

A DYNAMIC ANALYSIS OF STUDENT MATRICULATION DECISIONS
IN AN URBAN UNIVERSITY

Dissertation Proposal

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Chapter 1

Introduction

Over the past decade, institutional researchers have disagreed about the impact of student financial aid on enrollment and persistence in institutions of higher education. Recent national studies (St. John, 1990c) indicate that aid has a small, yet consistent impact. At the institutional level, however, there is still some controversy over whether student aid has an effect on matriculation.

There are several possible explanations for the disagreement over whether student aid is effective (St. John, 1991a). First, the logical models used in previous research may not be rigorous enough to measure the effect of aid. Second, the research methodologies in the studies may be inadequate or flawed. Third, the research findings may have been interpreted improperly.

This dissertation proposes and tests a model that can be used for institutional research on the enrollment effects of pricing policies, especially student aid policies. The model, derived from the

research literature on student choice in higher education uses extant data sources at an urban public university, and can be replicated by other colleges and universities.

Background

The changing environment during the 1980's for institutions of higher education underscored the need to predict student enrollment accurately. During this period, tuition charges increased consistently more than the inflation rate; the federal government shifted its student aid policy from grants to loans; the applicant pool began to shrink because of population declines; and state support of higher education was threatened by financial crises in many states. Dire predictions about the future of many colleges in this changing environment led top administrators to demand better planning by their institutions in terms of pricing, admissions, and retention. Planners turned to the accumulated research in several fields for guidance.

As institutional planners reviewed the data, they were justifiably concerned. While there was a large

body of research on the topic, much of it was limited in strategic ways. First, most of the inquiry into matriculation was over a decade old, measured only responses to tuition prices, and considered enrollment, and not persistence (e. g. Campbell & Siegel, 1967; Corrazzini, Dugan, & Grabowski, 1963; Hoenack & Weiler, 1977; Radner & Miller, 1975; and Kohn, Manski, & Mundel, 1974). Second, measures of how students responded to price changes were of questionable accuracy (Dresch, 1975) and varied from study to study (Leslie & Brinkman, 1988).

Third, the linkages between financial aid and matriculation were questioned by some researchers. In a widely-quoted study, Hansen (1983) concludes there is no direct relationship between federal financial aid and participation by low-income students in higher education. Studies done at the behest of the Reagan administration focus on how academic preparation influences minority enrollment and ignores the impact of student aid (Chaikind, 1987; and Pelavin & Kane, 1987). More recent research, however, indicates a relationship between income, financial aid, and

enrollment (St. John & Noell, 1989; St. John, 1990a; and St. John, 1990b).

Persistence is of interest because retaining current students is clearly as important as recruiting new ones. As a complication to drawing conclusions about persistence, however, different research methods are used in research on persistence in college (Tinto, 1975; Pascarella, Duby, Miller & Rasher, 1981; Spady, 1971). Such studies are generally of a single institution, but focus on sociological, rather than economic variables. While these analyses are useful, the methodology for persistence studies requires collecting survey data directly from students, which prevents many institutions from duplicating them. Further, only recently have indicators of student price response in persistence been available (St. John, 1990b). Despite the increased interest in price response research and the compelling need for it at the institutional level, research limitations have prevented colleges from performing such research.

While national research provides insights into particular facets of enrollment and persistence, it

cannot substitute for specific institutional research on pricing and student aid policies. However, there are several obstacles to performing institutional research. First, different methods are used for first-time attendance and persistence studies and researchers don't always agree on critical variables.

Second, performing research using models with disjointed existing institutional data is troublesome.

Third, planners may have problems in deciding which price response measure to use and how to employ such figures in their planning process.

Despite these limitations, the compelling need for institutional research on the impact of student financial aid argues for a new look at the research on attendance and persistence, with a focus on its use at the institutional level. Comprehensive models of attendance and persistence decisions using both sociological and economic variables are necessary. Standardized methodology and price response measures, which would allow planners to use extant institutional data, are also needed. Further, a research model permitting the use of extant institutional data would

provide all institutions with the opportunity to perform similar self analysis. If standard matriculation models using existing data were used to create clearly defined price response measures, institutions could use the results to make better informed decisions on program, financial, enrollment, and personnel management. Individual differences by type of institution and student characteristics would provide institutions with more intimate data on their students and their college-going behavior for use in the policy-making calculus.

While this type of research has been conducted at the national level for decades, studies of this nature are needed at the institutional level (St. John 1991b). Matriculation research at the institutional level could dramatically reshape individual college policies on admissions and financial aid, and enlighten the entire constellation of university policies. Moreover, it would assist the smallest, struggling colleges as well as the larger and more prestigious ones.

Planning Models

In response to concern over demographic and financial fluctuations, various planning methods and models were developed which used the results from the early student demand studies of the 1960's. Two comparable national models were used in the 1970's. The Financial Planning Model (FPM) was developed by the National Center for Higher Education Management Systems and Western Interstate Center for Higher Education. The second model was the Postsecondary Education Financing Model (PEFM) of the National Commission on the Financing of Post-secondary Education. While the emphasis of the models was national political and planning issues, many institutions modified and used segments of them for institutional planning purposes.

In 1973, using the early price response research, the NCFPE performed a series of national simulations which concluded that the Pell Grant Program had greater potential for increasing the enrollment of low-income students than did the proposed institutional grant program. The research done by NCFPE influenced Congress not to fund institutional

grants, but to have direct student financial aid (including Pell Grants) as the primary vehicle for financing higher education.

Dresch (1975) seriously criticizes the research used to develop these two planning models, rejecting both the scholarship and the models. He indicates that the early student demand studies on which the models are based were flawed. First, the studies considered only tuition prices (Corrazzini, Dugan & Grabowski, 1963; Campbell & Siegel, 1967; Kohn, Manski, & Mundel, 1974; Bishop, 1977; and Tannen, 1978), exclusive of financial aid. Second, the models completely ignored student persistence.

Third, the research is based upon economic assumptions built on the post-World War II years when there were high and sustained pecuniary returns to students for investment in higher education (Hoenack, 1971; Tannen, 1978; and Bishop, 1977). These labor market signals stimulated college attendance increases. Later, the market for college educated employees was saturated and as a result, the return on the investment declined. Yet the planning models

still used the labor market assumptions implicit in the immediate post-War period in predicting college enrollments.

Fourth, actual tuition and financial aid offers should be used. Both PEFM and FPM use estimated awards and imputed income levels. Since other studies (Hoenack & Weiler, 1977, Radner & Miller, 1975, Spies, 1973; and Campbell & Siegel, 1967) indicate that income and aid are significant, this is a major methodological flaw.

Fifth, research is limited because it measures either enrollment in an institution of higher education within one year of high school graduation or the matriculation rate for a single age cohort. This ignores students who begin college later in life and those who attend, drop out and re-enter. As more non-traditional students began attending college, predicting college matriculation choices of this group became important at the institutional level.

Sixth, price response measures should be at least reasonably accurate in order to be used in planning models. Dresch argues that the poor quality of price

response research seriously limits its utility and use in planning models. From this, it is clear that institutions need to have measures of price response for their own planning purposes.

Dresch concludes that the FPM and PEFM models should not be used as a firm basis in policy making. He argues for a renewed look at theory and methods which underlie matriculation research, with an interest in developing strong institutional models, methods, and price response measures.

Although almost twenty years have passed since Dresch's call for renewed scholarship on matriculation research, it is still current today for four reasons. First, there are deficiencies in institutional research historically. Further, no new institutional research on first-time attendance has been conducted during the past two decades. Third, there is no viable institutional research on the impact of student aid. Finally, institutions cannot plan effectively until viable models and institutional research on the impact of aid are available.

Theoretical Framework

College matriculation may be analyzed from different theoretical perspectives, but two fields predominate: sociology and economics. Sociology explores research on educational attainment, while economic studies focus on investment in human capital, student demand for higher education, and price response. More recently, a hybrid line of inquiry combining both fields has emerged.

Sociological models (e. g. Eckland & Alexander, 1980; Thomas, Alexander, & Eckland, 1979; and Wolfle, 1985) provide a framework for research on both matriculation and persistence. Key segments of these models are socioeconomic and family variables (Blau & Duncan, 1967), family income, academic ability (Sewell & Shah, 1967), and aspirations (Sewell & Hauser, 1975; and Trent & Medskar, 1968).

The sociological perspective on attainment makes an important contribution to research on matriculation. The attainment literature highlights the importance of background variables, including parent's education, family income, academic ability, and aspirations. However, much of the research uses

national databases, and is not directly applicable at the institutional level.

Student demand/aid studies, in contrast, are grounded in human capital theory (Schultz, 1960 and Becker, 1964). This theory classifies education as an investment in "human capital" which generates pecuniary returns to the student and Society. Student demand theory predicts that consumers purchase more education when prices are lower and less when prices are higher (Stafford, Lindstedt, & Lynn, 1984). Using this framework, the demand for postsecondary education (enrollment) relates to price. Lower prices and subsidies from financial aid should serve to stimulate the demand for higher education. From demand theory come various student demand and aid studies (Hoenack, 1971; Hoenack & Weiler, 1969; Orvis, 1973; Kohn, Manski, & Mundel, 1974; Radner & Miller, 1975; Orvis, 1975; Hoenack & Weiler, 1977; Bishop, 1977; Tannen, 1978; Spies, 1973; and Manski & Wise, 1983). These studies rely largely on economic variables, such as socioeconomic status, financial aid, and price of tuition, to examine matriculation.

More recently, comprehensive models of student choice have been developed (Jackson, 1978; Tierney, 1980; Tierney, 1982; Tierney & Davis, 1985; St. John, 1990b; and St. John, 1990c). These comprehensive models seek to span the two fields by using models grounded in traditional sociological research and adding relevant economic variables.

In persistence research the two major lines of inquiry are also sociological and economic. Like research on attendance, background variables are key to persistence research (Spady, 1971; Tinto, 1975; Pascarella & Terenzini, 1980; Pascarella & Chapman, 1983; Pascarella, Duby, & Iverson, 1983; Pascarella, Duby, Miller, & Rasher 1981; Terkla, 1985; Voorhees, 1985; Carroll, 1987; Moline, 1987; Andrieu, 1990; and St. John 1990a & b). In addition, academic performance (Spady, 1971) and academic and social integration are included in some persistence research (Tinto, 1975; and Pascarella and Terenzini, 1977, 1979 & 1980).

A review of the research on matriculation indicates many studies over a period a several

decades. However, the quality of institutional research is limited. First, the research on the topics of first-time attendance and college choice has largely been done at the national level. While this information is useful for government policy purposes, the utility for institutions is limited by the aggregate nature of the results and recommendations. Second, while much of the persistence research was performed at the institutional level, it has been inconsistent. Further, the data were gathered using special surveys, a formidable task for any institution wishing to duplicate the research. The models used in the persistence research largely ignored economic variables. Because of the limitations of the current studies and the compelling need for sound matriculation research, new approaches are warranted.

The purpose of this study is to create a dynamic model of matriculation. The prototype is grounded in research on the economics of education (Becker, 1964; and Leslie & Brinkman, 1988), attainment (Alexander & Eckland, 1975; Blau & Duncan, 1967; and Wolfle, 1985), access (St. John, 1990a & b), and persistence (Tinto,

1975; Pascarella & Terenzini, 1980, 1983; and St. John, 1990c).

The model examines the relationships between background, achievement, price, aspirations, and college experiences, in a three-step, dynamic matriculation model that includes first-time attendance, within-year persistence (Persistence 1) and year-to-year persistence (Persistence 2).

Problem Statement

Institutions of higher education need accurate predictions of enrollments to inform academic and financial policy decisions. Enrollment data include both initial registration and retention. Institutional planners face several dilemmas in designing and applying research on matriculation.

The first and most basic dilemma is which model to use. Existing models have been harshly criticized for their inaccuracy. Where institutional-level research has been done, it is limited in applicability. Second, the research on matriculation uses several different models, methods, and data sources. Planners are faced with choosing a model and

either specially gathering the data or fitting existing data to the model. Third, price response measures may be difficult to develop and interpret. Price information is often based on national studies, which may not be applicable to a particular institution. Further, researchers use different baseline measurements. Planners need guidance on designing and interpreting price response measures for their own institutions.

Early student demand studies examined the variables that affected college matriculation (Corrazzini, Dugan, & Grabowski, 1963; Campbell & Siegel, 1967; Trent & Medskar, 1968; Barnes, 1970; and Hoenack, 1971). These studies are of students who entered college before the Pell grant program was initiated. This early research generally focused on tuition charges only; those that included student aid did not reflect changes in federal policy, like the Pell Grants of the 1970's. Further, some of the studies were cross-sectional (Corrazzini, Dugan, & Grabowski, 1963; and Hoenack, 1971). Price response measures varied from attendance rates (Sewell & Shah,

1967), elasticity of demand (Campbell & Siegel, 1967), and a standardized price response coefficient (Bishop, 1963; Hoenack & Weiler, 1969, Orvis, 1973; Hoenack, 1971; among others).

In the late 1980's, there was a renewed interest in price response research at the national level. In part, this stemmed from changes in federal financial aid policy instituted after 1980, for which data had just become available. However, no measures of price response were developed for use at the institutional level. The new generation of research examines the impact of financial aid on attendance. In one of these studies, differential price response measures are developed (St. John, 1990b). This appraisal found that students are more price responsive to aid (all types) than tuition; low-income students are more responsive to grants than to tuition, and are not responsive to loans; middle-income students are more responsive to loans than to grants or tuition; and upper-income students are only slightly price responsive to tuition, but are not responsive to aid.

Another study (St. John, 1990c) extends price

response to persistence research. He concludes that:

1) students are price responsive in persistence decisions; 2) students are about as price responsive in persistence as they are in enrollment; 3) students are consistently responsive to student aid in persistence decisions, but are not responsive to tuition charges; and 4) students are price responsive to all forms of student aid - loans, grants, and work-study awards.

From this body of research, two conclusions emerge. First, student decisions to attend college respond positively to price cuts or increases in financial aid. Second, students' decisions about where to attend school also are influenced by changes in the relative prices of the alternatives. Thus, price response investigations have implications for financial aid and pricing policies, and for institutional planning.

Due to the ever-increasing cost of college, there has been a renewed interest in price response and its implications for financial aid, pricing policy, and overall institutional planning. Price response does

show great promise in helping institutions refine their enrollment management strategies to achieve institutional goals.

Purpose of the Study

The purpose of this study is to develop and test a workable dynamic student matriculation model grounded in the economics of education and sociology that can be used in institutional research on the impact of student aid. To accomplish this purpose, the following formulae are tested:

(1) $A = f(B, ACH, \text{ and } SA_1)$, where:

A = first-time attendance

B = background

ACH = achievement

SA₁ = student financial aid at time of
admission

Where first-time attendance is a function of the applicant's background, achievement, and financial aid offered.

(2) $P_1 = f(B, ACH, SA_2, \text{ and } C_1)$, where:

P₁ = within-year persistence

B = background

ACH = achievement

SA₂ = student financial aid during fall of
base year

C₁ = college experiences during fall of
base year

Where first-to-second semester persistence is a function of the student's background, achievement, financial aid received, and college experiences.

(3) $P_2 = f(B, ACH, SA_3 \text{ and } C_2)$, where:

P₂ = year-to-year persistence

B = background

ACH = achievement

SA₃ = student financial aid during entire
base year

C₂ = college experiences during entire
base year

Where first-to-second year persistence is a function of the student's background, achievement, aspirations, financial aid received, and college experiences.

Research Questions

The following research questions are developed from the theoretical framework and derived from the

formulae listed above:

(1) How much of the variance in the dependent variable, first-time enrollment, is explained by the factors background, achievement, and student financial aid?

(2) Given the influence of the factors background and achievement, does the receipt of any type of financial aid have an additional influence on first-time enrollment?

(3) Given the influence of the factors background and achievement, does the type of financial aid received have an additional influence on first-time enrollment?

(4) How much of the variance in the dependent variable, within-year persistence, is explained by the factors background, achievement, student financial aid, and college experiences?

(5) Given the influence of the factors background, achievement, and college experiences on within-year persistence, does the receipt of any type of financial aid have an additional influence on this persistence?

(6) Given the influence of the factors background, achievement, and college experiences on within-year persistence, does the type of financial aid received have an additional influence on this persistence?

(7) How much of the variance in the dependent variable, year-to-year persistence, is explained by the factors background, achievement, student financial aid, and college experiences?

(8) Given the influence of the factors background, achievement, and college experiences on year-to-year persistence, does the receipt of any type of financial aid have an additional influence on this persistence?

(9) Given the influence of the factors background, achievement, and college experiences on year-to-year persistence, does the type of financial aid received have an additional influence on this persistence?

The above questions are the research hypotheses of the study.

Significance of the Problem

Price response research can provide institutional planners with valuable information on college attendance and persistence. These data allow university administrators to develop more sophisticated and effective planning models, and to assess a wide range of financial strategies. Price response analysis could inform administrative decisions on university financial strategies. Moreover, price-response research can be used to influence state and federal policy on student aid.

Critics of price response research indicate that theory would have predicted a decline in college enrollment in the 1980's because of price increases (Gerald & Hussar, 1990). However, enrollment actually increased. More sophisticated, integrated matriculation models, like the one proposed here, may offer better predictive validity for colleges and universities.

On a more general level, well-designed institutional price-response research has potential national significance. The development of a standard methodology and logical model could influence the

testing of price response across various types of post-secondary institutions. The results of such comparisons would provide data for a meta analysis of price response in attendance and persistence.

Definition of Terms

Several terms used in this study require definition.

Access is a broad social goal that would allow any student who desires to attend college to do so, regardless of financial resources.

Attrition is the gradual reduction of students enrolled in an institution.

A dependent student is one who is considered to be reliant for financial support on his or her parents.

Dropout is the popular expression for a student's decision to terminate enrollment in the institution.

Enrollment is the decision of an applicant to attend for the first time or a student to continue to attend an institution of higher education.

Ethnicity - students are categorized as Black, Hispanic or Other based upon self identification. The

category Black (Afro-American) includes those individuals who have origins in any of the black racial groups of Africa. The Hispanic category embraces individuals of Mexican, Puerto Rican, Cuban, Central American, South American, or other Spanish origin, regardless of race. The Other category includes all other ethnic groups.

Financial aid is the aggregate amount of financial assistance awarded to students from sources other than family or self. Included in this are loans, scholarships and grants. Loans are repayable while grants and scholarships are not.

First-time attendance is the initial entry into college for the first semester of an undergraduate program.

Full-time student is one who registers for at least twelve credit hours.

A grant is a form of financial aid that is awarded based on the economic need of the student and does not require either repayment or employment.

An independent student is one who is not considered reliant on his or her parents for financial

support.

Institution of higher education (IHE) is used here to mean the types of post-secondary education provided by colleges. These institutions include community and junior colleges, four-year colleges, and universities. Not included in this definition are proprietary schools and the many types of post-secondary vocational education offered outside of colleges.

A loan is a form of financial aid that allows students to borrow money for their education. To obtain a loan, a student must sign a promissory note agreeing to repay the money under specified conditions.

Matriculation is used to describe a sequence of individual decisions, from the initial decision to attend college to the final decision to enroll in the final semester to receive the degree. Used in this paper, matriculation is the general term which includes both access and persistence. The matriculation model, then refers, to a comprehensive model of both enrollment and persistence.

A part-time student is one who registers for less than twelve hours of credit.

Persistence is defined in the research literature as first-to-second-year retention. That is, of the students who matriculate as freshmen, how many return as sophomores? A few studies look at within-year persistence (retention from one semester to the next) or persistence beyond the second year. In this study, Persistence 1 is first-to-second semester retention and Persistence 2 is first-to-second year retention.

The price of higher education is the total cost minus financial aid. The cost varies by student because of the differences in financial aid packages.

Price response is the measure of the sensitivity of students to changes in tuition or financial aid.

Price elasticity, an alternate calculation of price response, is a general measure of the price response coefficient. Since one-third of the eligible age cohort participates, the SPRC is multiplied by three to obtain the price elasticity (Leslie & Brinkman, 1978; McPherson, 1978) based on the assumption that one-third of the college-eligible

population matriculates. The use of this measure allows for an evaluation of the consequences of not enrolling.

The Standardized Price Response Coefficient (SPRC) is a common measure of price response developed by Leslie and Brinkman (1988) which measures changes in enrollment associated with a \$100 change in tuition or aid.

A stopout is a student who withdraws from the institution, but returns at a later time to some form of post-secondary education.

Tuition and fees include the total amount charged by the institution for instructional and other services.

Withdrawal is the student decision to terminate enrollment in the institution.

Within-year persistence is re-enrollment for the spring semester of a given academic year after having been enrolled for the preceding fall semester.

Year-to-year persistence is the enrollment for the fall semester of a particular academic year and continuing enrollment through the fall semester of the

next academic year.

Delimitations

Assumptions

Economic theory assumes that price influences enrollment (Monroe & Della Bitta, 1978; Shaman & Zemsky, 1984; and Tierney, 1982). General price theory predicts that fewer students will enroll if the net price (tuition minus aid) of education rises and that more students will enroll if the price falls. This approach assumes that student price response exists and it is measurable.

Economic theory also supposes rational behavior on the part of applicants and students. That is, people will tend to act in ways that will promote their economic self-interests.

Scope of the Study

This study examines the applicant pool and first-year class at a major urban public university. The state is one that uses a high tuition/low financial aid financing model (St. John, 1991b). Initial enrollment, first-to-second semester persistence, and first-to-second-year persistence are studied, using a

variety of economic and sociological variables.

The unique nature of an urban, commuter institution is evident in the group of applicants being studied. The students are somewhat older than the traditional eighteen- to twenty-two-year-old group. Many are married and have children. Very few live on campus; they live at home with their parents, with their spouses, or in apartments. With the changing demographics, this student profile will fit more institutions over the coming decade.

Limitations of the Study

The study's limitations center around the use of extant institutional data from a single school. The use of a single institution limits the generalizability of the findings to other institutions. Further, without testing of the model at other institutions, the applicability of the model is limited.

A second limitation is that the data used for the study were not specifically collected for research on matriculation. The data were collected for various purposes and the specifications of the variables are

not necessarily the most optimal for research on matriculation.

A third limitation is missing data elements. This is most crucial for the variable family income. As described in Chapter 3, a statistical method of adjusting for the missing data has been found.

A fourth limitation is the lack of variation in the price of tuition (Dresch, 1975). Most students pay "in-state" tuition, so there is virtually no variation in the price of tuition. Thus, price and total aid are used interchangeably in this study. Since the focus of the study is the student response to aid offers the lack of variability in price is not a significant problem.

A fifth limitation is the lack of a variable for labor market experience. According to Dresch (1975), for any one cohort of students at one point in time, labor market conditions are identical. This is particularly true with the population of this study, drawn primarily from one region of the country. No attempt was made to examine how the labor market might influence college attendance.

Three limitations related to the statistical method are discussed in chapter 3.

Organization of the Study

This study examines the economic and sociological research literature to develop a local model of matriculation for use at the institutional level. The theoretical model, which includes both enrollment and persistence is presented for testing.

The first chapter provides a framework for the research, discussing the problem and the concepts. The second chapter reviews the literature on the economics of education, the sociological models of attainment, college attendance, and models of persistence. This examination thoroughly grounds the study in theory. A three-step, dynamic, multi-disciplinary matriculation model is proposed.

The third chapter describes the method and specifies the data. In the fourth chapter, the results of the study are presented. The fifth chapter contains the conclusions and recommendations for theory and practice.

Chapter 2

Review of Literature

Research issues related to college matriculation have been of interest to social scientists for several decades. Scholars from several disciplines, including sociology, psychology, economics, and education have conducted this research. During this time, the preferred methodology for such studies shifted from purely descriptive to multivariate studies, particularly those using causal modeling and logistic regression.

This chapter reviews the research literature in two interrelated areas: first-time attendance and persistence in postsecondary education. Prior to this review, an historical analysis of financial aid since World War II is presented as part of the context for examining the impact of student financial aid. A three-step institutional matriculation model is presented for empirical testing.

Background

The Post-War Education Boom

The 1950's and 1960's were a time of

extraordinary growth and expansion for institutions of higher education. Between 1955 and 1970, post-secondary institutions were formed at the rate of almost one per week (Finn, 1978).

The rapid economic expansion which followed World War II was accompanied by a burgeoning of higher education enrollments. The initial stimuli for this growth were returning veterans, rapid industrialization, and an increase in the high school completion rate. During the 1960's, postsecondary expansion continued at an unprecedented rate, with most industrialized countries doubling or trebling their student populations due to the post-war Baby Boom and the increasing number of students, especially women, who attended institutions of higher education (Trow, 1979).

Financing Higher Education

Unlike many other developed countries, the responsibility for funding education in the United States is the purview of state and local governments.

Yet the federal government has assumed an increasingly larger role in higher education finance.

After World War II, two competing philosophies on who should pay for college emerged. The first was that higher education is a public good whose benefits accrue to the entire nation. Therefore, the costs of education should be underwritten by the general public through taxation. The second perspective was that higher education enhances the lives of those who participate and they alone should bear the costs.

This debate came at a time when a large number of veterans returning to the U. S. sought additional training. The government made a commitment to support the higher education of these veterans through the Serviceman's Readjustment Act of 1944 (the "GI Bill").

The assistance consisted of fixed stipends to the veterans and a direct payment to institutions for tuition.

However, as the number of veterans with unused GI bill benefits declined, private institutions responded by offering scholarships to desirable students. With no standard practices or procedures, a bidding war between colleges for the best students resulted. This

led to a chaotic situation in which the best negotiator could receive the largest scholarship.

In response to the financial aid chaos and uncertainty, a consensus among colleges emerged on the awarding of this aid (Finn, 1978). The informal arrangement that developed between financial aid directors was to limit aid to the difference between what a student's family could afford and the actual cost of attending the institution. This approach allowed more expensive colleges to increase their aid commensurately while still acknowledging the standard family contribution.

Packaging was the means of "evening up" aid offers. Packaging established a uniform system based on financial need that allowed for different sources of support (federal, state, and private), while allocating benefits equitably across families and institutions. In the mid-1950's, the College Scholarship Service formalized the process of needs analysis through the "Parent's Confidential Statement;" this mechanism continues to be used even today.

Two national commissions recommended less federal involvement in higher education during the 1950's (Finn, 1978). However, several far-reaching pieces of legislation were passed in the late 1950's and mid-1960's that had the opposite effect.

The National Defense Education Act of 1958 provided long-term, low-interest loans to needy undergraduates and fellowships for graduate study. Spurred on by the threat of Sputnik, the NDEA stated that "Congress hereby finds and declares that the national security of the Nation requires the fullest development of the mental resources and technical skills of its young men and women" (Gladieux & Wolanin, 1976). The original bill presented to Congress provided scholarships for undergraduate students, which many labelled as a "free ride." This issue was a recurring theme in the debate over student aid. In the House-Senate conference committee for the NDEA, the program was changed to low-interest loans, which set a precedent for future legislation (Gladieux & Wolanin, 1976). NDEA was also significant because it was the first broad-based financial aid program,

and represented a quantum leap in federal involvement in funding higher education.

The Higher Education Facilities Act of 1963 (HEFA) created both construction grants to colleges and financial aid to students. The legislation provided a five-year program of construction grants for graduate and undergraduate educational facilities administered through the states. In earlier versions of the legislation, aid to private institutions was limited, because of a concern about the separation of Church and State in religiously-affiliated institutions. During the debate, Congress developed a rationale for supporting higher education for defense-related purposes.

HEFA was particularly important in defining new federal concerns in higher education that continue to the present time. The Church-State issue, which had been extremely volatile in the early 1960's, was laid to rest. HEFA established a trend for omnibus higher education legislation and brought equal opportunity issues to the forefront (Gladieux & Wolanin, 1976).

With the landslide victory of Lyndon Johnson in

the 1964 election and the two-to-one Democratic majorities in both the House and the Senate, the Great Society was launched. In 1965, several landmark bills, including the Voting Rights Act, Medicare, the Elementary and Secondary Education Act, and the Higher Education Act of 1965 (HEA-65) were passed.

Title IV of HEA-65 contained several key provisions that are the cornerstone of current federal financial aid. Need-based educational opportunity grants for disadvantaged youth were established. This was the first significant federal scholarship program.

HEA created the National Direct Student Loan program and developed federal insurance for state and private educational loans and transferred the College Work Study program established in 1964 under the Economic Opportunity Act from the Office of Economic Opportunity to the Office of Education. The Act instituted a program of categorical grants to libraries and to Historically Black Colleges (HBC's).

The Great Society legislation sought to narrow the gap between the privileged and the underprivileged. One of the key strategies for doing

so was economic development through education. Census data showed that a young person from a family earning more than \$15,000 per year was five times more likely to attend college than a youth from a family with an income of less than \$3,000 (Gladieux & Wolanin, 1976).

Further, the differential could not be explained through economics alone: minority students were underrepresented in college enrollments. In addition, minority and low-income students tended to be enrolled in less selective and less expensive institutions.

The growing social awareness of the 1960's was coupled with legislative and judicial activism, and education was viewed as crucial to breaking the cycle of poverty. President Johnson said, "The answer for all of our national problems, the answer for all of the problems of the world, comes down, when you really analyze it, to one single word - education" (Johnson, 1964).

The Higher Education Act of 1965 embodied this legislative activism to promote social policy. For the first time, Congress chose to award scholarships rather than repayable loans. In a further deviation

from past practice, these scholarships were given to economically disadvantaged students and not the academically superior.

At the same time, colleges and universities embraced the moral imperative to extend education (Gladieux & Wolanin, 1976). The civil rights and the women's movements forced institutions to reduce barriers to attendance. Two types of institutions, the Historically Black College and the community college, played a large role in increasing access. However, four-year institutions were forced to expand opportunities for disadvantaged and minority youth. According to Newman (1971), 1966 was a benchmark in the effort of traditional universities to promote access. This resulted in large measure from Title IV of the Higher Education Act of 1965.

During the decade of the 1960's, there had been considerable discussion about how federal financial aid to higher education was channeled. The concern about how to appropriately disburse federal funds surfaced during the debate on the Higher Education Amendments of 1972. Most educational leaders assumed

that federal funding would continue to increase. Alan Pifer, President of the Carnegie Foundation, estimated that the percentage of federal aid would rise to fifty percent by 1975. He added that by the year 2000, higher education financing could "come to be regarded as almost exclusively a federal responsibility" (Pifer, 1968).

Pifer and others argued for a coordinated and coherent approach to federal funding of higher education. Several strategies were suggested. The first was to continue to channel aid to students. An opposing view suggested giving aid directly to the institutions rather than the students. A third proposal was to channel aid through the states in the form of block grants, the so-called "revenue sharing" that was in vogue at the time. Yet another recommendation would channel aid to parents through special income tax exemptions, deductions, or credits for their child's educational expenses.

The version of the bill that passed had several features. The key provision was that aid would go directly to the student and not the institution.

Promoting equal opportunity was the second important provision, and it was encouraged in several ways. First, students could use aid to attend both community colleges and various occupational training programs. Second, the variety of aid programs established or amended by the Act encouraged both access and choice.

The 1972 Amendments to Title IV represented a key victory for the proponents of student choice and access. The system of financial aid that was established has remained virtually the same over the last twenty years and includes campus-based programs (Supplemental Educational Opportunity Grants, College Work Study, National Direct Student Loans [now Perkins Loans]) and other programs (State Student Incentive Grants, Guaranteed Student Loans [now Stafford Loans], and Basic Educational Opportunity Grants [now Pell Grants]). Federally-insured Student Loans, a component of the Guaranteed Student Loans, were eliminated in the 1980's.

During the decade of the 1970's, the cost of attending college rose much more rapidly than inflation. As a result, Congress came under

increasing pressure to assist middle-income students in attending college. At President Carter's request, Congress enacted the Middle Income Student Assistance Act of 1978 (MISAA). This legislation changed the income ceiling for Pell Grants to make more students eligible. Moreover, all income restrictions were removed for the awarding of Guaranteed Student Loans (now Stafford Loans). In 1980, Title IV of the Higher Education Act was amended so that even more families were eligible for need-based aid.

However, in the 1981 Omnibus Budget Reconciliation Act, Congress made a number of changes that would limit the growth of student aid (Gladieux & Wolanin, 1976). Limits were placed on Pell Grants and only the amount needed for educational expenses could be borrowed. Further, Social Security survivor's educational benefits were eliminated. Additional limitations on aid were imposed in 1986.

These modifications have not slowed the growth of the programs in terms of participation, as the following comparisons between 1980 and 1989 demonstrate. Federal spending on Pell Grants grew

from \$1.8 billion in 1980 to \$4.5 billion in 1989, an increase of 29% in constant dollars. Perkins Loans have fallen from \$300 million to \$205 million with approximately the same number of borrowers. Supplemental Opportunity Grants grew from \$370 million to \$438 million, with a decrease of 50,000 participants. The College Work Study Program had an increase of funds from \$550 million to \$611 million, with a decrease of 80,000 participants (Hartle, 1991).

These figures signalled a dramatic shift in overall financing. The amount of federal aid dropped from 83% to 75% of the total. At the same time, the amount provided by institutions rose from 12% to 19%.

States contributed the remaining five percent (Levitz, 1991).

The shift from grants to loans as the primary source of federal financial aid has had an impact on recruiting and retention for colleges and universities. First, low-income students view loans as negative, perhaps because of negative experiences with consumer credit (Levitz, 1991). However, loans have a more positive influence on persistence.

Second, there seems to have been a subtle shift to shorter degree programs. Third, campus employment is more likely to increase persistence, however, funds for this area have been cut over the last decade. Finally, the default rate, especially for dropouts, has increased.

This discussion of the history indicates the complexity of and major changes in student financial aid over the past two decades. By way of review, the current federal student financial aid programs are:

- (1) Stafford Loan program - a need-based loan program.
- (2) Parent Loan program (PLUS) - a loan program for parents of dependent students of up to \$4,000 per year.
- (3) Supplemental Program (SLS) (formerly Auxiliary Loan to Assist Students - ALAS) - a loan program for independent students of up to \$4,000 per year.
- (4) Pell Grant (formerly Basic Educational Opportunity Grant - BEOG) - a need-based non-repayable grant.

(5) Supplemental Educational Opportunity Grant (SEOG) - a need-based, non-repayable grant of up to \$2,000.

(6) Perkins Loan program (formerly National Direct Student Loan and originally called National Defense Education Act Loan) - a need-based loan program administered at the campus level.

(7) College Work Study (CWS) - need-based subsidized student employment.

(8) State Student Incentive Grant (SSIG) - federal matching funds for state grants to students.

Understanding this panoply of programs is crucial to performing research on the impact of student financial aid. First, while there has been recent research on the impact of student aid at the national level, there is no current institutional research.

Second, research on student financial aid has important policy implications. An understanding of Congressional intent in the area of aid is helpful in reviewing these implications. Further, the results of studies on the impact of student aid can be framed in light of Congressional intent.

Third, a recognition of the large role that the federal government plays in student financial aid is important at several levels. For colleges and universities, this understanding is crucial in developing viable financial aid strategies. For state governments, this is important in reviewing tuition assistance policies.

First-time attendance decisions

First-time attendance in higher education can be analyzed from different scholarly perspectives. The field of sociology explores research on educational attainment. Economic studies focus on investment in human capital, student demand for higher education, and price response. In addition, there are more general comprehensive models of educational choice not tied to a specific discipline.

Sociological Perspective

Educational achievement, occupational attainment, and mobility processes have been of continuing interest to sociologists since the 1950's (Parsons, 1959). These sociological models (e. g. Alexander & Eckland, 1980; Thomas, Alexander, & Eckland, 1979;

Blau & Duncan, 1967; and Wolfle, 1985) are important because they provide a framework for matriculation research. Key segments of these models are socioeconomic and family variables (Blau & Duncan, 1967; and Eckland & Alexander, 1980), academic ability (Sewell and Shah, 1967), and aspirations (Sewell & Hauser, 1975; and Trent & Medskar, 1968).

Parsons (1959) identifies that educational institutions have "a crucial role in occupational sorting and selection" in industrial and industrializing societies. Blau and Duncan (1967) find a direct link between family status and a son's occupational achievements in their pioneering work on attainment. Four variables, family background, educational attainment, early occupational status, and current occupational status are presented in a causal, chronological model of attainment. However, the study does not include academic ability measures or information on interpersonal experiences. The work by Blau and Duncan, however, is "a reference point for subsequent analyses of attainment processes" (Alexander and Eckland, 1975, p. 471).

Possible changes in status differences over time are suggested in a longitudinal study (Alexander and Eckland, 1975) which extend the Blau and Duncan research, indicating the need to qualify the interpretation of relevant characteristics in the model. Alexander and Eckland find that three variables (ability, socioeconomic status, and expectations) have moderate effects on educational attainment, and ability and SES have indirect effects mediated by the goal orientation variable. Wolfle (1985) examines the differences in educational attainment in white and minority youth. He determines that "increments in background social status variables lead to similar increases in educational attainment for whites and blacks" (p. 501).

A few researchers treat educational attainment as a dynamic process. Boudon (1974) describes attainment as a series of branching points. Elimination at a particular point precludes reentry, but success leads to continued participation. Rosenbaum compares this process to a tournament (1976). Temple and Polk (1986) find that although early academic success does

not guarantee later success, early academic failure strongly predicts later failure.

The sociological perspective provides a foundation for research on college attendance. The attainment literature highlights the importance of background variables on educational decisions. These variables are important to the development of an integrated framework for examining college matriculation.

Economic Studies

The economics of education focuses on three areas: wealth redistribution, student demand, and student aid (Leslie & Brinkman, 1988). The three are grounded in human capital theory, which analyzes human behavior by focusing on economic variables (Schultz, 1960 and Becker, 1964). This school of thought arose from the inability of traditional economic theory to explain the differences in income growth between poor and rich countries. These differences could not be explained by variations in the traditional factors of production (labor and capital), but by variations in the quality of the labor (Denison, 1964; and

McPherson, 1982). The human capital theory asserts that activities that affect future monetary and psychic income by increasing the resources of individuals represent investments in human capital. These investments are of many types, including schooling, training, and postsecondary education. According to Becker, the investments: . . . differ in their effects on earnings and consumption, in the amounts typically invested, in the size of the returns, and in the extent to which the connection between investment and return is perceived. But all these investments improve skills, knowledge, or health, and thereby raise money or psychic incomes (1964, p. 1).

Human capital and demand theory form the logical base for student demand and aid studies. Demand theory predicts that the quantity of a good or service demanded (i. e. postsecondary education) is a function of the income of the customer, the price of the good or service, the price of alternative goods or services, and the tastes of the consumer. Student demand theory predicts that consumers purchase more

education when prices are lower and less when prices are higher (Stafford, Lindstedt, & Lynn, 1984).

Using this framework, the demand for postsecondary education (enrollment) relates to price.

Subsidies, in the form of tuition reductions due to grants, scholarships, loans, and other funds, should be effective in stimulating the demand for college education. If low-income individuals are more sensitive to subsidies than consumers with higher incomes, subsidies based on need will be more effective than low tuition in promoting college attendance.

The economic studies reviewed here are divided into two categories, student demand and student aid. The former considers the impact of tuition pricing, while the latter focuses on aid.

Student demand studies. The demand studies include cross-sectional studies, time-series studies, and two meta analyses. They use a standard measure, the Student Price Response Coefficient (SPRC) to gauge the change in enrollment for every \$100 change in the price of tuition. For example, an SPRC of $-.7$

indicates that for every \$100 increase in the price of tuition, enrollment will drop by .7 percentage points for first-time enrollment.

Several studies use a national sample of public and private universities. The most generalizable studies of national samples include Hopkins (1974), with an SPRC of $-.6$ using a net tuition figure (tuition net of aid) and Tannen (1978), with an SPRC of $-.8$, using net tuition plus foregone income and room and board. Corrazzini, Dugan and Grabowski (1963) figure an SPRC of $-.2$.

Orvis (1975) finds a price response for commuter students of -1.1 . Wilson (1977) and Hoenack and Weiler (1975) obtain SPRC's of $-.8$ and -1.3 respectively for the same population. However, these studies seem to measure "own-price elasticities," that is, they do not take into account students lost to other institutions, and are higher because of this (Leslie & Brinkman, 1988).

In a time series analysis, McPherson and Shapiro (1989) examine enrollment rates and net cost for every year from 1974 to 1984. The results show that

"increases in net cost over time lead to a decrease in enrollment rates" (p. 7). They estimate an elasticity of .47 and a 1.4% enrollment decline for every \$100 increase in costs.

In the first meta analysis, Jackson and Weathersby (1975) analyze seven student price response studies (Campbell & Siegel, 1967; Hoenack, 1968; Corrazzini, et al., 1972; Spies, 1973; Radner & Miller, 1970; and Kohn, Manski & Mundel, 1972). Using 1974 dollars, they conclude that a \$100 increase in tuition yields a decrease in the postsecondary education participation rate of 18- to 24-year-olds of approximately one percentage point.

In the second meta-level study, Leslie and Brinkman (1988) standardize and combine data from twenty-five studies (American Association of State Colleges and Universities [AASCU], 1977; Bishop, 1977; Campbell & Siegel, 1967; Corrazzini et al., 1972; Hoenack, 1968; Hoenack & Feldman, 1969; Hoenack & Weiler, 1975; Hopkins, 1974; Jackson, 1978; Kohn et al., 1966; Orvis, 1975; Radner & Miller, 1970; and Tannen, 1978). They conclude a Student Price Response

Coefficient (SPRC) of $-.7$ for every \$100 increase in tuition price based on first-time enrollment for 18- to 24-year-olds using 1982-83 prices. This represents a price elasticity of 2.1%, because the enrollment rate for this age group was .33 in 1982. However, they predict that upperclassmen are not as sensitive to changes in price because of their commitment to the institution and the price changes would affect them for a shorter length of time (Leslie & Brinkman, 1988).

Community colleges are also considered in Leslie and Brinkman's meta analysis. As a result of an experimental price reduction in 2-year public colleges in Wisconsin, an SPRC of $+1.3$ was found (AASCU, 1977).

When prices were raised at those institutions, the resulting SPRC is -1.0 . From this, Leslie and Brinkman compute an overall community college SPRC of $-.9$, in 1982-83 dollars.

Using the SPRC of $-.6$ to $-.8$ per \$100 price increase, they calculate that approximately 50,000 first-time students and a smaller number of upperclassmen would not enroll because of the

increase. Over a four-year period, the model predicts that 200,000 - 250,000 fewer students will enroll because of the \$100 increase, if all other factors are equal (Leslie & Brinkman, 1988).

With the price increases in higher education over the last decade, why have the total numbers of students participating in postsecondary education remained relatively stable? Leslie and Brinkman (1988) cite three factors. First, the prices have not risen significantly in real terms because educational costs lagged behind inflation in the 1970's. Second, students have been able to avoid price increases by moving to lower cost institutions. Third, need-based student aid programs grew dramatically since 1972, at both the federal and institutional levels, although federal grant aid declined during the 1980's. Leslie (1984) finds that between 1973 and 1980 the student share of educational costs decreased from 28% to 18%. Parents and federal student aid programs make up the difference.

Student aid studies. Leslie and Brinkman (1988) identify three methodologies for studying the impact

of student aid: econometric analyses of enrollment behavior, surveys of student opinions on the impact of aid, and calculations of participation rates.

The most noted participation rate study was done by Hansen (1983), who examines the impact of federal student aid on postsecondary enrollment. He compares enrollment of 18-24 year-olds in 1971-2 with 1978-9.

His historic conclusion is:

These data force one to conclude that the greater availability of student financial aid, targeted largely toward students from below-median-income families, did little, if anything, to increase access. The results certainly do not accord with expectations that access would increase for lower-income dependents relative to higher-income dependents (p. 93).

While widely circulated, Hansen's work has several problems (McPherson & Shapiro, 1989). A longer time span than he studied may be necessary to discern underlying trends. Second, Hansen did not control for extraneous variables that might influence enrollment.

Finally, the significant changes in financial aid programs that took place in the 1970's are not reflected in the study.

Student opinion surveys ask aid recipients to

assess the impact of receipt of aid on their attendance decision. In a time series analysis, Fenske, Boyd, and Maxey (1979) find an increasing impact of financial aid during the 1970's. Fife and Leslie (1976) have mixed results in studying the impact of grants in scholarships at the state level.

Several econometric studies consider student aid.

In a pre-Pell Grant study, Blakemore and Low (1985) conclude that grants have a significantly different impact on students of varying backgrounds. Manski and Wise (1983) use the National Longitudinal Study of 1972 to estimate the effects of the Basic Educational Opportunity Grant Program established in 1972 (now called Pell Grants). They calculate a 37 percent enrollment decline for low-income students without the BEOG's.

These economic studies are important in the development of a college matriculation model, because of the economic variables they contribute to the overall framework of student choice models. Recently, comprehensive models have developed that more fully integrate the sociological and economic research

traditions on student behavior.

Comprehensive choice models. The most recent studies focus on price response to financial aid, using a stronger methodology and more current data. Several studies (St. John & Noell, 1989; Schwartz, 1986; Seneca & Taussig, 1987; and Tierney & Davis, 1985) examine the effect of aid on the enrollment decision. Tierney and Davis show a lack of price sensitivity on the in-state college choices of students in Pennsylvania. Seneca and Taussig find that increases in financial aid improve access, but if tuition increases to cover this aid, access may be hindered.

Jackson (1978) uses the National Longitudinal Study (NLS) class of 1972 to examine how student aid influences enrollment decisions. He finds that an applicant is 8.5 percentage points more likely to attend college if offered aid than other similar applicants not offered aid. To efficiently increase enrollment, he says, aid should be offered to highly responsive subgroups of the population, like low-income students.

In an institutional study, Jackson (1978) finds that a college that awards at least some aid to all of its applicants could increase the matriculation rate of first-year students by 17 percent. Astin, Christian and Henson (1980) examine applicants to two private institutions and discover that the size of the difference in grant aid offers is highly correlated with student choice of the institution offering the most aid.

St. John (1990a) extends price response research to financial aid, using the "High School and Beyond" cohort of 1982. A \$100 rise in grants, loans, and work-study increases the probability of enrollment by .43, .38, and .46 respectively. He has three conclusions: (1) applicants are more responsive to all types of aid than to tuition; (2) low-income applicants are highly price sensitive to grants, but not to loans; and (3) middle-income applicants are more price responsive to grants than to loans.

In another study using HSB-82, St. John (in press) discovers three factors that are likely to increase minority enrollment: academic preparation

(as measured by test scores and grades), postsecondary aspirations, and financial aid. He identifies three strategies based on these factors that can increase minority enrollment: (1) early intervention programs for at-risk students; (2) public information programs aimed at middle-income students; and (3) increases in financial aid, especially grants.

Terkla and Jackson (1984) synthesize two conceptual models of student choice, one for traditional-age students and the other for adult students. The models are similar.

The model for traditional-age students indicates that family background characteristics, including parents' education, occupations, and income have both direct and indirect effects on the college matriculation decision. These variables influence the neighborhood and high school context, the student's academic ability and aspirations, the choice set of institutions, and the amount and type of financial aid the student receives. The neighborhood variables, however, are limited to indirect effects only, which are mediated through high school context variables.

According to Terkla and Jackson,
Academic ability, as measured by high school GPA
and standardized test scores probably has
the strongest direct effect on the student's
matriculation decision (1984, p. 30).

These variables occur in the model to indicate that
they are influenced by both family background
variables and high school context variables. The
ability variables influence the types of institutions
to which the student applies and the actual choice of
college.

Educational aspirations have both direct and
indirect influences on the choice of institution.
Aspirations effect the types of institutions to which
students apply and more generally shape the choice
regarding the type of institution that will meet these
aspirations.

The institutional characteristics, environment,
availability, cost, amount of aid received, and
perceived value of the degree, have a direct effect on
college choice. Jensen (1983) finds the receipt of
aid influences the attendance decision, but that the
level of aid does not.

The final variable in the model is labor market effects. This has a direct effect on the actual decision to attend college, but is unrelated to other variables in the prototype.

Terkla and Jackson's synthetic model for adult students shows family background characteristics are a strong influence in the decision of an adult student to matriculate. However, the term "family" refers to the adult student's nuclear family, and the effect of parents has little impact.

Educational aspirations are also part of the adult choice model. Medskar, Edelstein, Kreplin, Ruyle, and Shea (1975) identify three educational aspirations relevant to adult students: to have personal enrichment, to obtain a college education, and to develop job skills. Paltridge, Regan, and Terkla (1978) find that the aspirations differ by sex.

The primary reason adult men return to college is to satisfy a personal desire for a college degree, while the most important reason for women is the opportunity for personal enrichment. Terkla and Jackson conclude that ". . .it appears that price-related variables

probably do have an effect on non-traditional students' matriculation decisions. . ." (p. 37).

Terkla and Jackson regard the synthetic adult student choice model as more tentative, because of a lack of research in this area that focuses on adults.

Although the models for traditional and adult students look quite similar, many of the variables are different. Further, the importance of the variables may vary, but the models will be very similar.

This review of the three traditions in matriculation research indicates the limits of these studies. First, much of the research has been done at the national level, using theoretical models that can be used with national databases. Such models may not be applicable at the institutional level where resource constraints limit the available data. Second, the studies have different outcome measures. Some measure change in attendance rate, others use a standard measure of responsiveness to changes in tuition pricing or financial aid amounts. Further, the methodology for these calculations differs. The focus of the theoretical model proposed for the

present study is how to use extant data to perform matriculation research that institutions can use in making policy decisions.

The three types of access models demonstrate the interdisciplinary nature of research on college choice. This perspective carries over to research on persistence and argues for a comprehensive model.

Persistence

The topic of persistence (attrition) has been an area of interest to researchers for over two decades.

As the model for higher education in the United States changed from elite to mass, attrition, and the causes of it, became a significant issue. At the same time, federal higher education policy defined persistence as a goal.

Astin (1975) indicates that research on college outcomes tends to focus on the economic impact. However, there are three types of measures that he identifies. First, the outcomes of a college education are both cognitive and affective. Second, the types of data that can be collected to measure these two outcomes are psychological and behavioral.

Third, the outcomes can be measured in both the short and long term. For example, an affective outcome that can be studied using psychological data include satisfaction with college while attending school (short-term) and job satisfaction after graduation (long-term). A cognitive outcome that can be studied using behavioral data is persistence in college (short-term) and income after graduation (long-term).

Much of the persistence research has been performed at the institutional level using special surveys. While these studies are helpful in terms of understanding the phenomenon of persistence, they do not establish either a standard model or a methodology using existing data that colleges and universities could use in studying persistence in their own institutions. Further, only recently (e. g., St. John, 1991a; Moline, 1987; Tinto, 1991) have financial aid variables been included in institutional models and the results have been contradictory.

Like the attendance models, persistence research comes from different disciplines. Again, the two major lines in persistence research are sociological

and economic.

Sociological Perspective

Much of the research on persistence comes from the sociological tradition. However, this research is limited in two strategic ways. First, most of the research uses a single institution rather than a national database. Moreover, the studies require special surveys rather than using extant data. Second, most of the models define persistence rather narrowly as undergraduate first-to-second year persistence within the same institution. Only recently (Andrieu, 1990 and Girves & Wemmerus, 1988) has graduate student persistence been studied.

In a pioneering persistence study, Spady (1971) gathers longitudinal data for the 1965 entering class of the College of the University of Chicago. He tests a theoretical model of undergraduate dropout based on balance theory and Durkheim's concept of social integration (1951). Each student enters college shaped by background variables and high school experiences, which influence the student's ability to adapt to the new environment (college). Over a four-

year period, Spady finds that academic performance is the dominant factor in attrition for both male and female students.

Rootman (1972) uses the theory of person-role fit (Biddle & Thomas, 1966) to explain the relationship between the individual and the student role at a particular institution. Rootman's study of freshmen attrition at the U. S. Coast Guard Academy conceptualizes voluntary student withdrawal as a failure of the adult socialization process. Rootman's model has two variables with a direct positive influence on voluntary withdrawal, discussion of leaving with outsiders and discussion of withdrawal with insiders. Two variables are negatively associated with voluntary withdrawal, interpersonal fit (friendship support), and person-role fit (shared group values). These are similar to the academic and social integration variables in other persistence models.

Tinto (1975) characterizes previous research on attrition as insufficient due to an inadequate conceptualization of the problem and because of the

use of purely descriptive (rather than analytical) models. His model has as one of its origins Durkheim's theory of suicide.

Durkheim (1961) says that suicide is much more likely to occur when individuals are insufficiently integrated into Society. The chance of suicide increases with insufficient moral (value) integration and insufficient collective affiliation. Tinto (1975) applies this analysis to attrition:

When one views the college as a social system with its own value and social structures, one can treat dropout from that social system in a manner analogous to that of suicide in the wider society. . .social conditions affecting dropout from the social system of the college would resemble those resulting in suicide in the wider society; namely insufficient interactions with others in the college and insufficient congruency with the prevailing value patterns of the college collectivity. . .lack of integration into the social system of the college will lead to low commitment to that social system and will increase the probability that individuals will decide to leave college and pursue alternative activities (p. 91-92).

Voluntary withdrawal, like suicide, can come from insufficient academic or social integration, or integration in one area but not the other.

Tinto's model describes the conditions under which attrition occurs and includes several variables.

Background characteristics (social status, high school experiences, neighborhood, etc.) are important, but so are the expectations and motivational attributes individuals bring to college. The latter are termed educational and goal commitment, and introduce psychological variables into the model. In addition, a student's commitment to a particular institution (institutional commitment), is important.

Tinto's model presents withdrawal as:
. . .a longitudinal process of interactions between the individual and the academic and social systems of the college during which a person's experience in those systems (as measured by his normative and structural integration) continually modify his goal and institutional commitments in ways that lead to persistence and/or to varying forms of dropout (1975, p. 94).

Tinto reviews the research relating to each set of variables. In terms of family background, he finds that a family's socioeconomic status appears to be inversely related to dropout. College persisters are more likely to have parents with higher levels of education, indicating that social mobility patterns

are transferred by parental expectations. However, a student's own ability is important, as measured by high school grades and test scores. Once ability is controlled for, a student's commitment to the goal of college completion is the most influential factor in persistence.

Persistence is also related to a student's integration into the social system of the college. This integration is an interaction between an individual with one set of background characteristics and other students with varied characteristics. Social integration involves both "levels of integration and degrees of congruency between the individual and his social environment" (p. 107). The individual's own perception of social integration is most directly associated with persistence. Peer group interactions are a part of the student's social integration, while extracurricular activities and faculty interactions are more closely linked with institutional commitment.

Academic integration is represented by two variables. The first is academic performance, the

most measurable aspect of college life. Grades are both a "reflection of the person's ability and of the institution's preference for particular styles of academic behavior" (p. 104). The second variable, intellectual development, relates to the student's identification with the norms of the academic system.

Withdrawal is a result of insufficient integration of the student into the academic system of the college.

Both variables change the student's educational and institutional commitments. These commitments are to the institution, and to the goals of graduation and starting a career. As the level of institutional and goal commitment increases, there is a corresponding increase in the likelihood of persisting at the institution.

The early research of Pascarella and Terenzini (1977 and 1979) supports the predictive validity of the Tinto model. Their 1980 study examines the predictive validity of measures of social and academic integration. To assess the dimensions of such integration, a series of items measure intellectual development, peer-group interactions, interactions

with faculty, and institutional and goal commitments.

The study controls for various background characteristics, freshmen grade point average, and the extent of involvement in extracurricular activities. The results support the predictive validity of the Tinto model. However, they demonstrate the strong contribution of faculty-student interactions, with the quality being as important as the quantity.

Pascarella, Duby, Miller and Rasher (1981) study preenrollment traits to determine if these factors could predict subsequent persistence, stopout or early withdrawal in an urban commuter university. Preenrollment traits are useful in identifying stopouts, who are more likely to be Afro-American, and to predict that they might stopout before enrolling. This group is less likely to join a fraternity, sorority, or club. A second function, defined by high school achievement and perceived likelihood of transferring to another institution, discriminates more between persisters and dropouts, however, stopouts are still the outliers.

The differences between persisters and early

withdrawals are not as clear cut. Persisters are younger, have higher levels of high school achievement, perceive themselves as less likely to dropout temporarily before enrolling, and are more likely to expect to transfer to another institution. Only when the first semester's academic achievement is added to the equation is a clear distinction between persisters and early withdrawals possible. The authors conclude that:

. . .the characteristics a student brings to college may be substantially less important in predicting voluntary persistence/ withdrawal decisions than his or her extent of integration in the institution subsequent to matriculation. . .for the urban nonresidential institution, academic performance is a particularly salient dimension of institutional integration. . .early withdrawals quickly became aware of a discrepancy between their own academic performance and institutional norms, which does not appear to exist in any comparable magnitude for either persisters or stopouts (p. 346-347).

Thus, what Tinto describes as a lack of adequate academic integration is prompted by the student's perceived inability to meet certain standards of academic performance.

Tinto (1982) asserts that:

Despite great expectations, we have yet to move into the realm of what Merton refers to as "grand theory." We remain in the middle range where our theoretical models serve to explain only a portion of the wide range of behaviors that constitute the universe of social interactions (p. 688).

He has several criticisms of persistence theory.

First, the models primarily measure dropout from one institution, and not higher education in general.

Further, this withdrawal is a result of individual actions and institutional responsibility is not

explored. Second, the model does not recognize the role of finances in the decision to withdraw. While financial considerations effect the initial decision to attend, finances also influence persistence

decisions. Third, it does not distinguish between various population groups. Finally, the model doesn't reflect the withdrawal process at two-year institutions.

In 1983, three studies (Pascarella & Terenzini; Pascarella et al., and Pascarella & Chapman) introduce the use of path analysis to test Tinto's theoretical model. Each study uses different population groups,

and thus develops distinct models of persistence.

Pascarella et al. draw their sample from a non-residential, commuter university. Five variables (background, institutional and goal commitment 1, academic and social integration, institutional and goal commitment 2, and intention) explain 28.2% of the persistence/withdrawal behavior.

Their reduced path model indicates that various background variables have direct, significant effects.

Women are significantly more likely to persist than men. Academic aptitude (measured by ACT scores) has a positive, direct influence, while high school grades have a significant negative effect. Both academic and social integration have relatively strong direct effects on persistence, although the influence of social integration is negative. They conclude that at commuter institutions, persistence is determined more by academic than social integration.

The authors determine that only certain parts of Tinto's model are functional for commuter institutions. While persistence is determined to a large extent by academic integration, . . .when applied to commuter institutions, other

aspects of the model appear to function in ways that generally conflict with hypothesized patterns of influence. Specifically, the negative influence of social integration on persistence is inconsistent with the model and with previous research at residential institutions (p. 96).

One explanation for this is that students with relatively high levels of social integration may be more likely to transfer to residential institutions, where possibilities for additional social involvement are greater. Likewise, students with high levels of academic integration may withdraw from commuter institutions because of their lack of honors programs, specialized curricula, or other academic resources. These results tend to confirm that ". . . student pre-college characteristics may have a stronger direct influence on persistence in commuter institutions than residential institutions" (p. 97).

Pascarella and Terenzini (1983) test the validity of Tinto's model for freshmen at a residential college. Their model is similar to that described in Pascarella et al., with the exception of intention. The classification analysis for the Pascarella and

Terenzini model correctly predicts 80% of the persisters and voluntary withdrawals. However, there are notable differences for male and female students.

For women, social integration has a larger direct effect on persistence, while academic integration is more important to the persistence of male students.

Finally, as Tinto has theorized, there are ". . . statistically significant compensatory interactions between social and academic integration and between institutional and goal commitment" (p. 225).

Pascarella and Chapman (1983) collect data from eleven institutions, including residential, commuter and two-year colleges. They find that Tinto's original model explains approximately 75% of the variance in persistence/withdrawal decisions, leading them to conclude that at least some important variables are not specified by the model. They also conjecture that: Perhaps a major portion of persistence/withdrawal behavior is so idiosyncratic, in terms of external circumstances and personal propensities, that it is difficult to capture it in any rational explanatory model (p. 99).

For four-year residential colleges, institutional commitment has a stronger effect on persistence than goal commitment, social integration has stronger direct and indirect influences than academic integration, and student background traits are mediated by college experience variables. However, for four-year commuter colleges, institutional commitment is stronger than goal commitment and the opposite is the case for two-year commuter schools.

Considered together, the three 1983 studies are consistent in many ways with Tinto's model. Through expanded data and better analytical methods, the studies add important elements to the model. Moreover, this research demonstrates marked differences between residential and commuter students, and students in two-year and four-year institutions.

Taken as a body, these sociological studies of persistence have several shortcomings. First, much of the national and institutional research utilizes specially-developed databases from extensive student surveys. While this research provides valuable information on the phenomenon of persistence, it is

not very helpful to institutions that cannot mount special surveys on persistence. The limited research resources of many institutions preclude such surveys.

Second, the impact of financial variables, especially financial aid, is usually not examined. Given the intended role of federal financial aid in promoting persistence, this oversight is troublesome.

Economic Perspective

Recently, several studies have incorporated financial aid variables in persistence models. However, the results are contradictory and the outcome measures include within-year persistence, year-to-year persistence, credit hours earned, student price response coefficient, and price elasticity (Astin, 1975; Moline, 1987; St. John, 1991a; Leslie & Brinkman, 1988; Vorhees, 1985; and Tinto, 1990). Much of the research has been done at the national level, using large databases collected by various agencies.

In an institutional study, Vorhees (1985) examines the role of campus-based financial aid (Supplementary Educational Opportunity Grants, College Work Study, and National Direct Student Loans) in

persistence, using data from an urban commuter institution. He suggests a model of persistence that ties various sources of financial aid with other variables and uses a LISREL (Linear Structural Relations) analysis. LISREL is an improvement over the path analysis techniques used in previous research, according to Voorhees, because ". . .it allows researchers to relax certain of the more restrictive assumptions mandated by the use of traditional path analysis" (p. 22).

The three variables that have the greatest impact on persistence are cumulative grade point average, the National Direct Student Loan, and College Work Study (CWS). Moreover, students receiving CWS are more likely to be involved in campus activities. Support is not found for the notion that loans have a negative effect on persistence. Perhaps, Voorhees suggests, "Future commitment implied by receipt of a loan may pose sufficient incentive for students to approach college more seriously" (p. 28). From a policy perspective, Voorhees' findings are significant, since campus-based financial aid programs are controlled by

financial aid offices, and the persistence model presents variables which can be directly influenced by the institution.

Moline (1987), in a single-institution study, finds no significant relationship between financial aid and persistence, but discovers both direct and indirect effects of background variables. Moreover, she identifies academic variables, rather than social integration variables, as the key to persistence in an urban, commuter institution. Her outcome measure for persistence is number of credit hours completed.

In a national study, Astin (1975) looks at the differential impact of aid on persistence to completion of the college degree. He finds that reliance on support from a parent or spouse; participation in work-study; support from ROTC; and receipt of scholarships or grants increase the chance of persistence. However, the results of his study were skewed by the negative role of loans in first-to-second-year persistence.

Using national data, Terkla (1985) examines the role of financial aid in withdrawal from the higher

education system in general, rather than withdrawal from a particular institution. In her model, background variables do not have a strong effect on persistence. The three variables with the strongest direct effects are degree level goal, high school grades, and financial aid.

In a national study, Carroll (1987) suggests a "threshold" effect, finding that overall grants are effective in promoting persistence but that larger grants may be effective while smaller grants are not.

He suggests that despite "the billions of dollar spent on financial aid, some students still face poorer chances of success in college" (p. 9).

Specifically, Afro-American and Hispanic students are much less likely to persist to degree completion than white students.

In another national study, St. John, Kirshtein, and Noell (1990) conclude that social and educational background can have differing effects on persistence at different points in the college. The college experience (full-time attendance and grades) and financial aid have a positive effect on persistence

for each year of attendance. Finally, they find that federal grants and loans have an impact on persistence, especially long-term persistence (St. John, 1991b).

St. John (1989b) examines the influence of student financial aid using cohorts from 1972, 1980, and 1982. This time span affords an opportunity to discern how the changes in financial aid philosophy have had an impact on persistence. Loans alone had a negative influence on persistence in the 1970's, but a positive influence in the 1980's. This agrees with earlier research (Astin, 1975). With this exception, both loans and grants have a positive impact on persistence during the first three years of college. However, no form of aid is significant in the fourth-to-fifth-year transition (graduation). This implies that the closer a student comes to graduation, the less aid influences persistence.

In another national study, St. John (1990b) examines how the amounts of financial aid and tuition charges effect year-to-year persistence. Using data from the early 1980's, he finds that persistence

decisions are more responsive to increases in aid (grants, loans and work study) than increases in tuition. In this study, students are more responsive to changes in tuition only between the second and third years of college. This finding represents a significant departure from the student demand studies, and may signal a shift in student response.

Several of these institutional studies are contradictory. St. John (1990c) suggests: One possible explanation for the discrepancies in findings from institutional studies is that the students in the same institutions are subject to the same tuition charges and the same packaging philosophies. . . Another possibility is that there are differences in logical and statistical models used at the institutional levels that result in discrepancies in the effects of student aid when institutional studies are compared.

The implications of this are important for researchers. If these discrepancies are a result of the relatively little variation in tuition pricing and financial aid awards, this could place an important limitation on research on the impact of financial aid at the institutional level. If, however, the discrepancies are a result of shortcomings in the

logical models used, this argues for a new look at alternative models coupled with statistical testing.

In the following sections, logical models and statistical methods are suggested which may accomplish this standardization. This uniformity is particularly useful for institutional studies.

The Matriculation Model

In the research on both attendance and persistence, a number of variables have been studied.

To accurately specify a dynamic model of matriculation which embraces both attendance and persistence, critical and non-critical variables need to be identified.

St. John (1991, in press) identifies five criteria for models to investigate the impact of aid at the institutional level. First, the models must be logically sound and include all of the factors that the research literature has demonstrated influence matriculation. Second, the models must be amenable to the use of extant institutional data. Third, the research methodology should be sound, but understandable and accessible to administrators on the

average college campus. Fourth, there must be sufficient control for variables other than student aid that may affect matriculation. Fifth, the results must be useful to administrators at the institutional level. First-time Attendance Model

A review of the three main traditions of literature recognizes three major factors as necessary for an attendance model. They are: background, achievement, and price. Each are discussed separately.

Background. Common sense suggests that a student's background is a major influence in the college matriculation decision. Most of the research (Alexander & Eckland, 1975; Blau & Duncan, 1967; Dresch, 1975; Hearn, 1983; Hu & Stormsdorfer, 1973; Hoenack & Weiler, 1977; Kohn et al., 1974; Manski & Wise, 1983; Radner & Miller, 1975; Rosenbaum, 1980; Trent & Medskar, 1968; Urahn & Hearn, 1984; and Wolfle, 1985) reports that general background variables effect enrollment. These general background variables include parents' education, occupation and income, or socioeconomic status. The effects are both

direct and indirect, with the latter manifested through mediating variables.

The sociological studies confirm the importance of background variables. Blau and Duncan's (1967) study shows the significant effect that a father's education has on his son's achievement. Later studies (Sewell & Shah 1967; Alexander & Eckland, 1975; Trent & Medskar, 1968) expand and extend this theme by looking at other background variables, including mother's education, aspirations, and neighborhood influence.

Many economic studies include family or parental income as the single background variable (Alexander & Eckland, 1975; Hoenack, 1968; Hoenack & Weiler, 1977; Galper & Dunn, 1969; Hu & Stromsdorfer, 1973; Jackson, 1978; Terkla & Jackson, 1984; Radner & Miller, 1975; and Wolfle, 1985). In almost all of these studies, the income variable has a significant effect on matriculation or achievement. Surprisingly, ethnicity and sex are variables in only a few studies (Alexander & Eckland, 1975; Hansen, 1987; Terkla & Jackson, 1984; and Wolfle, 1985).

In all of this research, the commonality is that background variables do have a significant effect on college enrollment and attainment. How background is defined and its significance varies from study to study. However, the clear conclusion is that background must be included in an institutional matriculation model.

Achievement. Many of the studies contain a measure of achievement. The most common measure is high school grade point average (GPA) (Alexander & Eckland, 1975; Dresch & Waldenberg, 1978; Hearn, 1983; Jackson, 1978; Kohn et al., 1974; Manski & Wise, 1983; Radner & Miller, 1975; Rosenbaum, 1980; Trent & Medskar, 1968; and Urahn & Hearn, 1984). Class rank (Manski & Wise, 1983 and Hoenack & Weiler, 1977) and test scores (Hoenack & Feldman, 1969; Corrazzini et al., 1972; Manski & Wise, 1983; Jackson, 1978; Sewell & Shah, 1967; Sewell & Hauser, 1976; Alexander & Eckland, 1975, Trent & Medskar, 1968; Radner & Miller, 1975; and Hoenack & Weiler, 1977) are other measures of ability. As Terkla and Jackson observe, "Even when background variables are controlled, student's ability

has a very strong influence on matriculation decisions" (1984, p. 19). This argues for the inclusion of achievement in the institutional model.

Price. Price-related variables are found in over 70% of the literature reviewed here. The variables take the form of tuition costs (Dresch & Waldenberg, 1978; Hearn, 1984; Hoenack & Weiler, 1977; Hu & Stormsdorfer, 1973; Kohn et al., 1974; Manski & Wise, 1983; McPherson & Shapiro, 1989; Radner & Miller, 1975; Seneca & Taussig, 1987; and Terkla & Jackson, 1984) or financial aid offered (Hansen, 1987; Hoenack & Weiler, 1977, Hu & Stormsdorfer, 1973; Jackson, 1978; Jensen, 1983; Leslie & Brinkman, 1987; Manski & Wise, 1983; Schwartz, 1986; Seneca & Taussig 1987; St. John & Noell, 1989; and Tierney & Davis, 1985).

Two conclusions emerge from this body of research (Terkla & Jackson, 1984). First, the price of an education has a direct impact on enrollment. Second, financial aid also has a strong independent effect on matriculation. Since much of the research on the impact of specific types of aid on persistence has been very recent (e. g. St. John & Noell, 1989 and St.

John, 1991c), this represents a new avenue of exploration.

Other variables. Several other variables are included in some of the access models described in the literature. The first is college characteristics. These may indeed have an influence on college choice.

However, the local model examines data from a single institution. Without surveying each applicant, these data are not available.

Another variable included in some studies is preparation. This includes high school track or neighborhood context for the school. These data were not available for this study.

Dresch (1975) concludes that the labor market has an impact on college choice. However, in a deteriorating job market, these effects may show up as declining high school graduation rates rather than a decrease in college enrollment. Bishop (1975) reports that the effect of foregone earnings has little effect on college attendance. Wage rates and labor market effects probably do have an impact on college attendance. However, these changes may manifest

themselves over a period of time. For a single cohort of students graduating from high school, this effect will be minimized. Further, the labor market effects are similar within the same region of the country.

Aspirations are included in several of the studies (Alexander & Eckland, 1975; Hearn, 1983; Hoenack & Weiler, 1977; Jackson, 1978; Rosenbaum, 1980; Trent & Medskar, 1968; and Urahn & Hearn, 1984).

While there is some evidence that aspirations are important to college choice, the problem of measuring aspirations is a difficult one. A summary of the variable specifications discussed here is found in Table 1.

Institutional First-time attendance model.

One of the challenges of developing an institutional access model is that of using existing data. While the three main factors are represented by various variables, data are not available to support all of the variables discussed above. The difficulty is to develop a valid model based on extant data.

In step 1 the proposed institutional matriculation model, in which access is defined as: First-time attendance = f (background, achievement, and

student aid)

The background variables include income, sex, ethnicity, marital status, and dependency. Background has direct and indirect effects on academic ability, student aid, and the attendance decision.

The achievement variable uses test scores. The scores - either the SAT or ACT - are converted by use of a crosswalk if necessary (Astin, 1971). The achievement variable has an impact on financial aid and matriculation.

The final factor is student financial aid. The aid variables are receipt of any aid, total aid, grants, loans, Pell grant, scholarships and College Work Study. These have a direct influence on the matriculation decision.

Once an individual chooses to attend college, some of the variables in the model influence the decision to remain in college. Persistence is discussed in the following section.

Persistence Model

Steps two and three of the matriculation model, Persistence 1 and Persistence 2, are similar to the

attendance portion in several ways. The review of the literature identifies four factors in the persistence model. They are background, achievement, college experience, and financial aid.

Background. Like the access literature, the persistence literature demonstrates the importance of background variables on persistence. Socioeconomic status is included in most of the studies (Moline, 1987; Pascarella & Terenzini, 1980; Pascarella & Terenzini, 1983; Pascarella et al., 1983; Spady, 1971; Terkla, 1985; Tinto, 1975; Vorhees, 1985; Andrieu, 1990; Carroll, 1987; St. John, 1989a; and St. John, 1990b). Both race (Pascarella et al., 1983; St. John, 1990a, Terkla, 1985; Vorhees, 1985; Andrieu, 1990; Carroll, 1987; St. John 1989a; and St. John 1990b) and sex (Moline, 1987; Pascarella & Terenzini, 1983; Pascarella et al., 1983; Terkla, 1985; Vorhees, 1985; Andrieu, 1990; Carroll, 1987; St. John, 1989a; and St. John 1990b) are separately identified as having an effect on persistence. With the growing concern about minority student persistence, it is clear that general socioeconomic status, as well as ethnicity must be

contained in the local model. In addition, the differential achievement rate for women (Pascarella & Terenzini, 1983) argues for the inclusion of this variable also.

Achievement. As in the access portion of the model, achievement is an important factor. For the reasons listed previously, achievement is included in steps two and three of the model.

College experience. The college experience factor contains a range of variables. The first is college GPA, probably the most straightforward measure of success. GPA is cited by several researchers (Pascarella & Terenzini, 1980; Spady, 1971; Terkla, 1985; and Vorhees, 1985) as being significant in persistence. Attendance status (full-time/part-time) is the second variable.

The third experience factor is academic integration, which was described previously. Several researchers (Pascarella & Chapman, 1983; Pascarella & Terenzini, 1980; Pascarella & Terenzini, 1983; Pascarella et al., 1983; Pascarella et al., 1981; and Tinto, 1975) conclude that various measures of

academic integration effect persistence.

The fourth measure of college experience is social integration. Pascarella & Chapman, 1983; Pascarella & Terenzini, 1980; Pascarella & Terenzini, 1983; Pascarella et al., 1983; Pascarella et al., 1981; Rootman, 1972; Spady, 1971; and Vorhees, 1985 all find that various types of social integration influence persistence.

Several of the studies find that academic (Moline, 1987; Pascarella et al., 1983; and Spady, 1971) or social integration (Pascarella & Terenzini, 1980; and Pascarella et al., 1981) variables are significant in persistence. The challenge, of course, is to find adequate academic and social integration measures from extant institutional data. The literature reviewed here indicates that a measure of integration is necessary in an institutional matriculation model.

Financial aid. While common sense suggests that aid effects persistence, only recently have total financial aid (Moline, 1987 and Terkla, 1985) and specific types of aid (St. John 1990a; Vorhees, 1985;

Carroll, 1987; St. John, 1989a; and St. John, 1990b) been found to effect persistence. Moreover, St. John (1990a) suggests that students are more sensitive to aid than to price. These studies indicate that total financial aid, receipt of any aid, and the specific types of aid should be included in the model.

Institutional Matriculation Model - Steps 2 and 3

In the institutional matriculation model, persistence can be described as:
 Persistence = $f(\text{background, ability, financial aid, and college experiences})$

where Persistence 1 = within-year persistence and

Persistence 2 = year-to-year persistence

The background variables include income, sex, ethnicity, marital status and dependency. Background has direct and indirect effects on academic ability, college experience, student aid, and persistence.

The achievement variable uses test scores. The scores - either the SAT or ACT - are converted by use of a crosswalk if necessary. The ability variable has an impact on college experiences, financial aid, and persistence.

There are two college experience variables in this model. The first is college grade point average (GPA). The other is participation in the College Life program, a retention program.

The final factor is student financial aid. The aid variables are total aid, grants, loans, Pell grant, scholarships and College Work Study. These have a direct influence on persistence.

The local attendance and persistence models presented here incorporate economic, sociological and interdisciplinary research. The access model contains background, achievement, and student aid variables. Persistence is portrayed as a function of background, achievement, financial aid, and college experiences. Because these are both institutional models, the challenge is to use extant data for the analysis. The method for doing this is described in the following chapter.

Chapter 3

Method

Introduction

The purpose of this dissertation is to develop and test a workable dynamic student matriculation model that can be used in institutional research on the impact of student aid. This chapter discusses the methodology used to accomplish this objective and contains sections on the sampling, statistical method, model specifications, and limitations.

Sample

The subjects for the enrollment study are the 2558 admitted applicants to the first-year class for the fall semester of 1989 at an urban, commuter institution of 16,000 students. Located in a large metropolitan area, the university is ranked "Doctoral II" by the American Association of Universities. Most of the student financial aid is federal, with the notable exception of full scholarships for National Merit Finalists. These scholarships include room, board, tuition, and a semester of study abroad. For the within-year persistence study, the subjects are

the students who entered this same institution as first-year students in the fall of 1989 who enrolled for the spring of 1990. For the year-to-year persistence study, the sample consists of the group that entered in the fall of 1989 and who were enrolled again in the fall of 1990.

The data on the subjects were obtained from extant university sources, including the computerized admissions records system, the computerized financial aid management system, the computerized student records system, and the records of the Office of Retention. Two of the university's academic programmers retrieved the data and downloaded it onto a floppy disk. The data were extensively edited and reformatted using PC-FOCUS and the initial runs to test the model were done using STATPAC GOLD on a personal computer. The data were then uploaded to the university's mainframe computer and analyzed using SAS version 6.06.01.

Appendix B indicates the source of each variable; not all data received were used in this study. An identifying number was assigned to each record for the

purposes of matching data from the four sources. Permissions were secured and the confidentiality of the data was maintained throughout the study. The number of cases for each step of the model is indicated below:

Group	Number
Applicants	2726
Admitted applicants	2558
Enrolled in fall of 1989	1903
Persisted to spring 1990	1478
Persisted to fall 1990	1142

Admissions Records

The Office of Admissions computerized record system provided data for the 2,726 applicants for first-time study in the fall semester of 1989. The admissions system provided the data on sex, ethnicity, test score, age, zip code, and admission status. The university provided information on all applicants, however, only the 2,558 admitted applicants are included in this study.

Financial Aid Records

The Financial Aid Office computerized record

system provided data on dependency status, marital status, income, aid offered (aid/no aid), aid package offered, grant award, Pell Grant award, work study award, and scholarships offered.

Retention Records

The Office of Retention provided lists of students participating in a special retention program.

The lists included the student identifying number. The data were entered into the computer by hand.

Student Records

The university's computerized student record system provided data for several variables. Included were the enrolled flag (enrollment for fall of 1989), persistence 1 (enrollment for spring 1990), persistence 2 (enrollment for fall 1990), credit hours completed by spring of 1990, grade point average for spring of 1990, credit hours completed by fall of 1990, and grade point average for the fall of 1990.

Statistical Method

Introduction

To describe the relationship between an outcome (dependent) variable and one or more explanatory

(independent) variables, statistical regression methods are used. Regression techniques are used to find the "best fit" between the explanatory variables and the outcome variable.

Linear Regression

In a linear regression model, the outcome variable is assumed to be continuous; it can take on any value in a given range. The general equation of the linear regression model is:

$$L = E(Y|X) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \quad (1)$$

where $E(Y|X)$ is the expected value of Y (the outcome variable) given " n " explanatory variables X_1, X_2, \dots, X_n . The regression equation is used to find the values for the coefficients $\beta_0, \beta_1, \beta_2, \dots, \beta_n$ to best predict the outcome of Y based on the sample data. This is termed Ordinary Least Squared (OLS) regression and the result is a straight line.

Logistic Regression

For a model where the outcome variable is dichotomous (such as this study), OLS regressions can seriously misestimate the dependent variable. Instead, a technique known as logistic regression is

used. Since a student chooses to enroll or not, and later chooses to persist or not, the outcomes are dichotomous: either yes or no (coded as 1 or 0). The resulting graph of the relationship is not a straight line, but a curved line bounded by 0 and 1.

Mathematicians have constructed a function called the natural logarithm, $\ln X$, which is derived from calculus (Thomas, 1968). The definition of the natural logarithm is less important to researchers than its properties, which include:

- (1) It is continuous.
- (2) It is only defined for positive values of X .
- (3) It has an inverse function, denoted e^X , or $\exp(X)$, which is continuous and is always greater than zero for any value (positive or negative) of X .

This property of $\exp(X)$ always being greater than zero is used in the equation:

$$Y = \frac{\exp(X)}{1 + \exp(X)} \quad (2)$$

With this formula, if $\exp(X)$ is very small (almost zero) the value of Y is approximately zero, while if $\exp(X)$ is very large, the value of Y is

almost 1. Thus this mathematical construct results in values that are always between zero and one.

If instead of X in the above equation the regression model is used, i.e.

$$X = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

where n represents the number of variables in a given study, then this substitution defines the basic logistic regression model:

$$P = E(Y|X) = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)}{1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)} \quad (3)$$

Regardless of the values of the constants β_i or the variables X_i , this equation still results in values between zero and one, because of the properties of the natural logarithm. The value P can also be thought of as a probability measure that the outcome variable will be 1 (yes). This is precisely what a dichotomous model requires.

A great deal of statistical work has been done with the linear regression model in equation (1). The dichotomous model (3) can be made to look exactly like the linear model by performing a mathematical device called the logit transformation as follows:

$$g(X) = \ln \frac{Y^{\frac{P}{\Gamma}}}{1 - P} \frac{1}{N} \quad (4)$$

Substituting the logistic regression model for P , and using the properties of the natural logarithm $\ln X$ and its inverse function $\exp(X)$, this equation is reduced to:

$$g(X) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

which is the general equation used in the linear regression model. This allows the values of β_i for the dichotomous model to be calculated using the same well-documented techniques as the standard linear model. Also, according to Afifi and Clark (1984), this transformation has the benefit that no assumptions are necessary concerning the distributions of the X_i variables. This is a major advantage to model builders since independent variables may by their nature be either discrete or continuous and logistic regression may be used for either type.

The Probit Model

Another method for doing analysis is called the probit transformation, which is based on the

cumulative normal distribution rather than the logarithmic distribution. According to Aldrich and

Nelson (1984, p. 34),

The logistic and normal curves are so similar as to yield essentially identical results. In practice they yield estimated choice probabilities that differ by less than .02 and which can be distinguished, in the sense of statistical significance, only with very large samples. The choice between them, therefore, revolves around practical concerns such as the availability and flexibility of computer programs and personal preference and experience.

In this study, the logit transformation is used instead of the probit transformation, primarily because of its availability on various computers.

Fitting the Regression Model

In a dichotomous model, the actual "outcome" is zero (no) or one (yes), but the estimated value of the outcome is somewhere between zero and one. This results in calculation of an error in estimation, designated ϵ which takes on one of two possible values and is expressed with an associated probability (Hosmer & Lemeshow, 1989). If the actual outcome for a sample is 1, then $\epsilon = 1 - g(X)$ with the probability of $g(X)$; if the actual outcome is 0, then $\epsilon = -g(X)$

with the probability of $1 - g(X)$. Thus, the error estimation variable ϵ has a distribution with mean zero and variance equal to the product $g(X) [1 - g(X)]$.

The logistic regression model given by equation (3) is "fit" to an experimental set of test data using a method of estimation for the coefficients (β_0, β_1 , etc.) called a maximum likelihood estimation. This is done by defining a log likelihood equation:

$$L(\beta) = -\sum_{i=1}^n \{Y_i \ln[g(X_i)] + (1 - Y_i) \ln[1 - g(X_i)]\} \quad (5)$$

where Y_i is the outcome for observation i and $g(X_i)$ is the logit transformation for observation i .

A computer is used to find the values of the coefficients in the regression model (1) that maximize the value of $L(\beta)$, using an iterative trial-and-error process, until the value converges to a maximum with some given tolerance. The result, the log likelihood function, is a measure of the model's fit to the experimental data, the highest probability of obtaining the observed sample.

Testing for Significance

Two measures for testing the significance of the model are used. The first is a measure of each independent variable's effect on the dependent variable. To measure this, the t -statistic is used for testing the null hypothesis that the coefficient B_i is zero, which means that the i th variable has no effect on the independent variable. The t -statistic

for each variable is compared to a one- or two-tailed value of the Student's t -distribution with $n-k$ degrees of freedom, where n is the sample size and k is the number of independent variables. If the computed statistic exceeds an a priori significance level, the null hypothesis is rejected, and the explanatory variable is judged significant to the outcome (Aldrich & Nelson, 1984). The significance level chosen for this study is .05.

The second measure relates to goodness of fit, which uses a likelihood ratio statistic:

$$C = -2 \ln (L0 / L1) = -2(\ln L0 - \ln L1) \quad (6)$$

where $L1$ is the value of the likelihood function for the full model and $L0$ is the maximum value of the likelihood function if all coefficients except B_0 (the intercept) are zero (Aldrich & Nelson, 1984). The value of C is compared to a critical value of the χ^2 statistic with $k-1$ degrees of freedom (k = number of independent variables), and a desired significance level (again, .05 for this study). If the value of C exceeds the critical χ^2 value, the null hypothesis is rejected, i. e. the model as a whole is significant in

predicting the outcome variable.

Model Plausibility

In regression analysis, R^2 , the coefficient of determination, is calculated to measure the proportion of the variance "explained" by the independent variables. R^2 uses the sample mean and variance, and a "best fit" of the model is found by minimizing the variance by adjusting the sample mean. In dichotomous models measured by logit, however, the mean P and the variance $P(1 - P)$ are both dependent on the same parameter P . Further, the variance is obviously minimized (i.e. zero) when P has a value of either 1 or 0, regardless of the sample data. Thus, for dichotomous models, "minimizing the variance" is not a useful concept (Aldrich & Nelson, 1984).

Measures of dichotomous model plausibility (called "pseudo R^2 " measures) have been proposed, including one by Aldrich and Nelson (1984) defined as:

$$\text{pseudo } R^2 = C / (N + C) \quad (7)$$

where $C = \chi^2$ statistic for overall fit, and $N =$ total sample size. This measure has the advantages that it is easy to compute, and it ranges between zero and

one. If the χ^2 statistic is small (i.e. the quality of fit is low), this measure will be close to zero; if the χ^2 statistic is large, the measure will approach 1.

However, this measure also has disadvantages. There is no "penalty" for increasing the number of dependent variables (such as number of degrees of freedom), and the measure is not universally accepted. In concluding their discussion of "pseudo R^2 " measures,

Aldrich and Nelson warn:

"[The discussed formulations] of R^2 type measures have disadvantages, as do others that have been proposed. The most consequential criticism is probably that no one measure is universally accepted or employed (combined with the belief by many that no such measure should be employed)...Our recommendation, therefore, is to use summary measures with extreme caution, if at all."

Delta P

One of the most important questions posed by model users is will a change in the independent variable have a positive or negative impact on the outcome? This question is answered by computing a statistic called "delta P," which measures the effect on the dependent variable given a change of one unit in a selected independent variable.

A commonly used calculation for delta P is:

$$\text{Delta P} = \beta_i P(1-P)$$

where P = the sample mean of the dependent variable, and β_i = the coefficient of the i th independent variable. In a discussion of the use of this measure for logit and probit models, however, Petersen (1984) points out that the result of this calculation may well be greater than 1 in absolute value, leading to estimated changes in the dependent variable outside the zero-one range. He proposes this alternate calculation:

$$\text{Delta P} = \frac{\exp(L_1)}{1 + \exp(L_1)} - \frac{\exp(L_0)}{1 + \exp(L_0)} \quad (8)$$

where L_0 is the logit score before the change in the i th variable, and $L_1 = L_0 + \beta_i$ is the logit score after the unit change in X_i . This calculation can be done easily with a computer spreadsheet program that contains exponential functions, and a Delta P value for each independent variable in the model can be calculated. The delta P can be used as a Standardized Price Response Coefficient (SPRC) (Leslie & Brinkman, 1988).

SPRC

St. John (1991b) indicates problems in deciding which type of price response measure to use in research on the impact of student financial aid. Recent studies use differential price-response measures by type of price change for all students and by income levels (St. John, 1990c); differential price measures by type of price change (grants, loans, tuition, work study) for all students (St. John, 1990d); a standardized measure from a trend analysis (McPherson & Shapiro, 1989), and a standardized price-response coefficient (SPRC) from a meta analysis (Leslie & Brinkman, 1988).

St. John (1991b) suggests four ways to analyze price response:

- (1) Aid only (receipt of any aid).
- (2) Receipt of aid package (e. g. more than one type of aid).
- (3) Total aid.
- (4) Type of aid.

There are two ways to use price-response coefficients in planning models (St. John, 1991b).

The first is as an estimation of participation rates in projection models. Second, the SPRC can be converted to a price elasticity, which is then used to estimate enrollments after participation rates are calculated. Since about one-third of the eligible population attends institutions of higher education, this figure is multiplied by three to obtain a price elasticity (Leslie & Brinkman, 1988). If the price elasticities are significant, they will be presented in chapter 5.

Model building

Selection of model variables is a mixture of statistical testing and logic. Logic requires that all factors be represented; specific variables can then be chosen using statistical testing. Hosmer and Lemeshow (1989) indicate several methods of statistical model testing. A combination of the statistical and logical methods is used in this study.

Model Specifications

The independent variables used in the three models are described below. The following section enumerates the variable specifications for each model.

Factors

Background. The factor of background includes the following variables: ethnicity--Black, ethnicity--Hispanic, gender, age, dependency, and need (three variables). Ethnicity includes two variables to allow for comparison of ethnic groups (St. John, 1991a). For the Afro-American variable, Black = 0 and Others = 1; for the Hispanic variable, Hispanic = 0 and Others = 1.

Gender is coded as 0 = male and 1 = female to allow for analysis of differences by sex. While prior research on access is silent on the gender issue, the persistence literature (Pascarella & Terenzini, 1983) shows sex differences. The numeric variable, age, is also included.

Because some applicants did not provide data on family income, three variables address income, which serves as a proxy for need. Applicants are categorized as 0 = No and 1 = Yes for each of the need categories. The low-income category (0 - \$15,000) represents high need; the middle-income range (\$15,001 - 40,000) represents moderate need; and the high-

income range (\$40,001+) signifies low need.

Achievement. One variable represents the factor of achievement. That variable is test scores, as indicated by the ACT composite test score. While the institution accepts both SAT and ACT scores, the preferred test is the ACT. SAT scores are converted to ACT scores by use of a crosswalk (Astin, 1971).

Student financial aid. The factor of student financial aid is represented by ten variables: financial aid offered, aid package offered, total financial aid offered, Pell Grant offered, financial aid amount, grant offered, work-study offered, loans offered, scholarships offered, other aid offered, and grants + scholarships offered. This elaborate coding facilitates the analysis described previously.

The first variable, financial aid offered, gives an indication of whether or not aid was given to the student. A "0" means that no aid was offered, while a "1" signifies that it was given. The second is financial aid package offered (0 = No and 1 = Yes). The third variable is the total financial aid offered, divided by 1,000 to allow for comparisons by one-

hundred-dollar increments.

Several variables represent the amount and type of aid given. In each of these cases, the amount is divided by 1,000. The first variable indicates the amount of total financial aid. The other variables indicated the amount of grants, work-study, loans, Pell grant, scholarships, and "other dollars." Grants and scholarships are also added to comprise a variable.

College experiences. Six variables indicate experiences during the first year of college. The first variable, grade point average, is the most typical indicator of student performance in college. Measured on a four-point scale, the GPA is rounded off to the nearest tenth. GPA 1 is for the spring of 1990 and GPA 2 is for the fall of 1990.

The second variable is participation in the retention program. This is included because it met the criterion of academic integration in the Tinto model. The variable was coded 0 = no and 1 = yes.

The third variable is attendance status (full-time, part-time). Full-time students are coded as yes

("1") and part-time students are coded as no ("0"). Two variables, credit 1 and credit 2, indicate the number of credit hours earned as of the spring and fall of 1990 respectively.

First-time Attendance Model Specifications

The independent variables for this model are gender, ethnicity--Black, ethnicity--Hispanic, age, test score, independence, low need, moderate need, high need, aid offered, aid package offered, total financial aid offered, Pell Grant offered, loans offered, grants offered, work study offered, other aid offered, scholarships offered, and grants + scholarships. The dependent variable is enrollment for the fall semester of 1989. Each of the four analyses described previously are used for this model.

Within-year Persistence Model

The independent variables for this model are gender, ethnicity--Black, ethnicity--Hispanic, age, test score, independence, low need, moderate need, high need, aid offered, financial aid package offered, total financial aid offered, grants offered, Pell Grant offered, loans offered, work study offered,

scholarships offered, other aid offered, grants + scholarships offered, grade point average 1, attendance status, credit 1, and retention program participation. The dependent variable is Persistence 1. As with the first-time attendance model, the four analyses are performed on the sample of students from the original population who registered for the spring semester of 1990.

Year-to-year Persistence Model

The independent variables for this model are gender, ethnicity--Black, ethnicity--Hispanic, age, test score, independence, low need, moderate need, high need, aid offered, financial aid package offered, financial aid amount, grants offered, Pell Grant offered, loans offered, work study offered, scholarships offered, other aid offered, grants + scholarships offered, grade point average 1, attendance status, credit 2, and retention program participation. The dependent variable is Persistence 2. Again, the four versions of the model are tested using the sample of students from the original population who enrolled for fall semester of 1990.

Limitations

There are two key limitations to this study which relate to the statistical method. The first is the use of extant institutional data. In no case is this more limiting than with the variable of income. Because not all students applied for financial aid, income information is only available for 933 admitted students. To adjust for this, three income variables are created (low, middle, and high income). Each person is either coded as a "yes" for the variable or a "no/no information."

This treatment of the data has been used in other studies (Hosmer & Lemeshow, 1989). However, at best, this scheme only serves as a proxy for financial need.

One of the key limitations of this study is that without the manipulation of the data, this research could not be done.

A second limitation of the study is the statistical method. Logistic regression is the only method of analysis when the dependent variable is dichotomous. While other types of analysis may be more desirable, logistic regression is currently the

only method which can be used. Further, it is assumed that there is a relationship that can be measured between the independent variables and the dependent variable, and all significant variables are included in the model.

A third limitation is that a single sample is used in the study. A different sample might produce another set of results.

To reduce these limitations, the most rigorous method possible has been chosen. Advanced model building and testing techniques are used. However, additional testing of the models with data from other sources will be necessary to confirm the results.

Summary

This chapter presents first-time attendance, within-year persistence, and year-to-year persistence logical models. The sample, drawn from the applicant pool at an urban university, is described. Statistical methods, specifically logistic regression, are introduced to analyze the data; four analyses are suggested. The results of this investigation are presented in the following chapters.

Appendix A
Table 1

Variable specifications - Step 1 of Institutional Model

<u>Critical variables</u>	<u>Non-critical variables</u>
income	parents' occupations
dependency	high school grades
ethnicity	high school track
sex	high school rank
age	college characteristics
marital status	foregone earnings
receipt of any aid	neighborhood context
receipt of aid package	aspirations
grants	social integration
Pell grant	unemployment rates
College Work Study	military service rates
scholarships	tuition
loans	
test score	
total aid	

Table 2

Variable specifications - Steps 2 and 3 of
the Institutional Model

<u>Critical variables</u>	<u>Non-critical variables</u>
income	parents' occupations
dependency	high school grades
ethnicity	high school track
sex	high school rank
age	foregone earnings
marital status	unemployment rates
grants	student activities
Pell grant	neighborhood context
College Work Study	academic clubs & honoraries
scholarships	tuition
loans	aspirations
total aid	
test score	
college GPA	
academic support program	
receipt of any aid	
receipt of aid package	
attendance status	

Appendix B

Table 1

Data Sources

Variable	Source
Identifying number	All
Sex	Admissions
Race	Admissions
Test score	Admissions
Age	Admissions
Dependency status	Financial aid
Marital status	Financial aid
Income	Financial aid
Aid offered?	Financial aid
Aid package offered?	Financial aid
Grant offered	Financial aid
Pell Grant offered	Financial aid
Work study offered	Financial aid
Other grants offered	Financial aid
Scholarships offered	Financial aid
Grant + scholarship offered	Financial aid
Total amount of aid offered	Financial aid
Zip code	Admissions
Retention program	Retention program office

participation	
Enrolled for spring 1990	Student records
Credit hours completed by spring 1990	Student records
Enrolled for fall 1990	Student records
Grade point average for spring 1990	Student records
Grade point average for fall 1990	Student records
Admission status	Admissions
Enrolled flag	Student records
Attendance status	Student records

Table 2

Variable Specifications

Factor/variable	Coding	Comment
Background		
Gender	0 = male 1 = female	Compares males to females
Ethnicity - Black	0 = No 1 = Yes	Compares Blacks to others
Ethnicity - Hispanic	0 = No 1 = Yes	Compares Hispanics to others
Age	Numeric	Indicates age
Independence	0 = No 1 = Yes	Compares financially independent students to others
High need (income of 0 - \$15,000)	0 = No 1 = Yes	Compares high-need students to others
Moderate need (income of \$15,001 - 40,000)	0 = No 1 = Yes	Compares moderate-need students to others
Low need (income of \$40,001+)	0 = No 1 = Yes	Compares low-need students to others
Achievement		
Test score	Numeric	Indicates ACT (or converted

		SAT) score
Student financial aid		
Aid offered	0 = No 1 = Yes	Compares aid and non-aid recipients
Aid package offered	0 = No 1 = Yes	Compares aid package recipients to others
Total financial aid amount offered (divided by 1,000)	Numeric	Indicates total amount of aid offered
Pell grant offered (divided by 1,000)	Numeric	Indicates amount of Pell Grant offered
Grants offered (divided by 1,000)	Numeric	Indicates amount of grant offered
Work study offered (divided by 1,000)	Numeric	Indicates amount of work study offered
Loans offered (divided by 1,000)	Numeric	Indicates amount of work study offered
Scholarships offered (divided by 1,000)	Numeric	Indicates amount of scholarship offered
Other aid offered (divided by 1,000)	Numeric	Indicates other type of aid offered

Grants + scholarships offered (divided by 1,000)	Numeric	Indicates combined amount of grants and scholarships offered
College Experiences		
Grade point average 1	Numeric	GPA in spring of 1990
Grade point average 2	Numeric	GPA in fall of 1990
Credit 1	Numeric	Credit earned by spring of 1990
Credit 2	Numeric	Credit earned by fall of 1990
Attendance status	0 = Part-time 1 = Full-time	Compares full-time students with part-time students
Persistence program participation	0 = No 1 = Yes	Compares students enrolled in academic enrichment program with others
Dependent variables		
Persistence 1	0 = No 1 = Yes	Compares students enrolled in spring 1990 with dropouts

Persistence 2	0 = No 1 = Yes	Compares students enrolled in fall 1990 with dropouts
Enrolled flag	0 = No 1 = Yes	Compares students who enrolled to others

Table 3

Variables by Model

Variable	Use in models
Gender	A, P ₁ , P ₂
Ethnicity - Black	A, P ₁ , P ₂
Ethnicity - Hispanic	A, P ₁ , P ₂
Age	A, P ₁ , P ₂
Test score	A, P ₁ , P ₂
Independence	A, P ₁ , P ₂
Low need	A, P ₁ , P ₂
Moderate need	A, P ₁ , P ₂
High need	A, P ₁ , P ₂
Enrolled flag	A
Aid offered	A, P ₁ , P ₂
Package offered	A, P ₂ , P ₂
Pell Grant amount	A, P ₁ , P ₂
Total financial aid amount	A, P ₁ , P ₂
Grants offered	A, P ₁ , P ₂
Work study offered	A, P ₁ , P ₂
Loans offered	A, P ₁ , P ₂
Scholarships offered	A, P ₁ , P ₂
Other aid offered	A, P ₁ , P ₂
Grants + scholarships	A, P ₁ , P ₂
Grade point average 1	P ₁

Grade point average 2	P_2
Retention program participation	P_1, P_2
Persistence 1	P_1
Persistence 2	P_2
Credit 1	P_1
Credit 2	P_2
Attendance status	P_1, P_2

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