# DEMAND FOR HIGHER EDUCATION: A STUDY OF PRICE ELASTICITY AMONG VIRGINIA'S FOUR-YEAR INSTITUTIONS

by

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY
in
Educational Research and Evaluation

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December, 1983
Blacksburg, Virginia

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(ABSTRACT)

The purpose of this study was to model the demand for higher education enrollments and to determine whether or not enrollments were price elastic among Virginia's public four-year institutions. The underlying intent was to check the feasibility of a human capital theory based methodology for examining the demand dependency of higher education institutions in Virginia. Price elasticity and other determinants of enrollments were observed across different institutional groupings to observe the differential effects of these factors given institutional type or individual institution characteristics. The analyses were based upon the investment approach to human capital theory as adapted to the study of educational demand. Accordingly, it was assumed that individuals will display a willingness to

invest in themselves by enrolling in a college or university because they believe that such an investment will accrue both financial and psychological benefits.

Multiple linear regression was used to model five sets of determinants across three levels of analysis: statewide, institutional type (major universities, prior normal schools, and urban institutions), and individual institution. The direct cost of attendance, the size of the eligible population of prospective students, the educational attainment of the students' locale, and the rural nature of the students' environment generally were found to have significant effects on enrollment. Price, or the direct cost of attendance, was primarily negative and statistically significant for all types of institutions except the major universities and the one special purpose, military institute in the state. Several factors indicated that the location of the institution was important. In other words, students tended to enroll in nearby as opposed to distant institutions, while a geographically concentrated pool of institutions restricted the dependency of these same institutions on local student populations.

A cross-sectional design was used in this study, therefore the resultant demand models were descriptive only

of the time period covered in these analyses. Nevertheless, such research should be useful in assessing the impact on enrollments of selected demand factors and in determining the efficacy of the investment approach applied in this and similar research efforts.

# DEDICATION

This dissertation is dedicated with much love to my husband, . 's patience, encouragement, and emotional support during this study made its completion a reality.

# ACKNOWLEDGMENTS

I would like to thank my committee as a whole for an enjoyable and instructive process. My appreciation in particular goes to: my chairman, Dr. Impara, for his patience, guidance, and constant support; my cochairman, Dr. McLaughlin, for introducing me to this area of enrollment analysis; Dr. Hereford, for pushing me where I hesitated and for providing those essential recommendations that put this research into perspective; Dr. Montgomery, for his administrative and planning insights; and, Dr. Bonomo, for his explanation of the economic concepts underlying this research.

Special thanks are also extended to several other persons. First, I am indebted to , who in the event of Dr. Hereford's sudden illness served as a substitute committee member at the final exam. To my friend, , I am especially grateful for his time and thoughtfulness in helping me understand some of the econometric techniques used in demand studies. Finally, I could not have persisted in this research without the patient support, unfailing confidence, and good humor of my family

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# Chapter I

# INTRODUCTION

## Background for the Study

As state government and higher education policy makers confront the financial uncertainties of the 1980's, they increasingly are becoming concerned about future enrollment in postsecondary institutions. Much of this concern stems from an awareness that the postsecondary institution is dependent on specific groups and subgroups of prospective students. Not only do these dependencies vary from institution to institution, but the degree of dependency varies with factors often beyond the control of the policy maker. While the supply of students from a group may be beyond the immediate control of the decision maker, it is critical that the policy maker be aware and thus forewarned of possible shifts in the influx of potential enrollees. Given this knowledge, steps can be taken which help to insure the future vitality of an institution and of a statewide system of higher education.

Research on the demand for higher education and, hence, the degree to which an institution can depend on a given pool of prospective students is based primarily on the investment approach to human capital theory developed within the economics discipline. The resultant theory of

educational demand assumes that an individual will decide to invest, or enroll, in higher education if the present value of the expected stream of benefits associated with enrollment is at least equal to the present value of the direct and indirect costs of education (Becker, 1975; Blaug, 1966; Bowen, 1977; and Schultz, 1961). In other words, individuals will display a willingness to invest in themselves by enrolling in a college or university because they believe that such an investment will accrue both financial and psychological benefits.

Studies on the demand for higher education enrollments date from the 1960's, the majority of which are national or regional in scope. Although most studies are consistent in their finding of a negative relation between tuition, or the cost of attendance, and enrollment, the more important and difficult question of how much of an impact costs and other demand related factors have on enrollment is unresolved. Contributing to the difficulty in estimating these effects is the differential impact these factors have across different types of institutions and across different regions of the country (Johnson, 1976; Tannen, 1978; Minter & Bowen, 1982a; Carnegie Council on Policy Studies in Higher Education, 1980; and Feldman & Hoenack, 1969). Continued research is required before substantive information on the distributional effects of economic, demographic, and other

demand related factors is available at both the state and institutional levels.

In Virginia, several events have exposed the need for such information. A recent update of The Virginia Plan for Higher Education (State Council of Higher Education for Virginia, 1981) focused on five issues confronting higher education in Virginia in the 1980's: teacher education, student aid, education for military personnel, the costs of higher education, and business administration programs in the four-year institutions. Two of these five issues (student aid and the costs of higher education) reflect concern over enrollment demand in Virginia. This concern is based on recent changes in Virginia's funding formulas for higher education, changes that have resulted in increases in the proportion of educational costs borne by students and their families. At the same time, evidence has been found to suggest that current financial aid programs are insufficient to meet the financial needs of applicants to Virginia's public institutions.

These issues are particularly significant in light of other economic and demographic developments in the state. Not unlike the national trend, Virginia institutions experienced rapid growth in enrollments over the 1960's and early 1970's. Much of this growth can be attributed to the development of the Virginia Community College System, which

now accounts for over 40 percent of all students enrolled in public institutions. However, the growth in Virginia enrollments has slowed during the late 1970's, with slight declines expected by the mid-1980's. A declining pool of high school graduates and a stabilization, and possible decline in some instances, of the college going rates for this traditional pool of students has been identified as contributing to the deceleration of growth in the 1980's (State Council for Higher Education in Virginia, 1979).

While demographic changes in the population will undoubtedly affect Virginia enrollments in the 1980's, several economic factors are cited by the State Council of Higher Education in Virginia (SCHEV) that may further curtail the demand for higher education. Due to recent restrictions on federal spending, the burden of escalating costs for higher education will most likely bear upon the state, and students and their parents. The proposal to increase the share of revenues paid by students is a consequence of such restrictions and, unfortunately, comes at a time when inflation has diminished the discretionary income of Virginia families (SCHEV, 1981). By academic year 1983-84, the proportion of instructional costs borne by the state and the students respectively is to be shifted from 70/30 to 65/35--the increase for students to be realized through greater costs for attendance at public institutions.

Furthermore, state revenues are also constrained by current economic stagnation as well as by an increase in the demands for state revenues for other social areas such as health care, law enforcement, and retirement.

Although the decline in high school graduates may be mediated by an increased college-going adult population and sustained financial aid programs, the importance of understanding the demand for higher education among the former group is underscored by SCHEV in both its 1979 and 1981 plans. The increase in older students is not believed to be sufficient to compensate for the decline in traditional 18-24 year old students primarily because the former tend to be part-time and evidence a lower overall demand for higher education. Decreases in full-time entering freshmen also signal a potential lack of revenue to finance dormitories among residential campuses. Changes in financial aid programs, typically targeted toward the full-time, undergraduate student, need special attention in the face of rising costs, but not, states SCHEV, until it is determined how costs affect enrollment patterns. According to SCHEV, such research "will be particularly important as the 18-24 year old group...declines during the 1980's, thereby reducing the pool of traditional full-time higher education students" (p. 46, 1981).

## Purpose and Summary

The main purpose of this research was to model the determinants of enrollment, or the demand for higher education, and determine whether or not enrollments were price elastic among Virginia's public four-year institutions. Given the primarily significant and negative effect of price on enrollments in Virginia, the magnitude of this effect across different institutional groupings was of considerable interest. The analyses were based upon the investment approach to human capital theory and included: (1) a descriptive overview of selected sets of higher education enrollment determinants representing various economic, noneconomic and environmental factors; and (2) statistical analyses of the specific variables comprising each set of determinants, including estimates of price elasticity.

Multiple linear regression was used to model the determinants across three levels of analysis: for all institutions combined, for three major institutional groups or types (major universities, prior normal schools, and urban institutions), and for each individual institution. All variables were measured to correspond with a 1980 time frame. In general, it was found that the direct cost of attendance, the size of the eligible population of students, the educational attainment level for the locale in which

students reside, and the rural versus urban nature of this same locale had significant effects on enrollment among Virginia's four-year institutions. Price, or the direct cost of attendance, and the rural nature of students' environment had a primarily negative effect on enrollment, while the educational attainment level and size of the high school graduate population had positive effects on enrollment.

Differential effects across institutional groupings were observed particularly with regard to price. The direct cost of attendance proved to be nonsignificant, with mixed coefficient signs, for each of the three major universities individually and collectively. The size of the eligible population and the rural nature of students' environment reflected the dependency of some institutions on nearby localities, as well as the possible substitution of other enrollment options for public, four-year enrollment. Also, since the price variable included the cost of dormitory living for those students estimated to live beyond a reasonable commuting distance to a given public, four-year institution, this variable reflected the tendency of students to choose nearby as opposed to distant institutions. The price effect was particularly strong and negative for urban institutions and the one commuter college included in the sample--indicating the dependency of these

institutions on their local region for their enrollment base.

It should be noted that this research was based on aggregate rather than individual student data. Reasons for using aggregate rather than individual data included the unavailability of certain data and the lack of standard reporting practices across different institutions with regard to the individual student. Since the purpose of this research was directed toward statewide enrollment planning efforts, it was considered more appropriate to focus on the study of demand at the macro level by the hypothetical average individual rather than on demand at the micro level by the unique individual. Such research should be useful both in assessing the impact on enrollments of selected demand factors and in determining the efficacy of the investment approach applied in this and similar research efforts.

# Chapter II

# REVIEW OF THE LITERATURE

## Introduction

In relating the theory of human capital to the context of higher education enrollment, it is reasonable to infer that variations in factors influencing the expected stream of benefits (or rate of return) are related to variations in enrollment or demand. For instance, a rise in the expected monetary returns resulting from education should increase enrollment, while an increase in the costs of education should decrease enrollment.

This argument forms the basis of the human capital investment approach to educational or enrollment demand. Briefly, this approach hypothesizes that variations in the demand for higher education will be associated with those factors that affect the expected stream of benefits to investment in higher education. Consequently, it may be expected that: (1) the demand for higher education will vary inversely with the direct and indirect costs of education (i.e., higher costs result in less demand); and (2) the demand for higher education will vary positively with those

factors which enhance, or reduce the uncertainty of, opportunities to realize future expected returns to college enrollment (i.e., higher returns result in higher enrollments).

Since Campbell and Siegel's seminal work on enrollment demand in 1967, applied research in this area has shown increased sophistication. Simultaneously, the research has been quite disparate, incorporating a variety of data bases, functional forms, conceptual approaches, and estimation techniques. Study of the literature, however, reveals several common issues which must be considered. These issues were used in this study as criteria for evaluating five of the more prominent higher education demand studies to demonstrate the treatment of those problems which arise in investigating enrollment demand.

The remainder of this chapter is organized into three sections. In the first section, the evaluation criteria are identified and discussed. Next, each of the five studies are described briefly and evaluated using the criteria. Finally, some concluding remarks based on the critiques are provided and discussed in terms of both research and policy based perspectives.

## Evaluation Criteria

Although the enrollment demand research based on human capital theory has been disparate with regard to methodological and conceptual approaches, several specification issues or problems prove to be crucial in conducting research on enrollment demand. Five such issues are identified and discussed in this section. These issues serve as criteria for evaluating five, major empirical studies on enrollment demand in the subsequent section.

### Identification of Correlates of Demand

In traditional economics, the demand for a service is assumed to be a continuous function of economic and environmental factors. In general, the key factors included in demand analyses are: price, tastes and preferences, number of consumers, consumer incomes, prices of related goods, and range of goods available (Leftwich, 1964). Based on these factors, educational economists have identified at least three categories of demand determinants which may be classified as: economic--factors demonstrating the direct/indirect costs of enrollment and the ability to finance education; noneconomic--factors demonstrating academic ability, educational background, and tastes or preferences; and environmental--factors demonstrating familial, local, or regional characteristics which influence the propensity to attend college. In general, these

determinants reflect correlates of demand resident in the person (i.e., the student or the student as representsed by the family unit) versus those resident in external factors (e.g., an institution, local area, government policy, etc.).

Factors resident in student. Two economic factors related directly to the student (or the student and his/her family) are suggested by the investment approach to demand analysis. These are ability to pay and socioeconomic level. Since most research on enrollment demand focuses on beginning entering freshmen, these factors typically are measured at the corporate, or family, level because most freshmen students are presumed to rely on family resources to finance their postsecondary education. Family income, therefore, represents students' ability to finance their investment in higher education. As family wealth increases, there is less constraint on the option to pursue further education and students and their families are more likely to choose institutions whose costs/returns are relatively high. Socioeconomic level is sometimes used as a proxy for family income; however, it more often is used to stratify data in order to examine the distributional effects of family status on enrollment demand. Both family income and socioeconomic level are expected to bear positively on demand.

Noneconomic demand factors resident in the student include academic ability, sex, and race. Student ability reflects not only the students' capacity to overcome any nonprice rationing that may exist via college admissions policies, but also the students' probable expected return from a college education. In other words, the higher the students' ability the less their risk in investing their resources (nonmonetary and monetary) in higher education (Blaug, 1966; and Becker, 1975). Academic ability also is assumed to be related to the students' tastes and preferences for education; that is, students of higher ability will prefer to continue their education and, most likely, at relatively selective institutions. Student ability is expected to have a positive impact on enrollment.

Use of sex and race variables has been slight in enrollment demand studies. In most cases, these variables were included to examine the distributional effects of explanatory variables on various sex/race subgroups. While Becker's (1975) theoretical and empirical analyses of the differing rates of return to higher education for white males, nonwhites, and females concluded that white males realized the highest rate of return (and, therefore were more likely to attend college), significant results for sex, at least, have not been evidenced in recent applied demand studies (Radner & Miller, 1975; and Tierney, 1980).

According to Becker, variation in rates of return within a given sex/race group was much greater than could be explained by the variation in ablilty alone. Thus, sex/race cohort differences may not be as helpful in examining enrollment patterns as other student demographic variables. Nevertheless, more research incorporating sex/race cohorts is required before substantive comment about the differential effects of sex/race on enrollment demand is possible.

Environmental factors unique to students involve their family background. Parents' educational level or attainment has been the primary focus for this category of factors. Drawing upon the sociological research on educational tastes, researchers of educational demand have argued that enrollment demand increases as successive generations achieve ever higher terminal education levels (Blaug, 1966; and Brazer & David, 1962). This variable has been used frequently as a proxy for family income, however its function as an indicator of students' propensity or taste for higher education was most often noted. Studies have shown that family educational background has a differential positive effect across various income groups, the strongest effect being evidenced at lower socioeconomic levels.

Financial difficulties notwithstanding, students may still be inclined to continue their education due to the regard for education present in their home environment.

External factors of control. The human capital approach to educational demand recognizes that expenditures on education represent an investment not fundamentally unlike other modes of investment. The resultant theory of educational demand assumes that students will decide to invest, or enroll, in higher education if the present value of the expected stream of benefits associated with enrollment is at least equal to the present value of the direct and indirect costs of education (Becker, 1975; Blaug, 1966; Bowen, 1977; and Schultz, 1961). These costs represent the economic category of external factors influencing enrollment demand.

The costs of higher education are divided into two components: direct and indirect. Direct costs include direct monetary outlays in the form of tuition, special fees, differential living fees, and other expenditures incidental to college attendance.[1] Indirect costs are viewed in the form of opportunity costs. Opportunity costs

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[1]While financial aid may also be considered a component of direct cost, very few major studies have taken into account the influence of financial aid or federal, state, and institutional interventions. This issue will be covered in a separate section following the remaining discussion on external correlates of demand.

refer to the loss of time and income that students would have realized had they not been enrolled in college and had been engaged in income producing activity (Becker, 1975; Blaug, 1966; and Schultz, 1961). Together, these direct/indirect costs introduce the price variable included in traditional economic demand analysis. It is expected that the demand for enrollment will vary inversely with the direct costs of education (i.e., higher costs result in less demand).

A potential confluence of effects for indirect costs makes it difficult to hypothesize the direction of the relationship between indirect costs and enrollment. In other words, higher opportunity costs may negatively influence enrollment yet, at the same time, provide a greater opportunity to pay the direct costs of enrollment. Higher unemployment rates may increase enrollments since potential students would have difficulty finding jobs, but may also diminish the ability of households to support the further education of recent high school graduates. Thus, hypotheses about the effects of indirect costs are sometimes avoided. However, a general hypothesis supported by some researchers argues that higher opportunity costs decrease the demand for enrollment while higher unemployment increases demand (Bishop, 1977; Corazzini, 1972; Rusk, Leslie, & Brinkman, 1982; and Salley, 1977).

Results for economic variables, particularly income and price, are typically expressed in terms of elasticity coefficients. In enrollment demand studies, the term "elasticity" is used to designate the relative responsiveness of enrollment (the quantity of education demanded) with respect to a specified determinant. To estimate a constant elasticity requires a double-log transformation of the dependent variable (Y) and the independent variable (X) in question. This transformation allows the assumptions of both a constant and a proportionate relationship between X and Y, where the resulting estimate reflects a proportionate change in Y resulting from a proportionate change in X. In this regard, elasticity estimates are particularly useful because they are "unit-free" and the effects of the variable to which they apply may be expressed in terms of percentage changes. The elasticity of Y (or enrollment) with respect to X (or price, for example) is referred to as the "X elasticity of enrollment" (or the price elasticity of enrollment). However, the dependent variable is usually understood; thus, one would simply refer to the "X elasticity" (or price elasticity) (Pindyck & Rubinfeld, 1980; and Tufte, 1974).

Noneconomic influences on the demand for enrollment have to do with the range of institutions, programs, and admissions policies present in what Blaug (1966; 1972) calls

the "educational market". Considering first nonprice rationing policies, such as minimum admission requirements, religious affiliation restrictions, or single-sex enrollment policies, those institutions that implement such measures are restricting their market and, in effect, reducing demand for enrollment. In other words, different minimum academic requirements define alternative demand curves for the institution, the highest possible demand being associated with the least restrictive requirement--possession of a high school diploma in most cases (Hight, 1975). While such administrative rationing may influence the distribution of students among individual institutions, it is not likely that such rationing effectively denies any high school graduate access to all of higher education, particularly in the public sector (Blaug, 1966; Corazzini, 1972; and Hopkins, 1974).

According to the investment motive of human capital theory, students choose to attend a given institution based on an evaluation of its relative costs and benefits. In other words, students associate different rates of return with alternative investment options to arrive at their decision. In this regard, the availability of institutions within the higher education market offering the desired programs of study, quality of instruction, social atmosphere, or breadth of field certainly comes to bear on

students' assessments of benefits. These noneconomic factors, as well as external, economic factors, influence students' perceptions of the varying benefits accruing from enrollment in different institutions. As a result, changes in certain variables, such as tuition, may encourage students to substitute enrollment (investment) in one institution for enrollment in an alternative institution. To the extent that the former institution has been successful, for example, in differentiating its product, the responsiveness to such changes will be less; however, the greater the availability of desirable or good substitutes, the greater the demand, or responsiveness, to price changes (Leftwich, 1964). Still, in some cases, this substitution effect may result in a "net discouragement effect" where the alternative is not to enroll in another type of institution but, rather, not to enroll in any form of higher education at all (Hopkins, 1974).

In addition to the economic and noneconomic variables discussed thus far, there are environmental factors to be included among the external influences on enrollment demand. One of the more obvious influences in this category is the eligible population factor. Because demand is dependent on the size of its relevant population, this factor is a necessary variable in the analysis of enrollment demand.

Regional or geographic characteristics have been found to demonstrate differences in attitudes toward education as well as the advantages of having a concentration of schools nearby. Regional attitudes reflect traditional or cultural perceptions of the investment value of continued education, while a geographically concentrated pool of higher education institutions provides greater access to and availability of affordable substitutes (Becker, 1975; Feldman & Hoenack, 1969; Hopkins, 1974; Jackson, 1978; Johnson, 1976; and Tannen, 1978). Also, the urban-rural composition of the students' environment is suggested as an influence on enrollment demand. Use of this factor is based on evidence that a person's urban-rural background affects the rate of return to college enrollment, with persons from urban locales realizing the greater return (Becker, 1975). Consequently, the urban nature of students' environment, a greater concentration of higher education institutions, and the presence of traditional or cultural inclinations towards continued education have a positive impact on the demand for higher education.

Measurement of Financial Aid

Research on the demand for higher education has been prompted primarily by concerns over equal opportunity. Early theoretical and empirical work by Schultz (1961), Becker (1964), Blaug (1966), and other educational

economists supported the egalitarian view of higher education, promoting it as a means for social and economic upward mobility. Public subsidies were adopted as a result of the concern for equal opportunity and included direct grants, loans, work-study opportunities, and low tuition; institutional funds were also allocated in these forms, drawing upon both restricted and unrestricted sources (Jackson & Weathersby, 1975; and Dickmeyer, Wessels, & Coldren, 1981). The availability of financial aid introduces a variable pricing component to pricing policy decisions which, in effect, allows institutions to be price discriminators at the individual student level (Chapman, 1979). However, there is a paucity of research on enrollment demand which incorporates the effects of financial aid in general and the differential impact of resultant pricing policies in particular.

Price, or the cost of attending an institution of higher education, includes tuition, room and board, additional fees as required, and financial aid in amount and type. While tuition, fees, and room and board estimates are generally accessible and reliable, similar estimates of financial aid awards have been difficult to obtain. Some studies have used an estimate of the average financial aid award to adjust the overall cost figure (Feldman & Hoenack, 1969; Hight, 1975; Hopkins, 1974; and Tannen, 1978).

However, use of such estimates overlooks the differential value of the various forms of aid across different types of institutions. Grants and scholarships do not require repayment and represent a direct subsidy; loans represent a much smaller subsidy in that the present value of the total amount to be repaid is generally less than the present value of the loan; and, work-study carries a current burden for the students required to finance their education in this manner (Tierney, 1980). More recent studies have attempted to simulate aid awards by type, but have been limited by general data inadequacies or distortions, lack of an acceptable specification of the distribution process, and the possibility of capricious behavior on the part of institutions (Carroll, Mori, Relles, & Weinschrott, 1977; Jackson, 1978; and Tierney, 1980).

Besides introducing a source of bias with respect to the price variable, the failure to estimate financial aid effects also disregards an important aspect in the formulation of pricing policies. With the advent of equal opportunity concerns came the incentive to consider the composition of the student population enrolled in higher education institutions. Pricing policy, in effect, became a means not only for controlling size but also composition;

financial aid, in its various forms, allowed the availability of differential aid packages for targeted groups of students.

Measurement of financial aid raises a question also as to the assumption of perfect capital markets in the analysis of educational demand. This assumption maintains that all who wish to purchase an investment will have loan capital available to them (Blaug, 1966); however, due to governmental and institutional interventions and the general difficulty in establishing financial policies for investments in human capital, funds to finance higher education are limited if unavailable for certain groups of students. Most demand studies have developed investment models under the assumption of limited capital markets, focusing on the current wealth from income or savings as the primary constraint on total costs of college attendance. When and if a measure of financial aid is considered, it is assumed to lower the monetary cost of attendance, increasing the present value of investment in higher education. Accordingly, a positive relationship is expected between the level of aid and enrollment.

Stratification

An important element of demand analysis referenced in previous sections of this chapter is that of differential effects. Disaggregation of data according to selected

strata yields insights into the distributional effects of the explanatory variables across these strata. Most studies have found stratification to be significant in that the estimated coefficients differ across cells, suggesting the possibility of aggregation bias from pooling strata in a single overall estimate. Stratification by income, socioeconomic status, ability, family educational background, race, sex, or type of institution has been attempted, with income or ability levels being the most common single choices for stratification. Where the available data have not allowed stratification directly, interaction terms have been included in the model to allow derivation of results comparable to those obtained from stratified data (Weinschrott, 1977).

## Methodology

A methodological issue traditionally plaguing demand analyses is that of the identification problem. In general, the problem of identification refers to a situation where the parameters of supply and demand are confounded in the estimates of the regression coefficients such that the coefficients are biased estimators of the true demand (or supply) behavior. Avoiding the identification problem is difficult in aggregate time-series studies since those variables identifying the demand curve can jointly determine the supply schedule. Various means can be taken to avoid

identification, such as use of individual data, the assumption of a predetermined price variable (for example), or the inclusion of exogenous variables to distinguish the separate supply/demand relationships. Inclusion of exogenous variables, however, can lead to overidentification, where more than one value is obtainable for some parameters (Pindyck & Rubinfeld, 1981; and Weinschrott, 1977).

Most demand studies have used a cross-sectional design to avoid the identification problem. This is advisable particularly in the event that individual data are unavailable. Use of cross-sectional data allows for the assumption of predetermined variables or fixed supply parameters. In addition, cross-sectional data are not as susceptible to occurrences of autocorrelation. At the same time, achieving variation for certain variables can be a problem when using cross-sectional data.

Level of Choice

Two aspects of choice have important consequences for specification of the demand model. These are the corporate/independent nature of students' decisions to invest in higher education and the set or range of alternatives incorporated by the demand model. The former level of choice was referenced earlier in the discussion on measurement of income, or ability to pay. The assumption of

choices or decisions about higher education enrollment being either (1) independent on the students' part or (2) corporate (including the family and student together) primarily affects the interpretation of factors representing ability to pay, and tastes and preference. Perhaps the independent or corporate assumption alone will not suffice for all purposes; nevertheless, one or the other must be applied to allow reasonable interpretation of results. For instance, one would assume that choices regarding students' curriculum or the specific school attended are largely a parental decision during the lower school years, while choices regarding graduate instruction are independent. However, choices made during high school or undergraduate years probably evidence greater variation between corporate and individual decisions. In general, it is assumed that with regard to prospective freshmen, the choice to enroll or invest in higher education is a corporate activity. Accordingly, family income, environment, or educational level become primary measures for examining the effects of current wealth, and tastes and preferences on enrollment demand (McMahon, 1974).

Student choices, with regard to the level or stage of the choice process, also affect the set of postsecondary options considered in demand analysis. In general, the

levels of the college choice process include: (1) the inclination toward or against college, where the student decides whether or not to consider enrollment in higher education; (2) given the decision to consider enrollment, the determination of which institutions to include in the choice set; and (3) the choice to enroll in a specific institution or not at all (Jackson, 1978; Kohn, Manski, & Mundel, 1974; and Tierney, 1980). Most studies focus on a discrete level of choice or simplify the general model of choice when considering it as a sequential process. Either approach affects specification of the model. Given the level of choice considered in the analysis, valid representation of the choice set in the demand model depends on the inclusion of all relevant alternatives confronting the student and the inclusion of those explanatory variables sufficient for describing the factors that influence this range of alternatives (Weinschrott, 1977). Development of the dependent variable is also affected in that it must cover the demand function defined by the list of explanatory variables.

## Evaluation of Research

In this section, five studies on higher education enrollment demand are reviewed. Each study was chosen on the basis of its soundness of design, its predominance in the field of enrollment demand, and the opportunity each provided to demonstrate approaches (both good and bad) to dealing with the specification issues described earlier. A brief description of each study is given, followed by a critique of the study with regard to the evaluation criteria. Further sources of reviews or evaluations of enrollment demand studies include Jackson and Weathersby (1975), McPherson (1978), and Weinschrott (1977).

The order of the reviews is based on the relevancy of the studies with regard to the methodology and data used in the current research. Since the current study was based on aggregate data and used a regression approach in its analyses, the reviews are presented such that studies based on individual data and/or the use of analytical techniques other than regression precede those based on aggregate data and/or the use of regression techniques.

Kohn, Manski, and Mundel (1974): An Empirical Investigation of Factors which Influence College-Going Behavior

Summary. The purpose of the Kohn et al. research was to develop a theoretical and empirical model of student behavior that would help to establish a method of forecasting enrollment patterns. The authors employed a three-stage choice process as the basis of their research design. These stages included: (1) for each available college, the choice of whether to commute or to live on campus, should that college ultimately be chosen; (2) the choice of the "best" college available; and (3) the choice of whether to enroll at this "best" college or not at all. Using a mathematical formulation called conditional logit estimation, Kohn et al. derived three models representing the residency choice, the college choice, and the college-going choice. The residency choice model was based on factors reflecting the distance from home to college, family income, dormitory capacity, sex of student, and other derived variables. The college choice model was composed of institutional variables, including tuition, room and board charges, average student ability, field breadth, and per student revenues, and of student variables, including family income, ability, and distance from home to college. Variables included in the college-going choice model were

parental education, student sex, family income, and the attractiveness of the "best" college alternatives.

At each choice level, the authors assumed that the student maximized a utility function over the relevant enrollment alternatives. In other words, the utility or value of each option was evaluated in terms of its dependence on a variety of student, institutional, and the interaction of student/institutional characteristics. Kohn et al. used McFadden's (1973) conditional logit maximum likelihood procedure to estimate the parameters of these utility functions. Taking the actual option chosen as the one preferred to all others in the feasible option set, this approach applies alternative weighting schemes to the factors associated with the decision process and derives the scheme that best accounts for the decisions or choices the students made. Estimation of the residency model was performed primarily to allow prediction of a student's hypothetical residency choice at each college and, hence, to trim the size of the choice set for use in the remaining model estimations. Both the college choice and college-going models were estimated using subsamples of the 1966 SCOPE survey--one subsample using data for Illinois and the other using data for North Carolina. These subsamples were then divided into three income strata, with each model being estimated separately for each stratum.

In the college-choice model, cost coefficients were found to differ across income strata. While tuition effects were uniformly negative and increasingly strong as incomes fell, coefficients for room and board charges shifted from negative at the lowest income level to positive at the highest income level. According to the authors, this latter result reflected a "quality of life" influence for the room and board variable in addition to its role as a cost factor. The measure of institutional academic quality (average institutional ability level) appeared to be a greater, positive influence on high income students than on low or middle income students; however, middle income students reacted more negatively to the difference between individual ability levels and average institutional levels, indicating that students preferred not to attend a school where the average ability was too far above their own ability level. The coefficient for breadth of field was positive, indicating that students preferred schools offering a wider choice of possible specializations. This preference seemed to be strongest for middle income students. Results for the remaining institutional variables had little significant influence on college choice decisions.

For the college-going model, very little difference was displayed across income strata with regard to the attractiveness of the college choice. The effect of

paternal education generally appeared to be greater than that of maternal education; although, among lower income students, maternal education appeared to be as, if not more, influential. In general, there was a decrease in the importance of parental education as family income increased. A "pure" income effect, achieved by holding all other variables constant, revealed that the probability of going to college increased from the low income stratum to the middle income stratum, and then decreased when reaching the high income stratum. According to the authors, this latter result did not contradict the fact that a higher proportion of students from high income families go to college than students from low income families. Rather, it implied that this pattern among enrollment rates was largely explained by the existence of more attractive college alternatives for students from high income families.

Critique. Obviously, the data requirements for analyses of this type were quite extensive. The use of individual student data allowed a more precise examination of the choice process and the factors associated with various levels of choice. However, due to the lack of data on unreported or unavailable information, there tended to be considerable dependence on the use of imputed data or variables. Given the range of alternatives open to a prospective student, even the amount of data necessary for

imputation was massive and sometimes involved arbitrary selection/decision processes in order to achieve closure on development of choice sets and related college attributes. For example, Kohn et al. found it difficult to measure family income due to the large amount of missing data and inherent reporting difficulties in the SCOPE survey with regard to family finances. As a result, family income was predicted on the basis of other variables from the SCOPE survey and data from the College Scholarship Service survey. Such procedures, of course, weakened reliable estimation of student demand and choice behavior. Notwithstanding these data related problems, use of individual data provided more information as to demand related choice patterns and allowed the variation necessary to examine a wider range of factors related to this behavior.

As indicated in the summary, each model was stratified by income level with varying results for each factor reported across the three income strata. Sex variables were included in the residency choice and college-going models, but little information was yielded from inclusion of this factor--race variables were omitted entirely from the analyses. With regard to stratification by other appropriate factors, Radner and Miller (1975) criticized Kohn et al. for not stratifying their sample by ability. They argued that if a single specification does not fit all

ability and income levels equally, then the estimates of the parameters will be affected by the distribution of the explanatory variables in the sample. Radner and Miller found that a single specification was inappropriate with a stratified sample, and used income by ability strata to present their findings. Thus, they asserted that Kohn et al. should have stratfied their sample by ability groups and made separate estimates for each group.

Perhaps one of the greatest limitations of this research was the inability of the authors to specify variables which represented important policy instruments, specifcally that of financial aid. Two different methods (a regression model and a discrete probability model) were attempted to predict the level and composition of aid that would have been offered to each student by each college. However, both methods were unsuccessful in providing accurate or reasonable forecasts of financial aid awards. Consequently, a financial aid variable was not included in the specification of the models.

Kohn et al. made two assumptions which enabled them to control for the identification problem, although they never addressed directly the issue of identification. They assumed (1) that all colleges make offers of admission and set levels of tuition in advance of the student's decision to enroll and (2) that these institutional actions remain in

effect throughout the student's choice process. The tuition data came directly from survey resources and the admission decision was simulated for each college in the student's set of college alternatives. To the extent the admission decision was correctly estimated, then supply factors were adequately controlled such that demand behavior was reflected in the resultant models.

Although individual student data were available for this research, the authors assumed a corporate level decision in terms, at least, of the financial constraints facing the students in making their enrollment choice. However, due to the availability of individual data, more information that dealt with the student's independent tastes and preferences was incorporated into the models. For instance, data were available on the student's preference for residency versus nonresidency given that money were not a factor in the decision. These data, as well as that for many other factors, enabled the researchers to assess adequately the set of enrollment alternatives to be included in the choice process for each student. Knowing more about this set of alternatives allowed the researchers to include more accurate or specific data with regard to external factors in the explanatory variable list. Still, as

mentioned above, obtaining individual data on all these measures was not quite possible, and in many cases imputation of data, if possible, was required.

Bishop (1977): The Effects of Public Policies on the Demand for Higher Education

Summary. The purpose of this study was to estimate a model of college enrollment that focused on the influences of public policy and the economic/social environment, and the interaction of these factors with student ability and parental income. Variables representing policy factors included cost of attendance, admissions requirements, location of different kinds of colleges, breadth of field, and draft deferments. Economic/social environment factors were examined through measures of the social status of the student's neighborhood, the opportunity cost of the student's study time, and the size of the anticipated earnings payoff to college graduation. A binomial logit model was developed using a maximum liklihood procedure and a sample of 27,046 male high school juniors in 1960. The sample was stratified by ability quartiles and five family income strata. The dependent variable was based on actual attendance and was measured as the probability that the "ith" individual attended college within two years of the spring of his junior year in high school.

Bishop asserted that a student attends college if, relative to the best noncollege alternative, there is at least one college that is simultaneously desired and possible to finance. However, identifying the "most attractive" college is not easy and reliable measures of many important facets are not available. The solution that Bishop attempted was to determine a set of colleges that were expected to be feasible for the student to attend and then to assume that the relevant choice was between the least expensive of these feasible colleges and not attending college at all. Accordingly, only the cost of this least expensive, feasible college was included in the model as the traditional price variable. The additional cost of attending the least expensive four-year college over the cost of the least expensive feasible institution of any type was also included to examine the range of costs facing the student. The selection of the feasible set of colleges was subject to the following conditions: (1) selected institutions provided a broad range of programs; (2) selected institutions admitted men; (3) selected institutions accepted at least 20 percent of the state's high school graduates; and (4) selected institutions were compatible with the racial and religious preferences of the student.

Results were reported for the twenty ability/income strata. In general, tuition, high admissions standards, foregone earnings, and travel and room and board costs were found to have significant, negative effects on enrollment. Moreover, the per dollar effect of tuition was larger than any other cost and was largest of all for low income, middle ability students. The size of the anticipated earnings payoff to college had a negligible relationship with enrollment. For the within-stratum models, $R^2$ ranged between 0.38 and 0.067, and entropy reductions ranged between 0.211 and 0.034.[2]

A detailed report of the results for two policy instruments used to control enrollments, tuition and travel plus incremental room and board costs, was also provided. Students with high income and high ability were found to have significantly lower price elasticities of demand. Applying the resultant variations in tuition elasticity to the policy process controlling enrollments, Bishop indicated that if the policy objective was simply "more students", aiding students from low-income families was more efficient

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[2]Entropy measures reflect the uncertainty of a probablity distribution and is defined as minus the expectation of the logarithm of the probability. For outcomes having only two alternatives, the entropy measure will range between 0 and -ln(.5), or .693. Bishop cited research demonstrating that the entropy measure is better than $R^2$ of goodness of fit for categorical dependent variables.

than general reductions in tuition. Given the results for travel, and room and board costs, Bishop suggested that policies that affect these factors would have their largest effect on middle-income students.

Briefly, with regard to other measures, admissions requirements had substantial effects on enrollment except among students from poverty backgrounds. The breadth of curriculum also had an important positive effect on enrollment. Establishment of a two-year institution in a city that has no college did not increase the local college attendance rate as much as did the establishment of a four-year college with the same tuition level. The social status of the student's neighborhood seemed to have an important effect on college attendance, the strongest, positive effects being evidenced among the lowest ability strata. Significant, positive effects for draft deferment were observed in nine strata, with a rise of one standard deviation in draft pressure predicted to increase enrollment rates by 1.5 percent.

Critique. Bishop's specification covered most aspects of the economic, noneconomic, and environmental categories for student and external based correlates of demand. Development of his measures, however, was limited in two areas. First, with regard to travel costs, Bishop assumed a constant number of trips, value of travel time, and so forth

in estimating travel costs for both campus residents and commuters. The assumption of constant values on these factors for both residents and commuters probably introduced bias to estimated price elasticities based on travel costs. A similar problem with regard to travel costs was observed in Hoenack's (1968) research. A second concern has to do with the lack of individual data for several variables, specifically foregone earnings, anticipated earnings payoff, and social status of neighborhood. Use of aggregate or regional averages for these variables resulted in a loss of information as well as measurement error.

Bishop informed the reader that only limited amounts of scholarship aid were available at public institutions in 1961, the time when the sample was graduating from high school. Consequently, inclusion of the financial aid factor was omitted with presumably little deleterious effect on the estimated coefficients. Still, the availability of aid due to a certain mix of institutions in the student's area may have lowered the cost of particular institutions such that the minimum cost institution was wrongly identified.

The sample was stratified according to ability and income groups. Other potential variables for stratification were, in most cases, accounted for in the model--for example, socioeconomic status, sex, and race. Only male students were included in the sample, thus an examination of

differential effects was limited to that within one sex group. No explanation for this limitation was offered. Race entered the model only through the selection of a feasible college set. If the student's race, however, affected demand and was correlated with any of the other variables in the model, then the coefficients of the variables were biased.

According to Bishop, most families make general college plans a few years in advance of the student's high school graduation. Therefore, for the purposes of his research, public policies such as tuition level and admissions selectivity were assumed predetermined with respect to the student's application for enrollment. In this respect, supply apparently was assumed fixed and the demand model identified.

Bishop focused on the student and his family with regard to the level of choice. Little information as to the individual student's preference for college, outside the fact that he did or did not enroll, was reflected in the specification. Use of the minimum cost college focused on the financial constraints to enrollment and overlooked the options open to a student due to the available mix of institutions--which, as mentioned earlier, may have affected the identification of the minimum cost college. In this regard, the choice set was restricted; however, inclusion of

a more expansive set of options might have raised the possibility of problems such as those confronted by Kohn et al. in obtaining all the relevant data necessary to specify relevant variables in the explanatory list. In short, Bishop's specification generally covered the decision to enroll and those factors related to that decision.

Tierney (1980): The Impact of Financial Aid on Student Demand for Public/Private Higher Education

Summary. Tierney's research attempted to model the variables that affect enrollment at public versus private institutions. He asserted that his research was unique in two ways: (1) only those students who applied to and were accepted by at least one public and one private institution were considered; and (2) the study assessed the impact of the quantity and form of financial aid on enrollment.

The dependent variable was measured as a dichotomous variable according to whether a 1975 prospective student enrolled at a public (Y=1) or private (Y=0) institution. Six institutional or external variables, measured as the difference between the institution of enrollment and that of the institution of opposite control that had the largest tuition difference from the institution of enrollment, comprised part of the explanatory variable list. These variables (or differences) were based on the following: tuition, distance from the student's home residence, college

selectivity, and three forms of financial aid--grants, loans, and work study. Seven student related variables were also included among the explanatory variables: parental income, father's education, mother's education, academic ability, sex, student's academic aspirations, and student's choice preference. Stepwise multiple regression analyses were run for each of six income by race strata, with $R^2$ values for the resultant models ranging from .15 to .49.

Results for the analyses were reported for each of the six strata. Positive coefficients were obtained on all financial aid variables except that for work study assistance among upper income, nonwhite students. The positive coefficients were statistically significant in each stratum except one--that for lower income, nonwhite students. In general, an increase in financial aid increased the probability of enrollment, with work study forms of assistance being ineffective among lower or upper income, nonwhite students. The coefficients for tuition were, as expected, negative and significant for all but the lower income, nonwhite students. Moreover, with the exception of upper income, nonwhite students, tuition differences appeared to be of lesser importance than the various forms of aid. In other words, an increase in financial aid had a relatively greater impact on enrollment than did lower tuition. College selectivity was

statistically significant for four out of six strata, exceptions being the lower and middle income, nonwhite strata. Results indicated that as the selectivity of the private institution increased relative to that of the public institution, a student was more likely to enroll at the private institution all else being equal. Coefficients for the distance of the institution from the student's home were not statistically significant, although their signs indicated that nonwhite students may have been more mobile than white students.

Among the student related factors, only two variables evidenced significant coefficients. For upper income, white students, an increase in parental income increased the probability that these students would enroll in a private institution. In addition, upper income, white students who aspired to more than a bachelor's degree were more likely to matriculate at a private institution.

Critique. Perhaps the two major omissions in Tierney's models regard the lack of reference to indirect costs and local/regional characteristics. Most other aspects of student and external related factors were included in the specifications. A problem with measurement remains in that the necessary sample derived for this research may not have been representative of the 1975 pool of prospective freshmen. Due to the restriction selecting only those

students who had applied and were accepted to at least one public and one private institution, only 18.9 percent of the the available baseline sample was retained in the final sample. When compared to national norms, students in the resultant sample tended to come from higher socioeconomic backgrounds as both parental income and educational levels tended to be substantially different from that for students generally. Moreover, the ability level for students in the Tierney sample was about half a standard deviation above the norm, and the overall level of academic aspiration was greater than that for the original sample. Another measurement problem concerns the family income variable. Students were asked on their survey instrument to check the category which best represented their family's income; to convert these categories to continuous data, Tierney assigned to each student the midpoint value of the category checked. Use of an average or aggregate value in this context may have resulted in a loss of variance and measurement error.

Tierney's problems with developing a sample and the data necessary for examining demand at the individual level are not atypical of studies using individual data. Despite these problems, results consistent with theory and extant research were obtained. The lack of significant findings for some variables, particularly student related variables

among the low and middle income groups, may have been due to a lack of variation in the data resulting from the restricted sample. Several stratification possibilities were available to the author and use of the income by race strata appeared to reveal substantial differential effects as well as allowing analysis by a much overlooked factor--that of race. Sex probably was not used in the stratification because, as noted by the author, it has not been found to be significantly related to enrollment. Another possibility for stratification--ability--was likely dismissed due to the restricted sample development, which may have narrowed variation for this factor.

One of the strongest points of this research concerns its examination not only of the quantity of aid awarded, but also of the forms of aid made available to the student. Data were available for each student regarding the institution of enrollment and the alternative institutions of application. Three categories of aid--scholarships and grants, loans, and work study assistance--were examined, allowing analysis of the possible differential effects of different forms of aid awards. Inclusion of these factors allowed further insight into the effect of different pricing policies on enrollments, particularly when observed across various related strata. The author suggested that consideration of the source (institutional, state, federal)

of aid funds would further enhance interpretation of the effect of aid and tuition factors with regard to pricing policy and enrollment planning.

Use of a cross-sectional design limited the potential of the identification problem by allowing the assumption of predetermined levels of tuition, for example, with regard to the enrollment decision. Also, as Tierney pointed out, the sample included only those students who had applied and been accepted at various institutions; thus, the supply constraint via selectivity or admissions policies was controlled and allowed the demand behavior to be identified.

Like most researchers, Tierney assumed a level of choice that was primarily corporate, although the availability of individual data allowed inspection of individual student preferences. Consequently, this study examined the demand behavior of individual students still dependent on family income and environmental influences who, upon deciding to pursue postsecondary education, were making a public versus private institution enrollment decision. Given that the author had reasonable access to the actual set of alternatives considered by the student, the range of enrollment options was covered fairly well by the models. However, to the extent that the nonenrollment option influenced the choice between private and public enrollment, then the model may have been misspecified. The explanatory

variable list, in terms of institutional factors, was representative with the possible exception of a lack of consideration regarding breadth of curriculum.

## Hoenack (1968): Private Demand for Higher Education in California

Summary. Hoenack's research was based on 1965 data for California high school seniors from the Project Talent survey. In general, he attempted to estimate the demand for freshmen attendance at the different campuses of the University of California (UC) and then to show how these demand functions might be used to improve the allocation of public financial assistance to college students. Using high school districts as the unit of analysis, Hoenack developed a cross-sectional multiple regression model to estimate the separate enrollment demand functions. The dependent, or demand, variable was measured as the proportion of eligible high school graduates who enrolled at a particular UC campus. Independent variables included tuition charges at each UC campus and at competing institutions, total number of high school graduates, median family income, and average wage and unemployment rates. Hoenack examined the demand of commuter versus resident students separately for each campus, stratifying these groups further by income class, to arrive at aggregate demand functions for freshmen places in the UC system. The separate demand functions were

incorporated into equations showing the various combinations of student enrollment levels in each income bracket made possible by alternative distributions of a given state subsidy. State subsidy, in this instance, referred to a cost of attendance for the student that was lower than the actual cost to the state of educating the student.

In general, Hoenack's findings were consistent with theoretical hypotheses. There was a negative relation between price and demand for enrollment, the average price elasticity being -0.85 for all income brackets combined. Moreover, the critical cost--or that cost at which students will consider alternatives to the current investment option--was shown to increase as wealth increases. In other words, as wealth increased, students were more likely to enroll in those institutions whose costs and benefits were relatively high. That wealthier students evaluated the future benefits of an investment as greater than did less wealthy students follows from the assumption of a limited capital market and from the assumption of a diminishing marginal utility of wealth.

Results concerning the wage and unemployment rates were reported according to their effect within each demand model. The coefficient for unemployment rate was statistically significant for only one campus; yet the wage rate coefficient was significant for all campuses. The latter

finding suggests that students placed a value on their time which was at least as high as the current wage rate. Hoenack suggested that the possibility of better employment opportunities presented mixed effects--a greater cost effect in terms of foregone income and a positive income (or benefit) effect in terms of current part time earning opportunities.

Consideration of opportunity costs as well as costs for alternative institutions provided insight on substitution effects. For instance, when the substitution of state colleges was entered into Hoenack's analysis via a predetermined mix of pricing policies between the state colleges and UC campuses, the average price elasticity dropped from -0.85 to -0.51, suggesting that California state colleges were sufficiently close substitutes for UC campuses. The possibility of net discouragement (substitution of nonenrollment for enrollment) was accounted for by the inclusion of wage and unemployment rates. Since the dependent variable was composed of all UC eligible high school graduates and the minimum requirement for entrance to California junior colleges was a high school diploma, Hoenack suggested that the net discouragement effect could also be interpreted as substitution of nonenrollment at a UC campus for enrollment at a junior college.

Critique. Although Hoenack's research, at the time it was released, improved upon the range of explanatory factors, there were some weaknesses in this area. One source of improvement was the inclusion of indirect cost measures via the average local wage rate and the unemployment rate. These measures reflected not only foregone earnings and time, but also the substitution or net discouragement effect between enrollment and nonenrollment. Substitution between different types of institutions were accounted for by the introduction of costs for alternative institutions in the separate demand functions. Estimation of these effects improved upon models measuring simply the effects of direct cost and household income. However, failure to include measures of family background, student academic/nonacademic characteristics, or local environment characteristics raised the possibility of specification bias among the remaining estimators. To the extent that ability, family educational background, or environment was correlated with other variables in the model and had an effect on demand, then to some extent were the coefficients for income, price, and other measures biased.

As mentioned before, given the estimated demand functions, Hoenack proposed to examine the effect of alternative distributions of state subsidies on enrollment. State subsidies were defined as reduced or differential

tuition levels across institutions in the UC and California state college systems. Unfortunately, the cost variables in Hoenack's demand functions did not include any measurement of financial aid. Any systematic variation in the type or amount of aid awarded across high school districts or institution types, therefore, would indicate a source of bias in the resultant cost coefficients as reported. If aid was perceived as an increase in income, then the effects across income strata also might have been biased.

With regard to stratification, it was noted previously that while Hoenack was progressive with regard to the introduction of several additional economic factors to demand analysis, his omission of student, family, and environmental factors limited the import of his work. Differential effects of the explanatory variables across income strata were incorporated in the demand function; however, this variable could have been measured directly or crossed with other student and external factors to provide further insight to the effects of cost on enrollments. In particular, the failure to stratify by other factors such as student ability, race, sex, family educational attainment, or environmental characteristics weakened the specification of the demand functions and limited the examination of differential effects, if any, across selected, appropriate strata.

Hoenack used a cross-sectional design, alleviating the prospect of the identification problem. Using cross-section data, he assumed the price variable to be predetermined and thus independent of demand. Also, because the demand variable was based on the eligible population of students, the supply factor was fixed and exogenously determined with regard to the demand function. One problem raised by the use of cross-section data, however, was measurement of the price variable itself. Since tuition charges for UC campuses were the same for all California residents, the price variable was based on transportation costs to each campus from the student's district and an estimate of additional out-of-pocket costs. The transportation costs were estimated on the basis of a uniform value set for the factors of value of time, rate of travel, and number of trips per year--variation being achieved through the distance factor alone. The assumption of uniform values for these three factors, particularly that denoting the number of trips per year for both resident and commuter students, is questionable. Also, it is possible that response to variations in transportation costs differed from that to tuition cost, posing a problem as to the credible interpretation of a price variable constructed in this manner (Weinschrott, 1977).

Lacking data at the individual level for all factors, Hoenack chose to use the high school district as his unit of analysis--focusing on the demand behavior of the average high school graduate rather than that of the individual student. Hoenack assumed the average student still to be dependent on family income, thus placing the choice about enrollment at the corporate or family level. As a result, the demand function was based on the behavior of the average high school graduate, still dependent on family income and eligible for enrollment at UC campuses, who was making an enrollment versus nonenrollment level decision. The eligibility characteristic allowed for a choice set including all UC campuses and those other type institutions that were at least as selective as the University of California. These included, according to Hoenack, the state colleges, the junior colleges, and any nonenrollment options. However, the dependent variable, as it was constructed, also reflected the possible demand for enrollment at private institutions. To the extent that private institutions were as selective as the University of California, or evidenced other characteristics not accounted for in the explanatory variable list, then the restricted choice set formulated by Hoenack may have impaired specification of the demand function and served as a source of bias for the estimated demand coefficients.

Corazzini (1972): Determinants and Distributional Aspects of Enrollment in U.S. Higher Education

Summary. The research of Corazzini, Dugan, and Grabowski (1972) was based on a cross-sectional analysis of national and Massachusetts (specifically, Boston) data. This review will focus on the national demand study. Based on human capital theory, Corazzini et al. formulated an enrollment demand model to examine the direct effects of economic, noneconomic, and environmental factors on enrollment as well as the distributional effects of these factors across socioeconomic quartiles. The distributional effects were of particular interest to the authors in that these results had implications for how policy might be applied to relieve financial and academic constraints on enrollment.

The enrollment demand functions were estimated using multiple linear regression, with the unit of analysis being each individual state. Accessing data from the Project Talent survey, the dependent variable was expressed as the percent of 1960 tenth grade students in a given state who enrolled in college in 1963. Independent variables included average state tuition rates at junior colleges, public four-year universities, teacher colleges, and private four-year universities, average level of father's education, average production worker's income, unemployment level, and academic

ability. All variables were measured at the state level. Results were reported for each socioeconomic quartile and for the total sample combined. Assuming father's education level was positively related to family income, paternal education was used as a proxy for family income or socioeconomic status--the stratification variable.

Corazzini et al. tested the hypotheses that the price and opportunity cost effects would be negative, father's education would be positive, and ability would have a positive effect on enrollment. These effects held up for the total demand function; however, for the different socioeconomic strata, differential effects for the various factors were evidenced. While tuition coefficients were significant for all but the teacher colleges in the total model, only those for junior colleges and public universities were significant for the lowest socioeconomic quartile. For the two highest quartiles, only the public and private universities showed significant tuition effects. This, of course, reflected the differential reactions of students from varying economic levels to the economic barriers of attending college. Coefficients for the opportunity, or indirect, cost factors also displayed differential impacts across quartiles. Both the unemployment and wage rates exhibited the greatest impact on low income groups. Results for the higher income groups,

although not statistically significant, evidenced opposite effects from what was hypothesized. The authors suggested the possibility of a substitution effect via admissions standards, where high opportunity costs forced low income students to forego college, making it easier for higher income students who were less sensitive to these costs to obtain enrollments.

Coefficients for both academic ability and paternal education were positive and significant for the total model, however, contrasting patterns arose when the data were stratified. Whereas, paternal education had the largest effect on the lowest socioeconomic quartile and the smallest effect on the highest quartile, the achievement variable exhibited an opposite pattern. Corazzini et al. attributed these results to a lack of variation in the two variables after stratification. Still, according to the authors, the noneconomic/environmental factors which paternal education and ability represent, appeared to be significant determinants of enrollment.

Critique. Corazzini's research improved upon specification of the explanatory variable list, covering most of the major categories for student-based and external-based correlates. A couple of variables were included to express jointly several noneconomic/environmental factors. For instance, academic ability was used to indicate not only

the tastes or preference of the student for education (a student-based noneconomic factor), but also the willingness of institutions of higher education to accept the student according to its standards (an external noneconomic factor). Although unable to determine directly the separate effect of these factors on enrollment, some insight as to the distributional effect of the variables on different socioeconomic groups was yielded.

The price factor did not reflect any form of financial aid due to the lack of data across all states. The authors suggested, however, that the availability of national NDEA loans in 1963 tended to equalize the opportunity of students across states to obtain loans, thus minimizing the effect of interstate differences in loans on enrollment. Nevertheless, the omission of financial aid factors may have introduced bias to the estimated coefficients, particularly that for price.

As mentioned previously, stratification was attempted using socioeconomic quartiles. In this respect, the greater responsiveness of lower income students to opportunity costs, paternal education influences, and tuition costs at junior colleges and public universities was reflected. In a footnote, Corazzini et al. referred to a stratification by sex as well. Specifically, males were more responsive than females to opportunity cost. Apparently, this was the only

area where differences were significant as the authors provided no further information on the analysis stratified by sex. Given the responsiveness of low income students to paternal education, it would have been helpful had Corazzini et al. examined the differential effects of the explanatory variables by ability level. Perhaps this latter analysis would have provided insight on the contrasting results between low and high income students on the paternal education and achievement factors.

The identification problem was limited in this analysis since the cross-sectional design prevented the included variables from reflecting joint determination of supply/demand schedules over time. Price variables were assumed to be predetermined, thus identifying the demand function. Weinschrott (1977), however, raised a question about the role of the ability variable. Corazzini et al. used the ability variable to express jointly the student's tastes or preference for college enrollment and the institution's selectivity potential. Since the dependent variable did not control for the eligible supply of students, the ability factor also may have reflected rationing of the enrollment supply. Consequently, identification of the demand function may have been jeopardized and coefficients for the ability variable biased upward.

The authors aggregated the individual student responses at the state level, allowing the introduction of various external factors (e.g., wage and unemplolyment rates) not available through the student survey. Like Hoenack, Corazzini et al. assumed a corporate level decision on the part of the average student in each state. The type of decision was one of whether or not to enroll in college. Most of the alternatives available to the student were reflected in the demand model; however, assuming the decision to enroll in college depended on the mix of institutions available to students in different states, the model may have been misspecified (Weinschrott, 1977). In other words, the list of explanatory variables allowed for aggregate types of institutions, ignoring the varying availability of this range across states.

## Summary and Discussion

A brief outline of the factors included in the reviewed studies and the primary results regarding each factor are provided in Table 1. The factors are organized according to their function as student related or external related factors and by the economic, noneconomic, and environmental categories described in the second section of this chapter. As demonstrated in Table 1 and the preceding reviews, conclusive results regarding each area of demand indicators depend largely on the manner in which a given factor or

Table 1

Summary of Reviewed Studies

| STUDENT FACTORS | HOENACK | CORAZZINI | KMM | BISHOP | TIERNEY |
|---|---|---|---|---|---|
| Economic: | | | | | |
| Family Income<br>Family SES | Family Income used as stratification variable; differential effects revealed. | Family SES used as stratification variable; differential effects revealed. | Family Income used as stratification variable; differential effects revealed. | Family Income used as stratification variable; differential effects revealed.<br>Family SES SES of family neighborhood reflect income, family tastes & preferences, as well as local characteristics generally a positive effect. | Family Income used with race as stratification variable; differential effects revealed. |
| Noneconomic: | | | | | |
| Academic<br>Academic Aspirations<br>Sex<br>Race<br>Program Preference | Academic Ability controlled through dependent variable ratio. | Academic Ability positive effects; proxy for tastes for higher education & for ability to overcome admissions restrictions.<br>Sex mix effects; few significant results revealed. | Academic Ability evaluated in terms of difference between student ability and IHE average ability; students prefer not to attend IHE where average ability is too far above their own.<br>Sex no significant effects. | Academic Ability used as stratification variable; significant differential effects revealed.<br>Sex sample based on males students only.<br>Race used only to specify feasible college alternatives. | Academic Ability mixed effects with regard to sign, no significant coefficients.<br>Academic Aspirations few significant effects except for upper income students aspiring to more than bachelor's degree, which increases likelihood of enrollment in private IHE. |
| Environmental: | | | | | |
| Parental Education | ------ | Parental Education positive effect for father's education; also a proxy for ability to finance education. | Parental Education paternal education generally has greater effect than maternal; general decrease in importance of parental education as income increases. | ------ | Parental Education paternal and maternal education used; mixed effects with regard to sign, no significant coefficients. |

Table 1 - Continued

| EXTERNAL FACTORS | HOENACK | CORAZZINI | KMM | BISHOP | TIERNEY |
|---|---|---|---|---|---|
| Economic: | | | | | |
| Tuition or Direct Cost<br>Financial Aid<br>Opportunity Cost or Indirect Cost<br>Unemployment Rate | Tuition negative effect; substitution of lower priced institutions indicated.<br>Opportunity Cost negative effects; significant for all campuses.<br>Unemployment Rate mixed effect due to confluence with opportunity cost. | Tuition negative effects; some positive yet nonsignificant effects may be due to indifference to enrollment at corrresponding IHE.<br>Opportunity Cost negative effects except among high SES group where coefficient was not significant.<br>Unemployment Rate positive nonsignificant effects except among high SES group--possible confluence with opportunity cost. | Tuition negative effects increasingly strong as incomes fall; room and board charges shift from negative to positive as income rises--indicates "quality of life" influence. | Tuition negative effects for tuition, room and board, and travel costs; some positive yet nonsignificant effects attributed to indifference to enrollment at corresponding IHE.<br>Opportunity Cost negative effects except among some income/ability groups where coefficients are not significant. | Tuition negative effects significant for all but lower income, nonwhite students.<br>Financial Aid positive effects for all but one coefficient--that of work study for upper income, nonwhite students. Lack of significance evidenced for low income, nonwhite students. |
| Noneconomic: | | | | | |
| Type of Institution<br>Location of IHE<br>Admissions/ Selectivity<br>Breadth of Field | Type of Institution models derived for each UC campus included costs for alternative IHEs. Indicates state colleges are good substitutes for UC campuses.<br>Quality of IHE indicated via tuition or direct cost variable; cost has less effect among higher quality IHE. | Type of Institution indicated via cost factor for each type IHE in each model; differential effects revealed. | Location used to reflect probability of residency; positive effect revealed.<br>Selectivity average ability used to reflect students attraction to selective IHE. Positive effect revealed to extent average IHE ability is not too far beyond that of student.<br>Breadth of Field positive effect revealed; strongest effect among middle income group. | Type of Institution examined with respect to location.<br>Location examined with respect to type of institution; few significant results.<br>Admissions negative effect. High standards constrain enrollments--depends on ability.<br>Breadth of Field positive effect generally. | Type of Institution limited to public versus private types.<br>Location no significant effects; signs imply nonwhites may be more mobile than whites.<br>Selectivity significant for two-thirds of coefficients; as selectivity at private IHE increases relative to that of public IHE, students more likely to enroll in private IHE. |
| Environmental: | | | | | |
| Local/Regional Characteristics<br>Population Size<br>Draft | Population Size controls for relevant population size; typically a positive effect. | Population Size controlled through dependent variable ratio. | ------ | Local Characteristics SES of family neighborhood used to reflect benefits of associating with "better class of people"; generally positive effects.<br>Draft some significant positive effects revealed. | ------ |

variable was incorporated in the analysis. Lack of specific data on direct measures necessitated use of proxy variables or indirect measures to account for various aspects of demand behavior. Consequently, consistent results for some factors were lacking. However, with respect to the major purpose of most demand studies, consistent findings were available--tuition, or the direct cost of attendance, had a predominantly negative effect on enrollment. Further, in most cases, indirect or opportunity cost effects were also found to bear negatively on enrollments. More importantly though, differential effects with regard to the magnitude of tuition or price elasticity were evidenced across income and ability levels, institutional types, and race categories.

Stratification of the demand function has been particularly beneficial in that the resultant differential effects have implications for approaches to pricing policy and enrollment planning. The ability to understand how students might respond to different pricing strategies is enhanced, of course, if policy makers understand not only the direct effects of changes in price on enrollment, but also the impact these changes have across different populations. Most studies have been able to stratify by income or institution type; in some cases, more than one level of stratification has been attempted. Two factors, race and sex, have been particularly slighted with regard to

potential stratification schemes. The omission of sex as a direct effect or as a stratification variable may have been due to the lack of significance obtained for this variable in several demand related studies (Corazzini, et al., 1972; Kohn, et al., 1974; Radner & Miller, 1975; and Tierney, 1980). At the same time, lack of individual data may have been an even more realistic factor underlying the absence of race and sex from demand analyses.

Perhaps the greatest weakness of most research on enrollment demand has been the limited examination of financial aid effects. The assumed positive effect of aid may mediate the negative effect of tuition; thus, omission of aid factors may result in overestimation of the negative effects of tuition. Moreover, knowledge regarding the effect of different forms and quantities of aid could prove particularly beneficial in assessing the impact of different financing strategies. As Tierney (1980) suggested, consideration of the source of aid, in addition to the quantity and form, would further enable institutional and governmental policy makers to understand the impact of varying pricing policies on enrollment size and distribution. To date, few studies have accounted for the effects of financial aid on the enrollment demand function.

Several approaches, or combinations of approaches, have been used to circumvent the identification problem. Use of

the cross-sectional design has facilitated the assumption of predetermined factors, particularly tuition (or direct cost of attendance), with respect to enrollment decisions. Also, selection of the sample or development of the dependent variable such that the relevant supply of students (e.g., all eligibles, all enrollees, etc.) was accounted for has been used to assure proper estimation of the demand function. These methods are acceptable as long as the demand function is the primary point of interest. However, as Weinschrott (1977) pointed out, in the face of projected enrollment pool declines, it might be wise for higher education policy makers and planners to analyze the supply side of the educational market in more detail.

The reviews in the previous section reveal that most research allowed for a primarily corporate level of choice with regard to student enrollments. These studies focused mainly on beginning, entering freshmen who were assumed dependent on family income with regard to financing their postsecondary education. Accordingly, family background measures became important sources of information regarding economic and environmental influences resident in the student. However, it is the level or stage in the decision process which affects the range or set of enrollment options considered in the demand analysis. Some studies, such as Corazzini's (1972), focused on a discrete point in the

choice process--enrollment versus nonenrollment, private versus public enrollment, and so forth. Other studies attempted to model several stages in the choice process, such as the Kohn et al. (1974) study where the residency choice, college choice, and college-going choice were modeled. The important point to remember in either approach is that the appropriate range of enrollment options and the correspondingly relevant explanatory variables are accounted for in the model specifications. Reliable data are usually available on actual enrollment choices, but, specification of discrete alternative choice sets as in the Kohn et al. study, or types of alternative options as in Corazzini's research, is less precise. Lack of data regarding the relevant explanatory variables for the alternative enrollment options further inhibits this area of the analysis. Limitations in this regard deter understanding of the effects of substitution and the effects of a certain mix of available enrollment options on demand behavior.

# Chapter III

# METHODOLOGY

## Research Objectives and Approach

Research on the demand for higher education has demonstrated that enrollment demand is a complex function of a number of external and student related determinants. These determinants may be classified as: economic--factors demonstrating the direct/indirect costs of enrollment and the ability to finance education; noneconomic--factors demonstrating academic ability, educational background, tastes or preferences; and environmental--factors demonstrating familial, local, or regional characteristics that influence the propensity to enroll in college. This research drew from each of these categories to develop factors representative of the classical elements of demand analysis--elements that have been adapted by educational economists to the study of enrollment demand.

As indicated in Chapter One, the main purpose of this study was to model the determinants of enrollment, or the demand for higher education, and to determine whether or not enrollments were price elastic among Virginia's public four-

year institutions. Given that price affects enrollments, the magnitude of these elasticities across different institutional groupings and across individual institutions was examined. Based on the investment approach to human capital theory, it was hypothesized that the demand for enrollments would vary inversely with the direct and indirect costs of education and positively with those factors that enhance, or reduce the uncertainty of, opportunities to benefit from enrollment. Consequently, tuition, or the direct cost of higher education enrollment, was expected to bear negatively on demand. Perhaps a more important aspect of this effect was the possibility of differential effects across different populations--in this research, different groups of institutions. If such effects had not been realized then inquiry into non-price factors would have been advised. Such research was meant to provide officials in the state with an understanding of human capital based methodologies as applied to the study of the demand dependency of higher education institutions.

The remainder of this chapter outlines the methodology used in examining tuition elasticity among Virginia's four-year institutions. First, a discussion of the dependent variable, or the measure of demand, is provided. Specific problems with regard to enrollment caps and grouping of institutions are addressed in this section. Following this

discussion is a description of the independent variables according to their function in the analyses. Details regarding measurement of variables in grouped versus institutional models are also discussed. Methodology, with regard to model specification, design, and analytical technique, is addressed in a third section. In particular, the three stages of analysis and the general functional form of the models used in this research are described in this section. The chapter concludes with some general comments on specific methodological concerns.

## Measurement of Demand

One of the most difficult problems in this research was determining an appropriate measure of the demand for higher education.[1] Earlier work has tended to focus on actual enrollment alone or enrollment relative to the total pool of potentially eligible students. Unfortunately this index is not appropriate in Virginia due to the imposition of enrollment caps on public institutions. As a result, the supply for most, if not all, of the institutions is limited by factors beyond the influence of tuition and fees. In addition, the acceptance of students for enrollment is based on academic and other noneconomic factors. These two

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[1]Portions of this chapter have been previously reported in Strickland, Bonomo, McLaughlin, Montgomery, and Mahan (1982).

circumstances combine to create a situation similar to that illustrated in Figure 1. In this situation, the lack of enrollment caps would result in a potential enrollment and price level as represented by point "a", assuming all other enrollment restrictions such as academic standards are held constant. However, given the need to restrict size, an institution may use price to control enrollment levels while maintaining current academic/admissions standards in order to preserve the diverse composition of its student population (see point "b"). Use of price for this purpose, of course, depends on the responsiveness of enrollment to changes in price. If enrollment is not sufficiently responsive to price, the institution then must use non-price restrictions and thus would not be operating on the curve shown in Figure 1.

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Figure 1 about here

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A second concern was the desire to examine the influence of price and other cost factors on demand. In the case of cross-sectional analysis (applied in this research), this desire required that several institutions, which were similar in character but had different cost factors, be considered simultaneously to achieve adequate variation in price. Both the problem with enrollment caps and the

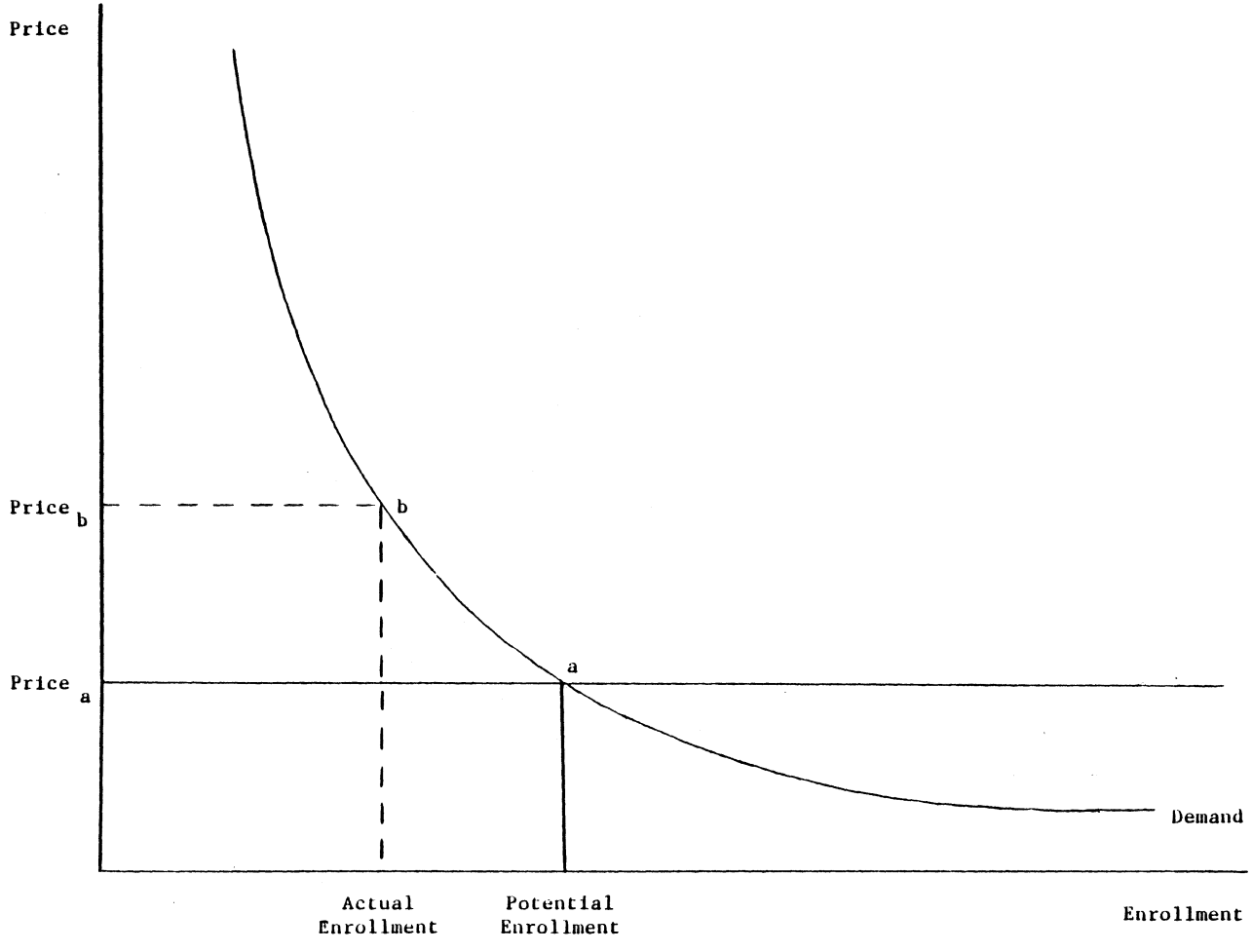


Figure 1. Results of Enrollment Restriction Cap

problem of grouping institutions can be greatly diminished by dividing the enrollment from a given municipality in a specific institution by the total entering freshmen enrollment for that institution. Since this study considered Virginia resident, or in-state, enrollments only, the beginning freshman enrollment in an institution from a given municipality was divided by the total number of beginning in-state freshmen at that institution.

Measurement of the dependent variable, or demand, in this manner was based on two assumptions. First, the proportion of students enrolled in public four-year institutions from a specific locality was assumed to be linearly related to the proportion who would have enrolled given a lack of enrollment and/or admissions constraints (i.e., a constant acceptance-to-application relationship). In other words, if all applicants from all municipalities were equally acceptable to an institution, then this measure estimated the point on the demand curve which would have been obtained if there were no cap on enrollments, all other things being equal. The assumption of a lack of nonprice rationing has both theoretical and empirical support in the literature (Blaug, 1966; Corazzini et al., 1972; Hopkins, 1974; and Schultz, 1961).

The second assumption was that all the institutions were equally desirable to the applicants (i.e., a constant

enrollment-to-acceptance relationship). In this regard, the demand ratio not only estimates the proportion of high school graduates from a municipality who were applicants to a given institution but also took into account the varying sizes of the different institutions. Of course, both of these assumptions do not strictly hold as is discussed by Radner and Miller (1975) and Kohn, Manski, and Mundel (1974). Research efforts by these individuals focused on the process of student choice and necessarily depended upon more unique, complex data analysis methods than applied in the current research. In fact, the analyses conducted for this research were a logical first step in the attempt to study student choice patterns, admittedly a refined or specialized area of student demand analysis.

The intent underlying the formulation of the dependent variable was to estimate some linear function of the number of students who would have enrolled had there not been an enrollment ceiling on each institution. The assumptions outlined above allow that if, in fact, the institutions in a given subgroup were very similar, then the number of students who would have entered each would be the same given the institutions were all the same size. Furthermore, when institutions were not the same size, the number of students these colleges accepted would be proportional to their number of beginning freshmen enrollment. In other words, if

two institutions, one having a freshmen class twice the size of the other, enrolled the same number of students from a particular locality, then the varying proportions of total enrollment derived from this locality for these two institutions would reflect varying levels of demand. On the other hand, if one were to use only the number of enrollments by locality or the ratio of enrollments to high school graduates by locality, then there would appear to be no difference in the demand dependency of these two institutions on the locality in question. It is obvious that all institutions are not equally desirable, even when homogeneous groups are formed. At the same time, it was believed that the error made in this assumption was substantially less serious than the erroneous conclusions which would have been drawn if the adjustment for size had not been made, particularly in the context of nonprice limits on enrollments.

For these reasons, the measure of demand derived for use in this study was closer to the true measure than the one which would have been obtained by dividing local enrollment by the total pool of potentially eligible students. Moreover, by using a research design which allowed the observation of demand within the context of a given type of institution, the differential impact of alternative institutions on student demand was demonstrated.

The joint dependence of demand on different types of institutions or other post-high school alternatives (Radner & Miller, 1975; and Kohn et al., 1974), however, was not reflected in the current research. Besides providing a more appropriate measure of demand for this research, relative to traditional measures used in past research, the demand measure as defined in this section standardized institutions of different sizes such that they could be analyzed in the same group. Calculation of the criterion in this manner prevented factors of supply from being confounded with demand in the regression weights, a concern predominant among earlier longitudinal studies (Campbell & Siegel, 1967; Hight, 1975; and Hoenack & Weiler, 1975).

In summary, the dependent variable (E) was measured as the ratio of the number of students from a specific municipality enrolled as first-time entering freshmen at a particular institution to the total in-state, first-time entering freshmen enrollment for that same institution. Use of this criterion alleviated the problem of enrollment caps and allowed the standardization of institutions of different sizes such that selected institutions could be grouped and price variation achieved.

## Independent Variables

The independent variables selected for this analysis were grouped according to their function in the models. Briefly, with respect to the five classifications of determinants used in this research, these variables included: (1) eligible population--the number of high school graduates or the total population of potential enrollees; (2) educational background--the average ability of prospective students and the educational attainment of adults within the students' environment; (3) family income--the ability of different income groups to finance a college education; (4) direct/indirect costs--cost of college attendance, opportunity cost and employment opportunity; and (5) county characteristics--the environmental influence of different local characteristics on enrollment demand. These variables are discussed in greater detail below.

Few studies have employed the eligible (consumer) population factor as an independent variable because, typically, this factor was used as the denominator in the enrollment or demand ratio. The measure of eligible population used in this study was the number of high school graduates (HSG) for each municipality. Hoenack (1968) included this factor among the independent variables in his regression analysis, using as the dependent variable a ratio

much like that used in this research. It was use of such a criterion variable that brought about favorable review of Hoenack's work in contrast to other enrollment demand studies (Radner & Miller, 1975). Because demand is dependent on the size of its relevant population, this factor is a necessary variable in analyses based on the demand dependency of various institutional types. Eligible population was expected to bear positively on enrollment.

The educational background factor involved two variables: average ability score (Short Test of Educational Ability--STEA) and educational attainment level. STEA was measured by the average STEA score for 1980 seniors, the STEA being administered when students were in the eleventh grade (see Appendix A for further details on measurement of variables). The STEA variable was used to reflect not only the students' ability to overcome any nonprice rationing that might have existed via college admissions policies, but also the students' probable expected return from a college education. Moreover, as in previous studies, student ability also served as a proxy for students' tastes and preferences for higher education. Similar variables have been included in the research of Feldman and Hoenack (1969), Corazzini et al. (1972), Spies (1973), Hopkins (1974), Hoenack and Weiler (1975), Bishop (1977), Chapman (1979), Radner and Miller (1975), and others. Theoretical support

for use of ability variables comes from Blaug (1966) and Becker (1975) who noted that the higher the students' ability the less their risk in investing their resources (monetary and nonmonetary) in higher education.

Educational attainment (EDL) was measured as the proportion of adults in the students' locality who had completed one or more years of college. Although its function primarily was to indicate the influence of the students' environment on their propensity or taste for higher education, this variable also was used as a proxy for family income. Several studies have recognized this joint function of educational attainment (Corazzini et al., 1972; Hoenack, 1968; Hopkins, 1974; and Tannen, 1978). Hoenack (1968) recognized the value of including educational attainment in his analysis but was forced to exclude it from his models due to its high correlation with income. Hopkins (1974) included this variable along with an income variable in his analysis; both were found significant in the case of public enrollments nationwide. However, the income factor became nonsignificant in his total enrollment function where private enrollments were also included. Educational attainment and price were identified as the strong influences on total demand. Notwithstanding these mixed results, educational attainment was recognized as a relevant factor and was thus included in this research.

Income, of course, relates to the students' ability to finance their investment. Many studies have included median or disposable family income as the measure of income in their analysis (Campbell & Siegel, 1967; Hopkins, 1974; and Hight, 1975). Others have stratified their data by income levels, intending to examine the distributional effects of income on enrollment demand (Corazzini et al., 1972; Feldman & Hoenack, 1969; Hoenack, 1968; Kohn, et al., 1974; Radner & Miller, 1975; and Spies, 1973). Some (Feldman & Hoenack, 1969; Spies, 1973; and Radner & Miller, 1975) further stratified by income/ability groups based on the premise that the higher the ability to finance an education as well as the ability to succeed, the greater the expected rate of return to education and, hence, the tendency to enroll.

The lack of data on individual students prevented such analysis in this research. In an attempt to account for distributional effects, income was measured as the proportion of households within four EBI (effective buying income) groups (INCA, INCB, INCC, INCD).[2] Assuming these proportions represented the distribution of high school

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[2]The EBI ranges for each group were: INCA - $8,000 to $9,999; INCB - $10,000 to $14,999; INCC - $15,000 to $24,999; and INCD - over $25,000. A fifth proportional group (INCE - less than $8,000) was excluded in order to avoid having the proportions add to unity within the given localities and, thus, to assure sensible estimation of income effects.

graduates across different income levels, it was proposed that membership in lower or higher income groups would demonstrate the distributional effects of income on enrollment demand. Unfortunately, coefficients for these measures proved to be insignificant and generally uninterpretable. Examination of the intercorrelations of these variables with each other and with other measures in the model evidenced a high degree of collinearity--thus, the EBI ranges were dropped from the model. Instead, a measure of local median income (INCOME) was included in the grouped models. An interaction term between this variable and PRICE also was examined; however, results from this specification proved to be insignificant.

For the individual institutional models, no separate measure of income was included in the general model. Rather, a measure of financial burden (FINBUR) was used in these models and results were discussed in the cost factors section. Since this variable was a ratio of PRICE to INCOME, the inclusion of a separate measure of INCOME produced high variance inflation factors for both the PRICE and INCOME variables (Belsley, Kuh, & Welsch, 1980). Also, due to the high correlation between EDL and INCOME, it was determined that EDL could jointly serve as a measure of the effects of educational attainment and as a proxy for family income effects.

The cost factor was divided into direct and indirect costs. Direct cost (PRICE) was measured as the tuition and required fees plus room charges depending on whether or not a given locality was determined to be within "reasonable" commuting distance of an institution. The commuting range was thirty (30) miles for those institutions where a policy exists requiring all freshmen to live on campus (excepting those students who live in the local vicinity with relatives). Otherwise, the commuting range was fifty (50) miles. See Appendix B for details on institutional housing policies. Similar distances or consideration of reasonable commuting distances were addressed in Hoenack (1968), Bishop (1977), and Kohn, et al. (1974). This variable also had some characteristics of a proximity measure since for any given institution the PRICE was substantially lower for those within commuting distance. If the geographic center for a region was beyond the commuting distance, the direct cost (PRICE) for an institution included room charges. Thus, tuition, fees, and room charges (where appropriate) introduced the price variable included in typical demand analyses and also allowed some reference to proximity.

A problem, of course, arose when attempting to include a cost factor in models developed for individual institutions. Use of a cross-sectional design resulted in limited variation in the PRICE factor for any given

institution. Consequently, this factor was not included in the analysis of enrollment demand for single institutions. However, an alternative measure successfully used by Radner and Miller (1975) was adopted. This measure (FINBUR) reflected the average "financial burden" of attending college and was measured as the ratio of direct costs to income, or PRICE to INCOME.

Indirect costs were measured as the average local wage of production workers (WAGE) and the local unemployment rate (URATE). The wage rate (measured in thousands) served to indicate the loss of income incurred due to enrollment in higher education--a variable familiar to us as the opportunity cost. The unemployment rate indicated the probability of employment given one was in the labor force. Use of these variables has yielded contrasting results in past research. Hoenack (1968) found wage rate to be significant and unemployment rate insignificant, suggesting that although California students placed value on their time which was at least as high as the current wage rate, unemployment rates were unrelated to enrollments. Corazzini et al. (1972), however, found wage rates to be insignificant and unemployment rates significant. Both variables did exhibit the greatest impact on low income/low ability groups in the two studies. Such results have been attributed to a confluence of effects between the two factors--a negative

cost effect due to foregone earnings, and a positive income effect in terms of current part-time employment opportunities. It may be that inclusion of both factors is unnecessary, a conclusion partially supported through the results of this study.

The last set of determinants included measures of county characteristics. These measures were used to reflect the tastes or preferences of students with regard to college enrollment. Several studies have incorporated a variety of environmental or geographic variables to explain differences in enrollment demand. Tannen (1978) found that regional dummy variables demonstrated differences in attitudes toward education or the advantages of having a concentration of schools nearby such that it enhanced enrollment rates in affected regions. Feldman and Hoenack (1969) included both regional dummy variables and variables denoting the urban-rural character of a locality. Use of the latter was based on evidence that persons' urban-rural background affects their rate of return to a college education, the urban students realizing a greater return (Becker, 1975). Although such measures have not proved significant in many cases, their impact was considered in this research.

County characteristics were measured as the proportion of income generated via different industrial sectors. These sectors included: (1) AGIND--natural resource industries

such as agriculture and mining; (2) MNFIND--nonnatural resource industries such as construction and manufacturing; and (3) SRVIND--support industries such as transportation, trade, finance, and service corporations. Since the proportions added up to unity for any given locality, only two sectors could be included in the models if sensible estimates of the county characteristics effect were to be obtained. However, in the models developed for this research, only the AGIND sector was included. There were two reasons for this approach. First, the two remaining sectors were found to contribute almost equally to the demand function, therefore separate estimation of their effects rather than that for AGIND was not warranted. Secondly, intercorrelations between MNFIND and SRVIND and other factors evidenced a high degree of collinearity, further warranting exclusion of these variables. It was assumed that the AGIND sector represented the rural-related characteristics of a locality and, hence, would be negatively related to enrollment.

## Methodology

Due to a lack of continuous data for all variables comprising each set of determinants and the possibility of confounding supply and demand via the longitudinal approach, a cross-sectional design was employed in this research. The design was cross-sectional in that it incorporated data for

one point in time across several higher education institutions within one state system. Although there are distinct advantages and disadvantages in employing this approach, use of it has been widespread in similar studies (Bishop, 1977; Corazzini et al., 1972; Feldman & Hoenack, 1969; Hoenack, 1967; Hoenack & Weiler, 1975; Hopkins, 1974; Kohn, et al., 1974; Radner & Miller, 1975; and Tierney, 1980).

As indicated earlier, the primary purpose for using the cross-sectional design was to diminish the identification problem. In this research, demand was assumed to be a function of price, income, academic ability, and other previously discussed factors. When such factors are examined over time, variation in the different factors may be associated not only with variations in demand, but also with variations in supply (i.e., an identification problem). The latter consequence would require specification of supply factors and the interactions between supply and demand. Such analyses were beyond the scope of this research. Using the cross-sectional design, the supply of enrollment places was assumed constant, allowing regression coefficients to reflect only parameters of demand.

Another noted advantage in using a cross-sectional design rather than a longitudinal or time series design is that there is less bias among the independent variables. In

at least one instance it was found that due to the high correlation between tuition charges over time, the use of cross-sectional rather than time-series data was the most appropriate for enrollment predictions, or, for estimating the effect of changes in various determinants on higher education enrollments (Hoenack & Weiler, 1975). The disadvantage of using a cross-sectional approach involves the lack of variation in some variables. For instance, the cost of attendance at community colleges in Virginia lacks variation because it is the same for all Virginia community colleges in a given year. As a result, the effect on enrollment of the community college alternative is difficult to examine using a cross-sectional design and, consequently, was not included in this analysis.

The lack of information on individual students required the use of an aggregate data base where the unit of analysis was the locality (county or city) from which students enrolled. Several studies have used similar units of analysis. Campbell and Siegel (1967), Hight (1975), Hopkins (1974), and Tannen (1978) used data aggregated at the state level in their separate nationwide analyses of educational demand. Although Corazzini et al. (1972) had individual student data available, they based their analysis on statewide averages of these data. Similarly, Hoenack (1968) compiled individual data to create aggregate measures at the

high school district level. However, both Corazzini et al. and Hoenack were able to stratify their data by income level due to the availability of their data at the individual student level. This stratification allowed these researchers to examine the distributional effects of income on enrollment demand.

Other studies (Bishop, 1977; Hoenack & Weiler, 1975; Radner & Miller, 1975; and Spies, 1973) have been based on individual student data, seeking to examine individual demand for higher education at various stages of the enrollment process by several classifications of student type, institutional type, or other classification schemata. While this level of detailed analysis may be preferred in many cases, the lack of individual data on Virginia students prevented such analysis in this research. Furthermore, since the purpose of this study was directed toward statewide enrollment planning efforts, it was perhaps more appropriate to focus on demand at the macro level by the average individual rather than on demand at the micro level by the unique individual. It is recognized, however, that the use of aggregate data raised the possibility of measurement error, particularly with regard to student related factors such as ability and family income.

Multiple linear regression was used to analyze the data across three stages of investigation. In the first stage, a regression model was developed for the statewide group of public, four-year institutions (see Appendix C for a list of these institutions). This model reflected the net effect of each determinant on enrollment across all types of institutions. In other words, possible differential effects for the variables across various types of institutions were not evident in these results. Institutional groupings were used in the second stage of analysis to examine this possibility.

The second stage of analysis examined enrollment demand within three institutional groupings: (1) the major, comprehensive universities--University of Virginia, Virginia Tech, and William & Mary; (2) those institutions which originated as normal schools--James Madison, Longwood, Mary Washington, and Radford; and (3) the urban institutions--George Mason, Old Dominion University, and Virginia Commonwealth. These groupings were selected in an attempt to investigate enrollment determinants within the context of more homogeneous groups of institutions, satisfying, in part, the assumption of equally desirable institutions for a given pool of students. The first group represented the traditional, comprehensive universities that offer professional, doctoral, and other graduate level

programs as well as an extensive research component. The next group consisted of those institutions which were former normal schools that broadened their curriculums to include liberal arts programs. The urban institutions, of course, shared the distinction of being located in large metropolitan areas as well as having a similar curriculum of liberal arts, professional or occupational programs, and some graduate work.

In the third stage of analysis, separate regression models were produced for each individual four-year institution. The general functional form of these models necessarily differed from that used for the grouped institutional models due to the limited variability in price, or tuition and fees, for any one given institution. In regard to the economic related determinants, the effect of financial burden (FINBUR) on enrollment replaced both income and direct cost factors since (1) these factors were used to construct the FINBUR variable, (2) the variation for direct cost was limited, and (3) the income factor was approximated by the educational attainment variable for the institutional models. Determinants related to noneconomic and environmental factors were examined not only in the context of their effect on a given institution's enrollment, but also in regard to their differential effects across institutions. In brief, fifteen linear regression models

were produced in stage three--one for each four-year institution--to examine the effects of income, financial burden, and other factors on institutional enrollment demand.

Using data to reflect a 1980 time frame (see Appendix A), the enrollment models were developed by regressing the enrollment ratio (demand measure) on the explanatory variables representing the five sets of determinants as described above. The general functional form of the models used in the analyses for stages one and two was:

$$\log E = b_0 + b_1 \log HSG + b_2 STEA + b_3 EDL + b_4 \log INCOME + b_5 \log PRICE + b_6 WAGE + b_7 URATE + b_8 AGIND$$

Models developed in stage three of this research had the following general form:

$$\log E = b_0 + b_1 \log HSG + b_2 STEA + b_3 EDL + b_4 \log FINBUR + b_5 WAGE + b_6 URATE + b_7 AGIND$$

## Comments on Methodology

A cross-sectional design was used in this research. Therefore, it is important to remember that the results of these analyses do not reflect transition, or the effects of shifts in the independent variables on the dependent variable. The models estimated direct effects only and were not used to postulate future effects. Therefore, changes in specific variables were interpreted in terms of the context in which they were set. For instance, a change in PRICE was discussed in terms of: "if price had been this, then the enrollment rate might have been this"--rather than "if price is this, then the enrollment rate will be this".

Three additional methodological issues concerned the use of a general functional form model across each grouping and/or institution in the three stages of analysis, the use of logged variables, and the degrees of freedom for testing the regression coefficients obtained across the three stages of analysis. For the first issue, it was recognized that if the models developed and included in the formal analysis of this study had not been restricted to a general functional form, the resultant models could have been quite different not only from the general model but also from other grouped or institutional models. While such models may have been more representative of the effects of explanatory factors on enrollment within a given context, they would not have

allowed comparison of these effects across different groupings or different institutions. One of the objectives of this research was to examine the differential effects of factors across institutions; therefore, only the results for models developed with regard to a general functional form were discussed.

The second issue concerned the inclusion of logged variables. One use of logged, independent variables was based upon the desire to produce estimates of constant elasticity for the economic factors, specifically the price and income variables. By logging these variables, direct estimates of the elasticity of these factors were obtained from the regression weights; otherwise, use of unlogged variables would have required the manual transformation of resultant regression coefficients into elasticity coefficients. Furthermore, the resulting estimates of elasticity obtained from unlogged variables would not be constant, for they would vary as a function of the point at which they were estimated. Elasticity coefficients provide information not only with regard to the general responsiveness of enrollment to selected factors but also provide an indication of the nature of enrollment demand with regard to these factors. Finally, use of constant elasticities are particularly useful, in that they are "unit-free" and the effects of the variables to which they

apply may be expressed in terms of percentage changes (Pindyck & Rubinfeld, 1980). Specifically, as opposed to the form for the slope of unlogged independent and dependent variables ($\beta_i = \Delta y/\Delta x$), elasticities derived from double-log transformations are of the form ($\beta_i = (\Delta y/y)/(\Delta x/x)$). These characteristics facilitated examination of price and other economic factors across institution types.

Another use of logged variables concerned their effect on the overall efficiency of the model. Because much of the data being used in this research constituted "count" data, vital statistics, census data and so forth, many variables were better expressed in logarithmic form. In those cases where logging a variable increased the $R^2$ of the general model and/or improved the significance level of the variable within the model, then the log of that variable was used.

The variance and covariance for all variables except the direct cost variables (PRICE, FINBUR) were a function of the 136 localities in the state, with all localities being represented for each institution. Therefore, the degrees of freedom, or independent "n", for these variables should be 127 for stage one and two models and 128 for stage three models--where df=(N-k-1). However, when institutions were grouped for stage one and two analyses, the locality by institution arrangement of the data increased the degrees of freedom for these variables to 399 for the major university

and prior normal school models, to 535 for the urban institution model, and to 2,031 for the statewide model. In other words, for each of the fifteen institutions, there were 136 observations--one for each county or city in the state. This increase in the degrees of freedom might affect the significance of t-values for the resultant coefficients. On the other hand, given the very slight change in magnitude of the t-values significant at the .05 and .01 levels of significance when the degrees of freedom equal 120 or more, the potential for error in this regard is minimized. Nevertheless, the reader should keep in mind the data configuration and the possible inflation in degrees of freedom when examining the results for models generated in stages one and two.

The analysis of higher education demand attempted in this research was descriptive in nature. The effects of different sets of enrollment determinants selected on the basis of the human capital investment approach were examined for a given statewide system of public, four-year colleges and universities. Results of this research were meant not only to provide information about the feasibility of this methodology with regard to examining the demand dependency of different types of institutions, but also to provide a base of research upon which subsequent research efforts could build. Differential effects evidenced with regard to

the institutional groupings may lead to linkages with related research efforts on, for example, pricing policies, student migration, growth management, or financial aid. Given the uncertain state of higher education enrollments, such information would be particularly important and necessary to the maintenance of a viable system of higher education.

# Chapter IV

# RESULTS

## Overview

This chapter presents enrollment demand models for three stages or levels of analysis: (1) statewide; (2) institutional type or subgroup; and (3) individual institution. Overall regression models for the different institutional groupings comprising stages one and two are presented in Table 2; models for the individual institutions in stage three are presented in Table 3. Results of the separate analyses in each stage are discussed with respect to the five sets of determinants described in Chapter Three. Because the models in stages one and two have the same functional form, differential effects across models in these stages are addressed within the same section for a given set of determinants. Where differing effects occurred, explanations are proposed with respect to past research efforts, differences in the institutions comprising the sample for each of the separate models, other variables included in the analysis, and/or possible methodological or theoretical problems evidenced with regard to development of

Table 2

Regression Results by Institutional Grouping

| Institutional Grouping | Constant | Log HSG | STEA | EDL | Log INCOME | Log PRICE | WAGE | URATE | AGIND |
|---|---|---|---|---|---|---|---|---|---|
| Major Universities | -6.833 | 0.643** | -0.008 | 4.085** | -0.234 | -0.155 | -0.379 | 0.483 | -1.251** |
| Prior Normal Schools | 4.156 | 0.520** | -0.0002 | 1.635** | 0.067 | -1.802** | 0.312 | -0.667 | -1.012** |
| Urban Institutions | 1.843 | 0.494** | -0.024** | 3.984** | 0.212 | -1.724** | -0.891 | 1.119 | -0.867* |
| STATEWIDE | -0.212 | 0.486** | -0.014** | 2.553** | 0.009 | -1.133** | -0.191 | 0.614 | -0.798** |

* Significant at p > 0.05
** Significant at p > 0.01

Table 3

Regression Results for Individual Institutions

| Institution | Constant | Log HSG | STEA | EDL | Log FINBUR | WAGE | URATE | AGIND |
|---|---|---|---|---|---|---|---|---|
| University of Virginia | -10.738 | 0.573** | -0.022* | 4.052** | -0.392 | -0.103 | -0.436 | -1.763** |
| Virginia Tech | -10.235 | 0.801** | 0.004 | 3.471** | 0.351 | -1.208 | 1.188 | -0.836 |
| William & Mary | - 9.281 | 0.511** | -0.008 | 3.972** | -0.146 | -0.895 | 1.495 | -1.181* |
| James Madison | -10.992 | 0.504** | 0.006 | 1.609* | -0.866** | 0.227 | 1.469 | -1.018 |
| Longwood | - 8.731 | 0.446** | -0.012 | 0.444 | -0.824** | -0.609 | -2.697 | -1.097 |
| Mary Washington | - 8.898 | 0.331** | -0.019** | 2.850** | -0.947** | -1.924* | 0.392 | -0.768 |
| Radford | -10.735 | 0.626** | 0.023** | -1.253 | -0.667* | -0.768 | 0.134 | -1.396* |
| George Mason | - 9.898 | 0.198** | -0.013 | 4.815** | -0.953** | -2.986** | -0.205 | 0.338 |
| Old Dominion | -10.923 | 0.602** | -0.039** | 3.831** | -0.982** | -2.382* | 5.282 | -1.371* |
| Va. Commonwealth | -10.640 | 0.524** | -0.035** | 2.591** | -1.172** | 0.031 | -0.352 | -1.682** |
| Christopher Newport | - 8.004 | 0.062 | -0.012 | 0.607 | -1.081** | -0.996 | 4.542 | -0.293 |
| Clinch Valley | - 6.572 | 0.075 | -0.0001 | 0.451 | -0.579* | -1.683* | -1.355 | 3.488** |
| Virginia Military | - 6.393 | 0.344** | -0.008 | 1.330* | 0.136 | 0.540 | -3.180 | 0.050 |
| Virginia State | - 7.944 | 0.464** | -0.059** | 1.782 | -0.675** | -0.603 | 5.052 | -2.251** |
| Norfolk State | -10.777 | 0.610** | -0.059** | 0.400 | -1.373** | -2.148 | 2.999 | -1.977** |

* Significant at $p < 0.05$
** Significant at $p < 0.01$

the model. The reader is reminded of the degrees of freedom concern discussed in Chapter Three. Because each locality was crossed with each institution, the degrees of freedom for testing the resultant nonprice coefficients may be artificially increased; however, the effect on the significance of these coefficients was believed to be slight if extant at all. Summary statistics for the overall models follow the discussions of determinants.

Results for the models developed in stage three are presented similarly in a separate section. The effect of the financial burden variable (FINBUR), for instance, is examined across all models developed in stage three. These results, however, are not compared directly with those obtained in stages one and two due to the unique functional form of the models produced in stage three. Differential effects across models within stage three, of course, are identified and discussed in a manner similar to the discussion outlined above for stages one and two.

Where appropriate, particular attention is given to estimates of elasticity produced for the direct cost and financial burden factors. Since the elasticity coefficients are unit-free, results are interpreted in terms of percentage change. In general, elasticities reflect the level or extent of responsiveness in the dependent variable with respect to the independent variable defining the type

of elasticity (e.g., the elasticity coefficient associated with the price variable is referred to as "price elasticity"). Also, at the end of each section, that for stage one and two models and that for stage three models, descriptive statistics for all variables included in the models are presented.

## Statewide and Institutional Group Analyses

### Eligible Population

The number of high school graduates by locality was a statistically significant determinant of enrollments across all institutional groupings. Table 4 contains the summary statistics for the three institutional types or groupings, and for the statewide grouping of all public four-year institutions.

Table 4

Estimated Effect of the Eligible Population Factor (log HSG)

| Institutional Grouping | Coefficient | t |
|---|---|---|
| Major Universities | 0.643 | 11.71 |
| Prior Normal Schools | 0.520 | 12.81 |
| Urban Institutions | 0.494 | 9.68 |
| STATEWIDE | 0.486 | 17.77 |

The results indicate that an increase in the number of high school graduates across different localities did not

lead to a proportionate increase in the number of students contributed to educational institutions. In other words, doubling the number of high school graduates was associated with more enrollees but significantly less than twice as many enrollees. These findings are consistent with previous research (Bishop, 1977; and Hoenack, 1968). They are also reasonable given the college bound rate of attendance for the entire state was about 50 percent.

Educational Background Factors

The average ability score (STEA) for graduating seniors and the proportion of adults (age 25 and over) who had completed some college work (EDL) constituted the educational background factors for each locality. These results are shown in Table 5.

Table 5

Estimated Effect of Educational Background Factors

| Institutional Grouping | STEA | | EDL | |
|---|---|---|---|---|
| | Coef. | t | Coef. | t |
| Major Universities | -0.008 | -1.40 | 4.085 | 6.88 |
| Prior Normal Schools | -0.0002 | -0.04 | 1.635 | 3.73 |
| Urban Institutions | -0.024 | -4.73 | 3.984 | 7.21 |
| STATEWIDE | -0.014 | -5.33 | 2.553 | 8.64 |

Results for the educational background factors were mixed. It was initially believed that high ability levels for high school graduates in a locality would have a positive effect on the area's contribution ratio. An examination of the results in Table 5 confirms that the effects were uniformly negative. Although the negative coefficients for STEA were unexpected, such an outcome is not unprecedented. Feldman and Hoenack (1969), in their separate analyses of public, private, and total combined enrollments, found that public enrollment declined the higher the ability/income level of the students. Findings of the current research suggest that higher ability graduates exhibited either a persistent tendency to "go away" to college or to substitute private for public enrollment. In other words, higher ability graduates in Virginia might have enrolled in out-of-state institutions or private institutions to a greater degree than lower ability graduates, particularly if higher ability students also came from higher income backgrounds.

The second educational background factor, the proportion of adult residents within the locality who had attended some college, was found to have consistently positive and statistically significant effects on enrollment in Virginia institutions. With regard to prior research, most studies have found educational attainment to be a

significant, positive indicator of the tastes and preferences of students for higher education. Thus, the educational environment or preference measured by this factor had the expected result. However, the strong relationship between educational background and income produced mixed results, perhaps partially accounting for the weak effect of income factors as incorporated in the grouped models.

Family Income Factors

Several measures of the family income factor were attempted in the institutional grouping analyses. Due to collinearity problems, measures reflecting distributional effects were dropped from the models, leaving simply a measure of median family income (log INCOME). There did not appear to be any significant effects, however, due to median income levels. Table 6 presents the results for INCOME.

Table 6

Estimated Effect of the Family Income Factor (log INCOME)

| Institutional Grouping | Coefficient | t |
|---|---|---|
| Major Universities | -0.234 | -0.91 |
| Prior Normal Schools | 0.067 | 0.35 |
| Urban Institutions | 0.212 | 0.87 |
| STATEWIDE | 0.009 | 0.07 |

In general, the coefficients for INCOME were positive and nonsignificant, although that for the major universities was negative. These mixed, weak effects might be due to the strong, positive correlation of INCOME with EDL (the educational attainment factor), where the latter evidenced a stronger, positive relationship with the dependent variable than did INCOME. It appears that if income entered into the enrollment decision, it did so through the educational attainment factor and/or through an interaction with the direct cost variable. These possibilities are discussed further in Chapter Five.

Cost Factors

Three types of cost factors were used in these analyses: (1) the direct cost of attendance (log PRICE); (2) the indirect cost via opportunity costs (WAGES); and (3) the indirect cost via employment opportunities (URATE). Statistical results pertaining to these cost factors are shown in Table 7.

Table 7

Estimated Effect of Cost Factors (log PRICE, WAGES, URATE)

| Institutional Grouping | Log PRICE | | WAGES | | URATE | |
|---|---|---|---|---|---|---|
| | Coef. | t | Coef. | t | Coef. | t |
| Major | -0.155 | -0.82 | -0.379 | -0.55 | 0.483 | 0.23 |
| Prior Normal | -1.802 | -8.64 | 0.312 | 0.61 | -0.667 | -0.42 |
| Urban | -1.724 | -10.55 | -0.891 | -1.39 | 1.119 | 0.56 |
| STATEWIDE | -1.133 | -12.87 | -0.191 | -0.55 | 0.614 | 0.58 |

The direct cost of education, or PRICE, had the expected negative effect across all institutional groupings, with price elasticities ranging from a nonsignificant low of -0.155 for the major universities to a statistically significant high of -1.802 for the prior normal schools. In other words, had PRICE been 1.0 percent higher, enrollments might have been 1.80 percent lower at the prior normal schools. Given the significance of these elasticities, with one exception, and the differential effects across institutional groupings, tuition and fees may be viewed as a viable instrument for rationing enrollments and for influencing the distribution of enrollments across prior normal schools and urban institutional types.

Indirect cost measures were included in the models as opportunity cost and employment opportunity. Opportunity cost, or foregone earnings, was measured in thousands by the

average manufacturing wage in the locality (WAGES); employment opportunity was measured by the local unemployment rate (URATE). Observing Table 7, coefficients for WAGES and URATE were not statistically significant for any of the institutional groupings. As in Hoenack's research (1968), expectations with regard to the sign of the coefficients for these two variables were not hypothesized due to a possible confluence of their effects. However, in the current research, the signs for the coefficients did tend to have a pattern, being negative for WAGES and positive for URATE for all groupings except prior normal schools. This pattern corresponds to a general hypothesis advanced by some researchers (Bishop, 1977; Corazzini, 1972; Hoenack, 1968; Rusk, Leslie, & Brinkman, 1982; and Salley, 1977), where higher opportunity costs are presumed to increase the perceived costs of education, thus decreasing the tendency to invest or enroll, and higher unemployment is presumed to decrease the probability of current income, thus increasing the tendency for students to invest their time, at least, in continued education.

County Characteristics

Previous theoretical and empirical research led to the hypothesis that rural areas, where there are significant agricultural and extractive industries, may not contribute students to colleges to the same extent as urban areas. In

other words, a negative relationship was presumed between demand for enrollment and the rural character of students' environment. For this study, the percent of income generated within each municipality was calculated for three broad sectors of industry: (a) AGIND--agricultural and mining; (b) MNFIND--manufacturing; and (c) SRVIND--services. Since these percentages added to unity for each area, only one of the three was included in the models in order to obtain sensible estimates. The manufacturing (MNFIND) and service (SRVIND) industries were excluded since these factors were found to be highly collinear with other variables in the model. Also, earlier analysis revealed that these two sectors contributed fairly equally to the demand function, eliminating the need to estimate their separate coefficients (Strickland, Bonomo, McLaughlin, Montgomery, & Mahan, 1982). Results for AGIND are shown in Table 8.

Table 8

Estimated Effect of the County Characteristics Factor (AGIND)

| Institutional Grouping | Coefficient | t |
|---|---|---|
| Major Universities | -1.251 | -3.26 |
| Prior Normal Schools | -1.012 | -3.56 |
| Urban Institutions | -0.867 | -2.44 |
| STATEWIDE | -0.798 | -4.17 |

All coefficients were statistically significant at the .02 level of significance or better, with the anticipated negative sign. As expected, the more rural the industrial character of the geographical area, the less was the contribution to college enrollment.

Explanatory Power of Statewide and Institutional Group Models

The ability of the general model to explain differences between area contribution rates can be evaluated by goodness-of-fit measures. These are shown in Table 9.

Table 9

Explanatory Power of the General Enrollment Model

| Institutional Grouping | $R^2$ | F-Value | df |
|---|---|---|---|
| Major Universities | .499 | 49.74 | 399 |
| Prior Normal Schools | .482 | 62.25 | 535 |
| Urban Institutions | .556 | 62.55 | 399 |
| STATEWIDE | .327 | 123.35 | 2,031 |

In general, models using the ratio of institutional enrollment from a locality to an institution's total freshmen enrollment produced encouraging results. The multiple correlations were consistent with previous research

efforts and seemed to be inversely related to the heterogeneity of the institutional types.

Descriptive statistics for all variables used in the stage one and two models are provided in Tables 10 and 11. Table 10 shows the intercorrelations between the independent variables. It should be noted that this matrix is identical for all groupings of institutions including the individual institution models (except with regard to the PRICE variable) since the variance and covariance was a function of the 136 localities and all localities were represented for each institution. It is interesting to note that in Virginia wealth, academic ability, educational attainment, and size (number of high school graduates) appeared to be positively related. The strong relationship between EDL and INCOME suggests that one might be used as a proxy for the other, an approach used in stage three analyses. Table 11 presents the correlations between the independent variables and the dependent variable for each of the institutional groupings. In general, almost all of the independent variables were significantly correlated with the enrollment ratio. The one exception regards the PRICE variable for the major universities, which may have contributed to the lack of significance demonstrated by this variable in the major universities model.

Table 10

Correlations Between Independent Variables

| | HSG | STEA | EDL | INCOME | PRICE | WAGES | URATE | AGIND |
|---|---|---|---|---|---|---|---|---|
| STEA | .319 | | | | | | | |
| EDL | .472 | .599 | | | | | | |
| INCOME | .556 | .511 | .658 | | | | | |
| PRICE | -.009* | .029* | -.056 | -.046 | | | | |
| WAGES | .427 | .331 | .434 | .647 | -.015* | | | |
| URATE | -.253 | -.344 | -.291 | -.364 | .030* | -.314 | | |
| AGIND | .054 | -.127 | -.221 | -.117 | .028* | -.073 | .266 | |

*Not significant for $p < 0.05$.

Note. Correlations and significance levels are for the statewide model. All coefficients are the same for all variables except PRICE across all groupings and individual models; significances, however, do differ for some coefficients due to the different n's for the various institutional groupings and individual models.

Table 11

Correlation of Independent Variables with Dependent Variable

| Independent Variable | Major Universities | Normal Schools | Urban Universities | Statewide |
|---|---|---|---|---|
| HSG | .624 | .591 | .525 | .468 |
| STEA | .301 | .320 | .157 | .142 |
| EDL | .557 | .459 | .521 | .377 |
| INCOME | .440 | .440 | .451 | .327 |
| PRICE | -.042* | -.253 | -.464 | -.258 |
| WAGES | .307 | .323 | .275 | .229 |
| URATE | -.215 | -.245 | -.165 | -.142 |
| AGIND | -.160 | -.151 | -.147 | -.099 |

*Not significant for $p < 0.05$.

## Individual Institution Analyses

### Eligible Population

The number of high school graduates from the different localities was a statistically significant determinant of enrollments for almost all institutions. Summary statistics for this coefficient across all institutions are contained in Table 12. In general, a 1.0 percent increase in the number of high school graduates was found to be significantly associated with a low enrollment proportion gain of 0.2 percent for George Mason University and a high gain of 0.8 percent for Virginia Tech. As expected, all coefficients were positive. For the two institutions where HSG was not significant, the value of the coefficients was very low and, most likely, reflected the unique commuter status of Christopher Newport College and the particularly local, less populous, rural localities supporting Clinch Valley's student base.

### Educational Background and Income Factors

The average ability score (STEA) and educational attainment level (EDL) were the two measures of educational background included in these analyses. Results for these two measures are shown in Table 13. As with the institutional grouping analyses, unexpected results with

Table 12

Estimated Effect of the Eligible Population Factor (log HSG)

| Institution | Coefficient | t |
|---|---|---|
| University of Virginia | 0.573 | 6.41** |
| Virginia Tech | 0.801 | 9.92** |
| William & Mary | 0.511 | 7.02** |
| James Madison | 0.504 | 6.66** |
| Longwood | 0.446 | 5.38** |
| Mary Washington | 0.331 | 4.44** |
| Radford | 0.626 | 7.37** |
| George Mason | 0.198 | 2.81** |
| Old Dominion | 0.602 | 6.80** |
| Va. Commonwealth | 0.524 | 6.76** |
| Christopher Newport | 0.062 | 0.83 |
| Clinch Valley | 0.075 | 1.32 |
| Virginia Military | 0.344 | 5.54** |
| Virginia State | 0.464 | 5.30** |
| Norfolk State | 0.610 | 6.15** |

* Significant at $p<0.05$
** Significant at $p<0.01$

Table 13

Estimated Effect of Educational Background/Income Factors (STEA, EDL)

| Institution | STEA | | EDL | |
|---|---|---|---|---|
| | Coef. | t | Coef. | t |
| University of Va. | -0.022 | -2.39* | 4.052 | 4.14** |
| Virginia Tech | 0.004 | 0.54 | 3.471 | 4.05** |
| William & Mary | -0.008 | -1.05 | 3.972 | 4.73** |
| James Madison | 0.006 | 0.74 | 1.609 | 2.03* |
| Longwood | -0.012 | -1.51 | 0.444 | 0.50 |
| Mary Washington | -0.019 | -2.48** | 2.850 | 3.63** |
| Radford | 0.023 | 2.69** | -1.253 | -1.41 |
| George Mason | -0.013 | -1.72 | 4.815 | 6.19** |
| Old Dominion | -0.039 | -4.43** | 3.831 | 3.95** |
| Va. Commonwealth | -0.035 | -4.41** | 2.591 | 3.04** |
| Christopher Newport | -0.012 | -1.65 | 0.607 | 0.73 |
| Clinch Valley | -0.0001 | -0.03 | 0.451 | 0.75 |
| Va. Military | -0.008 | -1.22 | 1.330 | 1.99* |
| Virginia State | -0.059 | -6.39** | 1.782 | 1.85 |
| Norfolk State | -0.059 | -6.00** | 0.400 | 0.37 |

* Significant at $p<0.05$
** Significant at $p<0.01$

regard to STEA were evidenced. In general, coefficients for average ability were negative, indicating that enrollments were lower given higher ability levels across localities. In most instances, statistically significant effects were associated only with negative STEA coefficients--Radford University was the only case where a positive coefficent was found to be statistically significant. Moreover, four of the seven institutions having negative, significant STEA coefficients were located in urban areas. The instability of STEA coefficients with regard to sign in this stage of analysis most likely reflects results of collinearity in that STEA tended to be highly correlated with EDL and/or FINBUR for many institutions, and positively related to both EDL and HSG across all institutions. Each of these measures, EDL, HSG, and FINBUR, proved to have a higher correlation with the criterion than did STEA for most institutions. The ability measure, therefore, might have served as a suppressor variable in some models, or might have been collinear with other variables in the model such that its relatively weaker relation with the criterion produced unstable coefficients.

The educational attainment level of the locality proved to be a primarily positive influence on enrollment rates. The one negative coefficient for Radford University was statistically nonsignificant. Effects for this factor were

particularly strong among the major universities and urban institutions, suggesting that, in general, these institutions depended more heavily on localities where higher educational backgrounds were evidenced than did other institutions. In addition, the educational background factor served as a proxy for income levels in this stage of analysis. Thus, according to the results in Table 13, higher proportions of institutions' total freshmen enrollments were associated with higher income levels across Virginia localities. This positive effect was statistically significant for nine out of fifteen institutions, and agrees with prior research measuring income and educational background factors in this manner.

Cost Factors

Direct and indirect cost factors were included in this analysis. Direct costs in this stage of analysis were approximated through a ratio of PRICE, tuition and fees plus room charges where appropriate, to INCOME, median family income by locality. The resultant measure (log FINBUR) represented the financial burden of attending Virginia's four-year institutions for students within each locality. Use of this measure was necessary due to the limited amount of variation in PRICE for individual institutional models based on cross-sectional data. Indirect costs were measured

by WAGES, or foregone earnings, and URATE, the unemployment rate. Results for these factors are presented in Table 14.

Coefficients for FINBUR were uniformly negative for all but two institutions, where the positive effects were not statistically significant. Financial burden effects were statistically significant for all institutions but those comprising the major universities group and one special purpose institution, Virginia Military Institute. The former agrees with those results obtained in the analyses by institutional groupings. With regard to the positive but statistically nonsignificant coefficient for Virginia Military, it appears that for a special purpose institution of this type, factors other than costs were the more important determinants of enrollments. In general, for those institutions showing significant effects for FINBUR, a 1.0 percent increase in FINBUR in 1980, be it due to an increase in PRICE or a decrease in INCOME, was associated with anywhere from a 1.4 percent lower enrollment proportion (on the average) at Norfolk State to a 0.6 percent lower enrollment rate at Clinch Valley College. Detailed examples of interpretation of the FINBUR variable are provided in Appendix D.

Few statistically significant effects were produced with regard to indirect cost measures. In general, opportunity costs (WAGES) tended to have a negative effect

Table 14

Estimated Effect of Cost Factors (log FINBUR, WAGES, URATE)

| Institution | log FINBUR | | WAGES | | URATE | |
|---|---|---|---|---|---|---|
| | Coef. | t | Coef. | t | Coef. | t |
| UVA | -0.392 | -1.08 | -0.103 | -0.09 | -0.436 | -0.12 |
| VPI | 0.351 | 0.99 | -1.208 | -1.21 | 1.188 | 0.38 |
| W&M | -0.146 | -0.60 | -0.895 | -1.02 | 1.495 | 0.51 |
| JMU | -0.866 | -3.04** | 0.227 | 0.24 | 1.469 | 0.49 |
| LC | -0.824 | -2.47** | -0.609 | -0.61 | -2.697 | -0.81 |
| MWC | -0.947 | -4.33** | -1.924 | -2.18* | 0.392 | 0.13 |
| RU | -0.667 | -2.08* | -0.768 | -0.75 | 0.134 | 0.04 |
| GMU | -0.953 | -5.56** | -2.986 | -3.45** | -0.205 | -0.07 |
| ODU | -0.982 | -3.71** | -2.382 | -2.29* | 5.282 | 1.54 |
| VCU | -1.172 | -5.85** | 0.031 | 0.03 | -0.352 | -0.11 |
| CNC | -1.081 | -5.01** | -0.996 | -1.14 | 4.542 | 1.55 |
| CVC | -0.579 | -2.27* | -1.683 | -2.37* | -1.355 | -0.61 |
| VMI | 0.136 | 0.47 | 0.540 | 0.69 | -3.180 | -1.31 |
| VSU | -0.675 | -3.21** | -0.603 | -0.56 | 5.052 | 1.41 |
| NSU | -1.373 | -4.57** | -2.148 | -1.84 | 2.999 | 0.78 |

* Significant at $p<0.05$
** Significant at $p<0.01$

on enrollment, while unemployment rates tended to be positively associated with enrollment. In other words, the cost of attendance in terms of foregone earnings appeared to influence college enrollments negatively, while increases in the unemployment rate tended to influence prospective students to invest their time, at least, in college while awaiting better employment opportunities.

County Characteristics

The rural versus urban character of a locality was reflected in the level of income generated by various sectors of industry. As in the institutional grouping analyses, the level of economic activity via the agricultural/mining industries (AGIND) was used to designate the rural character of the localities from which institutional enrollments originated. Regression results for this factor are shown in Table 15. Signs for AGIND coefficients were negative for all but three institutions. In other words, the more rural the locality, the less likely an institution depended on this locality for enrollments. Negative effects were statistically significant for seven of thirteen institutions.

Of the three institutions showing positive effects, AGIND coefficients were not statistically significant for Virginia Military Institute or George Mason University.

Table 15

Estimated Effect of the County Characteristics Factor (AGIND)

| Institution | Coefficient | t-Value |
|---|---|---|
| University of Virginia | -1.763 | -2.75** |
| Virginia Tech | -0.836 | -1.48 |
| William & Mary | -1.181 | -2.25* |
| James Madison | -1.018 | -1.89 |
| Longwood | -1.097 | -1.86 |
| Mary Washington | -0.768 | -1.45 |
| Radford | -1.396 | -2.32* |
| George Mason | 0.338 | 0.66 |
| Old Dominion | -1.371 | -2.22* |
| Va. Commonwealth | -1.682 | -2.99** |
| Christopher Newport | -0.293 | -0.56 |
| Clinch Valley | 3.488 | 8.04** |
| Virginia Military | 0.050 | 0.11 |
| Virginia State | -2.251 | -3.55** |
| Norfolk State | -1.977 | -2.86** |

* Significant at $p<0.05$
** Significant at $p<0.01$

The other institution showing a positive AGIND effect was Clinch Valley College. This institution is located in Wise County in the southwestern most part of the state--an area heavily dependent on the mining industry and agriculture. The size of the coefficient and its strong statistical significance suggest that Clinch Valley was highly dependent on enrollments from this part of the state, at least. This effect for Clinch Valley was indicated earlier with regard to the HSG variable.

Explanatory Power of Institutional Models

Summary statistics with regard to goodness-of-fit measures for the general model used in this stage of analysis are presented in Table 16. Multiple correlations ranged from a low of 0.280 for Christopher Newport to a high of 0.633 for Virginia Tech. The general model, however, appeared to describe enrollments better for the urban institutions as a group than for other types of institutions. It was least effective with regard to the one commuter college (Christopher Newport) and the military institution (Virginia Military Institute).

Correlation tables for independent variables and the dependent variable are presented in Table 17. Also, since the variance and covariance of FINBUR depended on the

Table 16

Explanatory Power of the General Institutional Model

| Institution | $R^2$ | F-Value | df |
|---|---|---|---|
| University of Virginia | .543 | 21.75 | 128 |
| Virginia Tech | .633 | 31.51 | 128 |
| William & Mary | .577 | 24.96 | 128 |
| James Madison | .599 | 27.33 | 128 |
| Longwood | .382 | 11.30 | 128 |
| Mary Washington | .478 | 16.74 | 128 |
| Radford | .501 | 18.39 | 128 |
| George Mason | .604 | 27.92 | 128 |
| Old Dominion | .588 | 26.10 | 128 |
| Va. Commonwealth | .626 | 30.63 | 128 |
| Christopher Newport | .280 | 7.11 | 128 |
| Clinch Valley | .481 | 16.95 | 128 |
| Virginia Military | .369 | 10.68 | 128 |
| Virginia State | .468 | 16.11 | 128 |
| Norfolk State | .523 | 20.03 | 128 |

Table 17

Correlations Between Independent Variables and the Dependent Variable and Between Independent Variables and FINBUR by Institutions

| Institution | HSG | STEA | EDL | FINBUR | WAGES | URATE | AGIND |
|---|---|---|---|---|---|---|---|
| UVA | | | | | | | |
| log E | .620 | .258 | .580 | -.480 | .364 | .252 | -.225 |
| FINBUR | -.477 | -.510 | -.630 | --- | -.574 | -.374 | .127* |
| VPI | | | | | | | |
| log E | .738 | .374 | .580 | -.457 | .298 | -.217 | -.102* |
| FINBUR | -.548 | -.529 | -.644 | --- | -.628 | .372 | .131* |
| W&M | | | | | | | |
| log E | .642 | .335 | .632 | -.469 | .322 | -.220 | -.189 |
| FINBUR | -.437 | -.380 | -.628 | --- | -.517 | .354 | .128* |
| JMU | | | | | | | |
| log E | .670 | .448 | .585 | -.613 | .447 | -.268 | -.155* |
| FINBUR | -.484 | -.549 | -.586 | --- | -.577 | .318 | .116* |
| LC | | | | | | | |
| log E | .547 | .166 | .356 | -.455 | .287 | -.262 | -.156* |
| FINBUR | -.487 | -.415 | -.583 | --- | -.555 | .377 | .140* |
| MWC | | | | | | | |
| log E | .525 | .224 | .520 | -.534 | .240 | -.187 | -.157* |
| FINBUR | -.451 | -.454 | -.544 | --- | -.494 | .298 | .118* |
| RU | | | | | | | |
| log E | .636 | .425 | .392 | -.492 | .317 | -.271 | -.145* |
| FINBUR | -.484 | -.528 | -.584 | --- | -.552 | .358 | .131* |
| GMU | | | | | | | |
| log E | .469 | .391 | .685 | -.632 | .256 | -.212 | -.079* |
| FINBUR | -.403 | -.528 | -.614 | --- | -.535 | .319 | .108* |
| ODU | | | | | | | |
| log E | .599 | .053* | .488 | -.568 | .224 | -.074* | -.147* |
| FINBUR | -.522 | -.296 | -.597 | --- | -.527 | .258 | .135* |

TABLE 17- CONTINUED

| Institution | HSG | STEA | EDL | FINBUR | WAGES | URATE | AGIND |
|---|---|---|---|---|---|---|---|
| VCU | | | | | | | |
| log E | .576 | .084* | .490 | -.608 | .387 | -.243 | -.228 |
| FINBUR | -.320 | -.210 | -.468 | --- | -.458 | .292 | .157* |
| CNC | | | | | | | |
| log E | .226 | -.038* | .243 | -.474 | .119* | .022* | -.068* |
| FINBUR | -.472 | -.243 | -.575 | --- | -.482 | .280 | .141* |
| CVC | | | | | | | |
| log E | .223 | .061* | .042* | -.325 | -.013* | .064* | .633 |
| FINBUR | -.545 | -.491 | -.555 | --- | -.601 | .291 | -.174 |
| VMI | | | | | | | |
| log E | .576 | .199 | .395 | -.377 | .325 | -.250 | -.024* |
| FINBUR | -.556 | -.511 | -.658 | --- | -.647 | .364 | .117* |
| VSU | | | | | | | |
| log E | .339 | -.295 | .157* | -.367 | .133* | .007* | -.206 |
| FINBUR | -.293 | -.132* | -.423 | --- | -.470 | .304 | .166 |
| NSU | | | | | | | |
| log E | .462 | -.227 | .175 | -.459 | .127* | -.021 | -.138* |
| FINBUR | -.524 | -.300 | -.600 | --- | -.531 | .260 | .135* |

*Not significant for $p < 0.05$.

particular institution for which it was measured, intercorrelations for FINBUR and the remaining independent variables are given in Table 17 along with the correlations between the dependent variable (log E) and the independent variables. Intercorrelations between the remaining independent variables are the same as those shown in Table 10 due to the dependence of all models on the variance/covariance evidenced across the 136 localities.

# Chapter V

# DISCUSSION AND CONCLUSIONS

## Summary of Study

Recent pricing policies in the state of Virginia have resulted in increases in the direct cost of public higher education for prospective students and their parents. Although the full impact of these policies were not evident in 1980, examination of the responsiveness to price (which was significant) before such policies were fully realized should provide a valuable baseline of data to compare against that observed after cost increases have been put into effect. These increases, coupled with potential decreases in the traditional pool of applicants, have raised concern among many higher education officials with regard to the demand for enrollments among Virginia's public four-year institutions. The purpose of this study was to examine the price elasticity of enrollments for these institutions, controlling for other economic, noneconomic, and environmental factors. Moreover, differential effects with regard to price and other determinants were to be observed across individual institutions and institutional types.

Consequently, information was provided not only about price elasticity across institutions, but also about the demand dependency of different institutions on various subgroups of students.

This research was based on the investment approach to human capital theory. Using this approach, five sets of determinants were derived from the more general economic, noneconomic, environmental categories as identified by educational economists. The five sets of determinants were comprised of both student and external related factors, including: (1) eligible population; (2) educational background; (3) family income; (4) cost of attendance; and (5) county characteristics. Multiple regression was used to examine the specific variables comprising each set across three stages of analysis: for all fifteen public, four-year institutions in the state; for three major types of public institutions; and for each individual institution.

The results presented in Chapter Four are discussed in further detail in this chapter. The discussion is divided into three sections: (1) determinants of enrollments; (2) critique of research; and (3) conclusions and areas for further research. The first section is organized according to the five sets of determinants included in the three stages of analysis. The second section is a critique of the

research based on the evaluaton criteria identified and used in Chapters Two and Three. These criteria referenced five specification issues as identified through review of past literature on enrollment demand: correlates of demand, measurement of financial aid, stratification of data, identification of demand function, and level of choice. Finally, conclusions and suggestions for future research are outlined in the third section.

## Determinants of Enrollment

### Eligible Population

The dependent variable was based on the demand dependency of the various institutions for which it was measured; thus, effects for the eligible population factor were measured directly in the general model for all stages of analysis. Because demand is dependent on the size of its relevant population, this factor is a necessary variable in analyses concerned with the demand dependency of different institutions. The results for this factor demonstrated that the size of the eligible population, or the number of high school graduates (HSG) was a positive and statistically significant determinant of enrollments across all institutional types and across most institutions individually.

Only two of fifteen institutions appeared to be unresponsive to this factor--Christopher Newport College (CNC) and Clinch Valley College (CVC). Christopher Newport was the only purely commuter institution in this sample, thus, the number of localitites supporting freshmen class enrollments is restricted. Moreover, CNC is located in the vicinity of several other public four-year institutions--William and Mary, Old Dominion University, and Norfolk State University. The concentration of institutions in this area of the state necessarily restricts the proportion of freshmen enrollments CNC would expect to attract across localities in this region. Consequently, a cross-sectional analysis of this factor for CNC was unlikely to reflect the dependency of this institution on the size of it eligible population pool.

It is likely that the location of Clinch Valley College also was responsible for its low responsiveness to this factor. Clinch Valley is located in a rural, less populous area of the state and the result of HSG for this institution suggests that CVC depended on this area, or similar localities, for its freshmen student base. Such an interpretation for CVC was supported in results for the county characteristics factor. For both Christopher Newport and Clnch Valley, HSG had a lower correlation (about 0.2)

with the dependent variable than did any of the other institutions.

Although direct comparisons cannot be made between stages one and two models and stage three models, results for some of the individual institutional models provided insight to differential effects for the grouped models. Among the grouped institutions, the urban universities showed the least response to larger population pools. This was surprising in that these institutions are located in highly populous, urban areas where college enrollments presumably would be higher. However, looking at the results for George Mason University (GMU) alone, it was found that after Christopher Newport and Clinch Valley, GMU had the next lowest response to the HSG factor. Also, GMU had a fairly low correlation between HSG and the dependent variable. George Mason is located very close to the northern most border of Virginia where several instate/out-of-state private institutions and out-of-state public campuses are accessible. This geographical fact may restrict GMU's enrollment proportions originating from the populous northern Virginia localities, reducing the variance in enrollment proportions evidenced across the state. Inclusion of GMU in the urban institution group, therefore, may have reduced the effect of HSG for this group as a whole.

Educational Background Factors

For all stages of analysis, mixed effects with regard to educational background factors were produced. Whereas high ability levels for high school graduates were hypothesized to have a positive effect on enrollment ratios, coefficients for the STEA variable were primarily negative. In other words, enrollments were lower given higher ability levels across localities. The possible substitution of private, prestigious institutions or out-of-state public/private institutions among higher ability/income students may be an explanation for these outcomes.

Such an explanation should not be interpreted necessarily as a slight on Virginia institutions. Similar results are likely to be found in other states. Virginia institutions will, of course, be attractive to higher ability students from other states. Yet, it should be remembered that public support of higher education is generally directed not at the high ability, resident high school graduates, who have more options, but at the lower ability graduates who, without locally provided options, might not continue their education. Tierney's (1980) research indicated this tendency, finding that private enrollment was substituted for public enrollment as the selectivity of private institutions increased relative to

that for public institutions. Obviously, the more academically able the students, the greater their liklihood to evidence this substitution behavior.

Another possible explanation for the negative weight comes from the fact that STEA was positively correlated with other factors such as HSG and EDL, but had a lower correlation with the criterion. In other words, STEA may well have been acting as a suppressor variable (McNemar, 1962). Also, the correlation of STEA with the dependent variable may necessarily be lower due to the distance in time between the administration of the test and the decision to enroll in postsecondary education. This resultant reduction in correlation would suggest measurement error with regard to STEA, further inhibiting estimation of the effect of ability on enrollment.

For the one institution (Radford University) having a statistically significant, positive coefficient for STEA, the positive correlation between STEA and the dependent variable is both significant and higher than that between EDL and the dependent variable. In this regard, EDL may have served as a suppresor variable for the Radford model. Two other exceptions concerning negative outcomes involved the two traditionally Black state universities, Virginia State University and Norfolk State University. Both

institutions showed a considerably higher and statistically significant, negative correlation between STEA and the dependent variable, while the correlation between EDL and the dependent variable was positive. The negative coefficients in these instances may have been representative of the true effect.

Results for the educational attainment level of localities were consistent with expectations, given the above explanation for the one negative, nonsignificant coefficient for Radford University. The higher educational environment was assumed to be a positive influence on students' preference for college enrollment. This effect proved to be particularly strong among institutions comprising the major universities group and the urban institutions group. The statistical significance of this variable compared to the lack of significance for PRICE among the major universities suggests that noneconomic as opposed to economic factors may have been the more important determinants of enrollment in these institutions.

Family Income Factors

Several problems were encountered in attempt to estimate the effects of family income on enrollment. Measures reflecting the distribution of income within localities proved to be highly collinear with each other and

with other variables in the models. Similar results were obtained when preliminary models including selected interaction terms based on income and cost factors were examined. Finally, it was decided to include only a measure of median family income (log INCOME) in the models.

Results for INCOME, however, were uniformly weak and statistically nonsignificant. As suggested in Chapter Four, it is possible that the effects of INCOME on enrollment were accounted for by other variables in the models. For instance, the economic aspects of income are in some respects built into the price factor. Given that PRICE was a significant factor, it stands to reason that income, or the ability to finance a college education, was a factor in demand. Moreover, educational attainment has been used in the past to reflect family income levels as well as the tastes or preferences of consumers for higher education or human capital investment. The strong relationship in this research between EDL and INCOME perhaps partially accounts for the weak effect of the income factor as incorporated in this study. In fact, in the institutional models, where education attainment was allowed to serve jointly as a noneconomic or preference measure and as a proxy for income levels, the effect for EDL generally was found to be positive and statistically significant. The development of

a more complete model using variable transformations, interaction terms, or proxy variables is recommended. For example, one might identify localities as having high, medium, or low income and also being high, medium, or low with regard to the educational attainment of their citizens. These nine cells could then be represented by dummy variables and regression analysis could be used to investigate the significance of various interaction terms and/or direct effects as incorporated into different model specifications.

Cost Factors

In general, the direct cost measures, PRICE and FINBUR, had the expected results across institutional groupings and individual institutions. However, for the three major universities (individually and as a group), PRICE was not statistically significant at the .05 level of significance. Similar results have been evidenced primarily among studies on private enrollment demand (Hight, 1975; Hopkins, 1974; Spies, 1973; and Tierney, 1980). It could be argued that institutions in the major university group are similar in many respects to private institutions. Although the institutions included in the major university group are distinguished by their image as traditional comprehensive universities, their individual functions or missions are

unique. Each institution is highly selective, due, in part, to the limitation on its size by a legislative cap on enrollment. Moreover, as Hight (1975) and Hopkins (1974) suggest, to the extent that these schools have successfully differentiated their curricula, the possibility of substitution is lessened accordingly. Hence, the major university group may be more heterogeneous than expected.

The fact that PRICE elasticities were larger and significant for the prior normal schools and urban institutions may also reflect substitution effects. The PRICE variable included tuition and fees, and room charges where residency as opposed to commuter status was deemed appropriate. Because of this structure, PRICE became somewhat of a surrogate for distance from the institution. Room charges for the normal schools were generally as high, if not higher, than those for the major universities, making PRICE for noncommuters at prior normal schools comparable to that at the other types of institutions. In this regard, given the opportunity, students may have chosen to commute to local or nearby institutions or to attend more distant universities which offer a wider breadth of field at a relatively comparable cost. The greater PRICE elasticity for urban institutions, relative to that for the major universities, may reflect the dependency of urban

institutions on more local populations for their freshmen enrollments. According to Leftwich (1964), the greater the availability of good or desirable substitutes, the greater the responsiveness to price changes. To the extent the major universities, other local, public colleges, or other enrollment options offer similar or greater benefits to students and the cost of these alternatives is about the same or less than that for urban institutions, then to that extent may students choose to substitute enrollment in these alternative institutions (or nonenrollment) for enrollment in urban institutions.

Results for the indirect cost measures were mixed. The confluence of effects for these two factors most likely contributed to the resultant outcomes. In other words, the higher the area wages, the greater the income foregone by college attendance; on the other hand, higher area wage rates may have meant that there was a greater ability to pay the directs costs of college attendance. The effect estimated for WAGES, therefore, was the net effect of two opposing influences on college attendance. As with the WAGES variable, the effect for URATE was probably two-fold and in opposite directions. A higher unemployment rate may have increased college attendance in that potential enrollees had greater difficulty finding employment in the

local area. On the other hand, higher unemployment rates may have diminished the ability of households to support the education of recent graduates, thereby having a negative effect upon college attendance.

As noted in Chapter Four, signs for the WAGES and URATE coefficients did tend to have a pattern--negative for WAGES and positive for URATE. This pattern suggests that higher foregone earnings increased the perceived costs of enrollment, thus reducing the tendency to enroll, while higher unemployment rates reduced employment opportunities, encouraging students to invest their time, at least, in higher education. Nevertheless, the two-fold effects discussed earlier, not to mention the influence of other factors such as type of institution, appear to have inhibited adequate estimation of the effects of indirect costs as measured here. More detailed analysis is required before further interpretation can be attempted.

County Characteristics

The generally negative and statistically significant coefficients for the county characteristics factor lends support to the suggestion of Becker (1975) and Feldman and Hoenack (1969) that rural backgrounds tend to influence enrollments negatively. The magnitude of coefficients for the institutional groupings were somewhat surprising in that

one might have expected the urban institutions to respond most negatively to the rural localities. However, observing the individual models, it is noted that George Mason University had a positive, yet nonsignificant, response to this factor. This outcome could be responsible for the apparent underestimation of the AGIND effect for the urban institutions.

The one positive, statistically significant coefficient for Clinch Valley College, as explained in Chapter Four, correctly depicted both the rural location of the institution as well as its dependence on local, less populous, rural localities. Results for the AGIND factor along with that for the HSG factor supported this interpretation for Clinch Valley.

## Critique of Research

Most aspects of student and external related factors were included in the general model specifications for this research. Perhaps the greatest weakness regarding development of demand measures concerned the family income factor. The aggregate measure of median family income was found to correlate highly with several variables in the model. As in the Corazzini et al. research, access to individual data for this factor, allowing stratification of the sample by income groups, might have circumvented this

problem. Such data, however, were not available. On the other hand, use of the educational attainment variable in the institutional models to express jointly noneconomic and economic factors proved to be an adequate means of indirectly observing income effects. Although it was impossible to estimate the separate effects of educational attainment and income, some insight as to the potential distributional effects of these factors across institutions and institutional types was obtained.

Due to the lack of data by locality in Virginia, a cost factor reflecting financial aid awards was not included in the models. Nevertheless, any systematic variation in the type or amount of aid awarded across localities or institutions would result in biased PRICE coefficients as measured in this study. Omission of this factor also limited the ability of this study to indicate the effects of different pricing policies incorporating various mixes of financial aid awards.

Stratification was achieved through three stages of analysis: statewide, institutional grouping, and individual institutions. Use of the same functional form for models developed in the statewide and institutional grouping analyses allowed observation of differential effects for individual factors across institutional groupings. While a

different functional form for the institutional models (i.e., FINBUR was used rather than PRICE and INCOME) did not allow direct comparisons across all stages of analysis, differential effects observed across institutions provided insight to the effects observed for institutional groupings. Due to the lack of data on sex and race for high school graduates by locality, these factors were omitted in this study. While sex has not proved to be a highly significant factor in previous research, the presence of two predominantly black universities in this state makes exclusion of race measures particularly undesirable. The possible benefit of stratifying by income has already been noted; given the unexpected, mixed results for the ability measure (STEA), stratification by income and ability is advised for future research.

The identification problem was circumvented in two ways. First, using a cross-sectional design, the supply of enrollment places was assumed constant and the price variable predetermined. In this regard, regression coefficients reflected only parameters of demand. Second, the development of a dependent variable such that it accounted for all instate freshmen enrollees allowed the assumption of a fixed supply of potential enrollments with regard to nonprice rationing policies. A similar approach

was used successfully for the same purpose in Hoenack's (1968) research.

This research used data aggregated at the county/city level across the state of Virginia. Like most studies in the past, a corporate level decision on the part of a hypothetical "average student" was assumed. The decision whether or not to enroll in a Virginia, public, four-year institution was the type of decision being examined. Various factors reflecting the economic, noneconomic, and environmental aspects of students, the localities where they lived, and the institutions were incorporated in the models. While the available mix of institutions with regard to public, four-year institutions was covered in the model, the influence of private colleges, community colleges, and out-of-state institutions was not accounted for in the model specifications. The potential for such influences was noted in the discussion of results for ability (STEA), cost (PRICE), and eligible population (HSG). Moreover, to the extent the institutional groupings were not adequate summaries of the major types of institutions present in this state, these groupings introduce bias to the resultant coefficients in the models. The results for the individual models, however, indicate that the institutional groupings were adequate for the types or subgroups of institutions examined in stage two models.

## Conclusions and Areas for Further Research

The primary purpose of this research was to determine whether or not enrollments were price elastic among Virginia's four-year institutions. According to the results reported in this study, enrollments generally were price elastic for the time period considered. More importantly, price elasticities were found to differ across institutions and institutional types, all else being equal. Differences in the effects of price, as well as in the effects of other factors, reflected the potential for substitution among various individual institutions, or institutional types, or between enrollment and nonenrollment altogether. Such information is particularly useful, given the additional knowledge about other factors that appeared to impede or encourage enrollments. Officials who ignore the price elasticity of Virginia enrollments in the development of pricing policies might discover college access to be limited to smaller proportions of the state's high school graduates and the viability of the state's institutions to be threatened due to unexpected changes in the level and composition of enrollments.

Other factors found to have an overall significant effect on enrollments were eligible population, educational attainment of students' locality, and county

characteristics. In general, the eligible population and educational attainment factors had positive effects on enrollments, while the rural character of a locality had a negative effect on enrollments. Differential effects for these factors with regard to sign and magnitude also were observed among institutions. The mixed or weak effects for other variables were due primarily to the high correlation between these and other variables. The lack of individual as opposed to aggregate data on student related factors made it impossible to test a number of alternate measures and alternate model specifications in attempt to estimate the effects of these factors.

The general functional form of the models used in this research appeared to fit the data rather well when compared to results of past research. The models showed particular improvement when stratified by institutional type and by individual institution, supporting the assumption of equally desirable institutions for a given enrollment group. Stratification in this manner allowed the special character or mission of an institution, or group of institutions, to be considered through the observation of differential effects of factors across institutions. Areas for improvement of the models and for further research are addressed below.

There are several areas which seem to provide promise for future research.. One of the more obvious is refinement of the current models. For instance, different monotonic transformations could be investigated. In the current study, logarithmic transformations were used for some measures since they produced constant elasticities for the related factors. Pindyck and Rubinfeld (1981) discuss several alternatives to this approach which include the Probit Model and Logit Model. While these transformations tend to complicate the interpretation of the results, they often improve the ability of the model to explain variations in the dependent variable especially when proportions are employed. Other transformations of a nonmonotonic nature are discussed in Mosteller and Tukey (1977).

Another way to refine the models would be to investigate alternative interaction terms or measures reflecting proximity, mix or concentration of institutions, and amount and type of financial aid awards. Kohn et al. (1974), for example, found that nonlinear interactions between income and distance to the institution contributed significantly to the explanation of enrollment demand. The current study's findings indicated that the location of an institution may influence its demand dependency with regard to eligible population and county characteristics. Measures

of proximity or concentration of institutions might clarify these effects as well as provide further information about substitution effects. Tierney's research certainly points to the necessity of incorporating measures of type and amount of aid. Given the differential effects observed across institutions with regard to economic factors, consideraton of financial aid amongst the cost factors should greatly increase the usefulness of these models.

In addition to refining the models by transformation of the current measures, it is important that work be done to determine more than the directs effects of the variables. As noted in Chapter Four, there was a tendency for size, wealth, and ability to be positively related in the state of Virginia. This preempted some of the measures, such as STEA and INCOME, from having a significant, direct role in explaining the dependent variable. Moreover, it could be a serious mistake to assume that the cost of attendance (PRICE) had no significant effect on enrollment for the major universities. It is very possible that price had an effect on an intermediate variable which then masked the total effect of price. Such an extension of this research would require that a causal sequence of the independent variables be determined and the techniques of path analysis be employed to obtain a more complete understanding of both direct and indirect effects of the independent variables.

Another area for further inquiry involves an examination of the differences in results from those obtained in past research when using the measure of demand developed in this study. For example, one might replicate Hoenack's (1968) research using a ratio of institutional enrollments by locality to total institutional enrollments as the dependent variable and then compare the resultant outcome with his earlier findings. On the other hand, the current study could be replicated using the more traditional measure of demand incorporated in the past (e.g., Corazzini et al., 1974; Hight, 1975; or Hopkins, 1974) and then comparisons of the changes in findings made.

The use of a general, functional form model for the grouped analyses and the individual institution analyses restricted the examination of effects for the specific types of institutions and individual institutions included in this research. Further research allowing different models for the various types of institutions and for the individual institutions would be useful in examining demand more closely at these levels. In this way, variable transformations or stratifications which do not enhance the interpretation of a model for a particular institution/group may be omitted and other measures or specifications attempted.

As noted earlier, the purpose of this study was to develop a preliminary model of factors which influenced the enrollment of Virginia's high school graduates in its public institutions of higher education and to determine whether these enrollments were price elastic across institutions. The models developed in this research appear to have accomplished this purpose. In general, the investment approach to enrollment demand based on the theory of human capital appeared to provide useful information about the nature of enrollments in Virginia. Those factors associated with the costs of enrollment, or a reduction in the perceived benefits of college attendance, were found to inhibit enrollments, while those factors associated with potential benefits from college enrollment were found to encourage enrollments. As expected, exceptions to this pattern were evidenced through stratification of the data by institutional types and by individual institutions. The findings of this research should be useful to state officials in considering pricing policies for the various institutions and to institutional leaders interested in understanding more about the demand dependency of their institutions.

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## Appendix A

## DATA SOURCES AND METHODS OF MEASUREMENT

Counties (n=95) and cities (n=41) were used as the units of analysis with data coming primarily from previously published state reports and census data. A description of each variable, how it was measured, and its data source are given below:

### Dependent Variable

E - the ratio of the number of students from a county/city enrolled as first-time entering freshmen at a particular institution to the total instate first-time entering freshman enrollment for that same institution. Data for both the numerator (number of first-time freshmen enrolled in a given institution by county/city) and the denominator (total first-time freshmen enrollment) were obtained from the B1 Supplement of the OCR6000 report entitled "Students in Institutions of Higher Education: Applications, Acceptances, and Actual Enrollments." Completion of this report is required for each four-year institution in Virginia and was made available for this study through the State Council of Higher Education for Virginia.

### Independent Variables

HSG - the total number of high school graduates by county/city. The source of data for this variable was Facing Up 15: Statistical Data on Virginia's Public Schools, published by the Division of Management Services of the Virginia Department of Education, January, 1981.

STEA - average ability score (STEA or Short Test of Educational Achievement) for students in the 1980 graduating class of all high schools by county/city. Students take the STEA during their junior year in high school. Therefore, to obtain data on the average STEA score for the 1980 senior class, data from the 1979 administration of the STEA had to be used. The data were obtained from Facing Up 14: Statistical Data on Virginia's Public Schools, published by the Division of Management Services of the Virginia Department of Education, February, 1980.

EDL - the proportion of adults (age 25 or older) by county/city who had completed one or more years of college. Data on educational attainment were drawn from the Virginia section of the 1980 census report, Characteristics of the Population: General Social and Economic Indicators, U. S. Department of Commerce, Bureau of the Census. Since published reports of certain components of the 1980 Census were not available at the time data were being collected for this research, these data had to be obtained through the Fifth Plannning District Commission in Roanoke, Virginia.

INCA thru INCD - the proportion of households by county/city within four EBI (effective buying income) ranges. Data on the EBI proportions were obtained from the "1980 Survey of Buying Power", Sales Management and Marketing, July 27, 1981.

INCOME - the median household income by county/city. Data for this variable were obtained from the "1980 Survey of Buying Power", Sales Management and Marketing, July 27, 1981.

PRICE - the cost of college attendance including tuition, required fees, and room charges. Room charges were included in the price factor only when a county/city was determined to be outside a reasonable commuting range for a particular institution. The commuting range was thirty (30) miles for institutions where a policy exists requiring all freshmen to live on campus (see Appendix B for exceptions to this policy); otherwise, the commuting range was fifty (50) miles. Data on tuition and required fees were obtained from state reports on instate undergraduate tuition for 1980-81 compiled by the State Council of Higher Education for Virginia. Room charges (separate of board charges) for 1980 were obtained from the "Survey of Tuition and Other Fees for the Fifteen State Colleges and the Community College System" prepared by the Virginia Council of State Senior Business Officers, 1982.

WAGE - the average weekly wage (measured in thousands) of production workers by county/city. The source of data for this variable was the average weekly manufacturing wage as published in a report on quarterly gross wages and average weekly wages by county/city. This report is prepared annually by the Manpower Research Division of the Virginia Employment Commission.

URATE - the unemployment rate as measured by the proportion of the total civilian labor force that was unemployed by county/city. The source of data was the "Population and Labor Force Data" report published by the Manpower Research Division of the Virginia Employment Commission, August, 1980.

AGIND - county/city characteristics expressed through the level of economic activity within three major industrial groups: (1)AGIND - natural resource industries such as agriculture and mining; (2)MNFIND - non-natural resource industries such as construction and manufacturing; and (3)SRVIND - support industries such as transportation, trade, finance, and service. Economic activity was measured as the percentage of income generated by each of these industry groups. These data were obtained from a report on quarterly gross wages and average weekly wages per worker by county/city prepared annually by the Manpower Research Division of the Virginia Employment Commission.

## Appendix B

## FRESHMEN HOUSING POLICIES FOR FALL 1980 AT VIRGINIA'S PUBLIC FOUR-YEAR INSTITUTIONS

I. Institutions with no policy requiring freshmen to live on campus:

Old Dominion University
Virginia Commonwealth University
Mary Washington College
Clinch Valley College
George Mason University
Virginia State University
Christopher Newport College[1]

II. Institutions with policy requiring freshmen to live on campus[2]:

College of William and Mary
Longwood College
James Madison University
Radford University
Virginia Military Institute
Virginia Polytechnic Institute and State University
Norfolk State University
University of Virginia

[1]Christopher Newport College is strictly a commuter college.

[2] Exceptions to the housing policy are usually extended to: married students; students living in the local vicinity with parents or guardian; single parents; veterans; and students over the age of 21.

Source: Phone interviews with personnel in Housing Office at each institution.

## Appendix C

## VIRGINIA'S PUBLIC FOUR-YEAR INSTITUTIONS BY INSTITUTIONAL GROUPING

Comprehensive Universities:

College of William and Mary
Virginia Polytechnic Institute and State University
University of Virginia

Prior Normal Schools:

James Madison University
Longwood College
Mary Washington College
Radford University

Urban Universities:

George Mason University
Old Dominion University
Virginia Commonwealth University

Other Four-Year Institutions:

Christopher Newport College
Clinch Valley College
Norfolk State University
Virginia Military Institute
Virginia State University

## Appendix D

## INTERPRETATION OF INCOME/PRICE VARIABLE FOR INDIVIDUAL INSTITUTION MODELS

The price elasticity for individual institution models was approximated by using a ratio of PRICE to INCOME. Due to the use of this ratio measure (FINBUR), two variables must be considered when examining the implications the elasticity estimate has for a given institution. For example, the FINBUR elasticity for Virginia Commonwealth University (VCU) was -1.172, where an increase of 1.0 percent in the ratio of PRICE to INCOME could have resulted in a 1.17 percent decrease in enrollment. This change in the financial burden measure could have been realized in several ways. The mean values for PRICE and INCOME respectively for VCU were $1,820.80 (s.d. = $380.30) and $15,402.60 (s.d. = $4,745.30), such that a mean (unlogged) value of 0.118 was obtained for FINBUR. If PRICE had been increased by 1.0 percent, from $1,820.80 to $1,839.00, and INCOME had remained constant, then the FINBUR ratio would have increased by 1.0 percent and enrollment would have decreased by an estimated 1.172 percent.

Obviously, several other scenarios could be drawn to interpret the impact of financial burden on enrollments. Incomes levels could decrease or increase for some localitites, and remain constant for others. It would appear that the important point to consider as pricing policies are developed is the overall profile of financial backgrounds for students enrolling in a given institution. If the majority of enrollments are typically drawn from localities demonstrating a trend of economic distress, then increases in tuition may curtail enrollments to the extent that such a policy, over time, reduces rather than increases the financial gain desired by the institution.

Since INCOME for all institutions is based on the same 136 localities, this variable will not be detailed further (mean = $15,402.60, s.d. = $4,745.30). Mean values and standard deviations for PRICE, of course, do vary across institutions and are given below for those who would want to examine various PRICE to INCOME situations for a given institution.

Means and Standard Deviations for PRICE

| Institution | Mean | s.d. |
|---|---|---|
| University of Virginia | 1774.10 | 195.60 |
| Virginia Tech | 1339.00 | 98.10 |
| William & Mary | 2117.80 | 317.50 |
| James Madison | 1955.60 | 217.30 |
| Longwood | 1991.20 | 196.00 |
| Mary Washington | 1929.40 | 263.30 |
| Radford | 1925.70 | 230.30 |
| George Mason | 1942.40 | 400.00 |
| Old Dominion | 1666.90 | 295.90 |
| Va. Commonwealth | 1820.80 | 380.30 |
| Christopher Newport | 1692.90 | 327.30 |
| Clinch Valley | 1198.20 | 119.80 |
| *Virginia Military | 1615.00 | 0.00 |
| Virginia State | 1780.40 | 437.10 |
| Norfolk State | 1336.940 | 234.00 |

*All cadets are required to live on campus; there are no exceptions.

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