggests that parents and family play a primary role in promoting the status attainment of their children, emphasizing strong social ties within the family (Dika & Singh, 2002). The common emphasis for both Bourdieu and Coleman is, however, on social memberships in a group, i.e., the foundation on which social capital is built, as well as the benefits that came from involvement in these social relationships that are useful to an individual in advancing their educational and social development (Sandefur, Meier, & Campbell, 2006).

Although social capital as an individual and family resource involves educational and social benefits, there is a gap in the possession of social capital caused by structural inequalities in access to social resources and information. Lin (2000) suggests that "inequality of social capital occurs when a certain group clusters at relatively disadvantaged socioeconomic positions, and the general tendency is for individuals to associate with those of similar group or socioeconomic characteristics" (p. 786), which results in the homogeneity of social networks among members. Accordingly, access to information and resources may depend on an individual's membership in a certain social networks and social groups have differential access to social capital because of their advantaged or disadvantaged structural positions and associated social networks.

Relevant literature reveal inequality in access to social capital across social class, gender, and racial groups and document that female, low-income and/or underrepresented minority groups tend to be structurally disadvantaged in the resources they have access to

the extent that they are embedded in social networks deficient in social capital. Relative to males, females tend to be affiliated with disadvantaged social networks and ties lower in hierarchical positions, and the homogeneity of their social networks leads to a network closure and reproduction of resource disadvantages among females (Lin, 2000). Studies document that high-income families have more options to diversify their social capital through contacts outside the family whereas low-income families do not enjoy the same quantity and quality of resources and information in their social networks (Hofferth, Boisjoly, & Duncan, 1998; Kao & Rutherford, 2007; Moschetti & Hudley, 2008). Whites are reported to possess higher levels of social capital than minority and immigrant children, and their higher volume of social capital is often related to higher academic achievement and educational attainment (Kao & Rutherford, 2007).

When navigating the college choice process, students from different socioeconomic and racial/ethnic backgrounds have unequal social networks, and differences in the availability of college-related guidance and information may influence inequalities in access to postsecondary education. Focusing on how the impact of social capital varies by racial and ethnic group, Perna and Titus (2005b) conclude that African Americans and Hispanics not only possess fewer of the types of capital that promote college enrollment but also attend schools with fewer of the resources that promote college enrollment. They further argue that the low college enrollment rates for African Americans and Hispanics are due in part to lower levels of resources that are available through the social networks at the school they attend (Perna & Titus, 2005b). Their study suggests that barriers based on social class and race/ethnicity restrict access to

institutional resources, and the postsecondary decisions of disadvantaged students are significantly limited due to their lack of social capital.

## The Combined Model of College Choice

Recognizing the limitations of relying on a single perspective, higher education scholars have attempted to draw upon the strengths of both economic and sociological approaches to inclusively explain the process of college choice, and thus a group of hybrid models emerged in the late 1970s (Hossler, et al., 1989; St. John & Elliott, 1994). The combined models typically involve multiple stages of the college choice process (e.g., Hossler & Gallagher, 1987; Jackson, 1982; Litten, 1982) that situates critical social and economic factors impacting students' college choice decisions in each phase of the process.

The early combined models, developed by Jackson and Litten, conceptualized college choice as a process that begins in high school, when students form aspirations for college and construct a choice set (Jackson, 1978; Litten, 1982). The choice process ends when students evaluate their choice set and select an institution to enroll. Consolidating the previous models, Hossler and colleagues (1989; 1987) defined three stages beginning as early as seventh grade, where students 1) develop aspirations for college attendance (*predisposition*), 2) search for information about colleges and develop a choice set (*search*), and 3) evaluate options, apply to, and choose to enroll in a particular college (*choice*). This staged process, however, is applicable mostly to traditional college-age students who made straight transition from high school to college (St. John, Paulsen, & Starkey, 1996), and thus offers limited insights into the choice of non-traditional students who had an interruption in their study after high school graduation.

Researchers have further incorporated social and cultural capital theory in an attempt to consider differences in college-choice decisions among different student subgroups. Centering on the search phase, Hossler and colleagues (1999) refined their early model by conceptualizing the dynamic roles of parents, peers, and high schools as information providers in shaping students' college choice decisions that vary based on an individual's habitus. More recently, Perna (2006b) extends Hossler and colleague's research to a multi-level framework that presumes that college choice is influenced by academic preparation, the availability of financial aid, and family resources to pay for college, which are nested within multiple contextual layers. The four hierarchical contextual layers that shape college choice decisions are: 1) individual habitus, 2) school and community context, 3) the higher education context, and 4) the broader social, economic, and policy context.

Perna's model illustrates that the college choice process is influenced not only by academic and financial resources but also "by an individual's habitus and, by the family, school, and community context, higher education context, and social, economic, and policy context" (Perna, 2006b, p. 119). A strength of Perna's model relative to other models is its explicit focus on how the differences in these contextual layers influence college-choice decisions for students from different social classes. Despite its comprehensive modeling of the internal and external forces affecting college choices, the procedural aspects of student choice of college are not well addressed because the model does not explicate how and when each layer of the context and the related factors frame a student's college choice at a specific stage of the choice process.

In sum, the combined approaches to college choice are a significant advancement from a single perspective that uses either economic or sociological aspects, and illuminate a wide array of interconnected social, cultural, and economic conditions that shape the college choice process. Economic perspectives illuminate the process by which student decisions to attend college are affected by internally weighing different values and costs associated with college attendance. In addition, the economic concepts of price and demand help describing the role of college costs and financial aid in college choice decisions. Sociological approaches consider social and cultural forces that also influence college choice by illuminating how socioeconomic background as well as social relationships and networks shape individual orientations toward college choice, and the sources of inequality situated in educational choices and attainment across social-class groups (Perna, 2006b).

However, the combined approaches mostly consider traditional student populations who enter college immediately after high school graduation, paying limited attention to the college choice of non-traditional students who delay college enrollment. Recognizing the gaps in the existing college choice literature, it is necessary to further examine how and why students delay postsecondary enrollment.

### Delaying the Transition to College

Delayed transition from high school to college can be explained by employing the aforementioned theories of human capital and social capital. In light of human capital theory, once prospective students decide to attend college, they may compare the expected benefits of whether or not to delay college entry with expected costs to choose the best timing of college enrollment that maximizes their expected utility. Based on this

cost-benefit analysis, student decisions to attend college immediately after high school may be considered a pay-off and worthwhile if a rate of return to an immediate transition to college is greater than delayed enrollment. Conversely, if postponing college enrollment and instead experiencing alternative activities maximizes internal expected utility, students may delay enrollment in order to gain exceptional work and life experience (Grasgreen, 2011). However, for many low-income students, delaying college enrollment may not be considered an available option, but inevitable choice because they may evaluate the immediate cost of attending college much higher than the long-term benefit of a college degree due to financial concerns.

In addition to financial factors, the timing of college enrollment may be influenced by differences in the possession of social capital if students delayed college entry because of difficulties in gaining access to social resources and a lack of information critical to one's college-going. Prior studies that identified the characteristics of high school graduates who delayed college enrollment document that students who delay their entry to college are more likely to come from socioeconomically disadvantaged families deficient in social, cultural, and economic resources (Goldrick-Rab & Han, 2011; Horn, Cataldi, & Sikora, 2005). Hearn's (1992) pioneer study of 1982 high school graduates (HS&B) revealed that socioeconomic status and academic achievement are important predictors of delayed transition to college. Hearn found that students who delayed college attendance by more than a year after high school tended to be males, African Americans, come from lower socioeconomic background, and had lower academic achievement.

Recent studies have employed the NELS:88 data to investigate the predictors of delayed enrollment among 1992 high school graduates. A descriptive analysis by Horn, Cataldi, and Sikora (2005) reports that greater percentages of delayed entrants are low-income, first generation, minority, and less academically prepared students (Horn, et al., 2005). Similarly, Bozick and DeLuca (2005) found that, net of other characteristics, students who delayed enrollment were disproportionately tended to be males, from lower socioeconomic backgrounds, had lower standardized test scores, and more often had dropped out of high school and earned a GED instead of a high school diploma. These delayers were also more likely to enter a two-year college rather than four-year colleges and to be married and/or have children.

Focusing on identifying socioeconomic differences in delayed enrollment, Rowan-Kenyon (2007) found that compared with graduates who enrolled immediately, graduates who delayed had lower SES, less academic preparation, and lower parental involvement. Another study conducted by Goldrick-Rab and Han (2011) also explored socioeconomic differences in delayed transition, and revealed that a substantial portion of the socioeconomic gap in college delay is explained by socioeconomic differences in family background, educational expectations, family formation, and academic course-taking. Net of other characteristics, low-SES students were nearly two times as likely as high-SES students to delay college. Goldrick-Rab and Han also found a substantial reduction in the likelihood of delay among students who took rigorous coursework in high school. However, even among students who took rigorous math and science courses, those of lower socioeconomic status were still more likely to delay than their advantaged peers. The authors concluded that the positive impact of rigorous academic preparation

on immediate enrollment is stronger for socio-economically advantaged students, and thus high-SES students benefit more from taking rigorous courses than their low-SES counterparts in terms of timely enrollment.

In sum, the previous studies on delayed enrollment identify race, gender, socioeconomic background, and academic preparation as important predictors in differences in the timing of college enrollment. The findings from past studies suggest that students who delay their postsecondary enrollment differ fundamentally from those who enroll immediately, and barriers to timely college enrollment based on socioeconomic status and academic preparation are especially of great concern. Recognizing the importance of socioeconomic and cultural factors in addition to academic preparation in the timing of college enrollment, I further discuss the literature investigating the roles of socioeconomic, cultural, and academic influences in college choice in the following section.

### The Role of Socioeconomic/Cultural Backgrounds in College Choice

In this dissertation, I define the scope of socioeconomic and cultural backgrounds as socioeconomic status (SES), forms of social and cultural capital manifested by family and parental influences, gender, and race/ethnicity. As an objective indicator of social status, a student's SES is a combination of parental education, occupational prestige, and family income. Considering that a higher- or lower-SES indicates the possession of greater or fewer social, cultural, and economic resources respectively, the review also sought to cover the social and cultural influences to the extent that they are associated with a student's SES on postsecondary choice, e.g., parental involvement, access to information network or social resources (McDonough, 1997; Perna & Titus, 2005a). In

addition, gender and race/ethnicity also intersect and interact with socioeconomic factors influencing college choice (Hearn, 2001), and the exploration of gender and racial/ethnic variations in college access and success has received constant attention (Perna, 2006b). According to the determined scope of socioeconomic and cultural backgrounds, this section covers the review of literature that discusses the role of gender, race/ethnicity, and socioeconomic status in college choice.

## Gender and College Choice

For several decades, gender differentiation in education has been a social concern because women were historically discriminated against throughout the educational system. However, the picture has been slightly changed in recent years because women outnumber men overall in their college attendance and graduation rates (Goldin, Katz, & Kuziemko, 2006). Girls tend to do as well or better than boys in school in terms of the college preparatory courses they take, course grades, and high school completion (Buchmann, DiPrete, & McDaniel, 2008; Goldin, et al., 2006). All these advantages of females are related to the likelihood of attending college and to improved educational attainment.

Despite women's greater numerical representation in institutions of higher education, it is unclear whether women are equally advantaged in access to selective four-year colleges. Studies revealed that women are less likely than men to enroll in or graduate from elite (or highly selective) institutions (Davies & Guppy, 1997; Persell, Catsambis, & Cookson, 1992). Analyzing the data of 1993 college graduates obtained from HEGIS (Higher Education Graduates Information System), Jacobs (1999) found that female students remain slightly overrepresented in schools with higher acceptance

rates, lower faculty/student ratios, lower standardized test scores, and lower tuition and fees. The author attributes gender differences in major choices and enrollment status to the principle factors accounting for women's underrepresentation in elite institutions. Highly selective schools were more likely to have large engineering programs and have fewer part-time students, and the low number of female engineering majors and a high concentration of part-time female students explained why women were underrepresented in selective institutions in the study (Jacobs, 1999). The finding suggests that considering students' major choice and part-time attendance in the gender gap research may help better understand the relationship between gender and institutional selectivity.

Another study that explored a gender gap in college enrollment revealed that there is no difference in the likelihood of enrollment in four-year colleges between men and women, but conditional on attending a four-year college, men tend to enroll in more selective institutions in which students scored on average higher on SAT (Jacob, 2002). Although women are increasingly gaining advantages over men in terms of access to any college, the prior studies indicate that important obstacles in obtaining access to selective institutions may remain for a certain gender group. It is possible that gender still plays a role in restricting educational choices and outcomes, and thus should be considered a central control factor for investigating college choice.

### The Role of Race/ethnicity in College Choice

Racial/ethnic differences in college opportunities have consistently been described in numerous studies (Freeman, 1999, 2005; Paulsen & St. John, 2002; Perna, 2006b). With regard to disparities in college attendance, evidence suggests that Hispanics and African Americans are more likely to attend less-selective institutions, opt for an

institution with lower average tuition, and attend school part-time (Kao & Thompson, 2003; Karen, 2002). In addition, African Americans and Hispanics are less likely than Whites to attend their first-choice institutions and to make an immediate transition from high school to college (Hurtado, Inkelas, Briggs, & Rhee, 1997; Kao & Thompson, 2003). As a consequence, both African Americans and Hispanics are more highly concentrated in two-year rather than four-year institutions (Engberg & Wolniak, 2009; Kao & Thompson, 2003), and this participation gap between Whites and minority students suggests that race does factor in the college choice process (Freeman, 1999).

A few studies document that African American and Hispanic students tend to have less-educated parents and come from lower income backgrounds, and parental SES accounts for a substantial portion of the racial/ethnic gaps in postsecondary participation (Kao & Thompson, 2003). However, there is clearly a place for explanations that do not rely solely on social class differences. For instance, a study that examined community college choice by racial/ethnic groups demonstrates that even among higher-SES or high-achieving Latinos, they are more likely to attend a community college than other racial groups who are from similar socioeconomic or achievement levels (Kurlaender, 2006).

Underrepresented minority students face particular barriers in the college choice process such as a lack of support and information about postsecondary education and finances, availability of fewer college preparatory classes, and family and community environments that do not support college attendance (Bergerson, 2009). Freeman's (1997) qualitative study of African American high school students identifies perceived barriers limiting their college attendance. Freeman found that African American students lacked in confidence in the academic preparation they received in the school and thus

were uncertain as to whether they were qualified for admission to college, which may lower their postsecondary aspirations. Additional barriers identified by Freeman were that many African American students were not encouraged to pursue postsecondary education by their parents or other adults, and college decision-making of African American students was limited due to their perceptions and concerns about their ability to pay for college. Investigating racial differences in decisions to attend college, Perna (2000) also notes that parents' involvement in educational decision-making was lower for African American students than Whites.

Due to deficiencies in information and support within their family and community, African American students are more likely to rely on high school personnel including teachers and guidance counselors for information, particularly when their parents have not been to college (Farmer-Hinton, 2006; Plank & Jordan, 2001). However, in terms of high school context, the schools minority students attend are more likely to have fewer resources, suggesting that academic resources are limited for college guidance counseling and college-preparatory courses particularly if the school does not have a culture of sending students to college (Perna, 2004; Rowan-Kenyon, Bell, & Perna, 2008). In a comparison of African American and White ninth graders' aspirations for college attendance, Pitre (2006) documents that schools tend to discourage African American students' educational goals and their college attendance even if African Americans aspire to attend college at rates similar to their White counterparts.

Although information about postsecondary education is a significant factor in college enrollment, research evidence suggests that underrepresented minority students do not access information about college opportunities and financial aid in the same ways

that White students do (Bergerson, 2009). For example, African Americans have less access to information about college education that will assist them in the college choice process, and the lack of information has the potential to weaken their aspirations for college attendance and provide less incentive to do well academically (Freeman, 1997; Pitre, 2006). The limited access to information among minority students has been a focus of researchers who view a lack of social capital as a primary factor that disadvantages minority students in navigating their college choice process.

Various scholars using the social capital construct argue that underrepresented minority students, especially among Hispanics, do not have adequate access to the informal or formal social networks that may provide postsecondary knowledge and support for educational opportunities (Ceja, 2006; Gonzalez, Stoner, & Jovel, 2003; Stanton-Salazar, 1997). Hispanic students are reportedly more likely to lack in social capital and academic support from teachers and guidance counselors and have a feeling of being disconnected due to cultural and language barriers, which makes them less likely than Whites or African Americans to seek information from school personnel (Stanton-Salazar, 2004; Stanton-Salazar & Dornbusch, 1995). Instead, these students tend to resort to family and community resources in seeking out college opportunities and making postsecondary decisions.

Interviewing 20 Chicana (of Mexican-American origin) high school seniors, Ceja (2006) examined the role of parents and siblings in assisting students to navigate their college choice process. Ceja found that the role of parents in college planning and preparation process was very limited in that none had the necessary knowledge to guide their daughters through the process of applying to and choosing colleges due to their low

levels of educational attainment. Language (or communication) barriers between parents and the school were discussed as additional obstacles to obtaining parents' college knowledge. Instead of parents, older siblings who attend (or attended) college proved to be important sources of college information for these first-generation Chicana students. Through interviews with Latina students, Gonzalez, Stoner, and Jovel (2003) discuss similar findings. In Latina students' college choice decisions, siblings served as key agents of social capital in providing college information. Peers provided additional support and reinforced their motivation to attend an elite university by offering encouragement and sharing information about the admission process. However, Gonzalez et al. found that Latinas had lower access to high-volume social capital in schools than other students, which consequently limited their college aspirations.

It is true that family and community provide a dependable source of easily accessible information and are real assets for Hispanic students, but heavy reliance on such familial networks may result in limited information and support for postsecondary decisions. Investigating enrollment decisions among Hispanic two-year college students, Person and Rosenbaum (2006) found that Hispanic students relied more heavily on postsecondary information from family and friends of their own ethnic group than do other students. However, the authors point out that excessive reliance on information from family and friends can be a disadvantage for these students relative to those who seek information outside their network, because family and friends may provide narrow or less salient information about college options when their social networks are limited or isolated (Person & Rosenbaum, 2006).

In a similar vein, through interviews and focus groups with 106 high school Hispanic students, Perez and McDonough (2008) find that Hispanic students relied exclusively on extended networks of family and peers in postsecondary planning and application processes. Consistent with Person and Rosenbaum, Perez and McDonough argue that social networks that are limited in scope for Hispanics can significantly reduce their postsecondary options, and call for increased educational resources throughout the Hispanic community to enhance postsecondary support networks.

Hispanic students' high valuation of close ties to family and community members also makes them weigh proximity to home as very influential when they consider postsecondary options (Bergerson, 2009; Perez & McDonough, 2008). Kurlaender (2006) argues that one reason for the high presence of Hispanics students in community colleges is related to their preference for colleges located closer to home. It is, thus, conceivable that the lack of information (including financial aid information) among Hispanic students and parents and their strong family orientation could result in college-qualified students attending two-year colleges instead of four-year colleges, leading to Hispanics' highest overrepresentation in community colleges.

The studies of underrepresented minority students' college choice identify barriers they face as they navigate the college choice process, and suggest that there is less information and support about postsecondary opportunities available among African American and Hispanic students. Their limited access to college-related information may be related to both their families' lack of understanding of college choice processes and the lack of high school resources that do not support their preparation for college. Illustrating how underrepresented minorities experience the college choice process in

ways that are different from Whites, the research findings discussed above provide some clues as to racial/ethnic disparities in college enrollment behavior.

## The Role of Socioeconomic Status in College Choice

Social class differentiation begins at an early age, and the effects of social class are cumulative in educational attainment (Carneiro & Heckman, 2003; Goldrick-Rab, 2006; Hearn, 1988). In terms of college choice, it is evident that SES is a key determinant not only of developing aspirations and plans for college (i.e., predisposition), but also of choices of a particular type of college (Baker & Velez, 1996; Hearn, 1984, 1991; Karabel & Astin, 1975). Studies have demonstrated that students whose parents have higher incomes and educational attainment are more likely to aspire to, apply to, and enroll in selective and costly four-year institutions, whereas low-SES students are disproportionately channeled toward two-year institutions or less-selective and lower-cost four-year institutions, even when taking academic preparation into account (Cabrera & La Nasa, 2001; Hearn, 1991; Hossler, et al., 1999; Hossler & Stage, 1992; Karen, 2002; Perna & Titus, 2004).

### *Family Income, Liquidity Constraint, and College Choice*

Although the term of socioeconomic status involves different underlying aspects including family income, parental education, and different forms of capital, this dissertation research particularly focuses on a narrower dimension of socioeconomic factors, i.e., the role of family income operating mainly through monetary transfers from parents to their children to finance college education. A few studies about family income transfers reported that parents who have higher incomes and levels of education tend to make larger transfers to finance their children's college education (Ellwood & Kane,

2000; Keane & Wolpin, 2001). However, in the presence of the liquidity constraints, low-income parents often have difficulty financing their children's college education because of their limited financial resources.

Coupled with rising college costs, this financial restriction creates substantial barriers to college access and choice for students from low-income families even when economic returns from college education are high (Becker, 1960; Belley & Lochner, 2007; Kane, 2004). It has been evident that family financial resources (or family income) independently operate as a significant constraint to college attendance. In their analyses of the high school class of 1992 using the NELS data, Ellwood and Kane (2000) provided evidence supporting that there are sizeable gaps in college enrollment between low-income and high-income students even among the highest-achieving students.

Researchers also demonstrate how low-income students' opportunity to attend college has been declining over time. In their trend analysis of college destinations of entering freshmen who completed the Cooperative Institutional Research Program (CIRP) survey, Astin and Oseguera (2004) found a disproportionate overrepresentation of wealthy students with highly educated parents in the most selective institutions and an increasing concentration of poor and first-generation students in the least selective institutions. Similarly, comparing the enrollment choice of both the old cohort (NLSY:79) and the recent cohort (NLSY:97) using nationally representative data, Belley and Lochner (2007) found that students from low-income families are increasingly less likely than their affluent peers to attend college and to attend less-than four-year colleges, even after controlling for academic ability.

Together, the income disparities in college choices substantiate highly stratified and unequal pathways to college by income groups. The substantial increase in the effects of family income on college attendance indicates that liquidity constraints have become substantially more stringent over the past few decades, and the increasing financial constraints faced by students with lower financial resources are at the very least responsible for increasing college attendance gaps by family income (Belley & Lochner, 2007). Given the substantial and adverse impact of family income on college choice, differences in the availability of family financial resources for college education are considered the core socioeconomic determinant in college enrollment for this dissertation study. Other aspects of broader socioeconomic influences associated with producing the social, cultural, and academic resources are reviewed in the following sections because these are also necessary to further children's postsecondary attainment.

*Parental Influences and College Choice*

As agents of transmitting social status and capital to their children, parents have been identified as the most significant influencers of college choice, and parental involvement is frequently recognized as a strong determinant of college enrollment (e.g., Conklin & Dailey, 1981; Hossler & Maple, 1993; Tierney, 2002). Strong and consistent parental encouragement and high parents' educational expectations received in the early high school years have been found to have a positive correlation with forming aspirations and plans for college (Carpenter & Fleishman, 1987; Flint, 1992; Hossler, et al., 1999). Moving beyond parental expectations and encouragement, proactive parental involvement tends to be more tangible and direct, such as parents' saving money for college education, taking the child on college visits, involvement in school activities, and

assisting with forms and applications for college (Flint, 1993; Hossler & Vesper, 1993; Perna, 2000; Rowan-Kenyon, et al., 2008).

Assuming higher levels of parental commitment to their children's education, these proactive forms of parental involvement require a considerable amount of time, information, and resources to get involved with the process. A lack of economic, social, and cultural resources, therefore, creates structural barriers to low-SES parents' active involvement in their children's college choice processes (Tierney, 2002). Given the significance of family resources, parental support for children's college choice is closely linked to socioeconomic backgrounds, suggesting that high-SES parents are more actively involved in encouraging, supporting, and guiding their children's college planning and preparations than are low-SES parents (Cabrera & La Nasa, 2001; Tierney & Auerbach, 2004).

Considering the role of parents, their college knowledge is among the forces that shape parental decisions to become involved in their children's college choice (Tierney & Auerbach, 2004). Among types of college knowledge, studies suggest that information about college affordability is perceived differently by socioeconomic background and race/ethnicity. In other words, the amount and quality of information about college costs and financial aid increases proportionally with higher parental socioeconomic backgrounds and White parents are more likely to be better informed of college costs and the availability of financial aid than their minority counterparts (Flint, 1993; Horn, Chen, & Chapman, 2003; McDonough, 1997; Olson & Rosenfeld, 1984; Perna, 2006c).

Grodsky and Jones (2007) analyzed the data from the 1999 National Household Education Surveys (NHES:1999) to examine the extent to which parents' SES and

race/ethnicity determines their knowledge of college costs. Their analyses provide evidence that socioeconomically disadvantaged parents and minority parents (i.e., African Americans and Hispanics) are more prone to estimate the tuition with large errors than advantaged parents. Based on this finding, it is conceivable that the high uncertainty and confusions about college costs may deter low-SES and minority parents from encouraging their children's preparation for college enrollment.

*Parental involvement and information as forms of social capital.* Much of the previous research linking social capital and educational outcomes has been conducted based on large national survey data (e.g., NELS: 88), relying heavily on Coleman's proposed social capital construct that emphasizes the role of parents and family in educational attainment (Dika & Singh, 2002). Coleman (1988) stresses the role of parental involvement in building social capital, arguing that social capital communicates the norms, trust, authority, and social controls that are required for educational attainment. As indicators of social capital that can serve as a resource for education of the family's children, Coleman (1988) focused on the presence of two parents, the number of children (the more siblings in a family, the less of the total family resources per child), mother's employment when the children were young, communication and interaction between parents and children, and mother's educational expectations.

With a disproportionate focus on parents and family social capital following Coleman's tradition, educational researchers have typically conceptualized parental involvement as a form of social capital that promotes college enrollment (Perna & Titus, 2005b; Rowan-Kenyon, 2007). These studies tested the assumption that parents provide necessary social capital in the form of different types of interactions and resources to help

children prepare for and access to college (Anguiano, 2004). The strength of parental involvement as social capital is measured in terms of the amount of time children spend with their parents and the efforts parents make to provide a positive and healthy environment for their children's educational outcomes (Yan, 1999). Similar to Coleman's view, measures of social capital used in prior studies include parent involvement in the student's education, parent-teacher relationship, parent-child discussion about school experiences and academic matters, parents' educational expectations, parent-school involvement, and parent-parent relationship (Anguiano, 2004; Engberg & Wolniak, 2010; Kao & Rutherford, 2007; McNeal, 1999; Perna & Titus, 2005b; Rowan-Kenyon, 2007).

In numerous studies using NELS (National Education Longitudinal Study) data to examine the relationship between social capital and college enrollment, social capital manifested through parental involvement in education (such as educational encouragement, parent-child discussion of school activities, relationships with school personnel) is positively associated with postsecondary enrollment (Anguiano, 2004; Horn & Chen, 1998; D. H. Kim & Schneider, 2005; Perna & Titus, 2005b; Puyosa, 2009). Sandefur, Meier, and Campbell (2006) reveal that students whose parents expect them to get a bachelor's degree, talk with them frequently about school work, have frequent contact with the school on academic matters, and participate in school activities have increased chances of enrollment in four-year colleges. They further found that the positive relationship between social capital and college attendance is stronger and more positive for females and students of colors.

Sandefur et al.'s findings suggest that enhancements in social capital within a family through developing more strong connections with their children, schools, and

surrounding community may have a positive effect on higher postsecondary outcomes, especially for females and minorities who come from disadvantaged backgrounds. In a similar study, Plank and Jordan (2001) also conclude that exploring financial aid opportunities, communications and discussion among students, parents, and school personnel about academic matters, and parental encouragement to take college preparatory exams increase an individual's chances of enrolling in four-year institutions.

Kim and Schneider (2005) operationalize social capital that promotes college attendance as the following three measures: 1) parent participation in school programs about postsecondary opportunities and financial aid; 2) number of college visits with their children; and 3) discussion of academic issues and direct parental advice on college choice. Their study demonstrates that students whose parents reported frequently discussing academic issues with their children are more likely to attend any type of college, and the benefits of active participation in school guidance programs by parents are stronger for students whose parents have lower levels of education and who are from minority groups. Consistent with Sandefur et al.'s study, their results highlight the critical role of social capital enhancement in facilitating underrepresented students' transition to postsecondary education.

Perna and Titus (2005b) categorize parental involvement as manifestations of social capital in two ways: 1) parents engage actively with their children in discussing and planning for their postsecondary education, and 2) parents are involved with the school. Their study reveals that for all students, the probability of enrollment in either a two-year or a four-year college increased with the frequency with which the parent discusses with the student education-related issues and initiates contact with school about

volunteering and about academic matters. With regard to racial and ethnic variations in the effect of social capital, they reported differential findings depending on the type of parental involvement (e.g., involvement with children or with school). The positive impact of parent-initiated contact with the school about academic issues on enrolling in a four-year college or university is stronger for African Americans, while the impact of parental discussion with the student about education-related issues is weaker for African Americans than for other racial/ethnic groups. This difference suggests that underrepresented students may possess lower levels of resources and information available through their families, but their parents and family could help children's postsecondary decisions utilizing school-level resources through active participation in school guidance programs to obtain postsecondary resources and information.

In some research studies, social capital is also manifested through parents' and/or students' behavior of seeking information and knowledge available through social relationships and networks in the college choice process, and evidence on the effects of access to postsecondary information on college enrollment has been found. For example, Horn and Chen (1998) report that students' obtaining financial aid information from two or more sources and talking to school personnel or parents about financial aid increased their likelihood of enrolling in any type of postsecondary institutions. Using the most recent available national data, i.e., Education Longitudinal Study (ELS: 2002), Engberg and Wolniak (2010) utilized social capital measures of the extent to which students sought out college entrance information from different individuals including teachers, counselors, parents, friends, and college representatives. They found that the effects

related to seeking out college entrance information and discussing plans for school and college with one's parents increased the likelihood of four-year college attendance.

O'Connor, Hammack, and Scott (2010) used NELS to explore the impact of financial aid information on college-qualified Hispanics' postsecondary enrollment. Their measures of financial knowledge indicators that represent social capital include both parents' information-searching actions to find out about financial aid and student actions to find out about financial aid availability. Their study demonstrates that the more students and their parents know about financial aid, the more likely the student is to attend a four-year college regardless of race/ethnicity, but the effect of parental action to find out financial aid information is stronger for Hispanics than it is for Whites.

For the overrepresentation of Hispanics in two-year colleges, O'Connor et al. argue that Hispanic students' limited access to desirable social capital may result in a lack of adequate information about financial aid, and in turn may result in college-qualified Hispanics applying to community colleges instead of four-year colleges. Although Hispanics are far more underrepresented in a four-year sector than are other racial groups (Ceja, 2006; Nunez, 2009; Perna, 2000), the stronger positive effect of financial aid information for Hispanics underscores the importance of information about financial aid and college finances in directing students to four-year colleges especially for Hispanics.

### Academic Preparation and Endogeneity of Curricular Choices

Coupled with socioeconomic backgrounds, a student's academic ability and achievement in high school have been regarded as determinants of college choice (Arbona & Nora, 2007; Baker & Velez, 1996; Cabrera & La Nasa, 2001; Hossler, et al., 1999; Jackson, 1978; Karabel & Astin, 1975; Perna, 2006b), and there has been debate

over the relative influence of academic and socioeconomic factors on college choice. While some researchers note the independent roles of both academic and socioeconomic factors (e.g., Hearn, 1991; Karen, 2002; St. John & Chung, 2006b), others advocate stronger impacts of academic factors on college choice (e.g., Alexander, Holupka, & Aaron, 1987; Berkner & Chavez, 1997; Choy, 2002; Plank & Jordan, 2001). Focusing on diminishing (but still significant) effects of socioeconomic factors on college attendance once precollege academic variables are controlled for, these studies provide an empirical basis for advocating the importance of academic preparation in improving college opportunity for low-SES students. Based on the rationale of academic preparation, the NCES (National Center for Educational Statistics) research has claimed that taking the preparatory steps for college and rigorous mathematics courses in high school can help mitigate the effects of socioeconomic background on enrollment in a four-year college (e.g., Berkner & Chavez, 1997; Choy, 2002).

However, it is unclear whether these expanded college opportunities are due solely to course-taking differences or are partly the result of student self-selection into different courses. Most of the existing research fails to account for the non-random selection of students into high school courses, which may have biased the estimated effects of course-taking on the likelihood of college enrollment. A study by Attewell and Domina (2008) is, however, an exception. They accounted for the selection bias inherent in students' curricular choices by employing a propensity score matching technique that attempts to ensure the equivalence between the "treated" (students taking a college-preparatory curriculum) and a "control" group (those who did not). They found that taking a more demanding high school curriculum was associated with greater access to

and graduation from college than students who took a less intensive curriculum. Although their findings are consistent with the prior research that documented positive impact of rigorous course-taking on college enrollment, the smaller curriculum effects they estimated than the prior research suggest that studies failing to control for selection tend to produce upwardly biased effects of academic course-taking.

In terms of selection bias, a student's socioeconomic background has been one of the significant contributors related to the non-random selection into advanced high school courses. Studies have shown that socioeconomically advantaged students are more apt to take rigorous math and science coursework in high school (Cavanagh, Schiller, & Riegle-Crumb, 2006). Stated differently, "students do not enjoy equal opportunities to prepare for colleges" (Daun-Barnett, 2008, p. 17), and that access to academic preparation is more restricted for low-SES and underrepresented minority students (Perna, 2004). St. John and Chung (2006a) analyzed national data on the high school class of 1992 (NELS) to identify linkages between opportunity for academic preparation (operationalized as high school graduation with advanced math courses) and SES. Controlling for individual characteristics and state-level policies on K-12 education, their analyses revealed that higher levels of both family income and parents' education predict students' high school graduation with completion of advanced math. Given differences in the quality of schools attended by students' SES, their findings suggest that access to advanced math courses for low-SES students can be structurally constrained by poor school conditions that impede the provision of quality academic courses and learning resources.

Considering students' non-random selection into different courses and the limited access to college preparation for disadvantaged students, it is evident that pre-college

academic preparation alone cannot fully address socio-economic gaps in college choice. Both the availability of financial aid and family financial circumstances can influence students' college choice (St. John et al., 2004), and thus high financial barriers can even disadvantage "college-qualified, low-income students at many steps leading up to enrollment" in a four-year institution (Fitzgerald, 2004, p. 13). Given the tightening relationship between family financial resources and college enrollment over time, the following section examines the role of finances in college choice for students from different backgrounds.

## The Role of Finances in College Choice

A large body of research indicates that college costs and financial aid have a direct effect on the final phase of college choice, while it has become evident that student perceptions and knowledge of finances indirectly influence college-choice decisions through college plans and academic preparation (Perna, 2006c; St. John, Cabrera, Nora, & Asker, 2000). This section reviews both the direct and indirect effects of college costs (or prices) and the types of public financial aid on college choice for students from different background. With regard to the direct aid effect, this dissertation focuses on discussing the impact of public student aid policies implemented by federal and state governments.

### Impact of Federal Need-based Grants

Research on financial aid has confirmed that students from different socioeconomic and race/ethnic groups respond differently to student aid than they do to tuition, and respond differently to each type of financial aid in their enrollment and the choice of institutions (DesJardins, 2001; Heller, 1999; Jackson, 1978; Paulsen & St. John,

2002; St. John, 1990). In his extensive review of the price-response studies, Heller (1997) synthesized the findings of the prior studies that: 1) "students are more sensitive to financial aid in the form of grants than to work study or loans, 2) lower-income and Black students are more responsive to tuition and financial aid than are Whites and those from middle- and upper-income levels" (p. 650).

Given the higher price-responsiveness of low-income students, the escalating cost of attendance and diminishing affordability pose financial barriers to choices of those from disadvantaged backgrounds (McPherson & Schapiro, 1998; Terenzini, Cabrera, & Bernal, 2001). Traditionally, federal need-based grants have been considered to promote the goal of equal educational opportunities for low-income students who face these financial challenges. Despite the stated goal, during the past decades there has been controversy among researchers over whether the introduction of federal need-based grants has had the intended impact on college enrollment of needy students. A few researchers used the introduction of the Pell grant in 1970s as a "natural experiment" to estimate changes in student enrollment behavior, but found no distinguishable impact on enrollment of traditional college-age students (e.g., Hansen, 1983; Kane, 1995).

Although some researchers previously reported a positive impact of federal grants, their research did not explicitly consider the impact of a Pell grant, by simulating the effects using data collected before the introduction of the Pell program (Manski & Wise, 1983) or by examining publicly-provided grants that are not distinguishable from state grants (J. B. Schwartz, 1985, 1986). Using data from Current Population Survey (CPS), however, a study about the program impact on older, nontraditional students revealed that the Pell grant availability had a sizeable effect on the probability of college enrollment

among non-traditional students during the 1980s (Seftor & Turner, 2002). In addition to the introduction of the Pell grant, elimination of other forms of a federal grant program was utilized as a natural experiment that provides an opportunity to identify its effect on enrollment decisions. Using data from National Longitudinal Survey of Youth (NLSY), Dynarski (2003) examined the impact of the elimination of the Social Security Student Benefit Program in 1982. She found that after the discontinuation of the program, college enrollment of students with a deceased parent, who would have been eligible for the grant, declined substantially.

Despite a few positive findings about federal grant programs, no existing study has substantiated the effects of a Pell grant, a largest need-based program, on college enrollment among traditional-aged low-income students. Research based on economic approaches attributed its modest impact to relative reduction in aid to low-income students because of the extended eligibility that enabled awarding a substantial portion of a Pell grant to middle-income students (e.g., Fuller, et al., 1982; McPherson & Schapiro, 1991). An alternative explanation for the limited impact suggests that the complexity of the application process, combined with the lateness of notification processes of eligibility and award levels, limits the impact of federal aid programs on college choice among low-income students (Dynarski & Scott-Clayton, 2006, 2008; Kane, 1999; B. T. Long, 2007; Mundel, 2008). Dynarski and Scott-Clayton (2006, 2008) note that the complexity of filing the Free Application for Federal Student Aid (FAFSA) creates a substantial barrier to financial aid application and college opportunities among needy students. Their simulation analyses employing a national survey of financial aid for college students (NPSAS: 04) revealed that the current system of determining eligibility for federal aid

can be closely approximated by using only the two simple measures of adjusted gross income and family size with small error. Based on the findings, they recommended simplifying the process of federal aid applications to promote the effectiveness of federal need-based aid programs.

Impact of State Need-based Grants

Research on state grants have generally found positive influences of need-based grants on college choice and enrollment decisions of low-income students. Using the NELS data merged by the Integrated Postsecondary Education Data System (IPEDS), Perna and Titus (2004) conducted multi-level analyses to explore how state-aid policies impact the types of institutions high school graduates chose to attend. After controlling for state appropriations, policies for K-12 education as well as student-level backgrounds, they revealed that state need-based grants are positively associated with enrollment in in-state private and public four-year institutions relative to non-enrollment.

Using state-level data compiled from different sources for the 1992 to 2000 fiscal years, St. John and colleagues (2004) used fixed-effects regression to investigate the impact of state financial aid (measured as need-based and non need-based grants for undergraduates per Full-time equivalent, henceforth FTE) on enrollment rates (measured as the aggregated percentage of high school graduates enrolled in higher education in the following fall). After taking state demographic context, tax rates, and state funding for education into account, St. John et al. reported a significant and positive impact of both need-based and non need-based grants on enrollment rates, with greater effects of need-based grants than non need-based grants. However, their analyses are restricted to identifying the relationships between state-level predictors, and do not provide an

opportunity to examine the direct effects of financial aid on individual students' enrollment decisions.

In attempts to overcome such limitations, St. John and Chung (2006b) analyzed the NELS data combined with the state-level data used by St. John and colleagues (2004) to conduct multilevel-multinomial analysis. The significant improvement over the prior studies is their exploring income differences in the impact of state aid on college choice, and by providing separate analyses of the effects of financial aid among students from different income groups. Controlling for academic preparation (as measured by advanced-math course-taking), their analysis revealed that state need-based grants increased the probability that low-income students enroll in either two-year or four-year institutions compared to non-enrollment. Their study demonstrates the substantial influence of state need-based grants on college enrollment for low-income students.

It has become evident that providing a guarantee of adequate and stable financial assistance for college-bound low-income students motivates them to become prepared academically as well as to attend college (St. John, Musoba, et al., 2004). The Indiana's Twenty-First Century Scholars Program created in 1990 "makes a commitment to low-income middle school students that the state of Indiana will provide a full-tuition scholarship to any public institution in the state or a portion of the tuition at private institutions" (Heller, 2006, p. 1725). To qualify for the program, students must be eligible for the federal free- and reduced-lunch school program, and should take a pledge in eight-grade to "graduate from high school, maintain a 2.0 GPA, apply for admission to an in-state college, apply for financial aid, refrain from using drugs and committing a crime,

and enroll full-time in a postsecondary institution within two years of graduation" (St. John, Musoba, et al., 2004, p. 839).

St. John and colleagues (2004) evaluated the impact of participation in the Twenty-first Century Scholars Program on college choice for low-income students who graduated from Indiana high school in 1999. Their analyses revealed that students who participated in the Scholars program were more likely to aspire to attain a four-year degree, apply for financial aid, and enroll in college than non-participants. Their findings suggest that being a Scholar improved the chances that low-income students plan for and take preparatory steps for college, which in turn promoted their eventual college enrollment.

Despite the sizable effects of the Scholars program, the results should be interpreted with caution in that the researchers lacked an ideal comparison group who are also from low-income families, but who did not participate in the program. In the absence of data available regarding family income, St. John and colleagues compared Scholars with non-Scholars who attended high-poverty school (presumably accommodating many low-income students). Schwartz (2008) argues that their lack of a valid comparison group may have resulted in selection bias in that students who became the Scholar are self-selected (or strongly motivated) because they chose to take the pledge and to further carry out the pledge by applying for financial aid and for college. Despite the potential for selection bias, the reported impact should not go unnoticed because the early guarantee of providing adequate aid may also have substantial intangible effects such as lowered concerns about college affordability that may incentivize low-income students to prepare for and attend college.

Impact of State Merit Aid

In addition to state need-based aid, there is growing evidence that state merit-based grants, awarded based upon high school academic achievement, influence student college choice. With a dramatic increase in state merit-based programs, researchers have increasingly investigated the effects of state merit aid programs on college choice, with most research studying Georgia's HOPE Scholarship (e.g., Cornwell, Mustard, & Sridhar, 2006; Dynarski, 2000; Singell, Waddell, & Curs, 2006). A series of evaluations of the HOPE scholarship by Dynarski (2000, 2002, 2004) reveal its substantial impact on aggregate in-state enrollment rates and the choice of four-year institutions for 18- to 19-year old residents in Georgia compared to other southern states, using the CPS data. Despite the increase in enrollment, Dynarski found that the enrollment gains were fully concentrated among White students from middle- to high-income families, with no substantial effect for students from African American and lower-income households.

Similarly, using the IPEDS data, Cornwell, Mustard, and Sridhar (2006) examine the effects of the HOPE scholarship on aggregate enrollment by race in Georgia relative to other southern states. Consistent with Dynarski, they found overall increases in first-time freshmen enrollment in Georgia after the introduction of HOPE in which the effects were heavily concentrated among four-year institutions, with greater gains in private institutions. Studies about merit-based programs other than HOPE (e.g., New Mexico's Lottery Success Scholarship) also reveal findings suggesting that the program disproportionately encouraged in-state enrollment of Whites and middle- to upper-income students at four-year institutions (Binder & Ganderton, 2004).

Contrary to prior studies that documented no distinguishable impact of merit-based aid on low-income students, one recent study reports a positive influence of the HOPE program on Pell-eligible students' college attendance in Georgia relative to other southern institutions. Analyzing the IPEDS and institutional Pell-award data covering the period from 1988 through 1997, Singell et al. (2006) found a substantial aggregate enrollment increase in Georgia at both two-year and four-year institutions after the introduction of HOPE, with the enrollment responses being significantly greater for Pell-recipients than for non-Pell students. However, their analyses revealed that a substantial portion of the increase in four-year enrollment rates by both the Pell-recipients and non-Pell recipients was concentrated among less-selective institutions. Their results suggest that although state merit-aid programs can promote the college enrollment of students from low-income families, these programs can also channel them into less-selective institutions.

The results from most studies suggest that merit-based programs had a disproportionate impact on the choice to attend in-state four-year institutions for students from White and middle- to upper-income families, while having little impact on minority and low-income students' college opportunity. The stronger influence of merit aid found among Whites and upper-income students may be a natural consequence of the fact that state merit aid, unlike need-based aid, is awarded disproportionately to Whites and those from wealthier families (Heller & Marin, 2004; St. John & Paulsen, 2001). A few studies documented that low-income and minority students qualify for the scholarships at much lower rates than Whites and those from affluent families, and receive a disproportionately smaller share of merit aid (Farrell, 2004; Heller & Marin, 2004). The eligibility criteria

based exclusively on academic merit may particularly discourage underprepared low-income and minority students who have limited resources and "feel that no amount of effort will increase their ability to meet these thresholds" (Mundel, 2008, p. 15).

One recent study, however, documents that state merit-based aid with broader eligibility criteria and a need component can positively shape perceptions of the aid availability and plan to attend college especially for disadvantaged students. Using survey data on high school seniors who are potential recipients of merit aid, Ness and Tucker (2008) explore whether student perceptions of their college plans were influenced by an opportunity to receive the state merit aid in Tennessee that includes need-based components as well as broad (academic) eligibility criteria. Their analyses indicate that compared to their advantaged peers, students from lower-income families and whose parents had low levels of education were more likely to perceive their eligibility for merit-based aid as integral to their plans for college attendance. Their findings suggest that the wide availability of merit aid based on both broad eligibility criteria and need components can expand the college choice of disadvantaged students through encouraging their predispositions toward college attendance while alleviating financial concerns.

Perceptions of College Cost, Financial Aid, and College Choice

Moving beyond the direct aid effect on college enrollment, studies have been extended to investigate perceptions and attitudes toward affordability. Perceptions and concerns regarding college costs and financial aid have been considered not only an integral part of the development of predispositions toward college (De La Rosa, 2006; Hossler, et al., 1999), but also of college preparation and enrollment decisions (St. John,

2006; St. John, Musoba, et al., 2004). Prior research suggests that the perceptions and concerns about college affordability are shaped by a student's socioeconomic background, and low-SES students have more concerns about paying for college (Avery & Kane, 2004; St. John, 2002). Studies also indicate that concerns about affordability influence students' college aspirations and preparation that are closely linked to their eventual choice of college. With a belief that perceptions of affordability can be improved by better information, researchers have highlighted the importance of improving early awareness of financial aid and college costs as well as targeted guidance, especially for low-SES students (De La Rosa, 2006; Mundel, 2008; Perna, 2006c).

In combination, the existing research illustrates that college costs and financial aid directly affect college-choice decisions, while perceptions of finance and college affordability also influence college choice through shaping aspirations and preparation for college. The research further provides evidence that the effects of state financial aid on college choice differ by the type of aid and are conditioned by a student's socioeconomic and race/ethnic backgrounds. For instance, prior research reported the positive role of need-based aid in expanding college choice and opportunities of low-income students, whereas merit-based programs differentially impact college opportunities in terms of family income and race/ethnicity.

Although these studies have paid proper attention to socioeconomic and race/ethnic differences in the impact of state aid policies on college choice, they are subject to several methodological limitations. First, despite the demonstrated association between state-level financial aid and student college enrollment, many of the studies, especially the merit aid research, are restricted to identifying the relationships between

state-level variables, namely, state-level financial aid policy variables and overall enrollment rates aggregated at the state level. Given that aggregated enrollment rates at the state level do not reflect the truer image of the enrollment behavior observed by individual students who reside within the state, the existing analyses do not provide an opportunity to fully examine the effects of state-level financial aid policy on individual students' college-choice decisions.

Second, and more importantly, despite a few studies that address the association between state-level financial aid policy and individual students' college choice behavior, they have modeled this relationship without considering the longitudinal (or temporal) process of enrollment decisions. Furthermore, prior studies failed to consider the time-variant nature of financial aid policies suggesting that year-by-year changes in state-level financial aid policies may affect students' enrollment decisions in the state in addition to their timing of enrollment once they decide to attend college. Studies that fail to consider temporal dimensions often made inferences based on cross-sectional data that contain information only about a single point in time, but this type of data "cannot be used to explain how *changes* in independent variables affect *changes* in the outcome of interest." (DesJardins, 2003, p. 425).

Given limited attention to the different timing of college enrollment among individuals, employing cross-sectional methods may produce biased results by ignoring the college choice of students who enrolled in college at later points in time (but were observed as non-enrollment for the studied academic year) as well as by ignoring time-varying information about financial aid policies that change over time. Therefore, it is critical to consider the temporal nature of the college enrollment process by utilizing an

appropriate longitudinal method that enables us to investigate the choice of students who enrolled in college at different time points as well as to examine their time-to-initial enrollment.

## A Conceptual Framework and Hypotheses for the Study

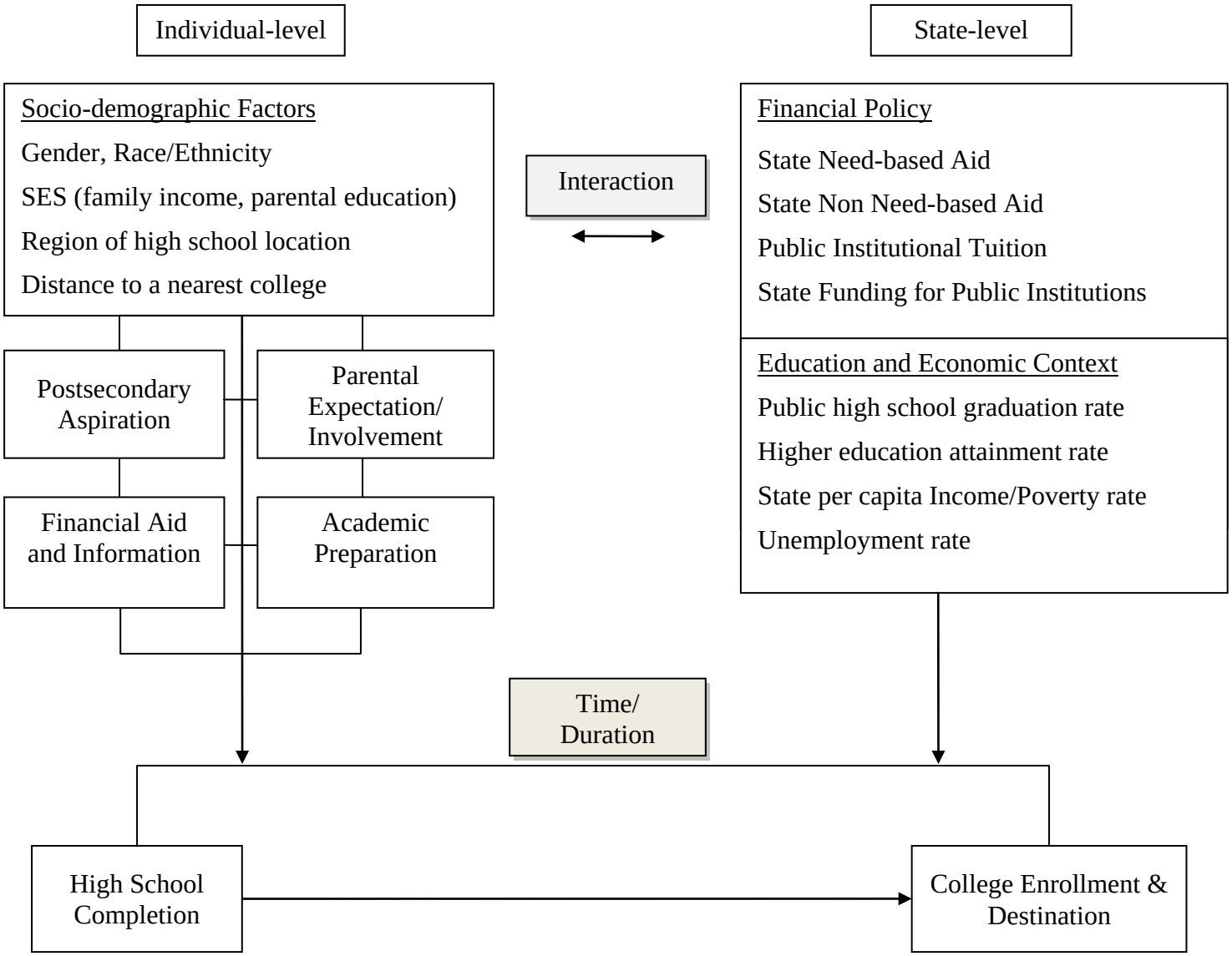
Based on an understanding of the theory and research discussed above, this section proposes the conceptual framework used for examining the role of state financial aid policies in individual students' enrollment decisions as well as their timing of enrollment. Figure 1 illustrates the outcome variable of the present study at the bottom, i.e., the occurrence as well as the time (or duration) to enrollment. Students who are examined in this study are restricted to high school or GED completers in or after the year 1992, and some of these students enroll in college at different points in time through the year 2000 while others do not choose to attend college by the end of the year 2000 (when the study was terminated). It is important to note that the "time" (measured in years) a student takes to make a transition from high school to postsecondary institutions is explicitly considered in this conceptual model as an important study outcome. For students who enroll in college, this framework considers college destination in terms of the selectivity and the type of an institution attended by a student. Therefore, in addition to whether a student attends a college, where she attends is examined as an important outcome for the study.

Figure 1 also presents both individual- and state-level factors that are hypothesized to affect students' enrollment choices and their time-to-enrollment after high school completion. As Figure 1 illustrates, individual-level covariates associated with college choice decisions include socio-demographic and other factors including

gender, race/ethnicity, region, distance to a nearest college, SES (measured by family income and parental education level), parental involvement, academic preparation, postsecondary aspiration, and financial aid. Students' gender is controlled for to eliminate potential gender differences in enrollment decisions. Region of the country (where high school is located) is also included to control for regional differences in college access and opportunities between urban and suburban settings. Distance to a nearest college is additionally controlled for to measure proximity from one's home to a closest postsecondary institution, which may indicate the availability of postsecondary educational opportunity in one's residence.

A student's socioeconomic and race/ethnic background plays a critical role in the college choice process, and widening college participation gaps in terms of race/ethnicity and family income have frequently been reported. Considering the relative disadvantages in postsecondary opportunities experienced by low-income and minority students, the present study hypothesizes that low-income students and underrepresented minority students (e.g., African Americans and Hispanics) are less likely than their advantaged counterparts to make transition immediately to college and to attend selective institutions.

Figure 1. A Conceptual Framework for the Impact of State Aid Policies on College Enrollment



As important sources of social and cultural capital, parental expectations and involvement in college choice process is hypothesized to positively affect children's college choice, while students' academic preparation is considered to have a strong independent effect on college enrollment and destinations. In addition, considering the stages that precede enrollment in the staged college choice model (e.g., predisposition and search), the model controls for students' postsecondary aspirations (or predispositions) that are hypothesized to positively influence college enrollment.

Financial aid awarded to individual students is a significant factor that impacts students' college enrollment decisions. Especially financial aid in the type of need-based aid rather than non need-based aid is assumed to have more positive impact on students' college enrollment. In addition, the importance of information about financial aid availability is tested in the model in that students' postsecondary information obtained from their social networks is considered a critical source of social capital that promotes college opportunities in prior research.

The right-side of Figure 1 represents state-level variables including state financial policy variables as well as educational and economic variables. Individual students are nested within states, and their enrollment decisions may be subject to the state's public financial aid policies and overall socioeconomic context as well as educational opportunities provided to its residents. State-level financial policy variables include the average amount of state need-based aid and non need-based aid, and average in-state undergraduate tuition and fees at public institutions. The level of tuition and fee at public institutions is hypothesized to negatively affect a student's college enrollment decisions

because its increase gives additional financial burdens to students and families who have to pay substantial costs of college education.

With regard to the effects of state financial aid variables, I hypothesize that state need-based aid and non need-based aid may have different effects on students' enrollment behavior because of differences in the eligibility criteria. State need-based aid is hypothesized to positively influence needy students' enrollment in any college, while state non need-based aid is hypothesized to have limited impact on enrollment in less-selective colleges or community colleges due to its academic restriction in award criteria. In other words, state non need-based aid will be awarded to students whose academic ability is above the specified criteria, and these students will be more likely to avoid two-year college enrollment when tuition differences between two-year and four-year colleges are narrowed due to the award of state non need-based aid.

In addition to state financial aid and tuition that directly impact students' college affordability, state funding for public institutions is considered in the model in order to control for potential enrollment effects attributable to states' investment in institutions over and above the direct student subsidizations. State-level socioeconomic and educational context is additionally controlled for by including average state per capita income and poverty rates, annual unemployment rate, public high school graduation rate, and the percent of population who attained a bachelor's or higher degree within a state.

Furthermore, interactions between students' background variables (i.e., income and race/ethnicity) and state-level financial aid policy variables are tested in an attempt to detect differential impact of state-level financial aid policies on enrollment decisions across students from different income and race/ethnic backgrounds. In testing how the

impact of state aid policy varies based on family income and race/ethnicity, I hypothesize that low-income and/or underrepresented minority students who may have more unmet need are more sensitive to changes in tuition and state financial aid policy than their upper-income and White counterparts. Specifically, increases in the availability of state financial aid are more likely to have larger enrollment effects among low-income and underrepresented minority students relative to their advantaged peers. In terms of college destinations, I hypothesize that increases in state financial aid will help low-income and underrepresented minority students enroll in any types of institutions including two-year and four-year institutions regardless of selectivity.

With regard to the impact of the duration time between high school and college, I hypothesize that a student's likelihood of enrollment decreases proportionate to the length of the duration time. In other words, students' chances of enrollment will decline as more time passes after high school. In addition, the effects of state financial aid, regardless of the type of aid, are hypothesized to be stronger when a student enrolls in college immediately after high school, but diminish as the elapsed time after high school increases.

*Hypotheses*

In concluding this chapter, the main hypotheses to be tested in this dissertation can be summed up as follows:

1. Low-income and/or underrepresented minority students will be less likely to enroll immediately in college after high school completion than are their upper-income and White counterparts.

2. Both financial aid awarded at an individual level and state-level financial aid policy will independently influence whether students enroll in college and/or where students enroll if they choose to attend college.

3. State need-based aid and merit-based aid will have different impact on students' enrollment behavior. Need-based grant will have more positive impact on college enrollment in any types of college, while non need-based aid will be likely to have more positive impact on enrollment in selective colleges due to its academic requirements.

4. The impact of state financial aid will vary based on family income and race/ethnicity. Low income and/or minority students will respond more to changes in state financial aid policy, especially in the form of need-based grants, than upper-income and White students do. Specifically, increases in state financial aid will exert larger enrollment effects among low-income and underrepresented minority students.

5. The chances of student enrollment will decline as more time elapses after high school. The effects of state financial aid will also diminish as the duration time between high school and college enrollment increases.

In sum, this chapter provided a review of literature with regard to college choice and the role of finances, and introduced a conceptual framework on which the study is based. This conceptual framework involves key social, educational, and economic factors found to be related with students' college choice process. Treating college enrollment as temporal process and testing interaction effects between student background and state financial aid policy variables is an important focus of this proposed

conceptual model. The chapter also provided a series of hypotheses to be tested throughout the study. Based on the framework and hypotheses, the next chapter discusses the data and variables as well as statistical methods used for the study.

# Chapter III

# RESEARCH METHODOLOGY

## Data Sources and Sample

To address the research questions mentioned in the introductory chapter, this study primarily uses data from the National Education Longitudinal Study (NELS: 88/2000) collected by the National Center for Education Statistics (NCES). NELS, a national longitudinal study of students' educational pathways, followed almost 25,000 eighth-grade cohorts from 1,050 public and private schools through their high school graduation and later postsecondary education or employment path. Since the beginning of the baseline survey, which was conducted in 1988 when students were eighth graders, the NCES conducted four follow-up surveys in 1990, 1992 (when students were seniors), 1994, and 2000 (eight years after high school completion). As the study sample experienced attrition, NCES refreshed the sample during the follow-up surveys, with the final panel of the survey including 12,140 total respondents.

The NELS data provide information regarding the specific year and month a student completed high school (or equivalent diploma) for high school completers as well as the year and month of students' initial postsecondary enrollment among higher education enrollees. Because high school completion is a prior condition necessary for transition to postsecondary enrollment, the study sample is restricted to students who graduated from high school or attained an equivalent diploma in or after 1992, and who

provided follow-up information on whether or not they attended postsecondary institutions by the year 2000. Students who did not indicate their high school graduation year/month in addition to those who completed high school (or equivalent diploma) before 1992 are therefore eliminated from the sample (n=1,060). Additionally, students who responded they had enrolled in a postsecondary institution prior to completing high school (i.e., duel or concurrent enrollees) are excluded from the analysis (n=170) because it is hard to track these students' time-to-enrollment trajectories given the reverse temporal order between high school completion and postsecondary enrollment.

I also exclude students who did not provide their state of residence information in $12^{th}$ grade (n=90, less than 0.5%) because the missing data for state residence makes it impossible to merge with the state-level data (discussed later in this section). Among the states, students who attended high schools in the District of Columbia (DC) are excluded (n=10) because of differences in some state characteristics between DC and the other 50 states and the absence of public two-year institutions in DC (Perna & Titus, 2004). After removing all these cases the final sample size is reduced to 10,810 individuals.

Because the present study tracks students' college enrollment in the years 1992 through 2000, it is required that the study sample to be included in the analyses should remain in the waves of the NELS study collected from 1992 through 2000. To fulfill this condition, I utilize the sample weight (f4f2pnwt), which applies to the sample who completed the surveys in 1992, 1994, and 2000. The purpose of weighting the sample is to adjust for the unequal probability of selection into the study so that the study findings can be generalized to the intended population. In this study, utilizing the sample weight

allows the analysis results to be generalized to the nationally representative population of high school seniors in 1992.

Although the NELS data include comprehensive variables used for the study, additional datasets are utilized for constructing the two student-level variables that are not available in the NELS data: 1) distance to a nearest college and 2) financial aid awarded to an individual student. With regard to the distance measure, the zip-code associated with each student's home (for which high school location was used as a proxy) is used to estimate the distance from one's home to a nearest postsecondary institution. The zip code information of the NELS participants is obtained through linking the NELS data with the Common Core of Data (CCD) collected by NCES. The Common Core of Data (CCD) annually collects fiscal and descriptive information (including name, address, and zip code) about all public elementary and secondary schools and school districts in the United States. The zip-code information of the public high schools attended by the NELS participants is obtained by matching the CCD data collected in 1992 with the information about public schools in the NELS data.

Having access to private high school zip codes was, however, not available because NCES used different sampling frame (which was outside of their database system) for private school students. For example, the Private School Survey (PSS) conducted by NCES did not match with private school information from the NELS data and thus could not be used for the study. The zip codes of postsecondary institutions used for estimating the distance to the nearest college are obtained through the institutional survey data from the Integrated Postsecondary Education Data System (IPEDS) collected in 1992.

The amount of financial aid awarded to an individual student is also not available in the NELS dataset, and the National Postsecondary Student Aid Study (NPSAS) sponsored by the NCES provides additional sources of information that can be used for imputing the amount of financial aid awarded to the NELS participants. The NPSAS is a comprehensive study that investigates how students and their families pay college costs and how much financial aid is available for them based on a nationally representative sample of students who attend postsecondary institutions (including undergraduates, graduates, and professional students). Since the first NPSAS study began in 1987, NPSAS has been fielded every three to four years, with the last cycle conducted during the 2007–2008 academic year. Among the waves of NPSAS studies, this study uses the data from the NPSAS:92 survey for imputing the amount of financial aid for the NELS cohort (who were high school seniors in 1992) in that the time frame surveyed is closer to the NELS study than any other NPSAS waves, which may increase the equivalency of student characteristics between the two datasets.

In order to link state-level policies for higher education into student-level analysis, I employ data for state-level covariates from publicly available databases, including National Association of State Scholarships and Grant Programs (NASSGAP), *Digest of Education Statistics* (NCES, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000), U.S. Bureau of Labor Statistics, and the U.S. Census Bureau. State-level financial aid data were gathered from NASSGAP annual surveys conducted in 1992 through 2000 (NASSGAP, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000), while data on public tuition, state appropriations, and public high school graduation rate were drawn from the *Digest of Education Statistics* compiled by the NCES. Other state-

level variables related to education, demographics, and economic conditions (e.g., unemployment rate, income, poverty rate, bachelor's attainment rate) were obtained from public sources such as the U.S. Bureau of Labor Statistics, Bureau of Economic Analysis, and the U.S. Census Bureau.

## Research variables

### *Outcome variables*

Two types of outcomes are examined in this study. The first outcome variable is a dichotomous variable indicating whether or not a student who graduated high school in or after 1992 was enrolled in a postsecondary institution over an eight-year period, i.e., 1992 through 2000 (1=enrolled, 0=not enrolled). For those who provided information about their enrollment time (in year and month), the outcome variable is coded as 1, while those who did not indicate their enrollment time by the year 2000 (when the NELS study was terminated) is coded as 0. The use of longitudinal data that provide information on when a student graduated high school (or obtained GED) and enrolled in college allows us to measure *time* between high school completion and college enrollment, which is the real outcome variable for the study.

However, it is difficult to know whether students who did not enroll in college by the year 2000 will ever enroll in higher education. It is possible that some individuals who have not enrolled in college by the end of the study period may later enroll, but the termination of the study in the year 2000 makes it difficult to track these students' enrollment choice made afterward. These cases are considered right-censored in statistical terms, and event history methods allow us to deal with this "censoring"

problem by accounting for the possibility of future event occurrences of enrollment (Censoring will be discussed in detail in the methods section).

The second outcome variable examined is a categorical multinomial measure that differentiates college enrollment in terms of selectivity and the type of an institution (0=not enrolled, 1=enrolled in two-year or less institutions, 2=enrolled in four-year non-selective institutions, 3=enrolled in four-year selective public institutions, 4=enrolled in four-year selective private institutions). Distinction by institutional selectivity is tested because studies report differential socioeconomic benefits and labor-market returns associated with attending selective and non-selective postsecondary institutions (Ehrenberg, 2004; Kane & Rouse, 1995).

The degree to which four-year institutions are selective is determined using the selectivity categories published in *Barron's Guide to American College* (Barron's College Division, 1991) that profiles American colleges and universities with respect to admissions requirements, academic programs, and student life. The Barron's guide provides information on the selectivity of a four-year institution by categorizing the colleges and universities into six groups according to their admissions selectivity (including ACT/SAT scores, high school grade and class rank): 1) Most Competitive, 2) Highly Competitive, 3) Very Competitive, 4) Competitive, 5) Less Competitive, and 6) Non-competitive.

This study collapsed these six selectivity categories into two distinct categories that indicate whether an institution is selective (at least competitive and above) or non-selective (less and non-competitive). The selectivity measure of four-year institutions is then linked to the information about the type of an institution (private or public) attended

by the NELS participants. However, the Barron's measure does not cover all four-year institutions attended by the students in the sample, and the types of institutions without the Barron's selectivity ratings include foreign institutions, tribal institutions, Christian colleges (or Bible colleges), technical colleges, and institute of art and design. The four-year institutions with missing selectivity categories are classified as non-selective institutions (n=150 out of 5,010). In creating selectivity measures, I initially distinguished public non-selective and private non-selection four-year institutions, but later combined these two groups into non-selective institution groups because very small number of students enrolled in private non-selective institutions (n=340 out of 10,810).

The independent variables used in the model consist of student and state-level variables (as the conceptual framework in Figure 1 suggests). Student-level variables that may influence students' enrollment decisions include students' socio-demographic factors, postsecondary aspirations, parental influences, academic preparation, and financial aid. These variables are included to control for students' self-selection into enrolling or not enrolling in college. State-level variables include variables related to state financial aid policy and public tuition as well as demographic and educational measures for each state (see Appendix for a full list of independent variables).

*Student-level Independent Variables*

Socio-demographic factors: Students' socio-demographic variables to be included are gender, race/ethnicity, high school location, distance to a nearest postsecondary institution, parental income, parental education, and family size. Several studies revealed significant gender and race/ethnic differences in college choice process, the timing of college enrollment, and postsecondary attainment (Beattie, 2002; Hearn, 1992; Perna,

2006b). Students' gender is dichotomized with female students serving as the reference group, and dichotomous variables indicating each race/ethnic group are used with White students being the reference group. In addition, prior research reports comparative disadvantages of students who attend urban and/or rural schools in terms of postsecondary readiness and enrollment (Hu, 2003). In this study, students who attended urban and rural high school are compared to those attended suburban school.

Proximity from one's home to the nearest postsecondary institution is included in the model because this may reflect the level of postsecondary opportunity available to students. In this study, distance from one's home to the nearest institution is measured as the minimum distance from high school a student attended to an open enrollment institution where admission is guaranteed for any applicants. The open enrollment institutions are either community colleges or non-selective four-year institutions, and the list of open enrollment institutions available for the year 1992 is obtained from the IPEDS survey data.

The distance from one's high school to the nearest open enrollment institution is calculated using the ArcGis program that is specially designed to perform spatial analyses utilizing a geographic information system (GIS). Specifically, the program locates each high school and postsecondary institution using zip codes in the map, and allows us to determine the postsecondary institution located within the closest proximity from each high school. Then the program calculates the minimum vertical distance between each high school and the nearest postsecondary institution.

As was discussed earlier, obtaining zip codes for those who attended private high school through the Private School Survey (PSS) is not available due to the absence of the

linking mechanism between the PSS and the NELS data. When high school zip codes are missing for students who attended non-public schools (because the CCD provides zip codes of public schools only), I impute their missing distance to an open enrollment institution using geographic information available in the datasets. Specifically, the missing distance for non public school attendees is replaced with the average distance for public school attendees calculated jointly by each state and the different level of urbanicity (e.g., urban, rural, and suburban areas). Such replacement is based upon the rationale that students who reside in a similar geographic location (approximated by the state of residence and the level of urbanicity) may face comparable levels of availability in postsecondary opportunity.

With regard to socioeconomic differences, prior studies demonstrate that students whose parents have higher incomes and educational attainment are more likely to enroll in four-year institutions, whereas students from lower socioeconomic backgrounds are disproportionately directed toward two-year institutions or are less likely to enroll in any type of college or university (Cabrera & La Nasa, 2001; Perna & Titus, 2004). In this study, the original family income variable (measured as the total family income in 1991) that has 15 categories (ranging from none to $100,000 or more) is collapsed into the seven income groups. Before grouping the original income categories, the preliminary analysis included 14 income groups (except for one reference group) in the estimation model and compared the odds ratios of each income variable to check similarities between the estimated odds ratios. In terms of relative similarities in the direction and the magnitude of the odds ratios, 15 income categories were regrouped into 7 groups (i.e., none to $7,500, $7,500 to $15,000, $15,000 to $25,000, $25,000 to $50,000, $50,000 to

$75,000, $75,000 to $100,000, more than $100,000). Parental education level is dichotomized to compare parents who received college or graduate education to those who received less than or equal to high school education. Finally, a variable that measures the number of family members is included because the presence of many siblings may indicate the less availability of family and financial resources that help one's college enrollment (Behrman, Pollak, & Taubman, 1989; Hearn, 1984).

Postsecondary aspirations: In the sequence of the college choice process, students' aspirations for college education is a first step that develops predisposition toward college enrollment, and that students' postsecondary aspiration may be positively related to their college attendance (Paulsen, 1990). Postsecondary aspiration, a categorical variable that measures students' highest education they plan to achieve (formed in $12^{th}$ grade), is dichotomized to compare those who expect to receive bachelor's degree or above to those who plan to receive less than a bachelor's degree.

Parental influence: High parental educational expectations and active parental involvement and support for children's college choice have been found to have a positive effect on college aspirations and enrollment (Hossler, et al., 1999; Plank & Jordan, 2001). In this study, parent-involvement variables are operationalized as parents' postsecondary expectations and parents' discussion with students about school matters and college preparation (both are measured in $12^{th}$ grade). Parent's educational expectation is recoded into a dichotomous variable that compares parents who expect their child to graduate college or beyond to those who expect less than finishing college. Parental involvement in school matters is measured by a set of dichotomous variables that indicate whether

parents discuss with children about 1) selecting courses, 2) school activities, 3) grades, 4) plans to take SAT/ACT, and 5) applying to colleges.

Academic preparation: A student's academic achievement and preparation have been regarded as strong determinants of college enrollment as well as the choice of institutions (Adelman, 2006; Arbona & Nora, 2007; Baker & Velez, 1996). In addition, literature often suggests significant gaps in educational achievement and college opportunities between public and private/Catholic schools, as well as between the academic and non-academic tracks in high school (Gamoran, 1992; Levin, 1998; Lucas, 1999). A group of variables included in this category are high school GPA, an indicator of whether a student took any type of postsecondary entrance exams, curricular program (e.g., academic or vocational), the type of high school a student attended (e.g., public or private), and an indicator of whether a student received a GED or a high school diploma.

Students' academic achievement in high school is measured by a continuous measure of standardized test scores in reading and math taken in 1991, respectively, in addition to a continuous measure of cumulative standardized GPA for the last year of high school attended. Categorical measures that indicate students' curricular programs and high school type are recoded: Students who belong to an academic (or college-preparatory) program are compared to those in non-academic programs, while students who attend public school are compared to those who attend private or catholic school. Because taking postsecondary exams may indicate a student's intention to attend college, students who took any postsecondary exams (including ACT, SAT) are compared to those who have not taken such exams.

Furthermore, differentiating the recipients of the General Educational Development Diploma (GED) from high school graduates is important because GED holders are significantly different from traditional high school completers in terms of non-cognitive skills (e.g., persistence, motivation) affecting one's educational attainment (Cameron & Heckman, 1993). Studies suggest that GED awardees are much less likely than regular high school graduates to pursue postsecondary education or to attend four-year colleges when they attend postsecondary institutions (Heckman & Rubinstein, 2001; Murnane, Willett, & Boudett, 1997). The GED variable is therefore necessary in order to help control for unobserved student characteristics (including the levels of non-cognitive skills) that may impact a student's postsecondary attendance decision.

Imputed financial aid: In the absence of the financial aid information among the NELS participants, it is possible to impute the *expected* amount of aid that may have been awarded to the NELS participants. This imputation can be done if the relationship between financial aid amount and predictors associated with aid award can be estimated using a secondary dataset where financial aid information is available. Using this two-sample estimation technique, the estimated relationship (represented as the regression coefficient of predictors) for the secondary sample can be "transplanted" into the primary dataset where financial aid information is unobserved. In this study, the absent aid information for the NELS participants is imputed using the NPSAS:92 dataset that provides information about how much a student received of different types of financial aid for a representative sample of college students for the academic year 1992-93.

The estimation of the relationship between financial aid and the predictors of aid award for the NPSAS sample focuses on first-time undergraduates because the study

examines first-time college attendance. To ensure the sample similarity between the two datasets, independent students are also excluded because their financial need might be significantly different from their dependent counterparts. The final NPSAS sample that provides the basis for imputation consists of 27,580 dependent, first-time students who attended college in the 1992-93 academic year.

The imputation procedure starts by estimating the expected amount of a Pell grant because the Pell grant eligibility can be relatively easily predicted using the Expected Family Contribution (EFC) formula based primarily on income, asset, and family structure. I examined the 1992 EFC formula that determines a student's financial need and identified the variables (common in both NELS and NPSAS data) that are important in predicting the Pell grant eligibility. These variables include parents' income and marital status, family size, gender, and race/ethnicity. It is important to note that these predictors for financial aid are also important factors that influence a student's college enrollment. If only these predictors are used to impute a student's expected amount of aid and are also used to predict college enrollment (along with the imputed financial aid variables), the enrollment prediction model is likely to be subject to the problem of multi-collinearity because these predictors are doubly included in the model. To reduce the potential of multi-collinearity and better identify the two estimation models, it is necessary to include variables that predict financial aid but are excluded from the enrollment prediction model. Employing the interaction variables between the aforementioned predictors of financial aid improve the identification strategy because these interaction terms are non-linearly related to financial aid, but are not necessarily related to enrollment. As such, the inclusion of interaction terms between the predictors

in the aid determination model (and excluding them in the enrollment prediction model) helps better identify the model.

Once the predictor variables are identified, the expected amount of financial aid are structurally estimated following the procedures proposed by DesJardins, Ahlburg, and McCall (2006) who examined the effect of financial aid *expectations* on college application and enrollment behavior. According to their study, the probability of receiving financial aid, multiplied by the predicted amount of aid conditional on receiving aid equals the expected amount of aid (or expectations about aid) for each student.

The process of estimating expected amount of aid for each type of aid, using DesJardins et al.'s methods, is as follows. Using NPSAS sample, I first estimate the probability of receiving a Pell grant (utilizing logistic regression) for each student conditional on gender, race/ethnicity, parents' income and marital status, family size, and a squared-term of family size that captures any non-linear effects. In addition to these predictor variables, the interaction variables between family size and income and between family size and race are included to capture any differences in the effects of race and family income depending on the number in the family (the increase of which represents fewer social and financial resources for college enrollment). The formal goodness of fit tests (i.e., likelihood ratio tests) supports the inclusion of these interaction terms (the model fit improves significantly with their inclusion compared to the model with no interaction terms). The results of these tests confirm that the effects of the interactions between family size and race, between family size and income for predicting a Pell grant are jointly significant ($p<.001$).

After estimating the probability of being awarded a Pell grant, I employ ordinary least squares (OLS) regression to estimate the predicted amount of a Pell grant for those who received a Pell grant, using the same set of predictor variables. The estimated coefficients of each predictor for the NPSAS sample in both regressions (i.e., logistic and OLS regressions) are used to estimate the probability of receiving a Pell grant and the predicted Pell amount conditional on receiving a Pell grant for the NELS sample. Finally, the expected amount of a Pell grant for the NELS sample is calculated by multiplying the probability of receiving a Pell grant by the predicted Pell amount, conditional on having received a grant award. This two-stage calculation process is done in order to replace unobserved expected Pell amount with its imputed value for each NELS participant based on the relationship between Pell award and the predictors of the grant estimated with the NPSAS data (Card & McCall, 1996).

Once the expected amount of a Pell grant is estimated, a similar calculation is done for estimating the expected amount of state need-based grant and non need-based grant, respectively. The predictors used to estimate the expected Pell amount are again employed to estimate the expected amount of state need and non need-based grants. For state non need-based grants, a student's SAT composite score (or converted ACT score) is also controlled for because academic merit is considered an important determinant of being awarded non need-based (or merit-based) grants in a sizeable number of states. As in the case of the Pell prediction model, formal goodness of fit tests support the inclusion of the interaction terms between family size and race/income in predicting state need-based and non need-based grants ($p < .001$).

Information about financial aid: In addition to the expected financial aid amount, information about college costs and the availability of financial aid may shape the perception of college affordability, which may influence students' college aspirations and preparation that are closely linked to college enrollment. Students' information about financial aid is measured by a set of dichotomous variables that indicate whether or not a student sought various sources of information in their 12th grade. These variables are: 1) student talked to a teacher/counselor about financial aid, 2) student talked to a school representative about financial aid, 3) student read information about financial aid provided by U.S. Department of Education, and 4) student read information about financial aid provided by colleges and universities a student applied for admission.

*State-level Independent Variables*

Public finance policy: Changes in state-level financial aid policy act as a policy signal to students regarding whether college is affordable for them, which may affect individual students' enrollment behavior. State-level finance policy predictors that may affect an individual's college enrollment include the average amount of state need-based aid and non need-based aid, the amount of state funding for public institutions, and average in-state tuition at public institutions per full time equivalent (FTE) undergraduates. The number of FTE is drawn from the *Digest of Education Statistics* published by the NCES. These policy predictor variables vary their values over the study period (ranging from the year 1992 to 2000).

Studies have demonstrated the substantial influence of state need-based grants on college enrollment for low-income students (St. John & Chung, 2006b), while other studies suggest state merit-based grants disproportionately encouraged college enrollment

of middle- to upper-income students (Cornwell, et al., 2006; Dynarski, 2004). Research exploring college costs and enrollment decisions demonstrate a negative impact of tuition increases on college enrollment, while state effort to reduce public tuition through direct appropriations to public institutions is positively related with college enrollment (Heller, 1999; Perna, Rowan-Kenyon, & Bell, 2008; Perna & Titus, 2004).

The main reason for focusing on average public tuition, which is an average of tuition and fees in two-year and four-year institutions, as a proxy for college costs is to prevent estimation problems that can happen when including two-year and four-year college tuition separately in the estimation models. Two-year and four-year tuition rates at public institutions are highly correlated both across states and within states over time (Kane, 1994). The high correlation between two-year and four-year tuitions (over .70) in public institutions suggests states that charge high tuitions at four-year colleges will also charge high tuition at two-year colleges, and when states raise tuition, they do so at both two-year and four-year colleges (Kane, 1994). Including both two-year and four-year tuitions in the enrollment regression models may, therefore, introduce a multi-collinearity problem. When high multi-collinearity is present, confidence intervals for coefficients tend to be very wide and the estimated standard errors tend to be very large. Thus, the presence of multi-collinearity usually reduces stability of the estimated coefficients because the significance of estimation results can vary dramatically even when a very small change has been made to a model specification. To maintain the stability of the estimation results, this study therefore employs a public tuition variable that averages out two-year and four-year tuition rates (i.e., a combination of two- and four-year tuition effects).

Another important point to note is that the study examines the effects of financial aid in terms of different levels (i.e., individual level and state level). The aforementioned

expected financial aid variable provides information on how much an individual student would have been eligible for financial aid based on their background characteristics, thus allowing us to consider individual variations in the financial aid packages offered to each student. However, the expected aid variables alone cannot forecast how trends (or changes) in one's expected amount of financial aid are related to students' enrollment over time because the imputation of one's expected aid values was conducted for a single-year only (and thus does not inform how the aid expectation changes over time). In addition, the imputation of expected aid values might better reflect aid packages awarded by traditional students who enrolled in college within a short period of graduation rather than those who delayed enrollment because the study used the NPSAS: 93 data for sources of imputation (very small time gap between high school completion and college enrollment).

In response to this problem when including expected aid values only, employing state-level measure of financial aid policy variables in addition to individual expected aid variables also allows variations in the amount of state financial aid over time. State-level aid variables change their values over the study period, and the presence of time-varying trends in state aid allows us to examine how changes in the amount of state aid are related to changes in enrollment over time. Thus, both levels of financial aid variables are necessary in the estimation model because they work in a different way.

In this study, state finance policy predictors are measured as follows: 1) state need-based and non-need based aid (most of which is referred to as merit-based aid) are (respectively) measured by the average amount of state need-based grants and non need-based grants for undergraduate students per FTE; 2) public tuition is measured by the

amount of undergraduate in-state tuition and fees for the public higher education system, and 3) state funding for public institutions is measured by the amount of state and local appropriations per FTE for the public higher education system. All of these measures are adjusted to 2006 dollars and are divided by one hundred for ease of interpretation.

The state-level financial predictors are included in the form of lagged variables because the decision to enroll in college may be influenced by state policies that took place prior to the year when a student enrolls in college. An important rationale for using the lagged state-level variables is that the amount of state-level financial aid, levels of public tuition and state appropriations in one period may affect whether a student will enroll in college in the future period. Essentially, the current analyses employ an approach of using past state-level finance policy variables to predict individual students' future enrollment behavior.

This study tried different lag structures for lagged variables (e.g., lag one, two, or up to three years) in addition to including the original non-lagged variables. The rationale for testing various degrees of the lagged structures up to three years is that at least the past three years of state-level finance policy might facilitate students' estimating the future trend in college affordability. For instance, past tuition and the average amount of state grants can be conceptualized as signals regarding the cost of college sent to students while they are in the early stages of high school (e.g., freshmen or sophomore). High school seniors may forecast college costs or state aid policy using cost and financial aid information for the past three years and their decision to enroll in college might be influenced by how they forecast the future trend.

Wald tests are conducted to assess the model fit of the estimated model with each set of lagged variables (up to 3 years) compared to the model with no such variables. Experimenting with different sets of lagged variables using a series of Wald tests revealed that for the state financial aid predictors, the non-lagged variables as well as the variables lagged 3 years significantly improved the model fit ($p < 0.01$), whereas the variables lagged up to 2 years did not contribute to the model fit. Based upon the results of the Wald tests, the final model includes the pair of state need-based and non need-based aid variables in the form of non-lagged ones and lags of 3 years.

State demographic characteristics: One concern with the study's empirical approach is that one or more unobserved factors that also vary over time at the state level may confound the effects that state financial policy predictors have on enrollment. To additionally control for between-state differences that may be correlated with state policy predictors, the study also includes economic and educational conditions that vary over the study period within a state, such as state per capita income (adjusted to 2006 dollars), percent of the state population that is in poverty, annual average unemployment rate, public high school graduation rate, and the percent of population who attained a bachelor's or higher degree within a state. As in the case of state finance predictors, these variables are included in the form of lagged variables because a state's levels of educational attainment, economic development, and unemployment conditions in one period may be correlated with college enrollment of students who reside in the state in the following periods.

I also tried different sets of lagged structures using a series of Wald tests in order to determine the set of variables that significantly improves the model fit. The Wald test

results indicate that both non-lagged variables and all forms of lagged variables up to 3 years improved the model fit significantly ($p < 0.001$). Based on the Wald test results, the non-lagged variables and all forms of lagged variables up to 3 years are included in the estimation model.

State fixed-effect dummy variables: Additionally, to control for any observable or unobservable state-specific fixed differences that may influence a resident's enrollment behavior across states, a total of 49 state-dummy variables that represent each state (assigned one for each state) are controlled for in the model (reference group: Alabama). The reason for including these state dummies can be found in the time-varying state-level covariates used for this study. All state-level variables change their value over the study period, and controlling for any time-constant (or fixed) state factors related with college enrollment by including dummy state indicators helps better identify the remaining effects of other time-varying state-level variables.

*Time*

Finally, in order to capture the effect of time, a series of year dummy-variables for each time period (i.e., 1992 through 2000) are included in the model, and these variables indicate whether a student enrolled in a specific year or not. In addition, the interaction terms between each year variable and the indicator of whether a student received GED are controlled for in order to allow for differential effects of obtaining GED (compared to high school graduates) that may vary over time.

## Statistical Method: Event History Modeling

The present study employs event history methods, also called survival or hazard modeling, to capture the temporal nature of postsecondary enrollment and the effects of

state financial aid policy that may change over time. Event history modeling is an empirical technique that allows us to "study the occurrence and timing of events" in a longitudinal process (DesJardins, 2003), and has been recently used in higher education research to investigate the temporal aspects of student dropout and degree completion (Chen, 2008; DesJardins, Ahlburg, & McCall, 2002). Defined as a transition from one state to another, the event modeled in this study is the transition from high school to college (i.e., initial postsecondary enrollment). It is also possible that a student can choose between different types of institutions, and in this case enrollment in institutions with different levels of selectivity are considered different or "competing" events because these events cannot happen at the same time when an individual student initially enrolls in college.

Advantages of using event history methods over other types of regression models in studying temporal events are twofold. First, the methods allow us to deal with censored observations that occur when the outcome or event of interest (i.e., enrollment) is not observed for an individual within the study period. There are two major types of censoring, i.e., right- and left-censoring, both of which make it impossible to determine an individual's time-to-event. Right censoring refers to the case when the actual time of event occurrence is not known. In studies of college enrollment, right censoring takes place when individuals who completed high school never enroll in college by the end of study time period (in this case the year 2000), and researchers have no way of determining if or when they will experience the event (of enrollment) after the study's observation period. Event history methods effectively handle this right censoring by accounting for those who have never enrolled at the end of the study period, and thereby

reduce possible estimation bias due to the exclusion of censored cases. Left censoring refers to the case when the beginning of the study is not observed, and is more difficult to remedy than right-censoring (DesJardins, 2003). In this study, because high school completion (or equivalent diploma) is a pre-requisite state for transitioning into postsecondary enrollment, the beginning of the study period is set as the time when an individual completed high school (or earned equivalent diploma). Therefore, the cases with no information on when a student experienced high school graduation (or completion of GED) are eliminated from the sample (6% of the total sample).

Another advantage of event history methods is its ability to incorporate time-varying covariates that change their values over the observation period. To conduct event history analysis it is necessary to construct a person-period dataset that includes a record for each time period in which time-varying covariates are assigned their value in each period. The conversion of the dataset into person-period data format that contains multiple records for each person for each time period distinguishes the event history analyses from cross-sectional data that have a single record for each person (with no temporal dimension), and enables the analysis of change in the outcome over time.

In this study, all state-level variables used in the study, including average state need and non-need based financial aid, public tuition, and state appropriations for public institutions, change their value every year. Given the importance of time order in identifying causal relationships between the two variables, the role of time-dependent covariates in causal inference has often been emphasized, and in event history models, time-dependent covariates "indicate that a causal factor has changed its state at a specific time and that an individual is exposed to another causal condition" (Blossfeld, Golsch, &

Rohwer, 2007, p. 25). Stated differently, inclusion of time-dependent covariates in event history modeling enables studying change processes that unfold over time and thereby alleviates time-related sensitivity and non-random selection problems that have plagued researchers when making causal inferences using cross-sectional data and methods.

The time-to-event can be measured continuously or discretely, and this difference in the metric of time used distinguishes discrete-time models from continuous-time models in event history analysis. Continuous-time models assume that the time when the event occurs is known precisely, whereas for discrete-time models the event is measured in discrete time periods (e.g., observed in months, semesters, and years) (Singer & Willett, 1992). At an individual level, the NELS data provide both the month and year of students' high school completion and/or college enrollment, but this study aggregates the time metric used for the analysis to the year-level in order to match the data with state-level data that contain information on yearly changes in the level of state variables (from 1992 through 2000). In this study, occurrences of an individual's event are observed in years and it is therefore appropriate to apply a discrete-time event history model that reflects the measurement characteristics of the data.

*Estimating the Discrete-time Hazard Model of Enrollment*

Due to its importance as a "fundamental dependent variable in an event history model" (Allison, 1984, p. 16), an understanding of the hazard rate should precede the discussion of the model specification used in this study. The hazard rate for discrete-time models is defined as the conditional probability that a student experiences an event in each discrete time period *t*, given that the event has not already occurred prior to that time period (Ishitani & DesJardins, 2002; Singer & Willett, 1991). In event history modeling,

the basic methods of exploring the chronological patterns of event occurrences over time and the hazard rate of the event involve the life-table method, Kaplan-Meier estimation, and Nelson-Aalen estimation methods. These are all descriptive methods for estimating the distribution of event occurrences given the observation period. Related to the aforementioned research questions, these estimation techniques allow tabular and graphical plotting of the time-to-enrollment trajectories as well as enrollment in specific types of institutions for different income and race/ethnic groups over the observation period.

The life-table method describes the distribution of event occurrences and non-occurrences over time by computing the number and proportion of cases that experience the event, the number and proportion of cases that do not experience the event, and the number of cases that are censored in the respective time interval throughout the observation period. Similar to the life-table method, the Kaplan-Meier estimation method calculates the distribution of event occurrences and non-occurrences over time for each of the time periods. The advantage of the Kaplan-Meier method over the life table method is that the resulting estimates do not depend on the arbitrary grouping of the data into specific time intervals (Blossfeld, et al., 2007). The Nelson-Aalen estimation method is used to plot the cumulative hazard rate of experiencing the event up to a specific time point for a sample of individuals who are at risk of experiencing the event.

These exploratory methods, however, are not capable of controlling for the influences of covariates that may differentially affect an individual's hazard of postsecondary enrollment. To investigate the independent effects of state financial aid and other variables on enrollment hazards, I include a set of covariates to estimate the

hazard of enrollment using either the logit link function (0=not enrolled; 1=enrolled in college) for a single-event model, or the multinomial logit link function (0=not enrolled, 1=enrolled in two-year or less, 2=non-selective four-year enrollment, 3=four-year selective public enrollment, 4= four-year selective private enrollment) for a competing-event model. The discrete-time hazard model is formally specified as:

$$\text{Log } h(p_{tij}) = \beta_0 + \beta_1 x_i + \beta_{12} z_j(t) + \beta_3 \sum_{t=2}^{9} Time_{ti} + \beta_4 \sum_{j=2}^{50} State_{ji}$$

where, using logit link, $h(p_{tij})$ is the probability that an individual *i* who resides in a state *j* enrolls in college in time period *t*, given that she or he has not experienced the event prior to that time. When estimating a multinomial model $h(p_{tij})$ represents a probability indicating whether an individual *i* who resides in a state *j* enrolls in a specific type of institution (among varying levels of selectivity) in time period *t*, relative to those who did not enroll in any postsecondary institution, given that she or he has not experienced any of the events prior to that time. The vector $x_i$ contains individual-level time-constant covariates (e.g., race/ethnicity, gender, parental involvement, academic preparation, distance to a nearest institution) including the variables that measure each individual's expected amount of a Pell grant, state need-based and non need-based grants, and squared-terms of the expectations of each aid type that capture any non-linear effects; The vector $z_j(t)$ contains state-level covariates that change over time (e.g., state-level need-based and non need-based aid, public tuition, state per capita income, and annual unemployment rate). Additionally, in order to capture the variation in state aid by race and income groups, interactions between race/income and the types of state aid are included in the model.

The variable $Time_{ti}$ denotes a vector of time-dummy indicators (assigned one for each year an individual *i* enrolls in college) that control for the effect of time. The year 1992 (*t*=1) is set as the reference category and the rest of time dummy variables from 1993 (*t*=2) through 2000 (*t*=9) are controlled for in the model. The interactions terms between a GED indicator and time-dummy variables are also included in an attempt to capture time-varying effects of GED receipt (relative to high school graduates). The vector $State_{ji}$ denotes state fixed-effect dummy variables that represent each state, which are included to control for unobserved time-constant state-specific effects on residents' enrollment behavior. The state of Alabama (*j*=1) is set as the reference category to the other 49 states, with District of Columbia removed from the analyses. The inclusion of these covariates allows us to examine how the selected covariates affect the hazard of postsecondary enrollment.

It is important to note that due to the nested structure of the data used in this study (i.e., students are nested within states), a clustered event history model by state is utilized to deal with the potential statistical dependence between students who reside in the same state. Consideration of this nested structure by adjusting standard errors to allow for clustering by state enables estimating correct standard errors, confidence intervals, and significance tests (Beise & Voland, 2002). In addition, since some of the predictor variables (e.g., expected financial aid) are based on the results of other estimated equations, the standard errors need to be adjusted. This was accomplished by bootstrapping techniques (Efron & Tibshirani, 1993) where I re-estimated the entire system of equations 500 times when using the logistic regression model, and conducted 200 replications when estimating the multinomial regression model. Because of using

multiple imputation methods to account for missing data, the number of resulting datasets for analyses increased to five (See the next section for the details of the multiple imputation method). The 500 replications of the logistic model were done for each of the five multiply imputed datasets (i.e., a total of 2,500 replications), while the 200 replications of the multinomial model were done for each imputed dataset (i.e., a total of 1,000 replications).

## Imputation of Missing Data: Multiple Imputation

Before estimating the model specified above, the problem of missing data should be accounted for because estimation biases may be caused by failing to handle missing data properly. It is important to respond to the missing data problem to make valid and unbiased inferences regarding a population of interest. There are different methods of addressing missing data used by researchers, including the deletion or replacement of missing data to produce a complete dataset with no missing cases. However, these methods have been found to have serious limitations. For example, eliminating all cases with missing data (called listwise deletion) for any variable may bias estimation results because a considerable proportion of the original dataset is excluded from analysis and therefore the remaining cases may not be representative of the entire sample. Another method, called mean substitution, handles missing data by replacing all missing values in a variable by the mean of valid cases for that variable. Because each missing data is replaced with artificially created "average," mean substitution artificially decreases the variance of a variable and this reduction in variance is proportional to the number of

missing data (i.e., the more missing data, the more "perfectly average values" will be artificially added to the data set).

Compared to these traditional methods, multiple imputation is considered a more methodologically rigorous approach to deal with missing data. Multiple imputation is "the technique that replaces each missing or deficient value with two or more acceptable values representing a distribution of possibilities" (Rubin, 2004, p. 2). Creating multiple versions of datasets filled with imputed missing values, this approach has been shown to produce unbiased estimates by accounting for the uncertainty associated with estimating missing data. For each imputed dataset, statistical analysis is performed on each of these imputed datasets, and then the estimation results of each analysis are later combined to produce a single set of estimates and confidence intervals that incorporate missing-data uncertainty (Schafer, 1999).

The estimation results (i.e., coefficients and standard errors) from each dataset are combined using Rubin's method (Rubin, 1987). Suppose that $\hat{Q}$ is an estimate of a regression coefficient obtained from each of the multiply imputed datasets (m > 1), while $U$ is the standard error associated with $\hat{Q}$. The overall regression coefficient $\overline{Q}$ is the average of the individual estimates obtained from each dataset ($\overline{Q} = \mathrm{m}^{-1} \sum \hat{Q}$). To obtain an overall standard error, one must calculate the within-imputation variance $\overline{U} = \mathrm{m}^{-1} \sum U$ and the between-imputation variance $B = (\mathrm{m} - 1)^{-1} \sum (\widehat{\mathrm{Q}} - \overline{\mathrm{Q}})^2$. The estimated total variance is $T = (1 + \mathrm{m}^{-1})B + \overline{U}$ and the overall standard error is the square root of $T$.

In this study, although all the state-level variables have no missing cases, data are missing on most of the student-level variables to varying degrees. The variables with

missing cases include students' race, parents' education level, family income, family size, postsecondary aspiration, parents' educational expectation, region of high school location, variables associated with parental involvement and information about financial aid, academic preparation variables in high school including reading and math scores, GPA, high school type, curricular program, and postsecondary entrance exam-taking. The proportion of missing cases for each variable ranges from 0.1 percent (race) to 26 percent (high school cumulative GPA). Table 1 displays details about the proportion of missing data present in each variable.

Removing all cases with missing data (i.e., listwise deletion) reduces approximately 60 percent of the total sample, and the statistical inference based on this non-representative sample may not be valid. Therefore, I use a multiple imputation software called *Amelia II* to impute missing data. *Amelia II* creates multiple "complete" datasets in which the missing values are filled in with different imputations that reflect the uncertainty about the missing data. Because the rate of missingness for the data is not high, adopting the program default of creating five imputed datasets (m=5) is deemed adequate for this study (Royston, 2004). Schafer (1999) also claims little or no practical benefits to using more than five to ten imputations when rates of missing information are not unusually high. After imputation, *Amelia II* saves the five imputed datasets and the analysis results drawn from these multiply imputed datasets are then combined using the STATA software.

After imputing the missing data using the multiple imputation method, I checked the robustness of missing data imputation: I estimated a series of logistic and multinomial regression models that predict the probability of postsecondary enrollment using student-

level variables only, and then compared the estimation results after imputation with the results using the same sets of variables before imputation. If the (imputed) data are missing at random, then there should be no substantial difference in estimated coefficients between the imputed and non-imputed estimation results. The comparison between estimation results before and after imputation (no test statistic was calculated) found no significant difference in estimated coefficients in terms of the direction and magnitude among student-level variables, suggesting that the missing data among student-level variables are distributed randomly. This randomness in missing data therefore justifies the use of the multiple imputation method.

Table 1. The Percentage of Missing Data in the Student-level Variables

| | Variable with Missing Data | % Missing Values |
|---|---|---|
| 1 | Race | 0.1% |
| 2 | Parents' education level | 8.5% |
| 3 | Family income | 15.4% |
| 4 | Family size | 13.1% |
| 5 | Postsecondary aspiration | 2.5% |
| 6 | Parents' educational expectation | 12.2% |
| 7 | Region of high school location | 2.07% |
| 8 | Variables that measure parental involvement | 12.9 to 13.1% |
| 9 | Variables that measure information about financial aid | 11.8 to 12.0% |
| 10 | Reading scores | 20.6% |
| 11 | Math scores | 20.6% |
| 12 | High school GPA | 26.2% |
| 13 | High school type | 1.7% |
| 14 | Curricular program | 1.8% |
| 15 | Taking postsecondary entrance exam | 0.9% |

## Steps in the Data Analysis

Data analysis proceeds in several stages with the initial stage providing descriptive statistics for the sample as well as estimation of the distribution of event occurrences and baseline hazard rates (that do not depend on a set of covariates) for each family income and race/ethnic groups over time. Then, the next step is to estimate a discrete- time hazard model (both single-event and competing-event models) to explore the association between each type of state financial aid and the hazard of enrollment probabilities over time controlling for a set of covariates. For a single-event model, the discrete-time logistic hazard regression is used while the discrete-time multinomial logistic hazard regression is used for a competing-event model that compares the hazard rate of enrollment in institutions of varying levels of selectivity to non-enrollment, respectively.

To investigate whether the financial aid effects vary by different income and race/ethnic groups, I also test interactions between types of state aid policies and family income groups, and between state aid policies and race/ethnic groups. Wald tests are performed in order to determine whether the addition of these interaction terms significantly improves the model fit relative to the models without the interaction terms. Using the results from these regressions, I conduct a series of graphical simulations that compare the probabilities of college enrollment for different racial and income groups in order to explore the differential impact of financial aid on student enrollment behavior in response to different levels of state financial aid schemes. In combination, all these estimation procedures contribute to identifying the differential effects of state financial aid on college enrollment of students from different income and race/ethnic backgrounds.

## Limitations

This study is subject to several limitations. First, due to the unavailability of information about the actual financial aid amount offered to each student, I impute the expected financial aid amount each student may have been eligible for using the NPSAS data. Using the NPSAS data for imputing financial aid amount awarded to the NELS participants may be subject to criticism because both datasets collect information from different student populations. The difference in the sample population suggests that financial aid award may not have the same relationship with predictor variables in the NPSAS sample as in the NELS sample. Although the sample of students are not exactly equivalent (because the two national studies used different sampling frames), both datasets collect information from nationally representative students who attended high school in the early 1990s and thus are likely to be comparable to each other. Regardless of the sample equivalency, at least the imputation and inclusion of expected aid amount in the model allows testing the sensitivity of the estimation results relative to the results that do not control for the individual expected aid amount.

However, causal statements about the relationship between the expected financial aid amount and students' enrollment outcome variables should be made with caution because of the weak instrument (or weak identification) problem. As discussed in the section that describes the procedure of imputing the expected financial aid, the group of predictors of aid determination were used as instruments for predicting the expected amount that individual students may have been offered. However, only a small number of variables were available for use (e.g., family income, family size, gender, race) to predict the expected amount of financial aid because the common variables included in both

datasets were insufficient. Due to the data limitation, it may be possible that the proportion of variance explained by these group of variables in predicting expected financial aid may not be high, leaving a substantial portion of unexplained variance in financial aid equations. Therefore, this study suffers from the weak identification problem because a lack of sufficient predictors used as an instrument made it difficult to truly identify the financial aid prediction model. Coupled with the data problem, the formal testing methods that provide information about whether these predictors are a valid instrument were not available in this analysis. In combination, the problem of weak identification and a lack of formal testing methods contribute to the difficulty in making causal inferences with regard to the effect of expected financial aid variables on college enrollment.

Second, the failure to completely control for individual-level aid award may be related to the problem of omitted variable bias (or self-selection bias) caused by the inability to control for all potential sources of variations in the outcome variable. Omitted variable bias happens when one or more explanatory variables that ought to be included in a model is left out, resulting in errors in the estimate of the effect of the variables included in the model (Jargowsky, 2005). Unobserved (and thus omitted) factors in this study, such as differences in individual aid packages offered by states and postsecondary institutions, may impact a student's enrollment decision significantly, and thus may confound the effect of other covariates on the outcome variable. Therefore, it is important to consider the possibility of omitted variable bias when interpreting the estimation results that follow this section.

Third, because the study focus is to investigate the effects of state financial policy, tuition and fees in the public higher education system only were included in the estimation models. However, students' enrollment responses, especially enrollment in private institutions, may be more influenced by changes in tuition at private colleges and universities rather than public tuition. The failure to control for the private tuition variable in the model makes it difficult to estimate the degree to which students who attend private selective institutions are responsive to tuition changes. Therefore, controlling for both public and private tuition variables could improve the model in the future analysis.

Fourth, I failed to retrieve zip code information of students who attended a private high school (approximately 8% of the total sample) because the zip codes of private high schools were not available through the CCD that only collects data from the public high school system. The imputation of the missing distance from one's high school location to the nearest postsecondary institution among non public school attendees, therefore, may be subject to bias if private schools are not located adjacent to public schools in a state. In order to increase accuracy in the results, it is necessary to find a linking mechanism between the PSS and the NELS data in the future analysis to obtain the zip code information of students who attended a private school.

Fifth, this study employs the multinomial logit model to analyze enrollment outcomes in terms of selectivity and the type of an institution. The multinomial logit model makes the assumption of the Independence of Irrelevant Alternatives (IIA), suggesting that adding or deleting alternative outcome categories does not affect the odds among the remaining outcomes (therefore these alternatives are irrelevant). There are

currently two most common tests of IIA assumption available: the Hausman-McFadden test and the Small-Hsiao test. However, these tests produced contradictory results in regard to testing the violation of the IIA assumption for the present study, and thus are not useful for assessing violations of the IIA property (J. S. Long & Freese, 2006). Instead, Long and Freese (2006) suggest that the multinomial logit model should be used in cases where the specified model involves distinct alternatives that are not substitutes for one another (J. S. Long & Freese, 2006).

When concerned about the violation of the IIA, the nested logit model can be used as an alternative to the multinomial logit model because of its ability to account for similarities between alternatives. The nested logit model relaxes the IIA restriction by grouping similar alternatives into nests and thus creating a hierarchical structure of the alternatives (Train, 2003). The error terms of alternatives within a nest are correlated with each other, while the error terms of alternatives in different nests are uncorrelated. However, the major weakness of the nested logit model is the frequent need to make a priori specification of the structure of dependence among alternatives (Taaffe, Gauthier, & O'Kelly, 1996). For example, with regard to the college destination outcomes, choices between non-competitive public four-year colleges and two-year colleges may be considered possible alternatives (driven mostly by tuition differences). However, choices between enrollment in non-competitive four-year colleges and private or public competitive four-year colleges may not be considered similar alternatives because other factors (e.g. academic competence) also influence the choice of a selective college against a non-selective college. Due to its difficulty in distinguishing a clear nested

structure of alternatives among enrollment destinations, testing the nested logit model against the multinomial logit model is suggested as an area for future research.

# Chapter IV

# RESULTS

This chapter begins by reporting descriptive statistics of the independent variables including the student- and state-level variables used for the analyses. Then the preliminary event history analyses that plot the chronological patterns of enrollment over time and the hazard rate of enrollment are examined depending upon student income and race groups. After the descriptive results are presented, results from the discrete-time event history regression models are reported and discussed in order to analyze the effect of different types of state financial aid on the timing of college enrollment, in addition to how the effects differ for students from different income and race/ethnic groups. The graphical simulations follow the regression analysis to examine the differential enrollment responses to changes in state financial aid policy across income and racial/ethnic groups.

## Descriptive Results

Table 2 offers the summary statistics for the student-level independent variables used in the regression analyses. The student characteristics reported in Table 2 are weighted by the sample weight (f4f2pnwt) that adjusts for the unequal probability a student is selected for the study. The proportion of female (49.7%) and male (50.3%) students is similar. White students comprise the largest race/ethnic group of the sample

(72.1%), whereas African Americans, Hispanics, and Asians comprising 12.4 percent, 10.1 percent, and 4 percent, respectively. Among the seven different income groups, more than a half of students come from families with incomes between $25,000 (35.2%) and $75,000 (21.6%). Approximately 5 percent and 10 percent of students come from the lowest (less than $7,500) and the second lowest income groups ($7,500 to $15,000), respectively, while the highest and the second highest income groups accommodate 6.4 percent and 7 percent of the total student population, respectively. A comparable proportion of students (14.2%) come from families with incomes less than $15,000. Approximately a quarter of students attended high schools located in urban areas (26.6%), whereas a higher proportion of students attended schools located in rural (32.6%) or suburban areas (41.3%).

Approximately 70 percent of the students have parents whose highest level of education is less than four-year college, but a majority of parents expect their child to achieve a bachelor's degree or above (78.5%). Consistent with parents' educational expectations, nearly 73 percent of the students have high postsecondary aspirations of achieving a bachelor's degree or higher. The group of variables associated with parental involvement in school matters indicate high levels of parental involvement: over (or nearly) 90 percent of the parents indicated that they discussed with their children about selecting courses (95.8%), school activities (95.4%), grades (98.1%), taking entrance exams (89.3%), and applying to colleges (94.8%). In contrast, students seek information infrequently about financial aid: About (or less than) half of the students seek information from a teacher or counselor (55.5%), from a school representative (39.4%), read

information from U.S. Department of Education (25.6%) or from colleges and universities (45.8%).

Measures of academic preparation in high school, including cumulative GPA and standardized scores in reading and math, are standardized (with zero mean), and a unit change in these standardized scores represents a change in a standard deviation of these variables in the following regression analyses. Table 2 also indicates that a majority of students attend public high school (92%) and are registered in an academic program (70.3%). Most of the students also take some types of postsecondary exams such as SAT or ACT (73.4%). Among the total sample of students, the proportion of students who received a GED is less than 10 percent (6.6%).

Table 2. Descriptive Statistics of the Sample: Individual Level (N=10810, Weighted)

| Category | Variable | % or Mean |
|---|---|---|
| Gender | Female | 49.7% |
| | Male | 50.3% |
| Race/Ethnicity | White | 72.1% |
| | Black | 12.4% |
| | Hispanic | 10.1% |
| | Asian | 4.0% |
| | Other Ethnicity | 1.4% |
| Family Income measured in 1991 | Income less than $7,500 | 5.3% |
| | Income $7.5k to $15k | 9.5% |
| | Income $15k to $25k | 15.0% |
| | Income $25k to 50k | 35.2% |
| | Income $50k to $75k | 21.6% |
| | Income $75k to $100k | 7.0% |
| | Income more than $100k | 6.4% |
| Parents' Highest Education Level | Less than bachelor's degree | 69.5% |
| | Bachelor's degree or beyond | 30.5% |
| Family Size | Number of family members | 4.24 |
| High School Location | Urban | 26.1% |
| | Suburban | 41.3% |
| | Rural | 32.6% |
| Postsecondary Aspiration | Less than bachelor's degree | 26.6% |
| | Bachelor's degree or beyond | 73.4% |
| Parental Educational Expectation | Less than bachelor's degree | 21.5% |
| | Bachelor's degree or beyond | 78.5% |
| Parental Involvement | Parents discuss with children about selecting courses | Yes: 95.8%<br>No: 4.2% |
| | Parents discuss with children about school activities | Yes: 95.4%<br>No: 4.6% |
| | Parents discuss with children about grades | Yes: 98.1%<br>No: 1.9% |
| | Parents discuss with children about taking SAT/ACT | Yes: 89.3%<br>No: 10.7% |

| Category | Variable | % or Mean |
|---|---|---|
| | Parents discuss with children about applying to colleges | Yes: 94.8%<br>No: 5.2% |
| Information on Financial Aid | Information from a teacher/counselor | Yes: 55.5%<br>No: 44.5% |
| | Information from a school representative | Yes: 39.4%<br>No: 60.6% |
| | Information from U.S. Department of Education | Yes: 25.6%<br>No: 74.4% |
| | Information from colleges and universities | Yes: 45.8%<br>No: 54.2% |
| Academic Preparation | High School Cumulative GPA (standardized) | 13.99<br>(0 to 104.6) |
| | Reading Score in High School (standardized) | 51.0<br>(29 to 68.4) |
| | Math Score in High School (standardized) | 51.2<br>(29.6 to 71.4) |
| Curricular Program | Academic | 70.3% |
| | Non-academic | 29.7% |
| High School Type | Public | 92% |
| | Private or Catholic | 8% |
| Postsecondary Exams | Took any type of Postsecondary Exams | Yes: 73.4%<br>No: 26.6% |
| GED | GED Recipients | 6.6% |
| | High School graduates | 93.4% |

Table 3 presents the U.S. averages of the state-level covariates throughout the study period. The amount of the state need-based grants for undergraduate students per FTE has increased during the years between 1992 and 1998 (from $260.7 to $324.9 in 2006 dollars), but then decreased to under $300 in 1999 and 2000. Although the amount of total state funding for non need-based grants is smaller than that of need-based grants, state non-need-based grants for undergraduate students per FTE have rapidly increased from $31.60 to $114.20 (in 2006 dollars) during the years between 1992 and 2000. The amount of undergraduate in-state tuition for the public higher education system has increased from $2514 (in 1992) to $3051 (in 2000) in 2006 dollars while the amount of state and local appropriations per FTE for the public higher education system declined from $8370 (in 1992) to $7091 (in 2000) in 2006 dollars during the same period.

With regard to state-level educational variables, the public high school graduation rate within a state exhibits a steady decline whereas the percent of the state population with a bachelors or higher degree exhibits a continual increase for the study period. The average state public high school graduation rate decreased from 74.8% in 1992 to 69.6% in 2000, while the percent of the state population with a bachelors or higher degree increased approximately 3.7 percentage points (from 21.5% to 25.2%) for the years between 1992 and 2000. State per capita income increased approximately by $5,690 for the same period ($29,946.3 to $35,636.9 in 2006 dollars). In accordance with the increase in per capita income, the percent of the state population that is in poverty declined steadily (from 14.8% to 11.3%), and state annual average unemployment rate also declined approximately 3.5 percentage points for the study period (from 7.5% to 4%).

Table 3. Descriptive Statistics of the State-level Variables: 1992 to 2000 [1)]

| Variable/ Year | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|
| Need-based aid per FTE | $260.7 | $283.2 | $306.3 | $293.0 | $300.8 | $305.8 | $324.9 | $ 271.3 | $ 283.9 |
| Non need-based aid per FTE | $31.6 | $36.3 | $55.0 | $57.7 | $63.1 | $78.0 | $88.6 | $95.5 | $114.2 |
| Avg. Public in-state tuition | $2514.4 | $2618.5 | $2705.0 | $2781.1 | $2855.4 | $2888.9 | $2956.0 | $ 3002.6 | $3051.2 |
| State and local appropriations per FTE | $8370.1 | $8414.8 | $8660.0 | $8278.2 | $ 8423.2 | $8269.2 | $8551.8 | $7017.6 | $7091.0 |
| Public HS graduation rate | 74.8% | 74.7% | 73.6% | 72.0% | 71.1% | 69.6% | 70.2% | 69.4% | 69.6% |
| % bachelors or higher | 21.5% | 21.5% | 21.9% | 22.8% | 23.2% | 23.3% | 24.0% | 25.0% | 25.2% |
| Avg. state per capita income (in dollar) [2)] | 29946.3 | 29857.5 | 30344.8 | 30775.8 | 31480.6 | 32125.0 | 33535.7 | 34265.1 | 35636.9 |
| % poverty | 14.8% | 15.1% | 14.5% | 13.8% | 13.7% | 13.3% | 12.7% | 11.9% | 11.3% |
| State avg. unemployment rate | 7.5% | 6.9% | 6.1% | 5.6% | 5.4% | 4.9% | 4.5% | 4.2% | 4.0% |

Note: 1) All dollar amounts presented in Table 3 are adjusted to 2006 dollars.

2) The measure of state per capita income is calculated as the real personal income of the residents of a given state divided by the resident population of the state using the Census Bureau's annual midyear population estimates.

Table 4 presents the findings from the life table analysis of student transition into postsecondary education conditional on high school completion (or equivalent degree). Specifically, the table summarizes the information about the total number of students who are at-risk of experiencing enrollment at the beginning of each year, the number of students who actually experienced enrollment in each time period, the cumulative proportion of students enrolled up to that year, and the conditional probability of having an event in each time period (hazard rate). Of the 10,810 students who are the subjects of this study, 6,950 students enrolled in any type of postsecondary institutions and 10 students were censored by the end of the first year after high school completion, leaving 3,860 students to be included in the group of students at-risk of experiencing enrollment at the beginning of the next year. In the second year, of the 3,860 students, 1,010 enrolled in postsecondary institutions and 20 cases were censored by the end of that year. Excluding these enrolled and censored students from the total number of students in the second year leaves 2,830 (=3,860-1,030) students at-risk of entry at the beginning of the third year period. By the end of the third year, 320 students enrolled and 30 cases were censored. This process continues until the ninth year, when 30 students enrolled with 1,450 cases were censored.

The life table presented in Table 4 suggests that most students who enroll in postsecondary institutions do so within two years of their high school senior years (i.e., 1992) because the number of students who enrolled by the end of the first and the second time period sums to 7,960, which is approximately 74 percent of all the respondents. Table 4 also indicates that the cumulative proportion of students enrolled by the ninth year is approximately 83 percent (increased from 64.2% in the first year). It is important

to note that the cumulative proportion of enrollment by the end of the study period (83.3%) is unusually high because the study sample has been reduced from its original number of 12,140 to 10,810 individuals for the analyses. Considering the total number of the original sample size, the proportion of enrollment by the ninth year is reduced to 73.8% (8,960 out of 12,140).

Whereas the cumulative proportion of students enrolled increases for the observation period, the hazard rate of enrollment in each year declines throughout the period. This steady decline in the hazard of enrollment (from 0.642 in year one to 0.019 in year nine) indicates that the probability of experiencing enrollment peaks just after high school, and decreases rapidly as time elapses after high school.

Table 4. Life Table Analysis of College Enrollment (Non-weighted)

| Year | Beginning Total | Enrollment | Censored Cases | % Cumulative Enrollment | Hazard Rate |
|---|---|---|---|---|---|
| 1 | 10810 | 6950 | 10 | 0.642 | 0.642 |
| 2 | 3860 | 1010 | 20 | 0.736 | 0.263 |
| 3 | 2830 | 320 | 30 | 0.766 | 0.112 |
| 4 | 2480 | 190 | 30 | 0.784 | 0.077 |
| 5 | 2260 | 140 | 30 | 0.797 | 0.063 |
| 6 | 2080 | 140 | 40 | 0.810 | 0.065 |
| 7 | 1910 | 110 | 60 | 0.821 | 0.058 |
| 8 | 1740 | 80 | 170 | 0.823 | 0.047 |
| 9 | 1480 | 30 | 1450 | 0.833 | 0.019 |

Note: All numbers reported here are rounded to the nearest ten in order to conform to the NCES guideline for using restricted-use data.

Next, changes in the hazard of enrollment are explored graphically and the differences in the enrollment hazard by institutional type, income, and race/ethnicity are presented in Figures 2 and 3. Figure 2 illustrates how the proportion of students who have never enrolled in a postsecondary institution changes over the observation period for all students and how these enrollment trajectories vary for students who attend different types of institutions as well as those who are from different income and race/ethnic groups. Consistent with the aforementioned life table analysis, Figure 2-1 indicates that over 60 percent of students enroll in postsecondary institutions by the end of the first year. At the end of the ninth year, less than 20 percent of the students never enrolled in college.

Figure 2-2 illustrates transition patterns by the type and the selectivity of an institution attended by students. Of those who enrolled in postsecondary institutions, more than 80 percent of students who choose four-year institutions (of all selectivity levels) enroll by the end of the first year, whereas only 60 percent of two-year enrollees experience the transition by the end of the first year. Among four-year enrollees, those who attend competitive institutions are more likely than their non-competitive counterparts to enroll immediately in college. The rate of transition to public or private competitive colleges is low after the third year since high school completion because almost 95 percent of students who choose competitive institutions enroll during the first two years after high school completion. In the case of two-year institutions, approximately 90 percent of two-year attendees experience enrollment by the end of the fifth year.

Figure 2-3 compares the time-to enrollment trajectories for students from different income groups. To simplify the graphical presentation, income categories are merged into

three distinct groups by quartile distributions. Low-income category (less than $25,000) approximates the first quartile, and middle-income category (between $25,000 and $75,000) involves the second and the third quartile, while high-income category approximates the fourth quartile (over $75,000). Throughout the observation period, low-income students (less than $25,000) experience the fewest transitions to postsecondary education, whereas a majority of students from high income families (more than $75,000) experience postsecondary enrollment by the end of the second year. Whereas only 50 percent of low-income students enroll, about 90 percent of high-income students enroll in higher education by the end of the first year. By the end of the ninth year, more than 20 percent of low-income students have never enrolled in a postsecondary institution whereas nearly all high-income students (over 95%) have enrolled in higher education. With regard to race/ethnic differences, Figure 2-4 suggests that Asian students are the most likely to make an immediate transition to higher education, followed by Whites. However, Hispanics and African Americans are less likely to do so throughout the observation period than their Asian and White counterparts. By the end of the second year, about 90 percent of Asian students have enrolled in higher education, while more than 35 percent of African American student populations have never enrolled in college.

Figure 3 (including Figures 3-1 to 3-4) describes the cumulative hazard of enrollment for all students as well as for varied student groups. These figures can be interpreted as the reverse of the figures illustrated in Figure 2 (including Figures 2-1 to 2-4). For all graphs, the hazard of enrollment records the highest jump by the end of the first year and the rate of increase in hazard declines over time. Transition to four-year

institutions has overall higher cumulative hazard than transitioning to two-year institutions throughout the period, with higher rates of hazard for competitive four-year institutions than for non-competitive institutions for the first four years (see Figure 3-2). Consistent with the time-to-enrollment trajectories illustrated in Figure 2, high-income groups have the highest cumulative hazard of enrollment whereas the low-income groups exhibit the lowest likelihood of transitioning to higher education throughout the observation period (see Figure 3-3). With regard to race/ethnic differences, Asian students are the most likely to make the transition to postsecondary education whereas African American students consistently have the lowest cumulative hazard of enrollment (see Figure 3-4). The graphical patterns that compare the enrollment trajectories by income and race/ethnicity indicate that there is a gap in enrollment rates for students who are from different income and race/ethnic groups.

Figure 2. Time-to-Enrollment Trajectories

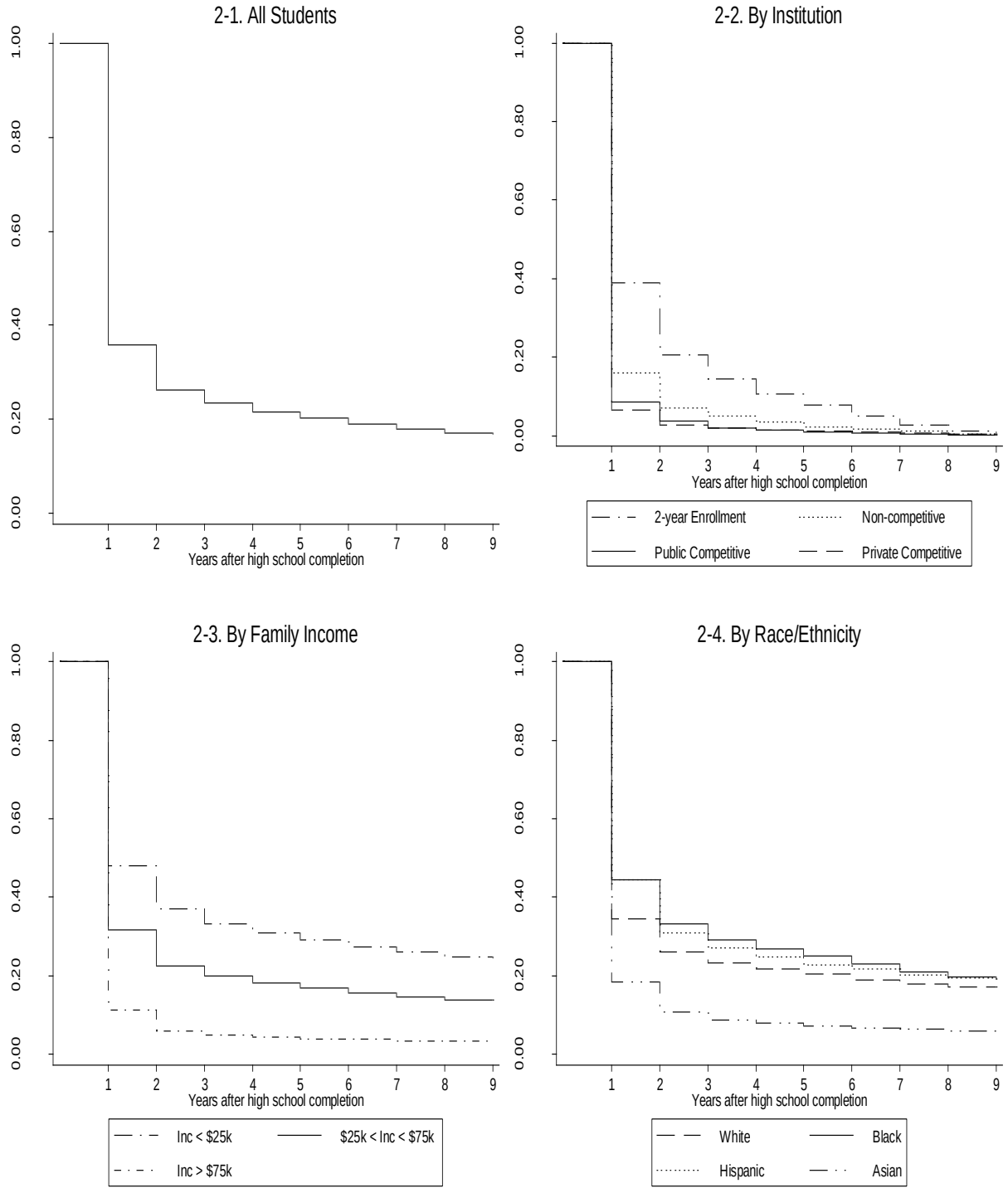
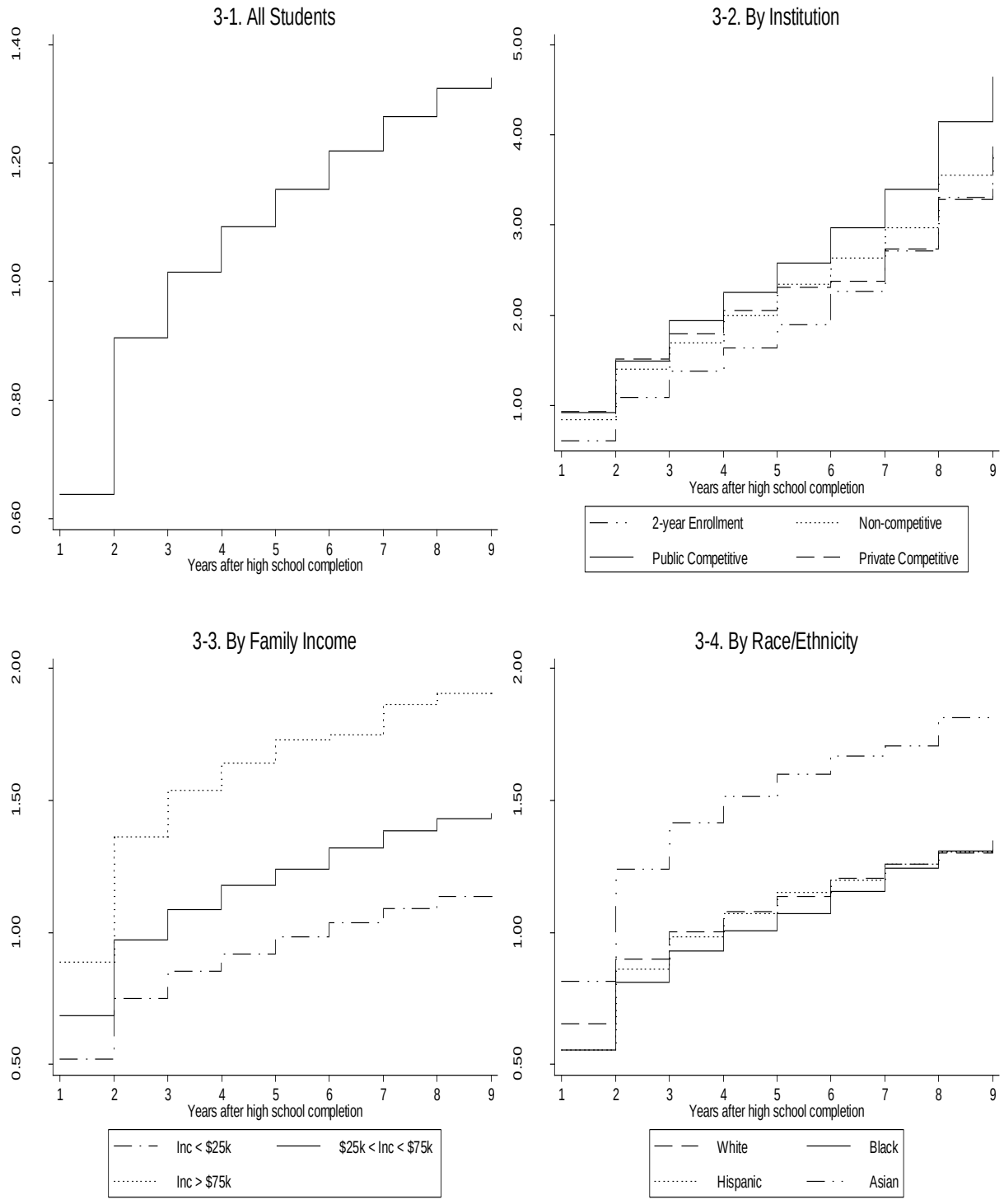


Figure 3. Cumulative Hazard of Enrollment



## Estimating the Hazard of Enrollment

This section presents the results of estimating a discrete-time hazard model of enrollment that controls for state financial aid policy variables and all other covariates, in addition to the interaction terms discussed above. This section will focus on presenting the main aid effects on the hazard of enrollment as well as the interaction effects between aid variables and student background variables including income and race/ethnicity. Table 5 displays the event history estimates of the binary enrollment model, whereas Table 6 illustrates the results of the event history model estimated to examine the selectivity of postsecondary institutions relative to non-enrollment. The effect of each covariate is presented in odds ratios (taking the exponential of the estimated coefficient) because its interpretation is more intuitive relative to the logit coefficient (J. S. Long & Freese, 2006). In this study, the odds ratio of an independent variable is interpreted as the ratio of the probability of enrolling in college to the probability of non-enrolling in any type of institutions in response to a unit change in an independent variable.

Although reporting odds ratios is deemed appropriate for dummy variables in binary or multinomial logistic regression models, for continuous variables, odds ratios are very difficult to interpret because their interpretation is dependent upon the unit of measurement (DesJardins, et al., 2006). Thus, this study reports odds ratios in Tables 5 and 6, in addition to plotting predicted enrollment probabilities for each group from different income and racial/ethnic backgrounds (holding other regressors in the model constant at their mean values or other relevant values) in order to complement the estimated the odds ratio results. Employing this strategy will help better understand how

changes in important policy-relevant variables affect the probabilities of postsecondary enrollment for different subgroups of students.

Table 5 presents the odds ratio, standard error, and the level of significance for each variable with and without the interaction effects. For most variables the two models do not differ much in their estimated odds ratios and level of significance. Thus, this section discusses mainly the results estimated with interaction effects when the estimates from the two models are similar in terms of its magnitude and the significance level, but also reports both results when estimates are different for some variables.

The results in Table 5 indicate that there is a significant gender difference in the probability of enrollment. The odds female students enroll in college are 36 percent greater than for men, holding other variables constant. A student's SES is also a significant factor for determining college enrollment. Students whose parents hold bachelor's or higher degrees and who are from higher income families are more likely to enroll in college than their disadvantaged peers. The number in the family is negatively associated with college enrollment (odds ratio=0.87), while the odds of enrollment for students who are from a rural area are only 23 percent that of those who are from a suburban area.

Both students' postsecondary expectations and parents' educational expectations are significant and positively related to college enrollment. Students who plan to receive at least a bachelor's or higher degree have 2.71 times higher odds of enrollment than students who expect to receive lower levels of education. The odds of enrollment for students who have parents expecting their child to graduate from a four-year college or more are 1.54 times greater than that of students with parents who expect less education

for their child. However, none of the variables that measure parental involvement in school activities and college choice have a statistically significant effect on the probability of enrollment.

Academic preparation is another factor related to the likelihood of enrollment. Students who took any type of postsecondary exams (e.g., ACT or SAT) have 1.63 times higher odds of enrollment relative to students who did not take any postsecondary exam. The odds of enrolling in college are 1.48 times greater for students who took an academic program in high school than students who took a non-academic program. However, attending a public high school significantly decreases the odds of college enrollment by 42 percent relative to attending a private high school. Students' expected financial aid and information about financial aid are also positively related to college enrollment. Students who obtained financial aid information from a teacher or counselor are 1.27 times more likely to enroll in college, but the positive relationship between aid information and enrollment becomes weaker when controlling for interaction terms ($p < .10$). Among types of aid expectations, students' expected amount of state need-based grants positively affects their probability of college enrollment (odds ratio=3.27).

The negative relationship between year dummies (for all years between 1993 and 2000) and college enrollment (illustrated by odds ratio less than one) suggests that the probability of college enrollment for high school completers becomes lower after 1992. The odds of enrollment are 45 percent smaller for students who enroll in 1993 than those who enroll in 1992. For students who enroll in 1994, the odds of enrollment are 68 percent smaller than those who enroll in 1992. The odds of enrollment for students who enroll in college in 1995 are only 26 percent that of those who enrolled in 1992. After

1995, the odds of enrollment relative to the year 1992 declines to greater than 80 percent, suggesting that the probability of enrollment four or more years after high school is very small and few students will be likely to attend college first-time by then. The decreasing odds ratios as the elapsed time since 1992 increases indicate that the probability of enrollment is much lower as more years pass after high school graduation.

The estimation results of the state-level financial variables reveal that conditional on individual aid expectations, state need-based grants (measured three years before enrollment) are positively associated with the probability of enrollment. For a hundred dollar increase in state need-based grants the odds of enrollment increase by 17 percent. The positive influence of state-level need-based aid (measured three years before enrollment) suggests that the presence of need-based aid may send positive signals to students regarding the net cost of college at least 3 years prior to college enrollment so that students can forecast the trend in college affordability in advance. However, this positive relationship between state need-based grants and the odds of enrollment is no longer significant when taking interaction terms into account. It is possible that the interaction terms included may have taken up the part of the significant relationship between state need-based aid and enrollment.

In the case of state non need-based grants, there is a negative association between state non need-based grants (measured in the same period the student enrolled in college) and the probability of enrollment. For a hundred dollar increase in state non need-based grants the odds of enrollment decline by 33 percent.

An increase in public tuition (measured one year and two years before enrollment) is negatively associated with the odds of enrollment, suggesting that higher levels of past

tuition act as a negative signal regarding the cost of college. State appropriations have both positive and negative effects on enrollment depending on when it is measured. The amount of state appropriations measured in the concerned year is positively related to the probability of enrollment (odds ratio=1.03), but state appropriations measured two years before enrollment are negatively associated with the odds of enrollment (odds ratio=0.96). Due to this inconsistency in the effects of state appropriations, it is difficult to conclude whether higher state investment in public higher education promotes or discourages college enrollment in this analysis.

Among state-level non-financial variables, state per-capita income, poverty rates, and unemployment rates within a state measured in the past period are significantly associated with the odds of future student enrollment. As expected, a higher percentage of state population in poverty (the level of poverty measured one year before enrollment) reduces the odds of enrollment (odds ratio=0.94) and higher state per capita income (measured three years before enrollment) is positively associated with the odds of enrollment. A thousand dollar increase in per capita real income (measured three years before enrollment) increases the odds of enrollment by 81 percent. State-level average unemployment rates (measured three years before enrollment) are positively related to college enrollment. For each additional percent increase in state unemployment, the odds of enrollment increase by 20 percent.

Next, whether the addition of the interaction effects significantly improves the model fit is tested using Wald tests that enable assessing the model fit of the estimated model with interaction terms relative to the model with no interaction terms. A series of Wald tests are conducted for all five imputed datasets in order to detect the variation of

state aid effects by family income and by race/ethnicity. With regard to interactions between income and state aid policies, the effects that state need-based aid and non need-based aid have on enrollment probabilities significantly differ by income groups (for all 5 imputed datasets, p-value < 0.001). With regard to interactions between race and each type of state aid, the effects that state need-based aid have on college enrollment significantly vary by each racial group (for 5 imputed datasets, p-value < 0.001). There are also significant differences by race/ethnicity on the effect of state non need-based aid (p-value <0.05 for all 5 dad tasets). An increase in state non need-based grants measured three years before enrollment is positively associated with the odds of enrollment for students from Asian groups (odds ratio=9.67).

Table 5. Estimating the Hazard of Postsecondary Enrollment

| | Model without Interaction | | | Model with Interaction | | |
|---|---|---|---|---|---|---|
| Variables | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Female | 1.37 | 0.07 | *** | 1.36 | 0.07 | *** |
| Asian | 1.09 | 0.28 | | 2.29 | 0.51 | |
| Hispanic | 1.25 | 0.28 | | 1.94 | 0.33 | ~ |
| Black | 1.62 | 0.26 | ~ | 1.63 | 0.35 | |
| Other Race | 1.20 | 0.35 | | 0.63 | 0.49 | |
| Parental education: Bachelor's or above | 1.54 | 0.13 | ** | 1.47 | 0.13 | ** |
| Income $7.5k to $15k | 1.08 | 0.23 | | 0.98 | 0.32 | |
| Income $15k to $25k | 0.98 | 0.31 | | 1.16 | 0.39 | |
| Income $25k to 50k | 3.12 | 0.56 | * | 3.94 | 0.59 | * |
| Income $50k to $75k | 9.43 | 0.68 | ** | 21.51 | 0.73 | *** |
| Income $75k to $100k | 15.18 | 0.77 | *** | 18.47 | 0.85 | ** |
| Income more than $100k | 14.57 | 0.75 | *** | 28.40 | 0.99 | ** |
| Family size | 0.89 | 0.16 | | 0.87 | 0.06 | * |
| Urban | 1.16 | 0.12 | | 1.13 | 0.10 | |
| Rural | 0.77 | 0.27 | | 0.77 | 0.07 | *** |
| Postsecondary plan: Bachelor's or above | 2.75 | 0.07 | *** | 2.71 | 0.07 | *** |
| Parental educational expectation: Bachelor's or above | 1.53 | 0.08 | *** | 1.54 | 0.08 | *** |
| Parental involvement in course selection | 0.85 | 0.23 | | 0.87 | 0.16 | |
| Parental involvement in school activities | 0.92 | 0.22 | | 0.90 | 0.16 | |
| Parental involvement in grade | 0.84 | 0.28 | | 0.83 | 0.28 | |
| Parental involvement in taking SAT/ACT | 1.04 | 0.15 | | 1.04 | 0.17 | |
| Parental involvement in applying to colleges | 1.02 | 0.17 | | 1.01 | 0.18 | |
| FA Info from a teacher/counselor | 1.27 | 0.10 | * | 1.25 | 0.10 | ~ |
| FA Info from a school representative | 1.06 | 0.18 | | 1.06 | 0.18 | |
| FA Info from Dept. of Education | 1.24 | 0.15 | | 1.23 | 0.15 | |
| FA Info from colleges and universities | 0.95 | 0.14 | | 0.96 | 0.13 | |
| HS Reading Score | 1.17 | 0.07 | * | 1.15 | 0.07 | ~ |
| HS Math Score | 1.02 | 0.13 | | 1.04 | 0.12 | |
| HS Cumulative GPA | 1.07 | 0.05 | | 1.05 | 0.05 | |
| Took Postsecondary Exams | 1.62 | 0.07 | *** | 1.63 | 0.07 | *** |
| Attend Public HS | 0.58 | 0.42 | | 0.58 | 0.22 | * |
| Academic program | 1.49 | 0.06 | *** | 1.48 | 0.06 | *** |
| GED | 0.90 | 0.19 | | 0.89 | 0.18 | |
| Distance to a nearest institution(in mile) | 1.00 | 0.00 | | 1.00 | 0.00 | |
| Expected amount of a Pell grant | 0.94 | 0.09 | | 0.95 | 0.08 | |
| Squared Expected Pell | 1.00 | 0.00 | | 1.00 | 0.00 | |

| | Model without Interaction | | | Model with Interaction | | |
|---|---|---|---|---|---|---|
| Variables | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Expected amount of State need grant | 2.99 | 0.25 | *** | 3.27 | 0.27 | *** |
| Squared Expected amount of State need grant | 0.91 | 0.03 | *** | 0.90 | 0.03 | *** |
| Expected amount of State non-need grant | 0.37 | 1.09 | | 0.58 | 1.11 | |
| Squared Expected amount of State non- need grant | 0.05 | 1.20 | * | 0.06 | 1.30 | * |
| State need-based grant | 0.93 | 0.08 | | 0.92 | 0.13 | |
| State non-need grant | 0.77 | 0.26 | | 0.67 | 0.10 | *** |
| Public tuition | 1.03 | 0.03 | | 1.03 | 0.03 | |
| State appropriation | 1.03 | 0.01 | *** | 1.03 | 0.01 | *** |
| Public tuition prior to 1 yr | 0.90 | 0.12 | | 0.89 | 0.04 | ** |
| State appropriation prior to 1 yr | 1.00 | 0.01 | | 1.00 | 0.01 | |
| Public tuition prior to 2 yrs | 0.78 | 0.02 | *** | 0.79 | 0.02 | *** |
| State appropriation prior to 2 yrs | 0.96 | 0.04 | | 0.96 | 0.01 | *** |
| State need-based grant prior to 3 yrs | 1.17 | 0.06 | ** | 1.27 | 0.15 | |
| State non-need grant prior to 3 yrs | 1.09 | 0.06 | | 1.13 | 0.14 | |
| Public tuition prior to 3 yrs | 1.01 | 0.02 | | 1.02 | 0.02 | |
| State appropriation prior to 3 yrs | 1.00 | 0.01 | | 1.00 | 0.01 | |
| GED * Year 2 (1993) | 1.42 | 0.29 | | 1.42 | 0.27 | |
| GED * Year 3 (1994) | 1.58 | 0.29 | | 1.63 | 0.29 | ~ |
| GED * Year 4 (1995) | 1.99 | 0.30 | * | 2.04 | 0.30 | * |
| GED * Year 5 (1996) | 1.78 | 0.34 | ~ | 1.78 | 0.33 | ~ |
| GED * Year 6 (1997) | 1.95 | 0.38 | ~ | 1.92 | 0.37 | ~ |
| GED * Year 7 (1998) | 2.55 | 0.58 | | 2.57 | 0.53 | ~ |
| GED * Year 8 (1999) | 0.75 | 0.72 | | 0.84 | 0.58 | |
| GED * Year 9 (2000) | 4.75 | 0.92 | ~ | 4.26 | 0.89 | |
| Year 2 (1993) | 0.54 | 0.66 | | 0.55 | 0.14 | *** |
| Year 3 (1994) | 0.32 | 1.19 | | 0.32 | 0.16 | *** |
| Year 4 (1995) | 0.25 | 1.45 | | 0.26 | 0.19 | *** |
| Year 5 (1996) | 0.19 | 1.76 | | 0.19 | 0.21 | *** |
| Year 6 (1997) | 0.15 | 1.99 | | 0.15 | 0.24 | *** |
| Year 7 (1998) | 0.10 | 2.40 | | 0.10 | 0.26 | *** |
| Year 8 (1999) | 0.05 | 3.12 | | 0.05 | 0.30 | *** |
| Year 9 (2000) | 0.01 | 4.88 | | 0.01 | 0.39 | *** |
| Public HS graduation rate | 1.03 | 0.02 | ~ | 1.03 | 0.02 | ~ |
| % bachelors or higher | 0.96 | 0.05 | | 0.96 | 0.03 | |
| State per capita Income | 1.03 | 0.08 | | 1.03 | 0.08 | |
| % Poverty | 0.98 | 0.03 | | 0.97 | 0.02 | |
| % Unemployment | 1.20 | 0.10 | ~ | 1.20 | 0.10 | ~ |
| Public HS graduation rate prior to 1 yr | 1.01 | 0.02 | | 1.01 | 0.02 | |
| % bachelors or higher prior to 1 yr | 1.05 | 0.04 | | 1.05 | 0.04 | |
| State per capita Income prior to 1 yr | 0.53 | 0.25 | * | 0.51 | 0.40 | ~ |
| % Poverty prior to 1 yr | 0.94 | 0.06 | | 0.94 | 0.02 | ** |

| | Model without Interaction | | | Model with Interaction | | |
|---|---|---|---|---|---|---|
| Variables | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| % Unemployment prior to 1 yr | 1.02 | 0.11 | | 1.03 | 0.11 | |
| Public HS graduation rate prior to 2 yrs | 1.00 | 0.02 | | 0.99 | 0.02 | |
| % bachelors or higher prior to 2 yrs | 1.03 | 0.04 | | 1.02 | 0.04 | |
| State per capita Income prior to 2 yrs | 1.03 | 0.06 | | 1.03 | 0.06 | |
| % Poverty prior to 2 yrs | 0.98 | 0.03 | | 0.98 | 0.02 | |
| % Unemployment prior to 2 yrs | 1.09 | 0.10 | | 1.08 | 0.10 | |
| Public HS graduation rate prior to 3 yrs | 1.01 | 0.02 | | 1.01 | 0.02 | |
| % bachelors or higher prior to 3 yrs | 1.00 | 0.04 | | 1.01 | 0.04 | |
| State per capita Income prior to 3 yrs | 1.78 | 0.17 | *** | 1.81 | 0.17 | *** |
| % Poverty prior to 3 yrs | 0.99 | 0.01 | | 0.99 | 0.01 | |
| % Unemployment prior to 3 yrs | 1.20 | 0.08 | * | 1.20 | 0.08 | * |
| Hispanic X State need-based grant | | | | 1.05 | 0.10 | |
| Black X State need-based grant | | | | 1.12 | 0.09 | |
| Asian X State need-based grant | | | | 0.94 | 0.18 | |
| Other X State need-based grant | | | | 1.05 | 0.18 | |
| Hispanic X State need grant prior to 3 yrs | | | | 0.83 | 0.11 | |
| Black X State need grant prior to 3 yrs | | | | 0.89 | 0.11 | |
| Asian X State need grant prior to 3 yrs | | | | 0.87 | 0.26 | |
| Other X State need grant prior to 3 yrs | | | | 1.07 | 0.20 | |
| Hispanic X State non-need grant | | | | 0.98 | 0.15 | |
| Black X State non-need grant | | | | 1.03 | 0.06 | |
| Asian X State non-need grant | | | | 0.21 | 0.89 | ~ |
| Other X State non-need grant | | | | 1.02 | 0.39 | |
| Hispanic X State non-need grant prior to 3 yrs | | | | 1.00 | 0.22 | |
| Black X State non-need grant prior to 3 yrs | | | | 0.93 | 0.10 | |
| Asian X State non-need grant prior to 3 yrs | | | | 9.67 | 1.01 | * |
| Other X State non-need grant prior to 3 yrs | | | | 2.03 | 0.43 | |
| Income $7.5k to $15k X State need-based grant | | | | 1.04 | 0.14 | |
| Income $15k to $25k X State need-based grant | | | | 0.97 | 0.15 | |
| Income $25k to 50k X State need-based grant | | | | 0.95 | 0.14 | |
| Income $50k to $75k X State need-based grant | | | | 1.02 | 0.15 | |
| Income $75k to $100k X State need-based grant | | | | 0.92 | 0.21 | |

| | Model without Interaction | | | Model with Interaction | | |
|---|---|---|---|---|---|---|
| Variables | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Income more than $100k X State need-based grant | | | | 0.83 | 0.20 | |
| Income $7.5k to $15k X State need grant prior to 3 yrs | | | | 0.92 | 0.16 | |
| Income $15k to $25k X State need grant prior to 3 yrs | | | | 1.00 | 0.16 | |
| Income $25k to 50k X State need grant prior to 3 yrs | | | | 0.99 | 0.15 | |
| Income $50k to $75k X State need grant prior to 3 yrs | | | | 0.83 | 0.15 | |
| Income $75k to $100k X State need grant prior to 3 yrs | | | | 1.05 | 0.21 | |
| Income more than $100k X State need grant prior to 3 yrs | | | | 1.13 | 0.20 | |
| Income $7.5k to $15k X State non-need grant | | | | 1.24 | 0.11 | ~ |
| Income $15k to $25k X State non-need grant | | | | 1.09 | 0.11 | |
| Income $25k to 50k X State non-need grant | | | | 1.11 | 0.11 | |
| Income $50k to $75k X State non-need grant | | | | 1.04 | 0.14 | |
| Income $75k to $100k X State non-need grant | | | | 1.20 | 0.34 | |
| Income more than $100k X State non-need grant | | | | 0.78 | 0.33 | |
| Income $7.5k to $15k X State non-need grant prior to 3 yrs | | | | 1.06 | 0.16 | |
| Income $15k to $25k X State non-need grant prior to 3 yrs | | | | 0.79 | 0.19 | |
| Income $25k to 50k X State non-need grant prior to 3 yrs | | | | 0.92 | 0.17 | |
| Income $50k to $75k X State non-need grant prior to 3 yrs | | | | 0.87 | 0.20 | |
| Income $75k to $100k X State non-need grant prior to 3 yrs | | | | 0.92 | 0.56 | |
| Income more than $100k X State non-need grant prior to 3 yrs | | | | 0.83 | 0.27 | |

Note: Standard errors are bootstrapped using 500 replications to account for the fact that some independent variables are based on predicted values. The 500 replications were done for each of the five multiply imputed datasets (i.e., a total of 2,500 replications). 49 State fixed-effect dummy variables (reference group: Alabama) are controlled for in the model, with District of Columbia dropped from the analyses.

*** p < .001 ** p < .01 * p < .05 ~ p <.10

## Estimating the Competing-event Hazard of Enrollment

Whereas the previous section reported the estimates for the probability of enrollment in any type of institutions (relative to non-enrollment), Table 6 presents the estimates differentiated by the selectivity and the type of postsecondary institutions relative to non-enrollment, including the interaction effects between income/race and state financial aid variables. Table 6 indicates that there are significant gender and race differences in the probability of enrollment by institutional type. Female students have higher odds of enrolling in two-year colleges and competitive four-year institutions (including both public and private) than their male counterparts. With regard to race/ethnic variations, the odds of enrollment in non-competitive institutions and competitive institutions (including both public and private) are significantly higher for Asian American students relative to their White counterparts (odds ratio=3.7 for non-competitive institutions; odds ratio=4.58 and 4.3 for competitive public and private institutions, respectively). Hispanic students exhibit higher odds of enrolling in two-year colleges or non-competitive four-year colleges than Whites (odds ratio=2.69 and 3.8, respectively).

Parents' education level seems to be an important factor for enrollment in four-year institutions, and matters the most for enrollment in private competitive institutions. Students whose parents hold a bachelor's or higher degree tend to have higher odds of enrolling in private, competitive institutions than their peers whose parents received less than a four-year college education (odds ratio=2.42). An increase in the number in the family negatively affects the probability of enrollment in two-year institutions, non-competitive institutions, and competitive public institutions. Living in an urban area is

positively associated with the probability of enrolling in competitive institutions, whereas living in a rural area is negatively associated with enrollment in two-year institutions relative to living in a suburban area. Students' postsecondary expectations are significantly and positively related to enrollment in two-year and all types of four-year institutions, whereas parents' educational expectations are significantly related to enrollment in four-year institutions only. The influences of postsecondary plan and parents' educational expectations are stronger for students who choose public competitive institutions than students who enroll in any other types of institutions (odds ratio=11.86 and 4.05, respectively).

Academic achievement in high school appears to be an important determinant of enrollment in competitive four-year institutions, and the effect of math achievement is stronger than that of reading achievement for enrollment in both public and private competitive institutions. A standard deviation increase in reading score increases the odds of enrollment in competitive four-year institutions by 24 (public competitive) and 43 percent (private competitive), whereas a standard deviation increase in math score increases the odds of enrollment by 66 (public competitive) and 72 percent (private competitive). An increase in reading score is also positively associated with the odds of enrollment in non-competitive four-year institutions (odds ratio=1.28) whereas math score is not.

Students who took any type of postsecondary exam have higher odds of enrollment in both two-year and any type of four-year institutions relative to students who did not take any postsecondary exam, with higher odds of enrollment in public and private competitive institutions than any other types of institutions. Students who

attended public high school have significantly lower odds of enrollment in private competitive institutions. The odds of enrolling in private competitive institutions for students who attended public high school are only 29 percent that of students who attended private or catholic high school. Being in an academic program is also related to college enrollment. The odds of enrollment in two-year and all types of four-year institutions are significantly greater for students who took an academic program than students who took a non-academic program in high school.

Among information on financial aid obtained from various sources, information from a school representative is significantly associated with enrollment in non-competitive institutions and private competitive institutions. Students who obtain financial aid information from a school representative have 1.49 (2.12) times higher odds of enrollment in non-competitive (private competitive) institutions relative to students who did not obtain such information. Students' expectation about state grants is also related to college enrollment. An increase in students' expected amount of state need-based grants positively affects their probability of enrollment in two-year colleges and non-competitive colleges (odds ratio=3.07 and 2.19, respectively), but is negatively associated with enrollment in private competitive institutions (odds ratio=0.36). The expectation about state non need-based grants increases the odds of enrollment in two-year, non-competitive, and private competitive institutions. The odds of enrollment in response to a hundred dollar increase in expected amount of state non need-based aid are significantly greater for non-competitive institutions (odds ratio=2518.73) than two-year institutions or private competitive institutions (odds ratio=16.53 and 25.93, respectively).

With regard to the main effects of state-level financial aid variables, conditional on the individual expectations of financial aid, an increase in state need-based grants is negatively (but weakly) associated with the odds of enrollment in public competitive institutions (odds ratio=0.57, $p < .10$), and state non need-based grants are negatively associated with the odds of enrollment in two-year institutions (odds ratio=0.67). The effects of public tuition measured two years before enrollment are also significantly negative for the odds of enrollment in all types of postsecondary institutions. An increase in state appropriations measured for the concerned year is positively associated with enrollment in two-year institutions (odds ratio=1.02), but when measured two years prior to enrollment, increases in state appropriations are negatively related with enrollment in two-year, non-competitive four-year, and public competitive institutions (odds ratio=0.97, 0.96 and 0.96, respectively).

Among state-level non-financial covariates, public high school graduation rates within a state are positively associated with the odds of enrollment in two-year institutions or private competitive institutions. One percent increase in states' public high school graduation rates (measured in the same period the student enrolled in college) increases individual students' odds of enrollment in two-year institutions by 5 percent. In response to one percent increase in public high school graduation rates (measured three years before enrollment), the odds of enrollment in private competitive four-year institutions increase by 15 percent. The percentage of state population who obtained bachelor's or above degree (measured three years before enrollment) is positively associated with enrollment in public competitive institutions.

Average state per capita income (measured income two and three years prior to enrollment) is positively related to enrollment in two-year (odds ratio=1.87) and competitive four-year institutions (odds ratio=1.47 and 1.68 for public and private competitive institutions, respectively). However, state per capita income measured one year before enrollment is negatively associated with the odds of enrollment in two-year institutions (odds ratio=0.45). Changes in the percentage of state population in poverty (measured in the same period the student enrolled in college and one year before enrollment) are negatively associated with enrollment in public (odds ratio=0.86) and private competitive four-year institutions (odds ratio=0.76), while poverty rates measured three years before enrollment are positively associated with enrollment in private competitive institutions (odds ratio=1.10).

With regard to interactions between race and each type of state aid, the effects state need-based aid have on college enrollment significantly vary by each racial group (all p-value < 0.001). As illustrated in Table 6, for Hispanics, an increase in state need-based grants significantly raises their odds of enrollment in non-competitive institutions (odds ratio=1.63), but increases in state need-based grants measured three years before enrollment lower their probability of enrollment in the same type of institutions (odds ratio=0.55). There are also significant differences by race/ethnicity on the effect of state non need-based aid (all p-value < 0.001). Changes in state non need-based aid (measured three years before enrollment) are positively associated with enrollment in two-year institutions for Asian Americans. With regard to interactions between income and state aid policies, the effects state need-based grants have on enrollment probabilities significantly differ by income groups (p-value < 0.001 for all imputed datasets). The

effects of state non need-based grants also vary significantly by income groups (p-value < 0.001 for all imputed datasets).

Table 6. Estimating the Hazard of Postsecondary Enrollment by Selectivity

| Variables | Two-year | | | Non competitive | | | Public Competitive | | | Private Competitive | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Female | 1.20 | 0.09 | * | 1.14 | 0.13 | | 1.36 | 0.13 | * | 1.48 | 0.16 | * |
| Asian | 3.02 | 0.54 | ~ | 3.70 | 0.63 | * | 4.58 | 0.59 | * | 4.30 | 0.68 | * |
| Hispanic | 2.69 | 0.35 | ** | 3.80 | 0.53 | * | 0.78 | 0.48 | | 0.79 | 0.61 | |
| Black | 1.62 | 0.44 | | 2.39 | 0.56 | | 0.79 | 0.53 | | 1.41 | 0.61 | |
| Other Race | 0.78 | 0.69 | | 1.91 | 1.01 | | 0.10 | 1.20 | ~ | 0.03 | 2.97 | |
| Parental education: Bachelor's or above | 1.37 | 0.18 | ~ | 1.65 | 0.21 | * | 1.88 | 0.19 | ** | 2.42 | 0.21 | *** |
| Income $7.5k to $15k | 1.41 | 0.35 | | 0.63 | 0.59 | | 1.68 | 0.64 | | 1.40 | 0.91 | |
| Income $15k to $25k | 1.23 | 0.68 | | 0.77 | 0.77 | | 2.15 | 0.86 | | 5.22 | 1.31 | |
| Income $25k to 50k | 3.29 | 1.02 | | 0.71 | 1.25 | | 4.02 | 1.30 | | 5.84 | 1.70 | |
| Income $50k to $75k | 14.30 | 1.18 | * | 2.57 | 1.43 | | 3.43 | 1.55 | | 3.39 | 2.01 | |
| Income $75k to $100k | 10.91 | 1.27 | ~ | 1.91 | 1.51 | | 1.84 | 1.45 | | 2.98 | 1.98 | |
| Income more than $100k | 19.19 | 1.37 | ~ | 3.19 | 1.63 | | 4.34 | 2.12 | | 10.40 | 2.50 | |
| Family size | 0.82 | 0.07 | * | 0.78 | 0.07 | ** | 0.84 | 0.08 | * | 0.91 | 0.10 | |
| Urban | 1.25 | 0.12 | ~ | 1.38 | 0.18 | ~ | 1.50 | 0.17 | * | 1.83 | 0.20 | ** |
| Rural | 0.81 | 0.09 | * | 1.13 | 0.15 | | 0.85 | 0.13 | | 1.09 | 0.19 | |
| Postsecondary plan: Bachelor's or above | 2.12 | 0.10 | *** | 5.66 | 0.15 | *** | 11.86 | 0.18 | *** | 5.59 | 0.19 | *** |
| Parental educational expectation: Bachelor's or above | 1.30 | 0.16 | | 1.88 | 0.20 | ** | 4.05 | 0.22 | *** | 2.34 | 0.25 | ** |
| Parental involvement in course selection | 1.08 | 0.31 | | 1.00 | 0.35 | | 1.18 | 0.33 | | 2.56 | 0.54 | ~ |
| Parental involvement in school activities | 0.77 | 0.34 | | 0.91 | 0.41 | | 1.04 | 0.46 | | 0.47 | 0.43 | ~ |
| Parental involvement in grade | 0.98 | 0.34 | | 1.60 | 0.57 | | 0.77 | 0.60 | | 1.01 | 1.18 | |
| Parental involvement in taking SAT/ACT | 0.94 | 0.19 | | 1.00 | 0.30 | | 0.81 | 0.26 | | 0.93 | 0.43 | |
| Parental involvement in applying to colleges | 1.06 | 0.34 | | 1.82 | 0.41 | | 1.11 | 0.38 | | 0.73 | 0.65 | |
| FA Info from a teacher/counselor | 1.05 | 0.14 | | 1.14 | 0.21 | | 1.24 | 0.15 | | 1.17 | 0.17 | |
| FA Info from a school representative | 0.97 | 0.22 | | 1.49 | 0.18 | * | 1.04 | 0.23 | | 2.12 | 0.31 | * |
| FA Info from Dept. of Education | 1.29 | 0.16 | | 1.36 | 0.21 | | 1.30 | 0.20 | | 1.23 | 0.30 | |

| Variables | Two-year | | | Non competitive | | | Public Competitive | | | Private Competitive | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| FA Info from colleges and universities | 0.93 | 0.14 | | 0.88 | 0.15 | | 0.99 | 0.15 | | 0.78 | 0.23 | |
| HS Reading Score | 1.13 | 0.07 | ~ | 1.28 | 0.10 | * | 1.24 | 0.09 | * | 1.43 | 0.12 | ** |
| HS Math Score | 0.86 | 0.12 | | 1.12 | 0.15 | | 1.66 | 0.13 | *** | 1.72 | 0.16 | ** |
| HS Cumulative GPA | 1.03 | 0.06 | | 1.15 | 0.10 | | 1.06 | 0.08 | | 1.11 | 0.11 | |
| Took Postsecondary Exams | 1.73 | 0.08 | *** | 3.11 | 0.16 | *** | 4.83 | 0.17 | *** | 4.35 | 0.21 | *** |
| Attend Public HS | 0.76 | 0.26 | | 0.62 | 0.31 | | 0.59 | 0.29 | ~ | 0.29 | 0.32 | *** |
| Academic program | 1.30 | 0.08 | *** | 1.54 | 0.15 | ** | 1.47 | 0.14 | ** | 1.48 | 0.18 | * |
| GED | 1.03 | 0.21 | | 0.55 | 0.50 | | 0.53 | 0.61 | | 0.22 | 0.82 | ~ |
| Distance to a nearest institution(in mile) | 1.00 | 0.00 | | 1.00 | 0.00 | | 1.00 | 0.00 | | 1.00 | 0.00 | |
| Expected amount of a Pell grant | 0.89 | 0.10 | | 0.86 | 0.15 | | 1.21 | 0.16 | | 1.05 | 0.21 | |
| Squared Expected Pell | 1.00 | 0.00 | | 1.01 | 0.01 | | 0.99 | 0.01 | | 1.00 | 0.01 | |
| Expected amount of State need grant | 3.07 | 0.24 | *** | 2.19 | 0.36 | * | 0.65 | 0.36 | | 0.36 | 0.45 | * |
| Squared Expected amount of State need grant | 0.91 | 0.03 | *** | 0.92 | 0.04 | * | 1.01 | 0.04 | | 1.12 | 0.04 | * |
| Expected amount of State non-need grant | 16.53 | 1.00 | ** | 2518.73 | 1.51 | *** | 0.35 | 1.36 | | 25.93 | 1.43 | * |
| Squared Expected amount of State non- need grant | 0.00 | 1.21 | *** | 0.00 | 1.61 | *** | 0.99 | 1.34 | | 0.62 | 1.32 | |
| State need-based grant | 0.97 | 0.16 | | 0.84 | 0.28 | | 0.57 | 0.32 | ~ | 0.64 | 0.32 | |
| State non-need grant | 0.67 | 0.14 | ** | 0.32 | 0.70 | | 0.67 | 0.57 | | 0.39 | 2.03 | |
| Public tuition | 1.01 | 0.04 | | 0.98 | 0.08 | | 0.93 | 0.08 | | 1.12 | 0.09 | |
| State appropriation | 1.02 | 0.01 | *** | 1.01 | 0.01 | | 1.02 | 0.02 | | 1.02 | 0.02 | |
| Public tuition prior to 1 yr | 0.93 | 0.05 | | 0.87 | 0.10 | | 0.90 | 0.08 | | 0.86 | 0.09 | |
| State appropriation prior to 1 yr | 1.00 | 0.01 | | 1.00 | 0.02 | | 1.01 | 0.02 | | 1.02 | 0.02 | |
| Public tuition prior to 2 yrs | 0.80 | 0.03 | *** | 0.81 | 0.05 | *** | 0.80 | 0.05 | *** | 0.80 | 0.05 | *** |
| State appropriation prior to 2 yrs | 0.97 | 0.01 | *** | 0.96 | 0.02 | * | 0.96 | 0.01 | ** | 1.00 | 0.02 | |
| State need-based grant prior to 3 yrs | 1.23 | 0.17 | | 1.18 | 0.34 | | 1.28 | 0.36 | | 1.40 | 0.39 | |
| State non-need grant prior to 3 yrs | 1.12 | 0.25 | | 0.18 | 1.09 | | 0.46 | 0.80 | | 1.54 | 1.11 | |
| Public tuition prior to 3 yrs | 1.02 | 0.03 | | 0.97 | 0.06 | | 0.98 | 0.05 | | 0.94 | 0.07 | |
| State appropriation prior to 3 yrs | 1.00 | 0.01 | | 1.01 | 0.01 | | 0.97 | 0.01 | ~ | 0.98 | 0.02 | |
| GED * Year 2 (1993) | 1.23 | 0.33 | | 1.20 | 0.73 | | 4.41 | 1.56 | | 3.90 | 1.94 | |
| GED * Year 3 (1994) | 1.52 | 0.33 | | 1.39 | 2.03 | | 1.74 | 9.07 | | 7.09 | 4.45 | |
| GED * Year 4 (1995) | 1.84 | 0.36 | ~ | 1.93 | 3.76 | | 2.42 | 8.74 | | 14.26 | 5.10 | |

| Variables | Two-year | | | Non competitive | | | Public Competitive | | | Private Competitive | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| GED * Year 5 (1996) | 1.66 | 0.40 | | 2.56 | 3.73 | | 2.89 | 9.22 | | 7.70 | 6.91 | |
| GED * Year 6 (1997) | 1.77 | 0.47 | | 3.86 | 6.95 | | 3.13 | 10.59 | | 6.99 | 8.75 | |
| GED * Year 7 (1998) | 2.44 | 0.59 | | 4.35 | 9.38 | | 0.00 | 1.20 | *** | 5.89 | 9.19 | |
| GED * Year 8 (1999) | 0.76 | 0.64 | | 1.42 | 10.99 | | 0.00 | 1.74 | *** | 1.55 | 9.81 | |
| GED * Year 9 (2000) | 1.43 | 5.61 | | 6.89 | 13.31 | | 0.00 | 8.60 | ~ | 16.09 | 13.03 | |
| Year 2 (1993) | 0.67 | 0.17 | * | 0.31 | 0.38 | ** | 0.44 | 0.37 | * | 0.25 | 0.57 | * |
| Year 3 (1994) | 0.39 | 0.20 | *** | 0.15 | 0.45 | *** | 0.24 | 0.44 | ** | 0.11 | 0.61 | *** |
| Year 4 (1995) | 0.32 | 0.23 | *** | 0.10 | 0.49 | *** | 0.27 | 0.53 | * | 0.05 | 0.76 | *** |
| Year 5 (1996) | 0.25 | 0.25 | *** | 0.07 | 0.57 | *** | 0.31 | 0.60 | ~ | 0.05 | 0.87 | *** |
| Year 6 (1997) | 0.22 | 0.28 | *** | 0.04 | 0.66 | *** | 0.39 | 0.73 | | 0.05 | 0.91 | *** |
| Year 7 (1998) | 0.14 | 0.31 | *** | 0.04 | 0.75 | *** | 0.42 | 0.88 | | 0.10 | 1.06 | * |
| Year 8 (1999) | 0.08 | 0.38 | *** | 0.03 | 1.12 | ** | 0.37 | 1.57 | | 0.04 | 1.81 | ~ |
| Year 9 (2000) | 0.03 | 0.53 | *** | 0.01 | 6.69 | | 0.03 | 8.71 | | 0.01 | 7.60 | |
| Public HS graduation rate | 1.05 | 0.02 | * | 0.99 | 0.04 | | 1.02 | 0.05 | | 1.05 | 0.06 | |
| % bachelors or higher | 0.97 | 0.04 | | 0.99 | 0.10 | | 0.89 | 0.10 | | 0.88 | 0.18 | |
| State per capita Income | 1.10 | 0.10 | | 0.92 | 0.19 | | 0.69 | 0.22 | ~ | 0.93 | 0.28 | |
| % Poverty | 0.99 | 0.03 | | 0.95 | 0.07 | | 1.06 | 0.06 | | 0.76 | 0.10 | ** |
| % Unemployment | 1.18 | 0.12 | | 0.89 | 0.25 | | 1.24 | 0.23 | | 1.36 | 0.36 | |
| Public HS graduation rate prior to 1 yr | 1.02 | 0.02 | | 1.03 | 0.04 | | 1.01 | 0.04 | | 1.00 | 0.06 | |
| % bachelors or higher prior to 1 yr | 1.05 | 0.05 | | 1.09 | 0.13 | | 1.04 | 0.11 | | 1.19 | 0.21 | |
| State per capita Income prior to 1 yr | 0.45 | 0.28 | ** | 0.73 | 0.36 | | 0.72 | 0.37 | | 0.51 | 0.37 | ~ |
| % Poverty prior to 1 yr | 0.96 | 0.03 | | 0.95 | 0.05 | | 0.86 | 0.06 | * | 0.83 | 0.09 | ~ |
| % Unemployment prior to 1 yr | 1.02 | 0.13 | | 1.25 | 0.27 | | 0.97 | 0.25 | | 0.71 | 0.44 | |
| Public HS graduation rate prior to 2 yrs | 1.00 | 0.02 | | 0.96 | 0.05 | | 1.00 | 0.05 | | 0.97 | 0.07 | |
| % bachelors or higher prior to 2 yrs | 1.05 | 0.05 | | 1.01 | 0.15 | | 0.87 | 0.14 | | 0.86 | 0.20 | |
| State per capita Income prior to 2 yrs | 1.00 | 0.08 | | 1.00 | 0.16 | | 1.47 | 0.19 | * | 1.05 | 0.25 | |
| % Poverty prior to 2 yrs | 1.00 | 0.03 | | 0.99 | 0.06 | | 1.03 | 0.07 | | 0.92 | 0.10 | |
| % Unemployment prior to 2 yrs | 1.08 | 0.13 | | 0.93 | 0.26 | | 1.23 | 0.25 | | 1.22 | 0.40 | |
| Public HS graduation rate prior to 3 yrs | 1.00 | 0.02 | | 1.05 | 0.04 | | 1.02 | 0.04 | | 1.15 | 0.06 | * |
| % bachelors or higher prior to 3 yrs | 1.01 | 0.05 | | 0.97 | 0.13 | | 1.36 | 0.12 | * | 0.93 | 0.17 | |
| State per capita Income prior to 3 yrs | 1.87 | 0.19 | *** | 1.49 | 0.27 | | 1.53 | 0.23 | ~ | 1.68 | 0.22 | * |
| % Poverty prior to 3 yrs | 0.99 | 0.01 | | 1.00 | 0.03 | | 0.98 | 0.03 | | 1.10 | 0.04 | ** |
| % Unemployment prior to 3 yrs | 1.18 | 0.10 | ~ | 1.15 | 0.19 | | 1.26 | 0.21 | | 1.37 | 0.29 | |

| Variables | Two-year | | | Non competitive | | | Public Competitive | | | Private Competitive | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Hispanic X State need-based grant | 0.95 | 0.14 | | 1.63 | 0.24 | * | 0.91 | 0.21 | | 1.38 | 0.22 | |
| Black X State need-based grant | 1.09 | 0.11 | | 1.26 | 0.23 | | 1.31 | 0.22 | | 1.35 | 0.21 | |
| Asian X State need-based grant | 0.91 | 0.19 | | 1.05 | 0.33 | | 1.00 | 0.25 | | 1.20 | 0.28 | |
| Other X State need-based grant | 1.08 | 0.23 | | 2.70 | 1.00 | | 0.72 | 0.75 | | 0.72 | 0.68 | |
| Hispanic X State need grant prior to 3 yrs | 0.92 | 0.14 | | 0.55 | 0.30 | * | 1.08 | 0.24 | | 0.75 | 0.25 | |
| Black X State need grant prior to 3 yrs | 0.92 | 0.12 | | 0.74 | 0.26 | | 0.73 | 0.26 | | 0.73 | 0.24 | |
| Asian X State need grant prior to 3 yrs | 0.83 | 0.25 | | 0.88 | 0.36 | | 0.79 | 0.33 | | 0.66 | 0.36 | |
| Other X State need grant prior to 3 yrs | 0.93 | 0.27 | | 0.27 | 1.04 | | 1.47 | 0.99 | | 2.80 | 0.66 | |
| Hispanic X State non-need grant | 0.96 | 0.16 | | 0.71 | 0.87 | | 0.41 | 0.71 | | 0.86 | 1.43 | |
| Black X State non-need grant | 1.06 | 0.08 | | 0.92 | 0.60 | | 0.33 | 0.58 | ~ | 0.99 | 0.59 | |
| Asian X State non-need grant | 0.13 | 1.10 | ~ | 1.25 | 1.50 | | 0.12 | 1.38 | | 0.06 | 1.82 | |
| Other X State non-need grant | 0.99 | 0.54 | | 0.85 | 1.80 | | 0.40 | 3.10 | | 2.01 | 5.12 | |
| Hispanic X State non-need grant prior to 3 yrs | 0.83 | 0.24 | | 0.92 | 1.03 | | 2.95 | 0.79 | | 1.57 | 1.55 | |
| Black X State non-need grant prior to 3 yrs | 0.92 | 0.13 | | 1.53 | 0.62 | | 2.39 | 0.64 | | 0.74 | 0.75 | |
| Asian X State non-need grant prior to 3 yrs | 19.26 | 1.26 | * | 0.45 | 1.87 | | 22.35 | 1.60 | ~ | 24.86 | 1.97 | |
| Other X State non-need grant prior to 3 yrs | 2.17 | 0.59 | | 2.84 | 1.80 | | 5.76 | 1.52 | | 0.10 | 5.37 | |
| Income $7.5k to $15k X State need-based grant | 1.00 | 0.18 | | 0.94 | 0.30 | | 1.70 | 0.35 | | 1.10 | 0.35 | |
| Income $15k to $25k X State need-based grant | 0.96 | 0.19 | | 0.87 | 0.34 | | 1.26 | 0.35 | | 0.98 | 0.35 | |
| Income $25k to 50k X State need-based grant | 0.96 | 0.17 | | 0.88 | 0.28 | | 1.46 | 0.31 | | 0.99 | 0.32 | |
| Income $50k to $75k X State need-based grant | 1.02 | 0.18 | | 0.90 | 0.30 | | 1.29 | 0.32 | | 0.97 | 0.34 | |
| Income $75k to $100k X State need-based grant | 0.96 | 0.23 | | 0.78 | 0.44 | | 1.09 | 0.36 | | 1.09 | 0.39 | |
| Income more than $100k X State need-based grant | 0.82 | 0.22 | | 0.82 | 0.35 | | 1.03 | 0.34 | | 0.86 | 0.35 | |
| Income $7.5k to $15k X State need grant prior to 3 yrs | 0.91 | 0.20 | | 1.10 | 0.35 | | 0.58 | 0.42 | | 1.02 | 0.41 | |

| Variables | Two-year | | | Non competitive | | | Public Competitive | | | Private Competitive | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. | Odds Ratio | SE | Sig. |
| Income $15k to $25k X State need grant prior to 3 yrs | 1.01 | 0.20 | | 1.07 | 0.40 | | 0.74 | 0.40 | | 0.90 | 0.43 | |
| Income $25k to 50k X State need grant prior to 3 yrs | 0.96 | 0.18 | | 1.18 | 0.32 | | 0.60 | 0.36 | | 0.90 | 0.37 | |
| Income $50k to $75k X State need grant prior to 3 yrs | 0.81 | 0.18 | | 0.97 | 0.34 | | 0.66 | 0.37 | | 0.85 | 0.40 | |
| Income $75k to $100k X State need grant prior to 3 yrs | 0.97 | 0.25 | | 1.38 | 0.50 | | 0.90 | 0.43 | | 0.81 | 0.44 | |
| Income more than $100k X State need grant prior to 3 yrs | 1.17 | 0.24 | | 1.39 | 0.41 | | 0.96 | 0.42 | | 1.09 | 0.40 | |
| Income $7.5k to $15k X State non-need grant | 1.27 | 0.14 | ~ | 1.22 | 1.16 | | 0.74 | 0.84 | | 2.21 | 2.14 | |
| Income $15k to $25k X State non-need grant | 1.16 | 0.15 | | 1.06 | 1.00 | | 1.01 | 0.62 | | 1.64 | 2.04 | |
| Income $25k to 50k X State non-need grant | 1.14 | 0.15 | | 2.16 | 0.70 | | 0.99 | 0.66 | | 1.47 | 2.07 | |
| Income $50k to $75k X State non-need grant | 1.11 | 0.18 | | 0.86 | 0.98 | | 0.77 | 0.64 | | 1.75 | 2.14 | |
| Income $75k to $100k X State non-need grant | 1.26 | 0.44 | | 1.12 | 1.38 | | 0.91 | 0.94 | | 1.34 | 2.35 | |
| Income more than $100k X State non-need grant | 0.57 | 0.55 | | 2.55 | 0.91 | | 0.62 | 0.76 | | 0.81 | 2.45 | |
| Income $7.5k to $15k X State non-need grant prior to 3 yrs | 1.10 | 0.26 | | 1.97 | 1.13 | | 1.17 | 1.00 | | 0.81 | 1.33 | |
| Income $15k to $25k X State non-need grant prior to 3 yrs | 0.72 | 0.26 | | 1.15 | 1.05 | | 0.80 | 0.80 | | 0.41 | 1.37 | |
| Income $25k to 50k X State non-need grant prior to 3 yrs | 0.90 | 0.27 | | 0.71 | 0.82 | | 0.65 | 0.81 | | 0.73 | 1.20 | |
| Income $50k to $75k X State non-need grant prior to 3 yrs | 0.91 | 0.29 | | 1.32 | 1.04 | | 0.84 | 0.78 | | 0.58 | 1.37 | |
| Income $75k to $100k X State non-need grant prior to 3 yrs | 0.77 | 0.72 | | 1.19 | 1.48 | | 1.56 | 1.00 | | 0.52 | 1.66 | |
| Income more than $100k X State non-need grant prior to 3 yrs | 1.02 | 0.37 | | 0.64 | 1.06 | | 0.58 | 1.04 | | 0.73 | 1.53 | |

Note: Standard errors are bootstrapped using 200 replications to account for the fact that some independent variables are based on predicted values. The 200 replications were done for each of the five multiply imputed datasets (a total of 1,000 replications). 49 State fixed-effect dummy variables (reference group: Alabama) are controlled for in the model, with District of Columbia dropped from the analyses. *** p < .001 ** p < .01 * p < .05 ~ p <.10

## Graphical Simulations of Enrollment Probabilities over Time

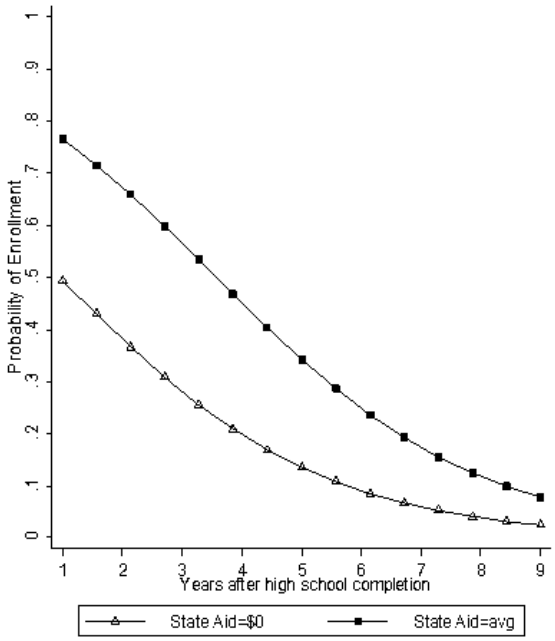
Using the regression results discussed above, I conducted graphical simulations to quantify the effects of changes in the amount of state financial aid variable on students' enrollment behavior over time. Specifically, this section compares the probability of college enrollment under a no-aid strategy (state need-based and non need-based aid are zeroed out) to the enrollment probability obtained under the average amount of state aid variable (both types of state aid are set to their average values) among all students. The probabilities of enrollment of these two alternatives are plotted and displayed in Figure 4. The upper part of Figure 4 displays how enrollment probabilities measured when both types of state financial aid are zeroed out differ from the probabilities produced when students face the average amount of state need-based and non need-based aid per FTE over the study period. The two graphs displayed in the bottom part of Figure 4 present the results of the simulations of enrollment destinations for all students when the amount of state aid changes from no aid to middle aid schemes.

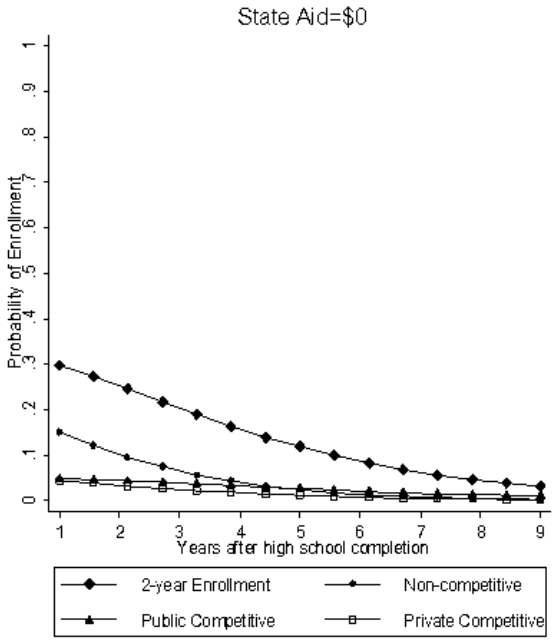
The uppermost graph in Figure 4 indicates that the probability of college enrollment declines precipitously as time elapses after high school. Relative to the no aid strategy, the availability of average state financial aid variables increases the probability of college enrollment over time, but the effects of state aid on the probability of enrollment are stronger when students enroll in college sooner after high school. For instance, the probability of enrollment under the no state aid strategy is about three percentage points lower than the probability under the average state aid strategy immediately after high school completion. However, the gaps in enrollment propensities

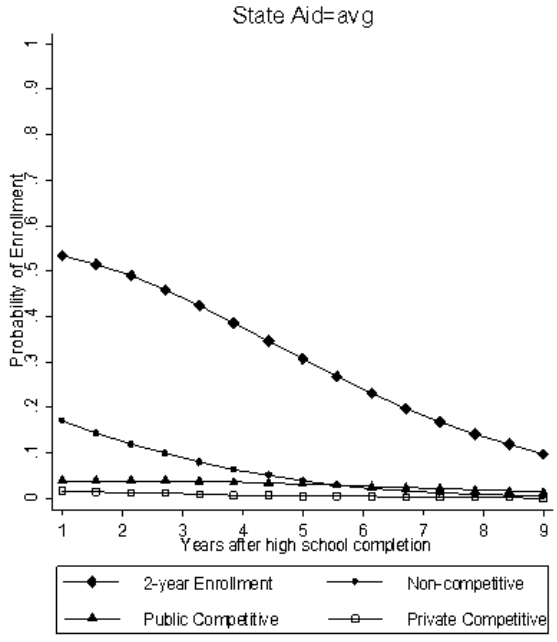
become far less than that (almost cut in half) after five or six years from high school completion.

The bottom parts of Figure 4 illustrate how the probability of enrollment in different types of institutions changes in response to changes in the amount of state financial aid. Regardless of state aid schemes, the probability of enrollment in two-year institutions is higher than any other types of four-year institutions, followed by non-competitive four-year institutions. On the contrary, the probability of enrollment in public and private selective institutions is very low throughout the study period. When state financial aid changes from no aid to average aid strategy, the probability of enrolling in two-year institutions increases the most (by more than two percentage points immediately after high school) over time, but the rate of increase is highest within five years after high school. Increased availability in state financial aid also contributes to higher propensities of enrollment in non-competitive four-year colleges at a smaller rate (of less than one percentage point immediately after high school). However, changes in the amount of state financial aid rarely affect the probability of enrollment in selective four-year institutions (including both public and private). The results suggest that enrollment in two-year institutions or non-competitive four-year institutions may be more influenced by college affordability due to changes in the amount of state financial aid, whereas enrollment in selective institutions is not.

Figure 4. Changes in the Probability of Enrollment Over Time: All Students




Note: Other variables (including individual's expected value of state aid) are held constant at their respective means. The average FTE values of state need-based grant and non need-based grant are $285.47 and $51.73, respectively.

## Graphical Simulations of Enrollment Probabilities by Income and Race

To explore the impact of state-level financial aid variables on student enrollment behavior by race and family income, I plotted the probabilities of enrollment for different racial and income groups in order to examine how sensitive students' enrollment probabilities are to changes in the state average tuition in public colleges and universities (in hundreds). Other variables used to predict the probability of enrollment are held constant at their mean values. Figure 5 displays the results of the simulation when both state need-based and non need-based aid are set to zero (i.e., the "No Aid" scenario). Figure 6 displays how enrollment probabilities vary when students from each racial/ethnic group face the average amount of state need-based and non need-based aid per FTE (i.e., the "Middle" aid scenario), and Figure 7 provides the results of the simulation when these students face the situation where both types of state aid are set to one standard deviation above the average values (the "High" aid scenario).

In Figure 5, under the "No Aid" scenario, the probabilities of enrollment for low income groups (less than $7,500) for all races are everywhere lower than the enrollment probabilities for high income groups (greater than $100,000). For all racial groups the enrollment gaps between the two income groups are maintained until the level of state public tuition reaches the $3,000 and $4,000 level but the gaps decline as the level of state public tuition increases greater than that. The initial levels (y-intercept) in enrollment probabilities for White and African American low-income students are relatively lower than their Hispanic and Asian low-income counterparts, suggesting their lower propensities of college enrollment when the level of public tuition is very low and no state-level aid is provided.

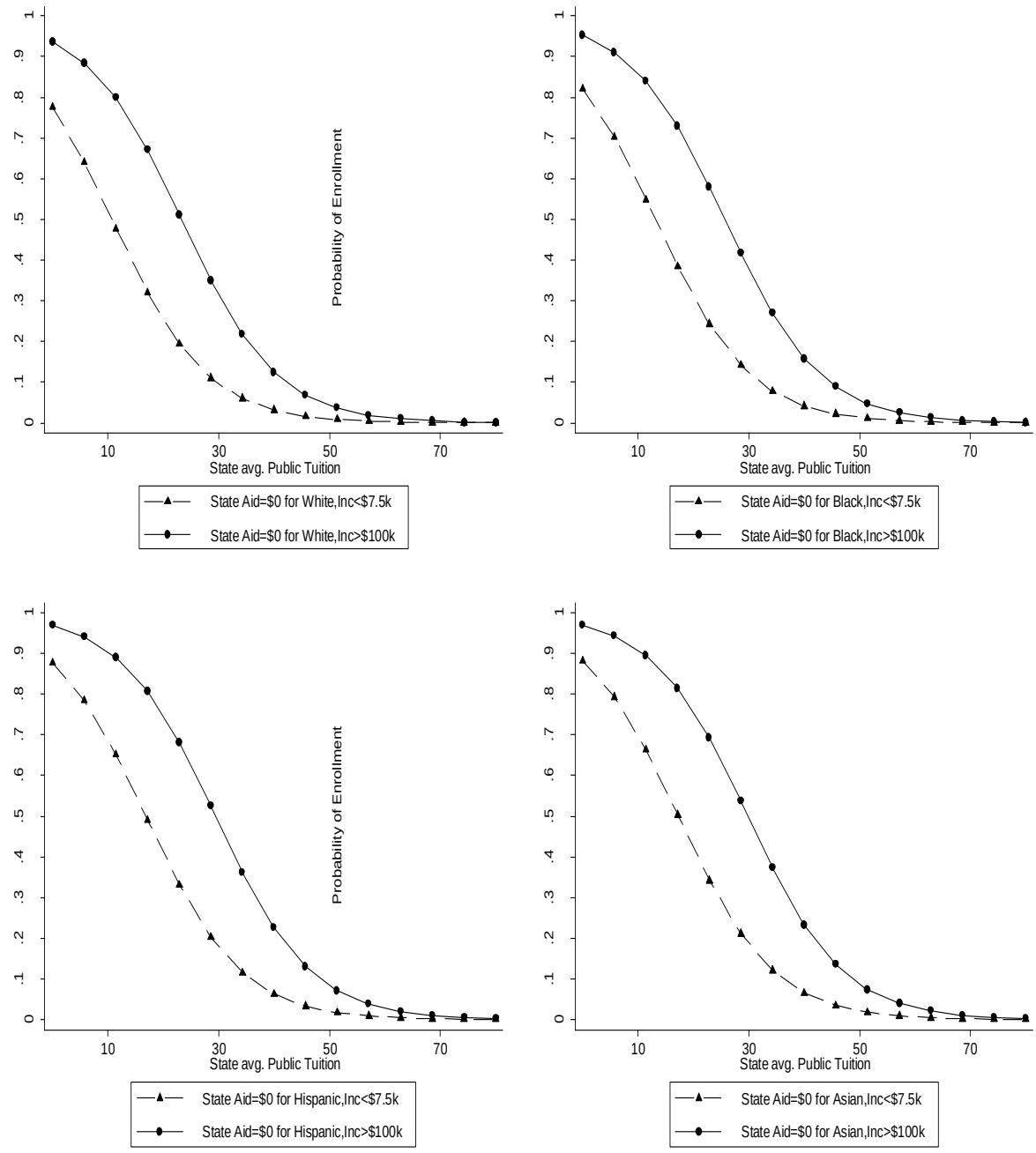
For the middle aid strategy displayed in Figure 6, the enrollment propensities for both low-income and upper-income groups (relative to "No Aid" scenario in Figure 5) increase in every racial group in response to the increased availability of state financial aid. For every racial group, because both income groups experience the comparable rise in enrollment propensities relative to no aid scenario, the enrollment gaps between low-income and high-income groups are maintained at a level comparable to where no state aid is provided. The similarities in the changes in enrollment propensities across racial groups suggests that students of different races are comparably responsive to changes in the amount of state financial aid when average levels of state financial aid are provided.

In Figure 7, under the "High Aid" scenario, the predicted enrollment propensities are very different for each racial group in response to increases in state-level financial aid. For most racial groups (except for Hispanics), the probability of enrollment among low-income students increases at each comparable level of public tuition when the state aid schemes change from middle aid to a high aid strategy. In contrast, high-income groups for most races (except for Asians) exhibit no substantial change (or a slight decline) in their enrollment propensities despite the increases in the availability of state-level aid (from middle to high aid strategy). As a consequence, the enrollment gaps across income groups narrow significantly for all racial groups, and the predicted enrollment probability of low-income students reaches approximately equal to that of high-income groups among African Americans. The rate of increase in enrollment probabilities (slope) in response to changes in the amount of state financial aid is higher for Asian students than other racial groups, suggesting that the enrollment responsiveness to increases in the amount of state aid is highest for Asians among all racial groups.

The simulations demonstrate that there are significant variations in enrollment probabilities depending on the size of state aid as well as a student's income and racial backgrounds. The examination of Figures 5 through 7 demonstrates that compared to high-income groups, the enrollment propensities for low-income students are more responsive to higher increases in state aid than their high-income counterparts for every racial group. Each racial group also exhibits very different patterns in enrollment probabilities in response to changes in the amount of financial aid that states provide and Asian Americans (including both low-income and upper-income groups) appear to be the most responsive to changes in the amount of state aid in their enrollment behavior, especially when higher amount of state financial aid is available.

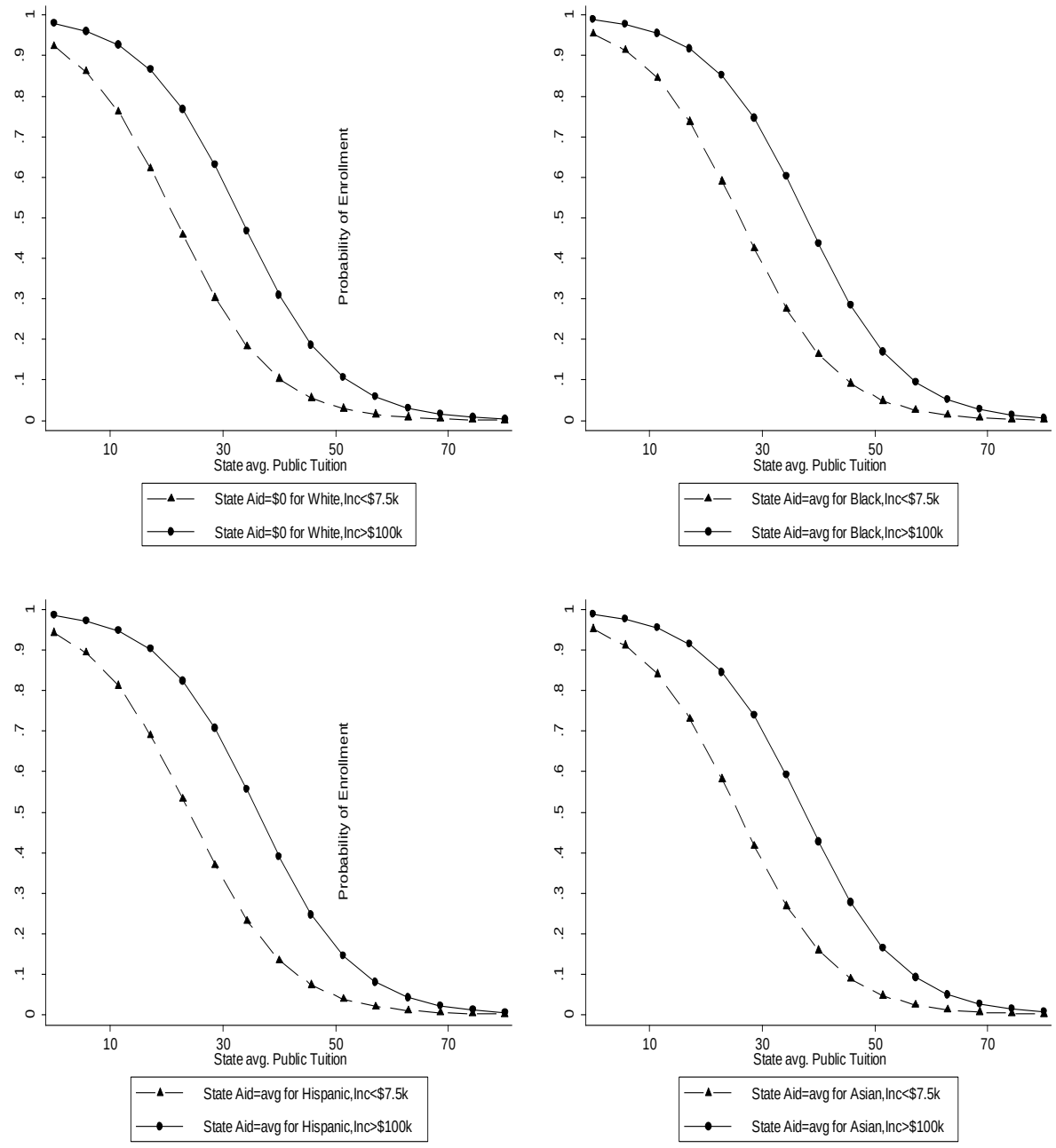
On the contrary, Hispanic students did not respond much to the increased availability of state financial aid, and their enrollment probability declined even when higher amount of state aid was available. The differences in enrollment behavior among racial groups suggest that the effect of state-level financial aid variables on college enrollment is stronger (weaker) for Asian Americans (Hispanics) than for any other racial groups.

Figure 5. Probability of Enrollment by Income and Race: No Aid Scenario



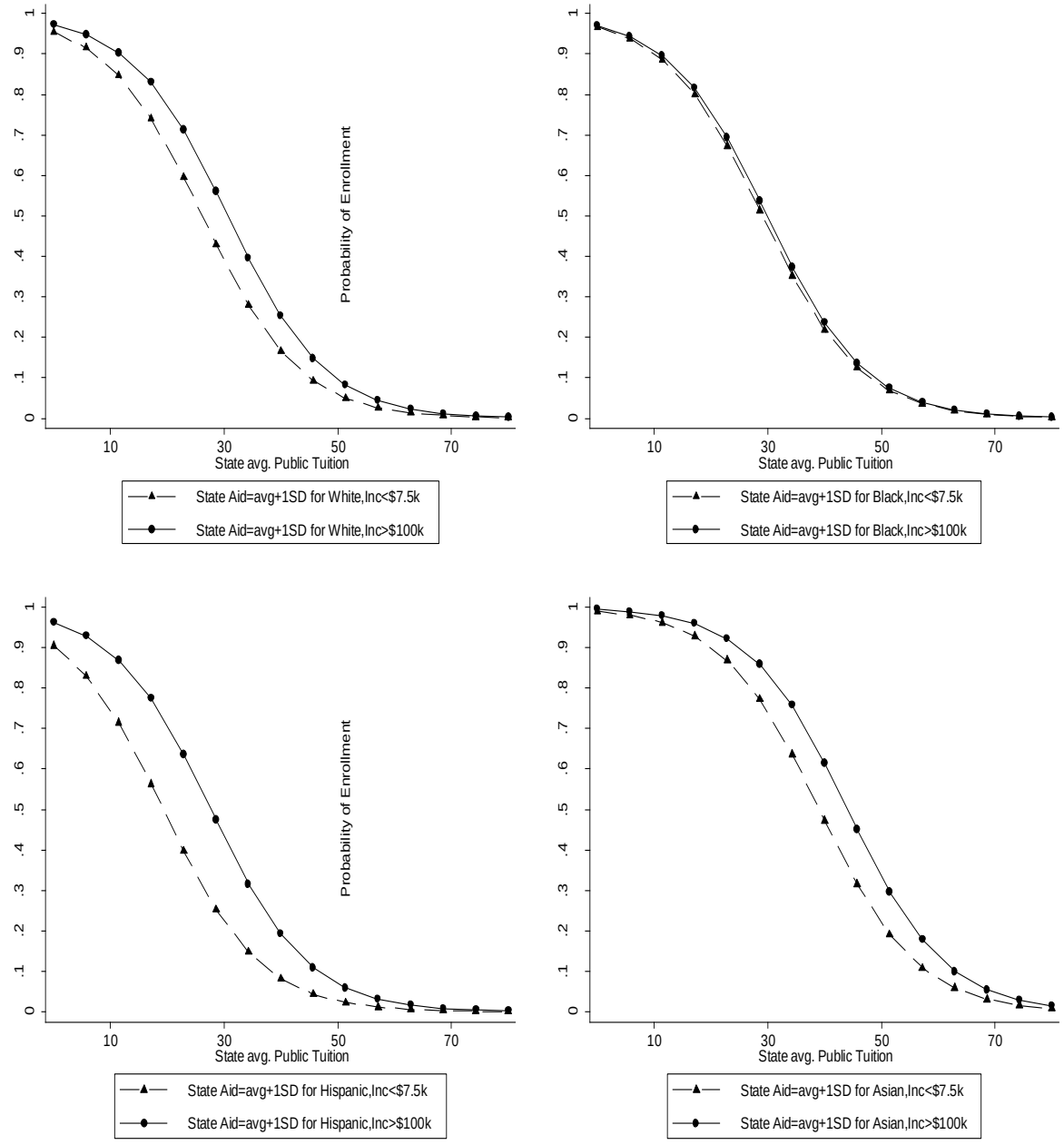

Note: For each racial group model, the values of state need-based grant and non need-based grant are set to zero and other variables (including individual's expected value of state aid) are held constant at their respective means.

Figure 6. Probability of Enrollment by Income and Race: Middle Aid Scenario




Note: For each racial group model, other variables (including individual's expected value of state aid) are held constant at their respective means. The average FTE values of state need-based grant and non need-based grant are $285.47 and $51.73, respectively.

Figure 7. Probability of Enrollment by Income and Race: High Aid Scenario




Note: For each racial group model, other variables (including individual's expected value of state aid) are held constant at their respective means. The one standard deviation above the average FTE values of state need-based grant and non need-based grant are $601.58 and $194.29, respectively.

The next step is to investigate differences in enrollment behavior by the selectivity of institutions in response to changes in the aid amount that states provide. As in the case of the previous simulations, this section presents the plotted predicted probabilities of enrollment in different types of institutions across racial and income groups in order to examine how sensitive students' enrollment probabilities in different types of institutions are to changes in public tuition. Other variables used to predict the probability of enrollment are held constant at their mean values. Figures 8 through 11 display the results of the simulations for each racial group (i.e., Whites, African Americans, Hispanics, and Asians) when the amount of state financial aid variables changes from no aid (i.e., state need-based and non need-based aid are set to zero) to middle aid schemes (i.e., both types of state aid per FTE are set to its average values). The changes in enrollment behavior in response to high aid schemes are, however, not reported because high increases in state aid (up to one standard deviation above the average) resulted in disproportionate increases in two-year college enrollment, completely zeroing out the probabilities of enrolling in other types of institutions for all subgroup (based on the simulation results). It was therefore impossible to compare enrollment responses differentiated by the type of an institution, and the simulation results when state aid changes from none to middle aid schemes are examined in this section. Each graph that plots enrollment probabilities for the four distinct racial groups compares enrollment in different types of institutions between low-income (less than $7,500) and upper-income groups (greater than $100,000).

Under the no aid scenario, the probability of enrolling in non-competitive four-year institutions is higher than enrollment in any other types of institutions for low-

income groups of all races, followed by enrollment in two-year institutions at a low level of public tuition that is less than $3,000 (see Figures 8-1, 9-1, 10-1, and 11-1). Asian low-income students especially exhibit higher probability of enrolling in two-year institutions than any other racial groups across all the tuition levels. However, the probabilities of enrollment in competitive institutions for low-income students are close to zero at any levels of public tuition across all races.

When average amount of state aid is expected for low-income groups, the probability of enrolling in two-year institutions increases for every racial group across all tuition levels relative to the no aid scenario and is higher than enrollment in any other types of institutions (see Figures 8-3, 9-3, 10-3, and 11-3). The probability of enrollment in non-competitive institutions declines for every racial group across all tuition levels relative to the case when no state aid is expected, while there is no substantial change in enrollment propensities for competitive institutions across all racial groups (all are still close to zero). This finding suggests that the larger enrollment responses of low-income students shown in the previous simulations for binary enrollment outcomes were driven mostly by increases in two-year enrollment in response to increases in the availability of state financial aid.

In the case of upper-income groups, when no state aid is provided, the probabilities of enrollment in public or private competitive institutions are noticeably higher than enrollment in non-competitive or two-year institutions (until the level of public tuition reaches around $4,000) for Whites, African Americans, and Asians, but not for Hispanic groups (see Figures 8-2, 9-2, 10-2, and 11-2). White and Asian high-income students exhibit higher propensities of enrolling in private competitive institutions than

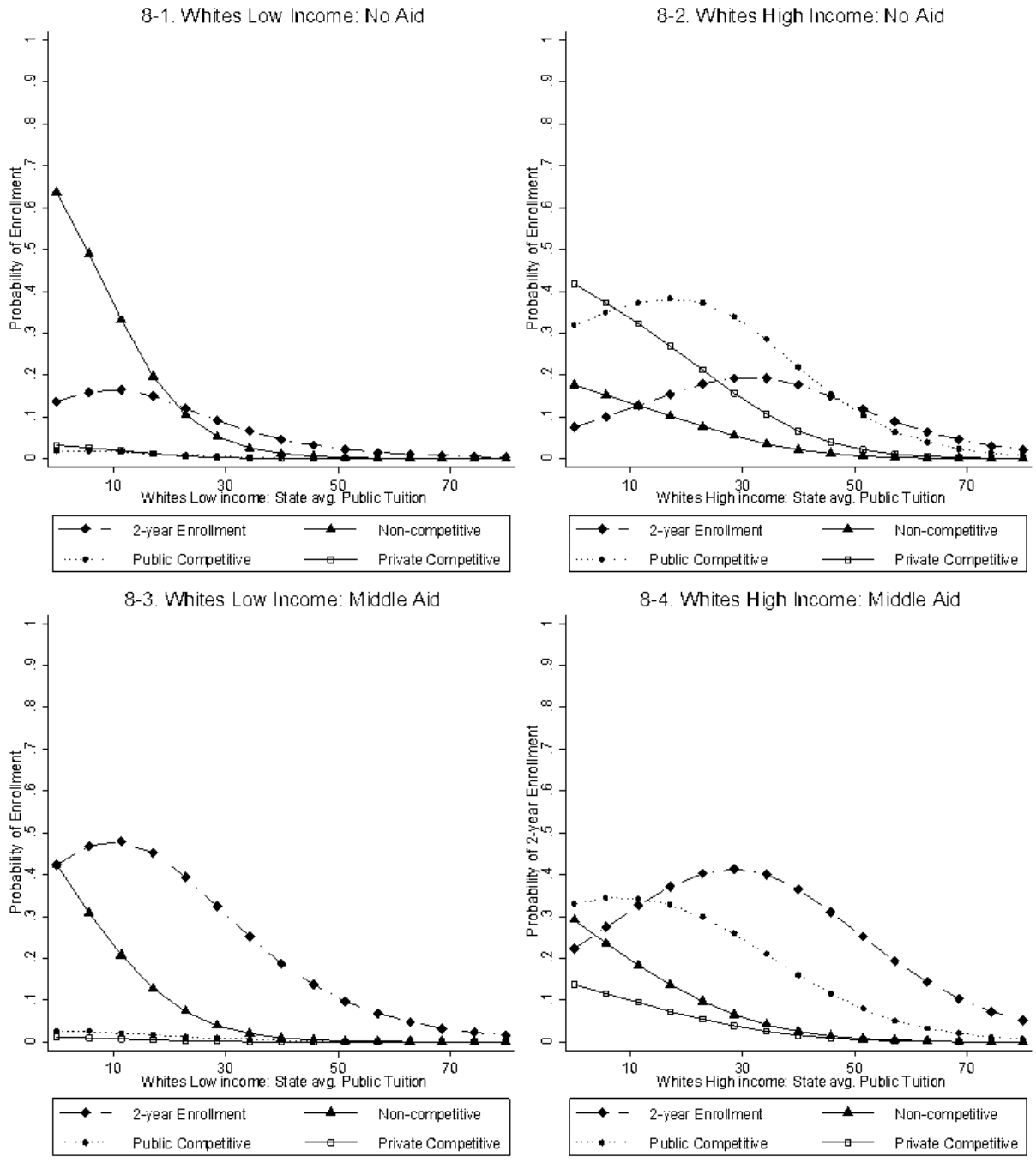
their African American and Hispanic counterparts across all the tuition levels. On the contrary, the probability of enrollment in non-competitive institutions is relatively higher for African Americans and Hispanics than for Whites and Asian Americans. Hispanic upper-income students have the highest propensity of enrolling in non-competitive four-year institutions when the level of public tuition is very low (less than $1,000), but their propensity of enrollment in competitive institutions is lower than any other racial groups who are from families with comparable incomes. Once the level of public tuition increases to greater than $3,000, however, the probability of two-year enrollment becomes higher than enrollment in any other institutions for upper-income groups across all races.

Under the middle aid scenario, the probabilities of enrolling in two-year institutions and non-competitive institutions for upper-income students increase for every racial group relative to the no aid scenario (see Figures 8-4, 9-4, 10-4, and 11-4). As the level of public tuition increases, the propensities of two-year enrollment are significantly greater than enrollment in any other types of institutions across all races. In contrast, the probability of enrolling in public or private competitive institutions shrinks for every racial group as a result of changes in the amount of state aid (from no aid to middle aid), with a much more decrease found among enrollment in private competitive institutions. The probability of enrollment in private competitive institutions for Hispanic upper-income students reaches close to zero across all tuition levels. In the case of White upper-income groups, the decline in the probability of enrollment in public competitive institutions (when the availability of state financial aid increases) is relatively modest compared to other races, and thus their probability of enrolling in public competitive

institutions is the second greatest among all types of enrollment (following the probability of two-year enrollment). However, for other upper-income minority groups, the probability of enrolling in non-competitive institutions is greater than enrollment in public competitive institutions when the level of tuition is low (less than $3,000).

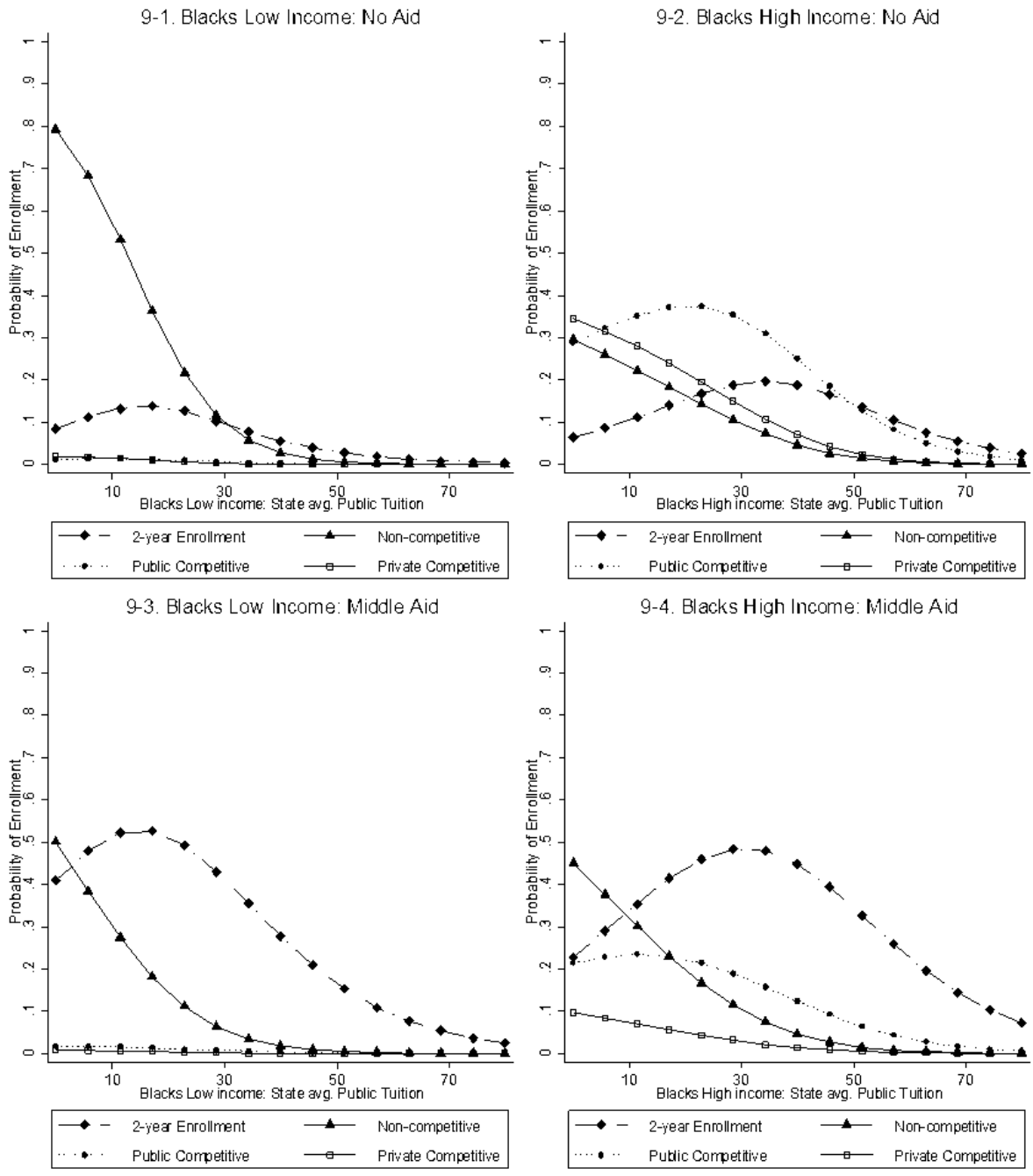
The graphical simulations from Figures 8 through 11 suggest that each income and racial group has a different sensitivity to changes in the amount of state aid in deciding where to enroll, and the probabilities of enrollment in two-year and non-competitive institutions are more subject to changes in the amount of state aid than enrollment in competitive institutions for every racial group. As a result, the simulation results suggest that increased funding for state financial aid may direct students toward enrolling two-year institutions or less-competitive institutions away from competitive four-year institutions. However, increases in the provision of state aid do not appear to promote the propensity of enrollment in both public and private competitive institutions for all racial and income groups.

Figure 8. Probability of Enrollment by Types of Institutions: Whites



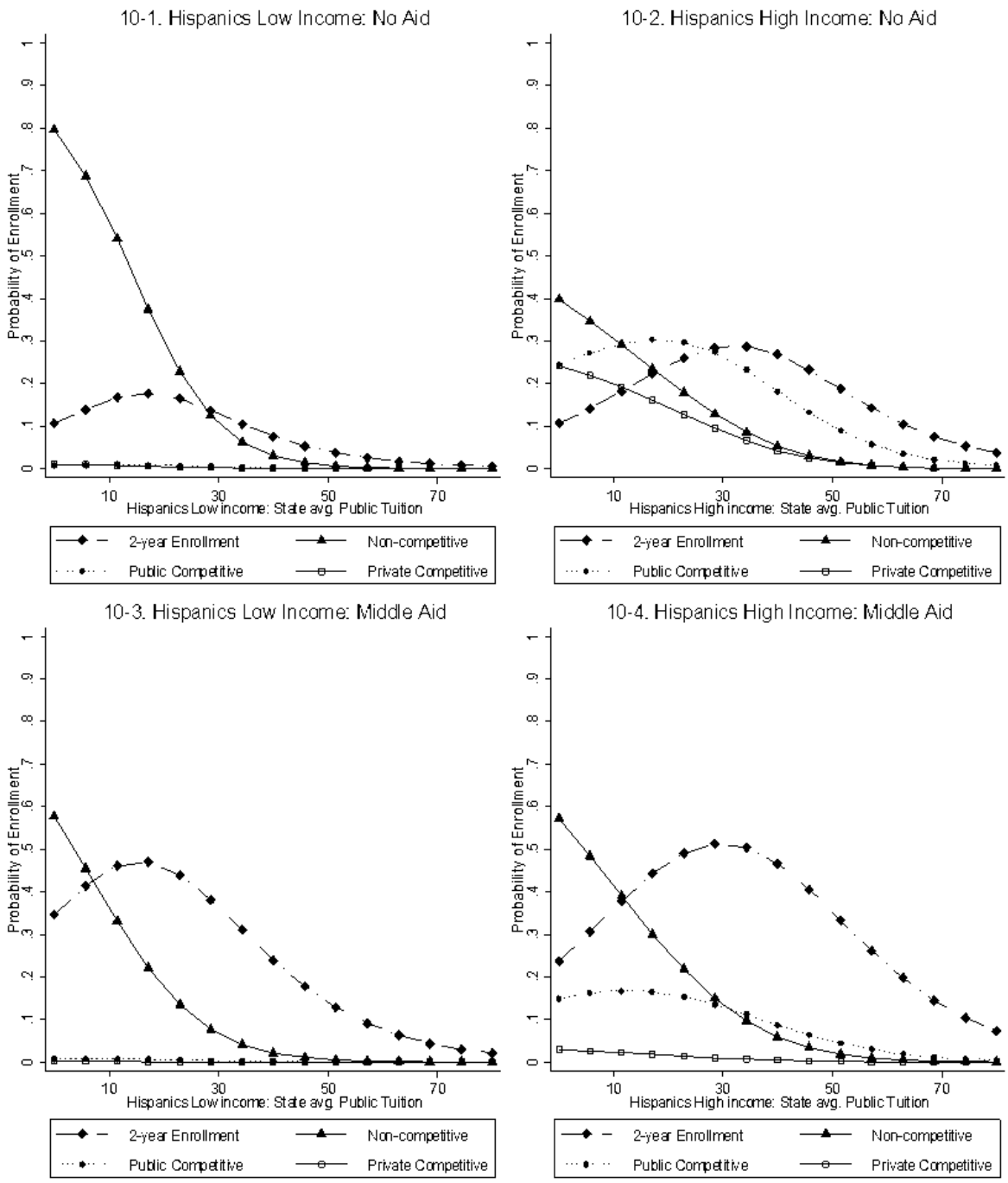

Note: In the "No Aid" model, the values of state need-based grant and non need-based grant are set to zero. In the "Middle Aid" model, the values of state need-based grant and non need-based grant are set to the average values. Other variables (including individual's expected value of state aid) are held constant at their respective means.

Figure 9. Probability of Enrollment by Types of Institutions: African Americans



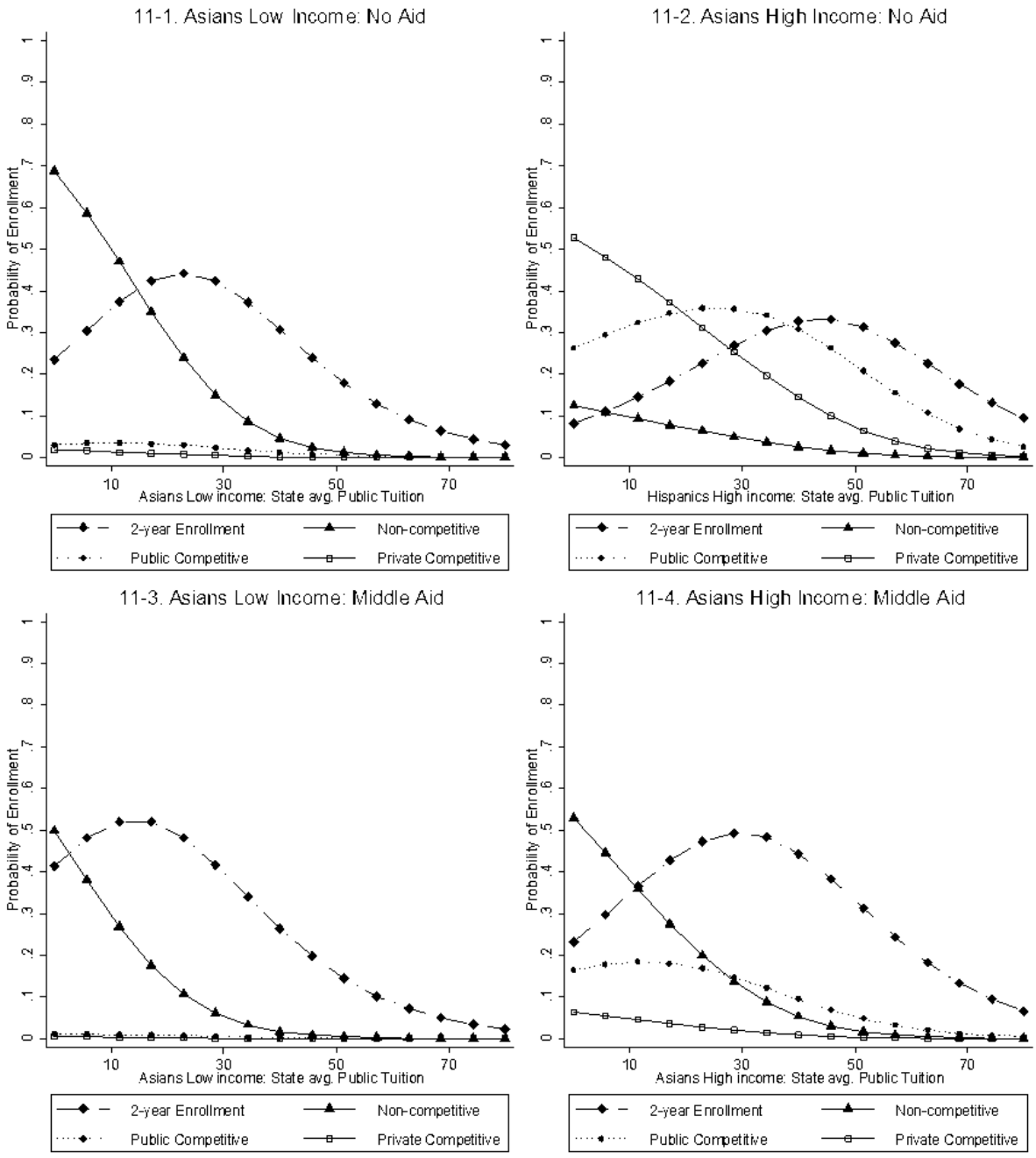

Note: In the "No Aid" model, the values of state need-based grant and non need-based grant are set to zero. In the "Middle Aid" model, the values of state need-based grant and non need-based grant are set to the average values. Other variables (including individual's expected value of state aid) are held constant at their respective means.

Figure 10. Probability of Enrollment by Types of Institutions: Hispanics




Note: In the "No Aid" model, the values of state need-based grant and non need-based grant are set to zero. In the "Middle Aid" model, the values of state need-based grant and non need-based grant are set to the average values. Other variables (including individual's expected value of state aid) are held constant at their respective means.

Figure 11. Probability of Enrollment by Types of Institutions: Asians




Note: In the "No Aid" model, the values of state need-based grant and non need-based grant are set to zero. In the "Middle Aid" model, the values of state need-based grant and non need-based grant are set to the average values. Other variables (including individual's expected value of state aid) are held constant at their respective means.

In sum, this chapter discussed the estimation results for a binary enrollment model and for a multinomial model differentiated by college destinations, in addition to the simulation results that examined the relationships between state financial aid and enrollment behavior that differs by the subgroups of students. The results indicate that both expected amount of state aid and state-level financial aid variables are significantly related to the probability of enrollment as well as the type of institutions a student attends. The graphical simulations provide evidence that students from different race and income groups respond differentially to state financial aid packages in their enrollment decisions depending on the changes in the amount of state aid. The next chapter will provide a more thorough discussion of these results and their implications to policy and research practice.

# Chapter V

# CONCLUSIONS AND IMPLICATIONS

A large body of research has investigated the effects that financial aid policies have on college enrollment and the choice of institutions, but researchers have paid limited attention to exploring socioeconomic and race/ethnic differences as well as the role of financial aid associated with the timing of student enrollment. In response to this gap in research, the present study adds new contributions to the college choice literature by exploring the effects that state financial aid policies have on the occurrence as well as the timing of college enrollment for high school graduates (or equivalent diploma holders). Using nationally representative and longitudinal data, this study particularly focused on addressing how state aid policies differentially affect students' postsecondary enrollment over time depending on their family income and race/ethnicity. This concluding chapter begins with a description of the study findings relevant to the research questions, and then offers discussions of implications for policy practices and future research, followed by a brief conclusion.

## Discussion of the Study Findings

The central research questions explored in this study include:

1. Do time-to-enrollment trajectories differ for high school graduates who are from different income and race/ethnic groups, and how do these enrollment trajectories vary for those enrolling in institutions of varying levels of selectivity?

2. Do state-level financial aid policies influence a student's decision of whether and when to enroll in college after completing high school?
3. Does state financial aid influence a student's decision of enrolling in more selective institutions after completing high school?
4. Does the effect of state financial aid policies differ by the type of aid (e.g., need-based and non-need based aid)?
5. Does the effect of state financial aid on college enrollment vary for students from different income and race/ethnic groups? (i.e., Do state-level financial aid policies reduce or increase enrollment gaps between low-income and high-income students?)

The conceptual model that frames these research questions is a significant improvement from the existing college choice models in that the "time" a student takes to make a transition from high school completion to postsecondary institutions is incorporated as a study outcome. Studying about the timing of college enrollment has been given increasing attention in that the timing of the transition from high school to college is an important indicator of whether a student completes a postsecondary degree. A substantial body of research has noted that delaying entry into college significantly increases dropout rates and reduces the likelihood of eventual degree completion (Ahlburg, et al., 2002; Bozick & DeLuca, 2005). Due to its significance as a determinant of long-term postsecondary outcomes, the timing of college enrollment is explored as a central focus in this dissertation. Consistent with the prior studies, my analyses that tracked students' time-to-enrollment trajectories revealed that increased waiting time between high school and college enrollment reduced the likelihood of one's attending college.

The existing research also documented factors for delayed college enrollment, and socioeconomic and racial differences were identified as major predictors of delayed

enrollment (Goldrick-Rab & Han, 2011; Rowan-Kenyon, 2007). Although my analyses did not examine why a certain subgroups of students have a higher tendency to delay enrollment than others, the results at the very least delineated insurmountable barriers to timely college enrollment based on socioeconomic status and race/ethnicity. According to the study results, low-income and African American students exhibited consistently lower likelihoods of transition to higher education throughout the observation period. The differences in the timing of enrollment by income and racial/ethnic groups indicate that social-class gaps exist in the timing of college enrollment, which may subsequently be related to students' enrollment outcomes (e.g., college destinations) and ultimate postsecondary attainment. Students who delay enrollment are more likely to attend less than four-year institutions (Bozick & DeLuca, 2005; Horn, et al., 2005), and the high concentration of low-income and/or minority students among delayed entrants may provide some clues as to underrepresented students' overrepresentation in two-year colleges and lower bachelor's degree attainment.

Given inequalities in college access and choice by income and race/ethnicity, my dissertation focused on whether and how different types of state financial aid policy affect a student's likelihood of enrollment differentially across income and racial/ethnic subgroups over time. Prior studies demonstrated the positive relationship between public financial aid policy and college enrollment, and the particular responsiveness of low-income and minority students to the availability of financial aid (Heller, 1997; St. John, Musoba, et al., 2004). However, the findings from most prior research on financial aid are based on cross-sectional designs that failed to consider temporal dimension of college enrollment and time-varying financial aid policy variables. Overcoming the

methodological drawbacks of the existing studies, this dissertation research reexamines the relationship between state financial aid policy variables and college enrollment using a longitudinal modeling method (i.e. event history modeling).

One of the notable findings of this study is identifying the time-varying effects of state financial aid policy. According to the simulation results, increased amount of funding for state aid (from no aid to average aid) raised students' enrollment propensities at a greater rate right after high school than a few years later. The effect of financial aid diminished substantially as more time passes after high school. This finding suggests that the effects of financial aid vary depending on the timing of enrollment, and non-traditional students who delay entry into college may not benefit from public financial assistance as much as traditional students who make the straight transition to a college.

In addition to addressing whether a student enrolls in college, my dissertation investigated whether state financial aid policy influence a student's chances of enrolling in selective institutions. The selectivity of an institution where a student attends does affect subsequent college experience and ultimate educational attainment because selective colleges invest significantly more resources in instruction and student subsidies and provide greater education benefits to students than two-year colleges or non-selective colleges (Carnevale & Rose, 2003; Jacobs, 1999). The benefits of attending selective institutions are also extended to higher rates of acceptance at graduate and professional schools and increased life-time earning relative to those who attended less-selective institutions (Black & Smith, 2006; Hoxby, 2009). Moreover, these differential effects may be magnified for socioeconomically disadvantaged or minority students whose

access to prestigious institutions tends to be more restricted than their advantaged peers due to either financial or academic concerns (Carnevale & Rose, 2003).

Controlling for academic preparation and other individual differences, the present study's exploration of whether or not state financial aid policy promotes disadvantaged students' opportunity of attending more selective institutions is therefore an important contribution to the college choice literature. Despite the expected role of state financial aid in enrollment in selective institutions, increased provisions of state aid were not significantly related to attending selective four-year institutions for all racial and income groups in my study. Instead, the simulation results revealed that the propensities for enrollment in two-year and non-competitive institutions were highly subject to changes in the amount of state aid. Although the results of the analysis are not encouraging in terms of the role of public financial aid in institutional selectivity, the results at least suggest that comprehensive approaches that provide academic assistance and encouragement in addition to financial resources are essential in promoting disadvantaged students' access to selective institutions.

## Implications for Policy Practices

### *The Impact of Delayed Enrollment and Socioeconomic Gaps in the Timing of Enrollment*

Numerous policy considerations related with postsecondary enrollment can be drawn from the results of this study. As previously mentioned, the temporal dimension of college enrollment was considered in this study, the importance of which has often been overlooked in other existing research. The results clearly demonstrated the lowering likelihood of attending any college once a student delays entry into college after high school. The study results further revealed that as the elapsed time between high school

completion and college enrollment increases, enrolling in four-year (especially competitive) institutions becomes much less likely. This finding is consistent with the prior research that reported the substantial increases in the chances of attending less-than-four-year institutions due to the delayed time between high school graduation and college enrollment among high school graduates (Ahlburg, et al., 2002; Bozick & DeLuca, 2005).

Although this study controls for important individual- and state-level variables related to college enrollment, the adverse impact of delayed time until enrollment on the likelihood of enrollment in selective four-year institutions could partly be a result of delayers' self-selection into two-year or non-competitive four-year institutions. As previous studies identifying the predictors of delayed enrollment indicate, students who delay enrollment and those who attend a college immediately after high school are different fundamentally in observable or non-observable characteristics. It is therefore possible that unobserved differences in high school experiences (e.g., less college-preparatory coursework or extracurricular activities) and non-cognitive skills (e.g., lack of persistence and motivation) not controlled for in this study may lead delayed entrants to be under-qualified for selective four-year colleges relative to immediate entrants.

Delayed time to college enrollment is also endogenously related to a student's likelihood of dropout, and the association between the duration time until enrollment and duration until college dropout indicates that observed or unobserved factors that affect delayed enrollment also predict a student's dropout behavior. A study by Ahlburg et al. (2002) accounted for this endogeneity of waiting duration to college enrollment in examining the negative impact of delayed entry on the likelihood of college completion and dropout. Unlike the Ahlburg et al.'s study, however, the present study does not

account for the endogeneity of delayed time until enrollment, and thus the results do not necessarily provide causal evidence as to the disadvantages of delayed entry to college on the benefits of postsecondary education. Despite the potential for self-selection bias, the harmful effects of delayed enrollment should not be ignored because the delayed transition to college is endogenously related to the significant decline in postsecondary opportunities (especially opportunities to enroll in competitive colleges) and the increased likelihood of dropout. The study results at the very least suggest the importance of timely enrollment and that promoting on-time enrollment should be a central concern of higher education policymakers.

The study findings also confirmed that low-income and underrepresented minority students experience far more transitioning difficulties than their upper-income and White peers after high school. Delayed entrants tend to be at a greater socioeconomic disadvantage than those who enroll in college immediately either due to a lack of financial resources and access to social network and information, or cultural capital that perpetuates a cultural of college-going behavior within a family. Recognizing these students' need, high schools and communities should provide better social, academic, and financial assistance to students from disadvantaged backgrounds so that they do not delay their postsecondary entry. In terms of a policy perspective, it is imperative that the current public student-aid policies should also be effectively refocused to ensure that financial barriers do not discourage underrepresented students' immediate enrollment. For example, increasing the provision of financial aid in the form of need-based aid rather than of non-need based aid would effectively encourage disadvantaged students' postsecondary participation immediately after high school.

*Gender Gaps in College Enrollment and Choice*

The study results also revealed the significant gender difference in the probability of enrollment and in the type of institutions a student attends. Female students had greater odds of attending a college, and they also had higher probability of enrolling in two-year institutions and competitive four-year institutions. This female-favorable gap in college attendance and choice is not consistent with the prior research that ascertained female disadvantages in attending selective colleges. A couple of possible explanations are proposed for women's advantages on attending more selective colleges. First, women's increased access to selective colleges is due in part to girls' better grades and test scores and the greater number of math and science courses they take in high school relative to boys as well as girls' tendency to spend more time doing homework and avoid behavioral or disciplinary problems (Goldin, et al., 2006; Jacob, 2002).

Second, it is possible that improvements in women's perceived employment opportunities and rising expectations of economic returns to college encourage them to attend and graduate from a more prestigious college. Declining discrimination against women in the workplace and changes in occupational sex segregation may affect women's incentives to attend selective colleges, and thus more women enter prestigious and often better-paid positions in occupational sectors such as law, business, medicine, and the sciences (Buchmann, et al., 2008). All these changes in the labor market contribute to women's decisions to attend selective colleges (Goldin, et al., 2006).

It is also plausible that changes in college costs or the availability of financial aid are affecting men and women differently. Women may be more responsive than men to financial aid incentives that decrease the net cost of college attendance, and the increase

in college costs and the availability financial aid may have positively affected women's access to selective institutions. In combination, the changing environment of labor market and changes in college affordability suggest that college gender gap favoring women will continue and policymakers should be cognizant of and address this growing gender gap in postsecondary choice and attainment.

*The Differential Effects of State Financial Aid by Type*

In examining the effect of state financial aid on college enrollment, this study controlled for both student-level expected aid amount and state-level financial aid variables by type. With regard to the effect of state need-based aid, both higher student expectations about need-based grants and average need-based aid (per FTE) increased significantly the probability that students enroll in postsecondary institutions. The findings on the impact of state need-based aid confirms the prior research on state aid policy variables documenting the substantial influence of state need-based grants on promoting eligible students' enrollment (Perna & Titus, 2004; St. John & Chung, 2006b).

In terms of college destinations, the expected amount of state need-based aid positively affected the odds of enrollment in two-year institutions and non-competitive institutions, but was negatively associated with enrollment in private competitive institutions. It is possible that although increased availability of need-based aid may remove financial barriers to access to *any* college, access to *selective* colleges requires more than financial resources. Admission to selective four-year institutions is more likely to be determined by other non-financial factors, such as academic preparation or parental involvement. The majority of students attending selective institutions come from families with higher income and highly educated parents (Carnevale & Rose, 2003), and their

accumulated social, cultural, and economic resources transmitted from parents and social networks comprehensively creates a competitive advantage over lower SES students on access to selective colleges. According to sociological theories, these advantaged students possess higher volume of social and cultural capital that can be converted into better academic preparation, greater access to postsecondary information, and higher educational attainment. Therefore, the study findings suggest that the long-term, cumulative non-financial family and environmental factors may play a more decisive role in shaping an opportunity to attend selective colleges than financial support simply provided at the last minute before enrollment (Heckman, 2000).

However, if needy students who lack in academic ability and thus were initially uncertain about college enrollment decide to attend two-year or non-competitive institutions because of expectations about being awarded state need-based grants, the availability of state need-based aid still positively influences their chances of college enrolment. Although need-based aid alone may not sufficiently address the unequal access to selective colleges by socioeconomic status, a targeted approach to need-based grants can help needy students (especially those with less academic preparation) attend a college not constrained by financial resources. It has been evident that family financial resources independently operate as an additional constraint to college attendance, and economic literature documents consistently how borrowing constraints limit low-income students' opportunity to attend college (Belley & Lochner, 2007; Sorokina, 2008). Therefore, the study findings suggest that state need-based grants play an important role in promoting underrepresented students' college enrollment, and state governments should continue to provide adequate need-based aid to ensure that these students, even

with low academic performance, are not deterred from enrolling in postsecondary institutions.

With regard to the effects of state non-need (or merit) based aid, higher expectations about non need-based grants increased students' probability of enrolling in most types of institutions (except for public competitive ones). This result is consistent with prior literature that demonstrated the substantial impact of state merit-based scholarship on in-state college enrollment (Cornwell, et al., 2006; Dynarski, 2004). The difference in the effect of aid expectations between state need-based aid and non need-based aid is that expectations about non need-based aid also positively affected the probability of attending (private) selective institutions. This finding appears to suggest that the availability of state non need-based grants encourages academically prepared students who expect to receive such aid to attend more selective institutions.

On the contrary, increased availability of state-level average non need-based grants (per FTE) lowered the probability of enrollment in general and especially enrollment in two-year institutions. This finding is consistent with the prior research suggesting that the merit-based scholarships have operated largely to transfer students (who would have enrolled in college anyway) from out-of-state to in-state institutions, and away from two-year institutions toward four-year institutions rather than expanding the net college access (Cornwell, et al., 2006; Dynarski, 2002). The shift from two-year to four-year colleges may primarily be driven by the reduction in the tuition difference (due to non need-based grants) but the results of this study do not provide evidence as to whether the lowered propensity of two-year enrollment translates into increased probability of attending four-year colleges. However, the study results at least confirm

the research to date that has failed to reveal the substantial impact of state merit-based aid on expanding the net college access and opportunities.

In summary, the examination of the effects of state need-based aid and non need-based aid substantiates the previous study findings that the expectation about the availability of state financial aid, in addition to the amount of actual financial aid, influences a student's decision to enroll in a college (DesJardins, et al., 2006; J. Kim, et al., 2009). The significant impact of student expectations about both types of state financial aid reinforces the importance of providing an early guarantee of adequate and stable financial assistance for college-bound students in order to motivate them to participate in higher education (St. John, Musoba, et al., 2004). State policymakers who intend to increase college participation rates in their state should recognize that a guarantee of adequate public financial aid can especially help alleviate students' financial concerns and build positive aid expectations "while they still have time to prepare both academically and financially to attend college" (Heller, 2006, p. 1726).

*Differential Aid Effect by Income and Race*

The graphical simulations that examined students' enrollment probabilities in response to changes in state financial aid policy suggest that students from different race and income groups differentially respond to state aid policy scenarios in their enrollment decisions. When students face high level of state aid scheme, higher rate of increases in enrollment propensities among low-income groups relative to upper-income groups resulted in narrowing the gaps in enrollment propensities significantly across income groups for most races. The results that the enrollment gap across income groups can be narrowed depending upon the increase in state aid indicate that higher investment in the

funding for state financial aid could effectively encourage low-income students' college participation, thereby remedying the persistent income gap in postsecondary enrollment.

However, dramatic increases in the provision of state financial aid do not appear to benefit all race/ethnic groups equally in terms of college participation gaps. Low-income Asians and African Americans responded fully to high increases in state financial aid and their predicted enrollment probabilities were comparable to their upper-income counterparts. On the contrary, low-income Hispanics especially exhibited lower responsiveness to changes in the amount of state aid than other groups. Prior research revealed that underrepresented minorities are typically embedded in social relationships and networks deficient in social capital, and Hispanic students' heavier reliance on family and community than other racial groups especially results in limited information and support for college enrollment (Ceja, 2006; Perez & McDonough, 2008). It may be that Hispanic low-income students tend to obtain information about applying to state grants from family or friends rather than seeking information from outside networks. However, their family or friends may provide limited information if they have no prior experience of college attendance or if their social networks are isolated or under-resourced. In combination, the lack of adequate information about the availability of state financial aid and unsettled financial concerns may prevent Hispanic low-income students from attending a college.

Without the consideration of socio-cultural differences within races, the existing price-response studies also tend to group African Americans and Hispanics into under-represented minorities and report their responsiveness to college costs and financial aid in enrollment decisions to be similar. However, the different levels of sensitivity to changes

in the amount of state aid between the two distinct minority groups shown in this study indicate that state policymakers should identify such differences in aid responsiveness by each racial group and pay special attention to the groups who are less affected by state aid than others.

Further graphical comparisons revealed that each income and racial group has a different responsiveness to changes in the amount of state aid in deciding where to enroll. When no state aid was expected, the probability of enrollment in two-year institutions and non-competitive four-year institutions was significantly higher for low-income and underrepresented minority students (e.g., African Americans and Hispanics), whereas the probability of enrolling in competitive institutions was higher for upper-income and White/Asian students. This income and racial disparity in terms of college destinations, however, was not addressed by state financial aid variables. Increases in the availability of state aid only promoted the probability of enrollment in two-year or non-competitive institutions especially among low-income and/or minority students, having no substantial effect on enrollment in competitive institutions. African Americans and Hispanics (even among upper-income students) still lagged behind in terms of attending selective colleges even when more state financial aid was available.

The limited access to competitive institutions among minority students suggests that the benefits of affirmative action policies to expand underrepresented minorities' postsecondary opportunity have not been extended to ensuring their access to prestigious institutions. At the same time, the results again confirm the notion that financial aid policy implemented in isolation with other postsecondary encouragement programs (providing information or academic preparation) may not help close socioeconomic and

racial gaps in attendance at selective colleges. Research have shown that the Indiana 21st Century Scholars Program that provides both early academic encouragement and financial assistance to low-income students has had a remarkable success in college preparation and enrollment (St. John, Musoba, et al., 2004). To promote underrepresented students' opportunity of attending more selective institutions, it is especially important to also provide early academic and encouragement programs to disadvantaged students who may not have the support at home or local community necessary to help them prepare academically.

*States' Financial, Educational, and Economic Context and College Enrollment*

In addition to state financial aid policy, this study examined how states' public financial policy (including public tuition and appropriations), educational attainment, and economic conditions affect students' chances of postsecondary enrollment. Higher tuition in public colleges and universities (measured two years before enrollment) significantly decreased the probability that a student enrolls in all types of institutions. This provides some evidence that recent tuition levels may provide a signal to prospective students about the cost of attending college. The negative impact of tuition on enrollment suggests that prospective students may gather information about tuition costs at least a year or two before going to college, but may be less influenced by the current tuition levels (determined when they actually make enrollment decisions).

State per-capita income and unemployment rate within a state measured a few years before enrollment were significantly related to the probability of enrollment. Average state per capita income and unemployment rates measured three years before enrollment positively affected current enrollment probabilities, suggesting that students'

(or their parents') enrollment decisions may be more influenced by longer-term state economic conditions rather than by short-term economic shocks. For example, for traditional high school students, their parents may plan to save money for college expenses at least three years before their child goes to college (while in sophomore or junior years), and their saving plans might be highly subject to their own economic status and statewide economic conditions in which they start savings for college. Thus, the significant impact of state-level economic conditions appears to be consistent with parents' long-term planning cycles for college savings plan at least among traditional students.

The results also indicated the positive effects of public high school graduation rates on the probability of enrollment in private selective institutions. Moreover, increases in the percentage of state population with bachelor's or above degree were positively related to enrollment in public selective institutions. High school graduation rates and the percentage of bachelor's (or higher) degree holders within a state reflect a state's level of educational attainment, and a state with higher high school graduation rates (a requirement for college entrance) and higher proportion of baccalaureate degree holders may promote individuals' postsecondary enrollment (especially in competitive institutions). The significant relationships between high school graduation rates, the percentage of advanced postsecondary degree holders, and enrollment in competitive institutions three years afterward suggest that fostering college-going (especially toward competitive ones) culture among its residents takes a considerable amount of time.

In sum, the significant influence of states' financial, education, and economic context in postsecondary enrollment suggests the importance of considering the past

conditions (rather than the current ones) because students and their families may prepare college-going through their prediction of the future educational and economic conditions based on the past records.

## Implications for Future Research and Practice

This investigation also has important implications for future research on the role of public financial aid policies in college choice of students from different income and racial/ethnic backgrounds. In this section, I discuss research implications that can assist educational researchers in exploring financial aid and student college choice. First, this study has modeled student enrollment behavior using longitudinal data and an appropriate technique specifically designed to study temporal events, i.e., event history modeling, to examine postsecondary enrollment. Although college enrollment should be examined longitudinally, very few prior studies have explored this complex and longitudinal process without consideration of temporal dimensions, thereby ignoring the role that time plays in college enrollment. In studies that do not capture the role of time, the failure to consider variations in students' time-to-enrollment and time-varying financial aid variables over time will result in the problem in model specifications and the estimation bias. Thus, employing this longitudinal modeling approach in the study of college enrollment expands our understanding of how individual students' timing of enrollment is influenced by changes in the amount of state financial aid.

Second, understanding of how changes in public financial aid affect college enrollment for different income and racial/ethnic groups can be enhanced by the effective use of empirical (or graphical) simulations conducted in Chapter IV. Plotting enrollment probabilities graphically depending upon changes in the amount of state financial aid

allows us to identify how state financial aid policies differentially affect students from different income and race/ethnic groups, thereby providing an improved understanding of how to remedy the persistent income and racial/ethnic enrollment gaps. The graphical simulations in this study were especially effective in indentifying the contrasting enrollment behavior in response to changes in the amount of state financial aid across income and racial groups. This graphical simulation of plotting probabilities of an outcome is an effective complement to regression results of a research study because of its intuitive and straightforward nature that is understood easily even for those readers who are not familiar with statistical modeling and methods. Therefore, researchers who seek to disseminate policy-relevant findings and implications should consider this type of policy-oriented simulations in their study in order to better explore the differential impact of financial aid across different student subgroups.

Third, this dissertation studied the sample of nationally representative1992 high school seniors and examined their enrollment behavior in response to changes in the amount of state financial aid. Because this study used a single cohort of students who were high school seniors approximately 20 years ago, the study findings may or may not be relevant to more recent cohorts who face a different state financial policy context in which public tuition costs has continued rising by double digits and state aid policy portfolio has changed substantially since then. For instance, from 1976 to 2005, the average cost of a public four-year institution increased by 270 percent when adjusted for inflation (B. T. Long & Riley, 2007), and the average tuition for students attending four-year public institutions jumped 40 percent between 2000 and 2005 (College Board, 2005).

In many states, the growth of state merit-based aid has been more prominent in its expansion in the type and the amount of funding than need-based aid since 2000, and the proliferation of state merit-based aid since then has contributed to a gradual decline in the proportion of need-based grants among total state funding for student financial assistance (Heller & Rogers, 2006). Given a significant change in college affordability and public financial aid policy, it is necessary to apply this empirical model to more recent national cohorts (e.g. Education Longitudinal Study of 2002) under different policy contexts in order to test whether the differential effects of state aid policy on college enrollment by income and racial/ethnic groups still hold true or are changed substantially. The termination of the ELS: 2002 survey collection (launched in 2002 for those who were high school sophomores and information being currently available for up to 2 years after scheduled high school completion) will make this empirical retest possible in the near future.

Fourth, an important area for future research would be to control for individual aid packages that a student was offered from federal, state, and postsecondary institutions in statistical models. As previously mentioned, the unavailability of individual financial aid offers in the study data and thus imputation of such information using a different dataset (i.e., NPSAS) may limit the interpretation of the impact of state financial aid on college enrollment discussed in the present study. For educational researchers who study college access and success, financial aid offered to individuals is examined as a core independent variable or at least an important control variable, and the exclusion of which often results in the omitted variable bias. Therefore, the future national longitudinal surveys should consider providing complete information on the amount of financial aid

offered by an individual student from various sources including a federal government, state, and institutions. When the variable that measures individual financial aid offers becomes available in the future waves of the improved national longitudinal dataset, researchers might be able to compare the results that controlled for individual aid offers to the present study findings that did not control for such factor and to avoid the omitted variable bias.

The NCES may also consider providing an effective crosswalk between the existing datasets they collect and manage. For example, NPSAS data provide detailed information about how much a college student was awarded different types of financial aid while in college. Currently there is no crosswalk (or linkage system) between NPSAS surveys and NELS (or more recent surveys that track educational experience of high school students through college completion) because the data were collected from different samples of students. Instead, all these surveys may be designed to allow for tracking the identical sample of students' progress over time, from entry into secondary school to exit from college, and eventually into the labor market. If all different types of NCES surveys track identical sample of students and collect truly longitudinal and comprehensive information available throughout the educational system, linking one dataset to another to obtain necessary variables (e.g., financial aid offers) would be much easier. Consequently, future researchers will enjoy utilizing expanded sets of variables in the study of educational process and attainment.

Fifth, the NELS data used for this dissertation research have been broadly used among educational researchers due to its wide availability of students' educational process and outcomes, in addition to other waves of data collected by the National Center for Educational Statistics (NCES). Although the quality of NCES data has been improved

significantly since NCES launched their first educational longitudinal survey (i.e., National Longitudinal Surveys: 1972), still, there is always room for improvement in the future. One of the biggest concerns related with the use of these national data is handling missing data. As illustrated in Table 1, most of the variables from the NELS data have missing information to some degree, and the missingness in the predictor variables affects substantially the results of the analyses. In other words, the estimation results may not be consistent depending on which methods a researcher employs to deal with the missing data problem. Because a considerable amount of the missing data present in the national dataset have a potential to lower the credibility of the results obtained from the analysis using these data, the NCES researchers should make efforts to reduce missing data by findings better ways to increase response rates through multiple contacts with the survey participants.

Sixth, this study considered family income as the most important measure that reflects a student's socioeconomic status. As reviewed in Chapter 2, socioeconomic status is rather a complex construct and involves broader underlying aspects such as family income, parental education, social and cultural capital. As a theory, habitus, social and cultural capital have been very useful in explaining the fundamental differences in social actions and behaviors observed among different social-class groups. However, conceptualization of social and cultural capital in the research studies (especially using the NCES database) has been problematic because the operationalization of these theoretical constructs is likely to be narrow and restricted by the variables available in the dataset (Dika & Singh, 2002; Swain, 2003).

Rather than depending on the measures of social and cultural capital that are mostly imperfect proxies for social and cultural constructs, I utilized a measure of family income that may be a more objective indicator of family wealth and socioeconomic status. Although family income may not be a comprehensive measure of one's socioeconomic backgrounds, it provides more exogenous and reliable information than do the measures of social and cultural capital that tend to be endogenously related to other observed or unobserved factors that affect college enrollment. Therefore, educational researchers should be cautioned about the use and the interpretation of proxy measures that conceptualize the theoretical social constructs. Instead, researchers should be encouraged to utilize objective and reliable (often numerical) measures such as family income or the number in family (that measures the extent to which family financial resources are distributed per each member).

In the NELS data, the original family income variable is presented in the form of a categorical measure (consisted of 15 different categories), and I further categorized the variable into smaller groups. Grouping the variable into smaller categories may lead to losing substantial variations in family income among the sample because there is no way to detect the possible variation within the group once a certain range of family income is grouped together. This may have biased the estimated relationship between family income and college enrollment in this study. To better reflect individual variations in family income and socioeconomic status, it is recommended that NCES researchers consider collecting a continuous measure of family income rather than a categorized (or grouped) measure because the measure in the form of continuous variables is more informative than the categorical measure in the estimation model.

Seventh, "college education has generally been viewed as the primary vehicle for socioeconomic advancement" (Thomas & Perna, 2004, p. 73), and the socioeconomic value of college education would be fully realized only when enrolled college students persist through and graduate from a college. Given the significance of a college degree in socioeconomic mobility, education researchers need to consider a broader range of postsecondary choice outcomes that include persistence in and successful completion of college. As was demonstrated in the research about delayed enrollment, delayed time until college enrollment is significantly related to the likelihood of dropout and ultimate postsecondary degree attainment. Therefore, future research is warranted to track students' postsecondary path longitudinally after their college enrollment (although this is beyond the scope of the present study), thereby expanding study outcomes into student persistence and eventual degree completion.

## Conclusion

Student decisions to enroll in college, however, is the central inquiry and policy concern that is worthy of investigation because if students do not choose to enroll in college, nothing follows afterward. In addition, in the presence of persistent socioeconomic and racial/ethnic disparities in postsecondary education opportunity, the reality that not all students enjoy equal access and opportunity to prepare for and to attend college requires deeper investigations of college access and choice issues varied by student income and race/ethnicity. The longitudinal modeling of college enrollment explored in this study sheds lights on how state financial aid policy affects students' enrollment and how the aid effects differ by income and race/ethnicity. I hope the findings from this study demonstrating different enrollment behavior by race and income

could assist policymakers to implement targeted financial aid policies toward the socially and economically disadvantaged student population in order to boost their college participation as well as eventual degree completion for maximizing their socioeconomic achievement.

APPENDIX: Coding of Independent Variables

| Category | Variable | Variable Descriptions |
|---|---|---|
| Gender | Female | 1 if female |
| Race/Ethnicity | White | 1 if White (Reference group) |
| | Black | 1 if Black |
| | Hispanic | 1 if Hispanic |
| | Asian | 1 if Asian |
| | Other Ethnicity | 1 if Other Ethnic Group |
| Family Income | less than $7,500 | 1 if Income is in associated range |
| measured in 1991 | $7,500 to $15,000 | 1 if Income is in associated range |
| | $15,000 to $25,000 | 1 if Income is in associated range |
| | $25,000 to $50,000 | 1 if Income is in associated range |
| | $50,000 to $75,000 | 1 if Income is in associated range |
| | $75,000 to $100,000 | 1 if Income is in associated range |
| | more than $100,000 | 1 if Income is in associated range |
| Family Size | Family Size | The number of family members |
| Parental Education | Parental Education | 1 if parents' highest educational level is four-year college graduation or beyond |
| Region of | Urban | 1 if Urban |
| High School | Suburban | 1 if Suburban (Reference group) |
| Location | Rural | 1 if Rural |
| Distance | Distance to a nearest college | Minimum distance to a nearest open enrollment institution (in mile) |
| Postsecondary Aspiration | Aspiration | 1 if a student' highest level of education planned is bachelor's degree or beyond |
| Parental Influence | Parental Educational Expectation | 1 if parents expect their child to graduate four-year college or beyond |
| | Parental Involvement in Course Selection | 1 if parents discuss with children about selecting courses |
| | Parental Involvement in School Activities | 1 if parents discuss with children about school activities |
| | Parental Involvement in Grades | 1 if parents discuss with children about grades |
| | Parental Involvement in Taking SAT/ACT | 1 if parents discuss with children about plans to take SAT/ACT |
| | Parental Involvement in Applying to Colleges | 1 if parents discuss with children about applying to colleges |
| Financial Aid | Imputed Financial aid | Expected amount of Pell grant, state need-based, and non need-based grants (/$100) |

| Category | Variable | Variable Descriptions |
|---|---|---|
| Information on Financial Aid | Information from a teacher/counselor | 1 if students talked to a teacher/counselor about financial aid |
| | Information from a school representative | 1 if students talked to a school representative about financial aid |
| | Information from U.S. Dept. of Education | 1 if student read information about financial aid provided by U.S. Dept. of Education |
| | Information from colleges and universities | 1 if student read information about financial aid provided by colleges and universities student applied for admission |
| Academic Preparation | High School GPA | A continuous measure of cumulative high school GPA for the last year attended |
| in High School | Reading Standardized Score in High School | A continuous measure of standardized test scores in reading |
| | Math Standardized Score in High School | A continuous measure of standardized test scores in math |
| Curricular Program | Academic | 1 if a student took academic program |
| High School Type | Public | 1 if a student attended public high school |
| | Postsecondary Exams | 1 if a student took any type of postsecondary exams |
| GED | GED/HS diploma | 1 if GED recipients |
| State Level | State Need-based Aid | Average amount of the state need-based grants for undergraduate students per FTE adjusted to 2006 dollars (/$100) |
| | State Non Need-based Aid | Average amount of the state non-need-based grants for undergraduate students per FTE adjusted to 2006 dollars (/$100) |
| | Public Institutional Tuition | Amount of undergraduate in-state tuition and fees adjusted to 2006 dollars for the public higher education system (/$100) |
| | State Funding for Public Institutions | Amount of state and local appropriations per FTE adjusted to 2006 dollars for the public higher education system (/$100) |
| | Public High school Graduation rate | Public high school graduation rate with in a state |
| | College Attainment rate | Percent of the state population with a bachelors or higher degree |
| | State per capita Income | State per capita real income adjusted to 2006 dollars (/$1,000) |
| | Poverty rate | Percent of the state population that is in poverty |
| | Unemployment rate | State annual average unemployment rate |

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