# A PRESTIGE MAXIMIZATION MODEL OF INSTITUTIONS OF HIGHER LEARNING

By

STEVE DALTON MULLINS

Bachelor of Science
Oklahoma State University
Stillwater, Okalhoma
1977

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1980

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF PHILOSOPHY
July, 1983

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OF HIGHER LEARNING

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

# PREFACE

The purpose of this research is to test an economic model of institutions of higher learning (IHLs). The Prestige Maximization Model suggests that college and university behavior, as measured by expenditure per student, will be affected by the sources of revenue available to an institution. The results of analysis of cross-sectional samples of IHL financial and enrollment data support the model's implication that IHLs placing greater reliance on non-students for revenue have greater expenditures per student.

Special appreciation is extended to the author's major adviser, Dr. Kent Olson, for his assistance with this research and also for the guidance, counseling, and instruction he provided throughout the author's stay at Oklahoma State University. The work of committee members Dr. Ansel Sharp, Dr. Michael Applegate, and Dr. Bill Adrian is also appreciated.

The faculty and staff at the Breech School of Business Administration deserve thanks for providing valuable suggestions and greatly appreciated encouragement. Thanks are also extended to the computer services staff at Southwest Missouri State University for assistance in the processing of data.

Finally, gratitude and love are offered to my family, especially my parents, Col. and Mrs. James A. Mullins, for their emotional and financial support.

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# CHAPTER I

## INTRODUCTION

Education is one of the largest industries in the United States. In the 1979-80 academic year, $166 billion worth of resources were consumed in the pursuit of education at all levels. 1979 fall enrollment at institutions of higher education was 11.6 million. This, along with the substantial explicit expenditure ($59.1 billion or about 3% of 1979 GNP), represents a significant allocation of productive resources to the higher education industry.

Not only is education an important industry from the standpoint of size, it is also one of the few activities which provides its consumers with investment benefits in the form of human capital appreciation. Education increases productivity and earning power. Much of the disparity between incomes of poor and rich nations is due to differences in investment in human capital. Studies relating the growth of real GNP to growth in the United States capital stock and labor force have uncovered a "growth gap", economic growth in excess of that expected from the growth in the quantity of resources and technology along (33). The answer lies in the increased quality of labor force due to investment in human capital via education and work training (34).

It is this accumulation of human capital that explains the so called "Leontif Paradox" (24). The United States, traditionally classified as capital intensive relative to its foreign trading partners,

was found to be exporting products that were labor intensive in production. This contradicted the accepted trade theory that predicts a nation will tend to specialize in and export products that use intensively its abundant factor, presumed to be capital. Only after U.S. labor inputs were adjusted for their greater skill and training due to education was the riddle solved. The United States was indeed "exporting" its abundant factor, highly educated and skilled labor (25, 35).

State, local and federal governments are deeply involved in the provision of education in the United States. State and local government agencies provide primary, secondary and higher education and the federal government disperses billions of taxpayers dollars annually directly to students in the form of loans and grants and appropriations to institutions and programs at all levels. Although heated debate over the appropriate level of and means of providing support exists, there is an economic rationale behind this involvement in education.

First, there is evidence that the market may fail in the provision of a good that provides "spillover benefits" in production or consumption. The private market will underallocate resources to the production of educational services as individual consumers (parents and their children) fail to internalize the external benefits generated in the schooling process as they make their decision as to how much education to consume. Most economists agree that primary education does, indeed, create these external effects, and that government support of education at the primary level is justified as a means of increasing allocative efficiency.

A second agrument in favor of government support of education is based on equity grounds. Aid can be provided to the poor in a variety of ways. Cash transfers, food subsidies, low cost housing, medicaid and many other programs are designed to help the less well-to-do. Although these programs were created to redistribute income to the poor and reduce the burdens associated with low incomes, they are not very effective in dealing with the causes of low incomes. One cause of poverty in the United States is unequal distribution of the quantity and quality of productive resources. Human capital, in the form of education and job training, is probably one of the most unequally distributed resources. Thus, aid to education could provide a type of dynamic income redistribution. Helping the less fortunate obtain education that they could otherwise not afford can provide these families with the resources necessary to help themselves. Investment in human capital has great potential for making long-run gains in the war on poverty. Although some economists argue that many current educational aid programs are perverse in their redistribution effects (17), most agree that government support of education for the poor is justified and that policies could be changed to make the redistributional effects most equitable.

As important as this industry may be in promoting economic growth and potentially reducing poverty, education has infrequently been the subject of the allocative and cost efficiency studies so prevalent in the main body of economic research. Only recently has the institution of higher education been the subject of efficiency questions such as "How much should we spend to support colleges and universities?" Economists have done little to address the issue of efficiency in the

production of human capital. Billions are being spent to produce human capital. Are we getting the most "output" possible given these large amounts of "inputs"?

A factor that may be responsible for the relative lack of research in this area is the problem of defining and measuring the inputs and outputs of the education process. All production efficiency studies require measures of outputs and inputs. We do not even know what all the outputs of the educational process are, let alone how to measure them. The benefits from attending college are nebulous and hard to quantify. Students receive both consumption and investment benefits and third parties probably receive spillovers. Human capital production is a unique type of asset appreciation. Students with x units of productive capacity enter schools as freshmen and leave four years later as college graduates with $x + x'$ units of productive capacity, where $x'$ is the value added during the education process. The freshman students' abilities and other characteristics must be known if the contribution made by education, alone, is to be estimated.

The purpose of this study is to develop a microeconomic model of institutions of higher learning (IHLs) and to test hypotheses about the behavior of these institutions with data from a cross section of private and public colleges and universities. The model stresses that the differences in the sources of IHL revenue and type of control (private or public) are determinants of differences in the constraints faced by college and university administrators. The model implies that these varying constraints placed upon the administrators of public (state-supported) and private institutions will be reflected in differences in the behavior of IHLs. It is hypothesized that these

constraint dissimilarities will be reflected in observable differences in behavior measured in terms of expenditures per student.

The model, and the methodology used to test its implications, will be developed and explained in Chapters III and IV, following a review of previous research on education cost functions and models of private and public non-profit firm behavior. Chapter V contains the empirical results and tests of the models implications. A summary and conclusions of the research are found in Chapter VI.

# CHAPTER II

## REVIEW OF THE LITERATURE

The purpose of this study is to develop and test a model os IHL behavior which predicts that colleges and universities will exhibit different behavior, as indicated by expenditures per student, due to differences in sources of revenue and type of control. The model suggests that these behavioral differences will show up in IHL average cost (expenditure per student) functions. The first part of this literature review focuses on previous estimates of college and university average cost functions.

A model attempting to explain IHL behavior will, of course, be different from the models of profit seeking, privately owned firms. Colleges and universities are non-profit organizations, many of which are state owned and supported. The second part of the literature review discusses a number of models of non-profit and public firm behavior. A model of a bureaucracy developed by Niskanen (26) is explained, followed by studies of the demand for private and public higher education. An empirical study comparing a private with a publicly owned airline (10), and three models of hospital behavior are then reviewed (9, 20, 27). Clarkson compares the performance of proprietary and non-profit hospitals and Lee develops a model which emphasizes the non-profit status of many hospitals as an explanation of rapidly rising health care costs.

The model developed and tested in this study is based on Newhouse's (27) model of hospital behavior which suggests that the prestige of a hospital is an important determinant of the utility of the administrators of the institution. As will be discussed later, this type of model may well explain the behavior of the administrators of IHLs. Newhouse's model is reviewed last, following the review of cost function research and the other non-market firm behavior models.

Maynard (26) uses the theory of long-run average cost to explain why IHLs should have U shaped average cost functions much like those expected for manufacturing firms. Economies of size cause the per-student instructional cost to fall over a range of increased size. Ultimately, the average cost curve will flatten out, and may even rise for large institutions as diseconomies of size set in.

Economies of size for IHLs are caused predominantly by a reduction in the faculty and administrative staff per student requirement as an individual institution approaches what Maynard calls the threshold staff size. A college or university is constrained to a minimum instruction and administrative staff size, regardless of the number of students. A small college with five academic departments may need a minimum staff of 30 in order to provide basic course offerings and administration. If the school is committed to a maximum student-staff ratio of 20, the staffing cost per student would fall as enrollment reached the threshold level of 600. At a greater enrollment than this, the school can add instructors as needed to maintain any desired student-faculty ratio and the average costs should flatten out. Since college instruction is very labor-intensive, Maynard argues that there is a tendency for costs per student to fall up to some threshold enrollment level as

a major part of the total costs per student are due to these faculty and staff requirements.

Maynard tests his theory by estimating long-run average cost curves which relate per student costs to the size of the institution as measured by enrollment. Maynard's reference to long-run costs is somewhat confusing as many of the reasons he offers in support of declining costs apply to short-run cost analysis. The notion of a threshold size of enrollment implies some fixed inputs, such as a minimum size physical plant, administrative staff, and faculty. Maynard assumes that institutions are in long-run equilibrium so that their short-run average cost functions trace out the long-run cost function which he is describing. Long-run cost savings can be realized as specialization and division of administration and faculty becomes feasible with increased size, but Maynard does not stress these sources of long-run average cost reductions.

Maynard used cross sectional data from state supported four-year colleges in 13 different states for his cost estimates. He assumes that the quality of the educational services will not vary between state supported colleges in a given state as state governing boards are pressured to appropriate funds in an equitable manner. Thus, the question of inter-school quality differences was addressed, although it is unlikely that it was resolved. No explanatory variables other than the number of students were included in his model and functions were estimated for each of the 13 different states.

A parabolic function ($y' = a + bx + cx^2$) was estimated using multiple regression analysis. $y'$ is predicted per student cost and $x$ is the school size as measured by number of full time equivalent

students. His results support the economies of size hypothesis as all of his estimated cost functions had negative and significant b coefficients. The general average cost function derived from the 13 separate estimates was $y' = 2 - .244x + .00002275\ x^2$. Each of the 13 separate functions differed significantly only in the intercept term, a, which measures the height of the cost function when x, enrollment, is equal to zero. This average cost function reaches its lowest point at an enrollment level of 5,363 and slowly rises as enrollment increases beyond that level.

Maynard's extrapolation of his results to explain the financial troubles of many private colleges is of particular interest for this study. Although he did not estimate cost functions for private schools, he argues that they suffer from small size which precludes their attainment of economies and low average costs.

An early study by Russell and Reeves (32) of higher education costs supports Maynard's findings of size economies. In this study, 44 institutions were divided into three homogeneous "excellence" groups. For each of these quality groups, freehand functions were drawn through the points relating enrollment and educational expenditure (cost) per student. Although schools were much smaller at the time the study was done, the lines of best fit did confirm that size economies were present.

The results of another study of private, church related liberal arts colleges done by Russell and Reeves (31) also indicated the existence of size economies in those schools. Maynard (26) used the data from this study to compute rank order coefficients of correlation for 17 accredited schools. The schools were ranked by size, with the largest school receiving a rank of one, and by expenditure per student,

with the institution having the lowest expenditure per student getting a rank of one. A positive correlation coefficient would indicate falling costs per student associated with increased size. After dividing the sample into two subgroups based on regional differences, Maynard determined that these rank order coefficients were significant and positive.

In a recent book, Bowen (6) looked at the relationship between institutional affluence, as measured by educational cost (or expenditure) per student, and the internal allocation of expenditures among the major functions of teaching, student services, scholarships and fellowships, academic support (expenditures for the support services that are an integral part of the institution's primary missions of instruction, research, or public service including expenditures for libraries, museums, galleries, audio-visual services, academic data-processing and administration, and personnel, course and curriculum development), institutional support (expenditures for the day-to-day operational support of the institution including general administrative services, executive direction and planning, legal and fiscal operations, and community relations), and plant maintenance and operation. No striking relationships between institutional affluence and expenditure patterns were found. As schools become more affluent (greater expenditures per student) they tend to allocate additional expenditures more or less equally toward all functions. Only one consistent difference between the expenditure patterns of public and private institutions was found. Private schools allocated a greater portion of their budgets to scholarships and fellowships than did public institutions. This is not surprising since private institutions are at a competitive disadvantage

as a result of less government support and therefore must rely more on student tuition and fees to cover costs.

Bowen also compared educational cost per student for different size classes of institutions in search of evidence of economies of size. The 268 institutions in his sample were partitioned into fifths by size (as measured by enrollments), and the educational cost per student was calculated for each of the five size groups. The data provide evidence that size economies do exist, but they are slight. The smallest fifth of the 268 IHLs had an average cost of $3,163. Average costs fell to a low of $2,475 for the next to the largest quintile of institutions, and increased to $2,835 for the largest fifth (6).

After studying the internal allocations for institutions of different size classifications, a tentative explanation for the lack fo strong evidence of economies of size was offered. Bowen found per student cost savings with larger institutional size for institutional support (administration), student services, and plant operation and maintenance but these savings seemed to be offset by the devotion of additional resources saved to instruction. Thus, economies of size did not show up as reductions in overall unit cost. Bowen argues that cost savings that accompany increased size serve as new revenues for higher salaries, new equipment, and the development of new programs.

Niskanen (28) developed a model of non-market decision making that attempts to explain the behavior of bureaucracies. His model can also be applied to non-profit firms that receive all or part of their revenues from sources other than the consumers of the firms output. The performances of non-profit decisionmakers' and government bureaucrats' are not evaluated on the basis of the profitability of their

enterprises. Niskanen assumes instead that the objective function of these administrators contains objectives other than profits, and that measures of these objectives are likely to increase monotonically with increases in the total budget of the enterprise. He argues that budget maximization is an adequate proxy for their objective function.

Niskanen's model assumes that bureaus possess two critical characteristics:

1. Bureaucrats attempt to maximize the total budget of their bureau, for given demand and cost conditions. The bureaucracy is constrained in that its budget must be greater than or equal to the minimum total cost of producing the output.
2. Bureaus exchange a specific output for a specific budget.

Niskanen concludes that the objectives of bureaucrats and the "all or nothing" conditions surrounding the "sale" of the bureaucracy's output will lead to greater growth than the bureaucracy would experience as a competitive firm. This theory, to the extent that it applies to state-supported higher education, may provide an explanation of the rapid increase in the size of public IHLs. In fact, the results of an empirical study by Hight (18) indicate that growth in public IHLs has been at the expense of private higher education, as Niskanen's model implies.

In his study, Hight developed a model to explain the falling ratio of private to public enrollments since 1947. His theory suggests that changes in income and relative tuition charges are the major factors determining the relative decline in private school enrollments. Institutions of higher learning are assumed to have some control over demand conditions by altering admissions requirements and tuition

charges. Changes in the private to public enrollment ratio can have two causes. First, given equal price elasticities of demand, unequal changes in tuition at private and public colleges and universities will lead to differential changes in enrollment. Since private tuition has risen by a greater amount (in absolute and relative terms) compared to state-supported institutions, private school enrollments have fallen relative to enrollments at public institutions.

Another possible source of the observed enrollment shift are differing price or income elasticities between the two types of institutions. If the public sector has a greater income elasticity, increases in income and/or equal increases in tuitions would cause the ratio of private to public enrollment to fall over time. Hight argues that there are no indications that this is the case. Time series data from various years between 1927 and 1972 were used to estimate these price and income elasticities for the two types of institutions. The price elasticities were insignificant in both cases while the income elasticity of demand for private higher education was significant and greater than the income elasticity for public institutions. This indicates that income increases by themselves tend to raise the private to public enrollment ratio. Hight concludes that the increase in private tuition relative to that of public institutions has swamped the income effect that favors private institutions.

Other studies of the demand for higher education fail to support Hight's findings. Hopkins (19) used cross sectional data from the 1963-64 academic year to estimate the enrollment demand for private and public IHLs. The ratio of in-state public (or private) enrollment to the number of eligible residents within a given state was used as

the dependent variable in an enrollment demand equation which included private and public tuition levels, a measure of private school proximity, family personal income, and family education as measured by the percentage of families in a state with at least one college graduate head-of-household. Public college tuition, close proximity to private institutions, and family income had a significant negative influence on the public IHL enrollment ratio while public IHL demand was positively related to family college education. The demand for private IHL services was positively related to family income. Hopkins determined that the price elasticities of demand were quite different between the two types of institutions. The elasticities of private and public enrollment demand were -.736 and -.29 respectively with the demand at public institutions being less elastic.

Campbell and Siegel (7) estimated the price and income elasticities of demand for higher education with time series data from the 1914 to 1964 period. They used the ratio of undergraduate enrollment to the number of 18 to 20 year olds with high school diplomas that are not in the armed forces as a measure of the demand for higher education. Aggregate data were used to estimate the function $R_t = a + b\ln Y_t + c\ln P_t$ where $R_t$ is the enrollment ratio in year t, and $Y_t$ and $P_t$ are real disposable income per household and average real tuition in period t. b and c provide estimates of the income and price elasticities of demand for higher education. The estimate of the income elasticity was 1.20. The price elasticity was estimated to be -.44. Both of the elasticity estimates were significantly different from zero.

Significant income and price elasticities of demand for higher education were also estimated by Lehr and Newton (21) using time series

data from Oregon institutions of higher learning. Yearly data from the period 1960 to 1974 on fall enrollment in institutions of higher education, average real tuition (weighted by institutional enrollments), mean real per capita personal income in Oregon, the annual unemployment rate in Oregon, the number of 18-24 year olds in the Armed Forces, and the total number of Oregon high school graduates were used to estimate a log-linear demand function relating enrollment to tuition, income, unemployment and the number of potential students. Estimates of the income and price elasticities of demand were 1.882 and -.6586 respectively. These are slightly larger in absolute value than the elasticities estimated by Campbell and Siegel. Lehr and Newton attribute this to their use of freshman enrollments as the dependent demand variable. They argue that total enrollment is less volatile in the face of changing costs and income as sophomores, juniors, and seniors are committed to continue school after the initial decision to attend college.

The emphasis of this study is on the differences in the constraints faced by decision makers in private and public IHLs and the effect these constraint differences have on educational costs per student. Economists have been interested in the effect that the type of organization and control have on other production activities. Some of the important studies in this area are reviewed below.

Davies (12) did an interesting study of two Australian airlines. He was fortunate in that the Australian airline industry provided a good "controlled experiment" on the effect of different types of ownership. The Australian airline industry is composed of two almost identical airline companies. Both have similar aircraft, are of equal

size, and service the same routes, the major difference being that one is privately owned and operated, and the other publicly owned. Even though both are regulated and precluded from the free pursuit of profits, Davies argues that the ability of the owners of the private firm to sell their ownership rights provides them with an incentive to engage in a certain amount of monitoring of the airlines activities that the onwers of the public firm would not find worthwhile. Taxpayers, who are unable to sell their ownership rights in public firms, have little interest in efficient and profitable operation, and would not be expected to expend as many resources to monitor the public airline. This provides the managers of the public airline with more leeway to pursue objectives that may be contrary to efficient operation. The public airline is expected to suffer from X-inefficiency to a greater degree than the private airline.

Output to input ratios for the two airlines were compared by Davies. The existence of lower output-intput ratios would indicate greater per unit costs and the presence of X-inefficiency. Davies compared (1) tons of freight and mail carried per employee, (2) the number of paying passengers per employee, and (3) revenue earned per employee for the two airlines, and four that the private airline had higher values for all three of these measures of productivity. He concludes that the difference in ownership constraints faced by the two airlines does lead to less efficient operation in the public firm.

A number of hospital studies have supported the hypothesis that behavior or performance will differ with different types of institutional ownership or objectives (9, 20, 27). Clarkson (9) derives and tests the implications of a model of hospital behavior that emphasizes

the importance of differences in property rights. Profit seeking (proprietary) hospitals' owners and trustees have property rights in the value of the firm that are transferable by sale. Owners of proprietary hospitals benefit directly from efficient hospital operation in the form of increased value in the property rights they possess. Claims to the ownership of non-profit hospitals are not transferable by sale, and managers do not have exclusive claims on any profits derived from efficient use of resources. For these reasons, Clarkson expects the owners of proprietary hospitals to appoint stricter managers and to spend more resources on the monitoring of management to ensure that managers will have greater incentives to act in the best interest of the owners. Non-profit hospital managers will be better able to pursue their own interests by channeling hospital resources to their personal use and "shirking" on the job, both at the expense of the net wealth of the owners of the hospital.

Clarkson does not calculate any productivity measures to compare the efficiency of the two types of hospitals. Instead, information concerning management effort and types of external controls is gathered and compared. Some important differences that are expected are:

1. External control efforts, such as rules set down by commissions or trustees, will be more extensive and explicit for non-profit hospitals than for proprietary hospitals.
2. Non-profit hospitals will show more variability of input mixes as their managers have less incentive to move toward the most efficient production technique.

Clarkson's empirical findings support these assertions. A greater percentage of non-profit hospitals than of proprietary hospitals have

formal budgets approved by an external governing board, use the American Hospital Association chart of accounts, have written sets of staff regulations, and have regularly scheduled staff meetings. Non-profit hospitals also have greater variances of input combinations.

Evidence that proprietary hospitals' managers are more concerned with market conditions and efficiency is also provided. Non-profit managers use market information less often than do the for-profit hospital managers, and for-profit hospitals are less likely to give automatic pay increases. Clarkson's major contention that the difference in property rights will affect managers efforts to pursue owner's interests seems to be supported by his findings.

Another model which suggests that non-profit hospitals are less efficient in resource use than their private counterparts is called the Conspicuous Production Model and was developed by Lee (20). This model incorporates prestige or status as an important component of hospital decision makers' utility functions. Non-profit hospitals compete for status, not profits, and Lee argues that this is the major cause of the spiraling costs in health care.

The administrators of non-profit hospitals seek to close the gap between the status they desire the hopsital to have and the hospital's actual status. The actual level of a hospital's status is determined by the quality and quantity of inputs used in producing medical care. A hospital's desired status is predominantly determined by the perceived status of other hospitals, which depends, in turn, upon the level of inputs they use.

Lee's model assumes that hospitals will strive to attain inputs to close this status gap, given a revenue constraint. The problem is

to minimize (I' - Ia), subject to revenues being greater than or equal to the costs of the inputs consumed. I' is the desired level of inputs for the hospital and is a function of the levels of inputs of other hospitals, and Ia is the actual level of inputs used by the hospital.

A hospital justifies additional expenditures on sophisticated equipment as an attempt to keep up with other hospitals. Hospitals depend heavily on doctors' referrals for their patients, and are therefore responsive to the medical staff's demands for complementary inputs. These inputs are viewed as implicity payments to physicians deemed necessary to maintain a flow of patients. Quality (and status) can be pursued with little regard for costs because the actual consumers do not directly feel the impact of higher prices in the short-run and they have allowed the medical care profession to make medical care decisions for them. In addition, the widespread practice of average cost pricing of health care weakens the association between increased expenditures on new inputs and increased costs for the services those inputs provide.

Lee's model indicates that hospital costs are determined not only by the level of the hospital's output, but also by the level of inputs used by other hospitals. The model implies frequent use of inputs superior to those necessary to provide adequate health care services. For example, highly trained technicians may be employed for tasks not requiring a high level of expertise. Overduplication of expensive and sophisticated equipment that is non-essential for most aspects of health care production is expected.

Some evidence is presented by Lee which supports these assertions. The rapid increases in per patient hospital costs, rapid growth of

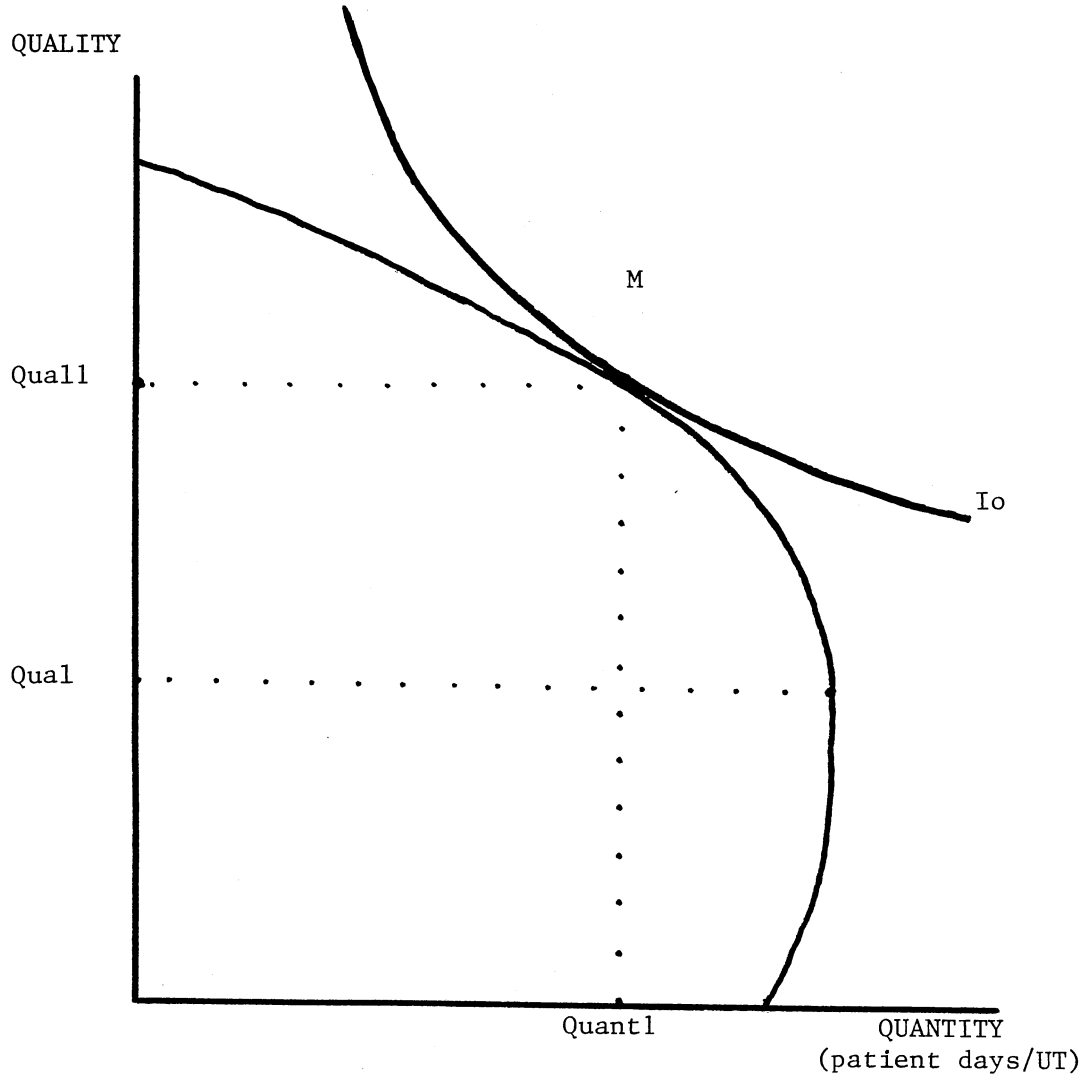
corporate hospital chains, and evidence of overduplication of extremely specialized heart surgery equipment support the Conspicuous Production Model of non-profit hospital behavior.

Institutions of higher learning have some things in common with hospitals. The non-profit status, and multiproduct nature of these institutions are similar. The model used in this study draws most heavily from an economic model of individual hospital behavior developed by Newhouse (27).

In Newhouse's model, the maximand, or objective function of hospital administrators has as an important component the quantity of hospital services provided. Large hospitals are viewed as prestigious by administrators, and this desire to be large produces an incentive to keep costs low to attract patients. Newhouse makes the argument that his model is also applicable to colleges and universities because third party payments, by insurance companies and government aid in the case of medical care, and private gifts and state and federal tax dollars in the case of education, are common payment practices in both industries. These payment schemes make the consumers of hospital and educational services much less responsive to cost-of-service increases.

A second important component of the administrators' objective function is the quality (as indicated by per patient expenditure) of the health care provided. Administrators' performance can not be judged by the profitability of the medical care unit so the institution's prestige is the predominant concern. The two most important determinants of prestige are assumed by Newhouse to be the size of the hospital in terms of the number of patients and the quality of the services provided.

Hospitals are constrained such that an increase in patient care or size with a given budget means per patient expenditures, or quality, will fall. Hospital administrators pick a combination of size and expenditures per patient (subject to the tradeoff between the two) that maximizes the utility of the administrators. As a hospital administration considers increasing the quality of its health care beyond the minimum necessary to obtain accreditation, the demand for the service increases also. Whether or not the amount of service units provided increases depends on the size of this increase in demand, brought about by a quality increase, relative to the increase in average costs of producing the greater quality health care. For initial increases in costs and quality, demand increases may be large enough so that the institution can grow in terms of both quantity and quality. This type of growth unambiguously increases the hospital's prestige. However, a point will ultimately be reached where the added costs of maintaining a given level of quality require patient charges high enough to reduce size (in terms of the quantity of service demanded). The frontier illustrating this quality-quantity trade off is shown in Figure 1. This graph illustrates the ultimate constraint of a limited willingness on the part of health care consumers to pay for higher quality services. At some level of quality, the costs of increasing the quality of service choke off increases in demand and higher quality comes at the expense of reduced size. The combination of quality and the number of patient days of service that the hospital administrator would actually pick is determined by his preference map. One indifference curve from such a map is shown as Io, which depicts combinations of quality and quantity which provide equal prestige. The hospital




Source: Newhouse (27, p. 68).

Figure 1. Newhouse's Hypothetical Trade Off Between the Quality and Quantity of Service for a Non-Profit Hospital

administrator's utility is maximized when the quality-quantity combination shown at point M is achieved.

An important implication of this model is that a bias exists against the production of lower quality (and cost) products because output quality is an important component of the administrator's utility function. Non-profit hospitals are not expected to produce all feasible qualitites of services. Low quality services do not add to administrator's utility to the degree that high quality services do. Therefore, a utility maximizing administrator is expected to opt for a higher quality mix of hospital services. Profit seeking hospitals are expected to produce some lower quality services if these are profitable, whereas non-profit institutions would not do so. Newhouse provides evidence that indicates that this is the case. A smaller proportion of profit seeking hospitals are accredited and for profit nursing homes have a smaller proportion of registered nurses. The model also predicts duplication by hospitals of the sophisticated and expensive equipment necessary for high quality health care. Newhouse also provides evidence that non-profit hospitals are generally more capital intensive than profit earning institutions (27).

Newhouse points out that third party payment schemes (insurance or government reimbursement of medical expenses) increases the tendency for hospitals to pursue high quality. This results in rapid increases in hospital costs and insurance rates as hospital administrators have little fear of pricing the insured or subsidized medical care recipient out of the market.

These empirical studies of non-market firm behavior and the theoretical work explaining decision maker's behavior in non-profit

and non-market environments should prove helpful in the study of higher education. An economic model of an IHL is developed in the next chapter and will be followed by tests of the models implications.

# CHAPTER III

## AN ECONOMIC MODEL OF INSTITUTIONS OF HIGHER LEARNING

As indicated in the previous chapter, there are many similarities between hospitals and IHLs. Both are multiservice firms relying on a mixture of payments from customers (patients or students) and third parties to obtain operating revenue. Both of these industries enjoy a substantial amount of freedom from competitive pressures to hold costs down. In addition to the lack of the profit motive and the third party compensation schemes, certain aspects of the production of health care and educational services are also detrimental to incentives for cost efficiency.

Such a high level of expertise is required to administer medical care that patients generally allow most decisions about the type and quality of treatment needed to be made by their physician. Little bargaining over the price or type of treatment necessary takes place as the patient assumes "the doctor knows best". Although the production of higher learning may not be as complicated and technical as medicine, so little is known by the potential customer about the education production process that educators also are given a relatively free hand to experiment with new curricula and teaching techniques. Very little input from parents or students is sought when decisions regarding

production techniques, which actively involve the student as an input, are being made.

The economic model of IHLs developed here is similar to those for hospitals for the above reasons. In the model presented below, the administrators of an institution of higher learning are assumed to pursue status, or prestige, given the constraints of private and public gifts and subsidies and the student demand for educational services. The administrators seek status because they are motivated to do so as a means of demonstrating success, and also because they have the opportunity to do so in the absence of any strong competitive pressures.

The most important components of IHL status are assumed to be the size of the institution, the expenditure per student, and the quality of the IHL's students. Expenditure per student is not to be interpreted as an actual measure of the quality of the "output" of a IHL but, rather, as a measure of the level of the inputs used per studnet. Studies have shown tendencies for greater qualities and quantities of education inputs to be associated with greater educational outcomes, but the relationships are often weak. Reed and Miller (30) found a weak, but positive, relationship between input quality (as measured by freshman aptitude scores) and graduate earnings. Weisbroad and Karpoff (36) found evidence that the earnings of graduates are positively related to their rank in their college's graduating class, as well as to a subjective measure of college quality (as measured by rankings given by company personnel officers). Bowles and Levin (5), in a critique of the Coleman Report, found a significant and positive influence of teacher verbal ability, teacher salaries, and instructional expenditure per student on student achievement. Astin (3) found little

relationship between measures of college environmental characteristics such as per student expenditures, library size and number of books per student, faculty-student ratios, and the proportion of faculty with terminal degrees, and outcomes as measured by GRE scores. The most important determinant of achievement (as indicated by GRE scores) in his study was the students' academic ability prior to attending college as measured by national merit scholarship qualifying exam scores.

In general, greater expenditure per student implies a greater quantity or quality of resources employed per student. An administrator of an IHL can increase the quality of the education services that are provided at his institution by either applying more and better resources to the instruction of students, or by employing the same quality and quantity of resources in a more efficient manner. Higher EPS could indicate greater effort and expense in the education process, or it could indicate inefficiency if the higher costs per student were not improving the institutions output. Measures of the quantity and quality of IHL output are needed before it can be determined if differences in EPS are indications of quality changes or changes in the efficiency of colleges and universities.

The actual quality of the education institution's output is not the point of interest in this study. The purpose of this study is to explain differences that exist in IHL behavior as evidenced by the institution's expenditures per student. The objective is not to label a particular institution as being of higher quality than another on the basis of differences in expenditures per student. The administrators of an IHL, however, are likely to assess the institution's commitment

to "quality" education on the basis of the resources available for each student. As an example, an administrator may use the faculty-student ratio as an important measure of the quality of the institution's instruction because a higher faculty student ratio, ceteris paribus, would indicate more personalized instruction. A higher faculty-to-student ratio will be associated with greater per-student labor costs. Other measures of resource consumption per student could be developed such as total staff (administration and faculty) per student or average class size (a smaller average class size indicating greater inputs per student), but expenditure per student is the most easily observed proxy for the "quality" of the educational experience and it will be used in this study as a quality variable in the IHL administrators objective function.

A second major factor determining the prestige of an IHL is size. Education is much like medical care in the sense that it is viewed by many that are responsible for supplying it as a service which everyone has a "right" to obtain. Above all, a lack of income or wealth should not be a barrier to an education. The administrator of a college or university perceives his job as one of promoting a social purpose, that of making the educational experience available to all who are qualified, regardless of income.

Baumol and Bowen (4) describe the basic characteristics of non-profit organizations and their emphasis on size. These institutions earn no monetary return on their invested capital and can not use profit as a measure of performance. Non-profit institutions claim to fulfill some valuable social function but always seem to be in need of more funds, either to create new programs or to expand existing

ones. The administrators of non-profit institutions view themselves as suppliers of virtue, believing their services should be distributed as widely as possible. According to Baumol and Bowen, the administrators of institutions of higher learning believe that the provision of educational services should not be inhibited by a lack of wealth or income.

In addition to their altruistic concern for large quantities of educational output, there are reasons based on self-interest which suggest that the size of a non-profit institution is directly related to the utility of the institution's decision makers. In non-profit institutions, the administrators' salaries and promotional opportunities are determined by criteria other than profits. The size of the institution is one indicator of the administrator's work load and hence his appropriate compensation. In addition to any pecuniary rewards that are influenced by the size of an institution, an administrator's personal status may be enhanced by the visibility that accompanies the larger institution.

Large institutions are generally more visible, well known and prestigious than small ones. There are other reasons, in addition to visibility, that may prompt IHLs to increase enrollments. Certainly in the case of state supported institutions, the availability of revenues is most often contingent upon increased "need" as demonstrated by a growing student population. For both private and public schools, increasing enrollments indicate success in providing for the educational demands of students. No institution can survive if its enrollment declines for an extended period of time. Different IHLs will, of course, place different emphasis on quality and quantity. Some schools

may prefer small size and a more personal atmosphere over large size and a less personal atmosphere. These differences in prestige functions will simply result in some schools seeking different quality and quantity combinations even if faced with similar constraints.

The tradeoff between size and expenditures per student is assumed to be essentially the same as that explained by Newhouse (27) in his model of non-profit hospital behavior (see Figure 1). The derivation of this tradeoff for an IHL is illustrated in Figure 2. The institution's average cost, or expenditure per student (EPS), is shown as the horizontal line labeled EPSo. For simplicity, this level of per student expenditure implies a certain "quality" of instruction at the institution. If the IHL charged a tuition sufficient to cover all of these costs, the institution would have an enrollment of qo given the demand for its service Do. The self-financed institution can increase its EPS in an attempt to increase quality but must charge higher tuition (EPS1) to do so. If there is no increase in demand in response to the higher expenditure per student of EPS1, the IHL will have reduced enrollments to qo' and the size aspect of prestige will suffer. Thus, the law of demand serves as an important constraint that underlies the inverse relationship between EPS and size.

An increase in EPS may cause an increase in the demand for educational services if the perceived quality of the institution's service increases. The increase in EPS to EPS1 will be accompanied by an increase in demand to D1 and the IHL will not lose as much enrollment (qo - q1) as in the initial case with no demand increase. The case where the added EPS actually leads to increased size is not illustrated. This would probably happen only for increases in quality from a very

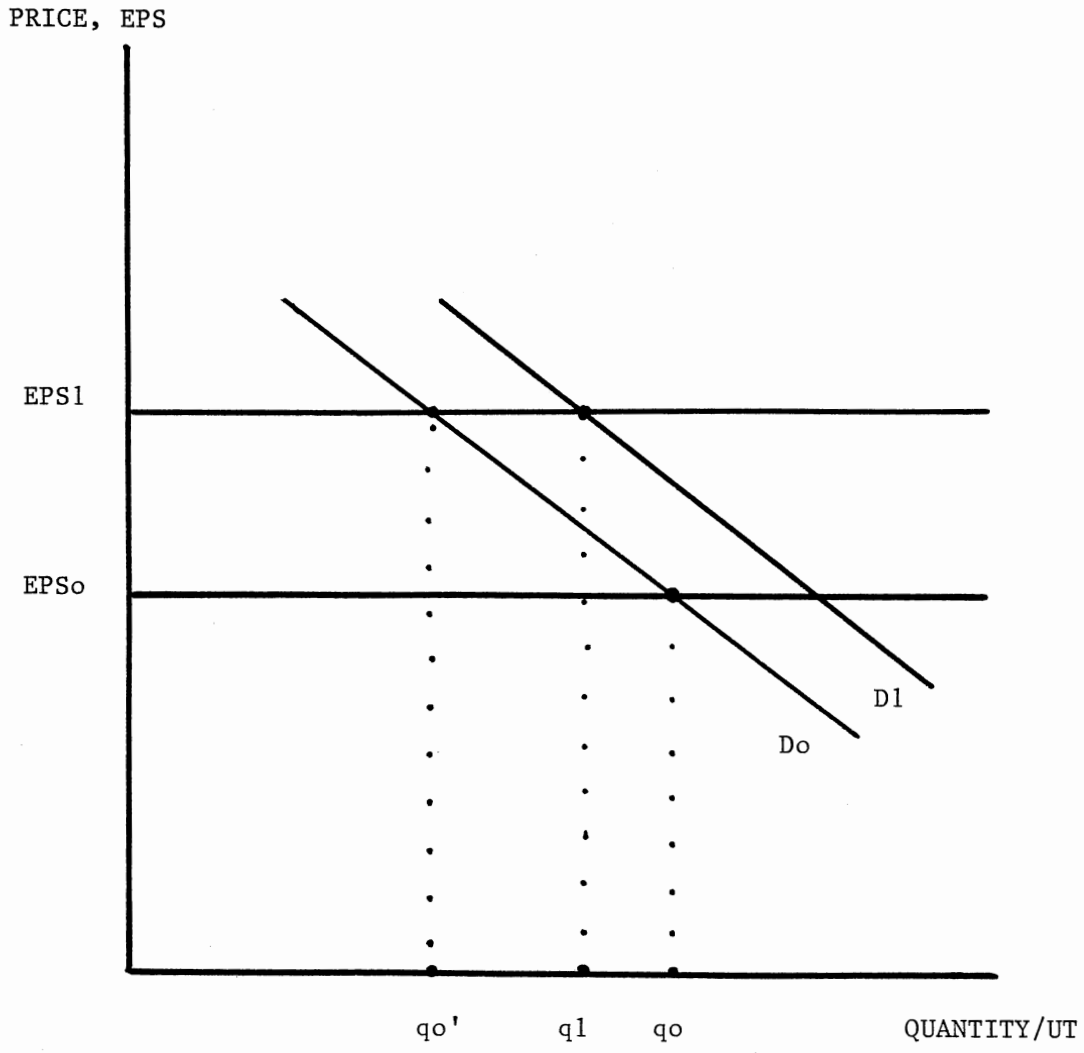



Figure 2. The Effect of Higher Cost (EPS) on IHL Size

low level as the consumers of higher education will ultimately experience diminishing marginal utility in the consumption of greater quality and become less responsive (in terms of demand increases) to higher quality education.

The IHL administrator will pick a combination of EPS and size that maximizes the administrator's utility function. The actual combination picked will depend upon the administrator's marginal rate of substitution of quantity for EPS relative to the marginal rate of transformation of quantity for EPS for an institution with a given level of prestige. A school administrator having a preference function like that illustrated in Figure 1 would chose the combination of EPS and size indicated by point M, the tangency of the EPS-Quantity frontier and the administrator's indifference curve I.

Student quality is likely to be a third determinant of the prestige of an IHL. The quality of the students at an IHL will have an effect on both the status of the institution and the non-pecuniary rewards accruing to the faculty. A higher quality student body would be expected to:

1. Provide a more enjoyable teaching experience for the faculty.
2. Enhance the prestige of the institution as graduates tend to be more successful, thus reflecting on the quality of the institution.
3. Enhance the attractiveness of the school to potential students.

To increase the average quality of the student population, the administrators of the IHL can enforce more stringent admission standards. Minimum required entrace exam scores can be raised as a means of screening out lower quality students. The effect that greater student

quality has on an institution's EPS and size depends, of course, on the effect that quality differences have on demand.

It is unclear, unfortunately, how student quality will affect the demand for an institution's services. Attempts to increase the quality of the student population may reduce the demand for the institution's educational services as a greater number of students are precluded from attending the institution because of the higher admission standards. In this case, a conflict would exist between the objectives of large size and high student quality. Increasing student quality would result in an institution with a given EPS (and tuition charge) being of smaller size in terms of enrollment. Alternatively, tightening admissions standards in order to increase student quality would cause an inward shift in the IHL's EPS-size frontier.

The effect that increased student quality has on EPS and size when greater student quality reduces the demand for the institution's services is illustrated in Figure 3. An IHL with a demand for educational services of Do and per student expenditure of EPSo, charging full cost tuition, will be of size No. Do is assumed to be the demand with relatively low admissions standards. The institution can increase the quality of the student population by enforcing more stringent admissions standards, but this will shift the demand curve to the left as some potential students are "priced" out of the market by the higher admissions requirements. With the same EPS (and tuition) the enrollment at the institution falls to N1. For the school to maintain an enrollment of No after the change in admissions policy, the EPS would have to fall to EPS1 or the school would have to lower the tuition charge to EPS1, maintaining expenditure at EPSo by obtaining more funds

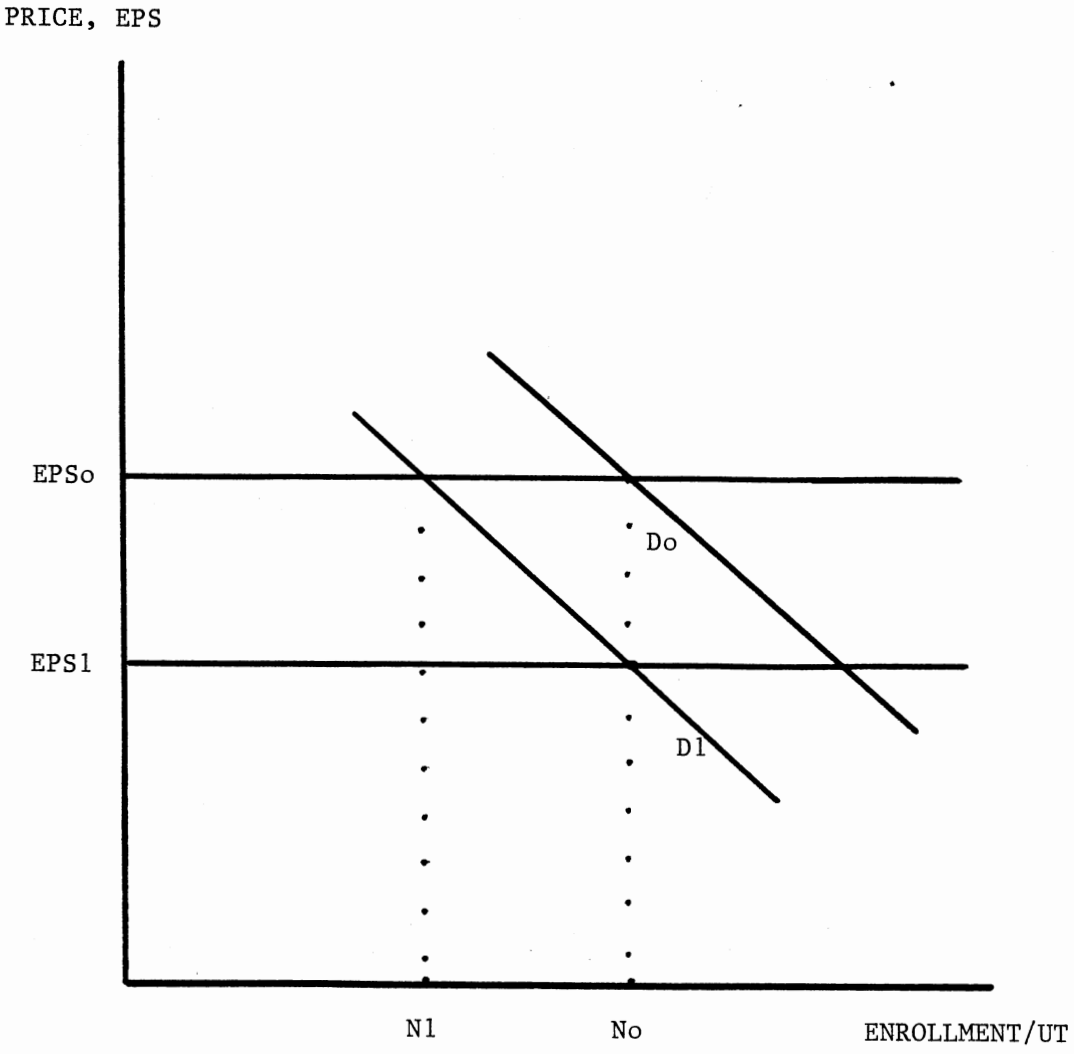



Figure 3. One Possible Effect of Greater Student Quality on IHL Enrollment

from government or private grants and gifts or by borrowing. Raising admissions standards will, therefore, cause the EPS-size frontier to shift to the southwest as the demand for the IHL's service falls.

The opposite would hold true if the greater student quality increased demand. In this case, the EPS-size frontier for the institution that increased student body quality would shift to the right as increasing student quality increased the demand for that IHL's service. Students may prefer an education at an institution with a reputation for high quality students as this would enhance their learning experience and possibly improve their job opportunities.

The purpose of this study is to test the implications of this model for differences in the behavior of private and public IHLs caused by different revenue constraints and type of control. The administrators of both private and public institutions are assumed to have the same objective, that of maximizing status or prestige. An important difference between institutions is the revenue sources available to the IHL. In general, private IHLs rely more on student tuition and fees than do public colleges and universities. A larger proportion of a public IHL's revenue is obtained from third parties, primarily the state and federal governments.

In the 1978-79 academic year, tuition and fees paid by students amounted to only 13.2 percent of the total current revenue of public IHLs while 36.5 percent of private IHL revenues were obtained from students. The remaining funds for both type of schools were obtained from federal, state and local governments and private gifts and grants. Public IHLs relied more on state appropriations (44.2 percent) than did private institutions (2.1 percent) while private schools obtained

10 percent of their funds from private gifts and public IHLs received only 2.3 percent from private sources (10).

This model of educational institution behavior stresses an objective function containing large size (enrollments), educational quality, and the quality of the student body. The important difference between private and public IHLs that implies different behavior in the context of this model is the differential burden placed upon students to finance their education. Since schools differ greatly in their reliance on student tuition payments to finance the institution, and any differences in tuition payments will affect the choices among alternative combinations of size, quality, and student body characteristics, IHL behavior should reflect these differences. As will be demonstrated below, institutions that rely less heavily on student tuition and fees are expected to have greater EPS, ceteris paribus, than do institutions requiring that students finance a greater proportion of their education.

Figure 4 illustrates the demand for educational services at hypothetical private and public colleges with equal quality students. Both schools have average costs (expenditure per student) of EPSo which implies that the institutions are of equal "quality". For simplicity, assume the private college requires students to pay full cost tuition equal to EPSo. Therefore, with demand equal to D, the private school will be of size Pri.

Assume that the public college, with equal EPS and demand conditions, charges a tuition of 50 percent of the full cost (EPSo/2). The state-supported college, by not having to charge as high a tuition because of greater government support, can be larger than the private school of equal "quality". In this example, the public school's enrollment is

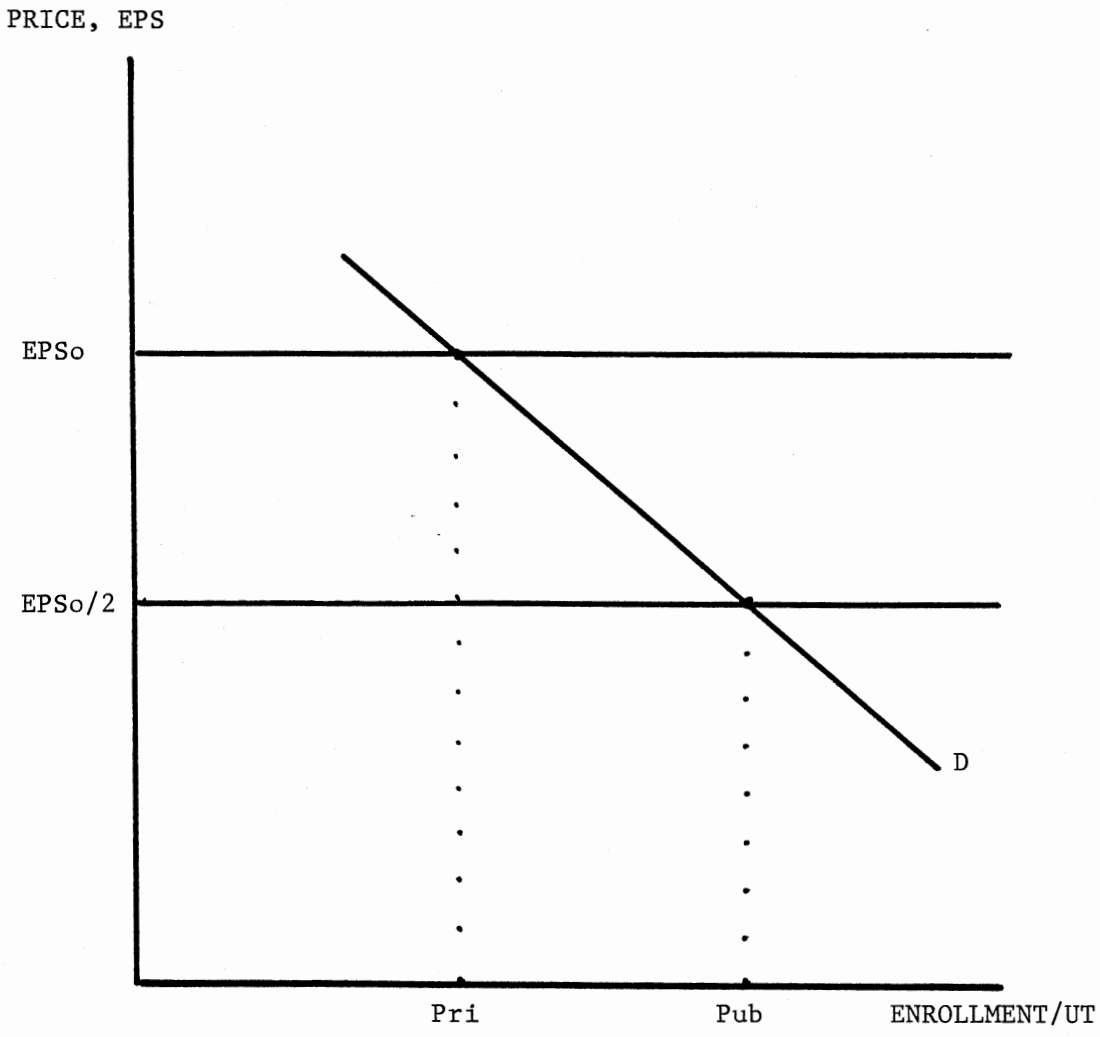



Figure 4. The Effect that Greater Reliance on Non-Students for Revenue has on IHL Size

Pub which is greater than the enrollment at the state-supported IHL (Pri) as the difference between the tuition charged by the private and public schools allows the state supported institution to attract more students.

This difference in size for a given level of EPS and demand implies that the EPS-quantity tradeoff curve for a college receiving less non-student revenue as a percentage of total revenues will be inside the frontier for a school that benefits from greater government and private support. Consider two institutions, one private and one public, equal in every respect except revenue sources. With equal expenditure per student the public college can have larger enrollments as the tuition charged will be less than that charged at the private school. This initial level of expenditures is shown in Figure 5 as EPSo. Two points, showing one of the many EPS-enrollment possibilities for the two schools are the points Pri and Pub, the public institution being the larger at the initial level of quality. These correspond to the enrollment levels Pri and Pub illustrated in Figure 4.

Under the assumption that the demand for each college's services responds in the same way to tuition and quality changes it can be demonstrated that the frontier for the private institution, which relies to a greater extent upon students for revenues, will lie inside that of the state supported school. This is due to the fact that as higher expenditures per student are made to increase quality, the private institution's tuition will rise by a greater amount than that at the public institution. This will reduce the quantity of educational services demanded at private IHLs by a greater amount than the lower tuition public institutions.

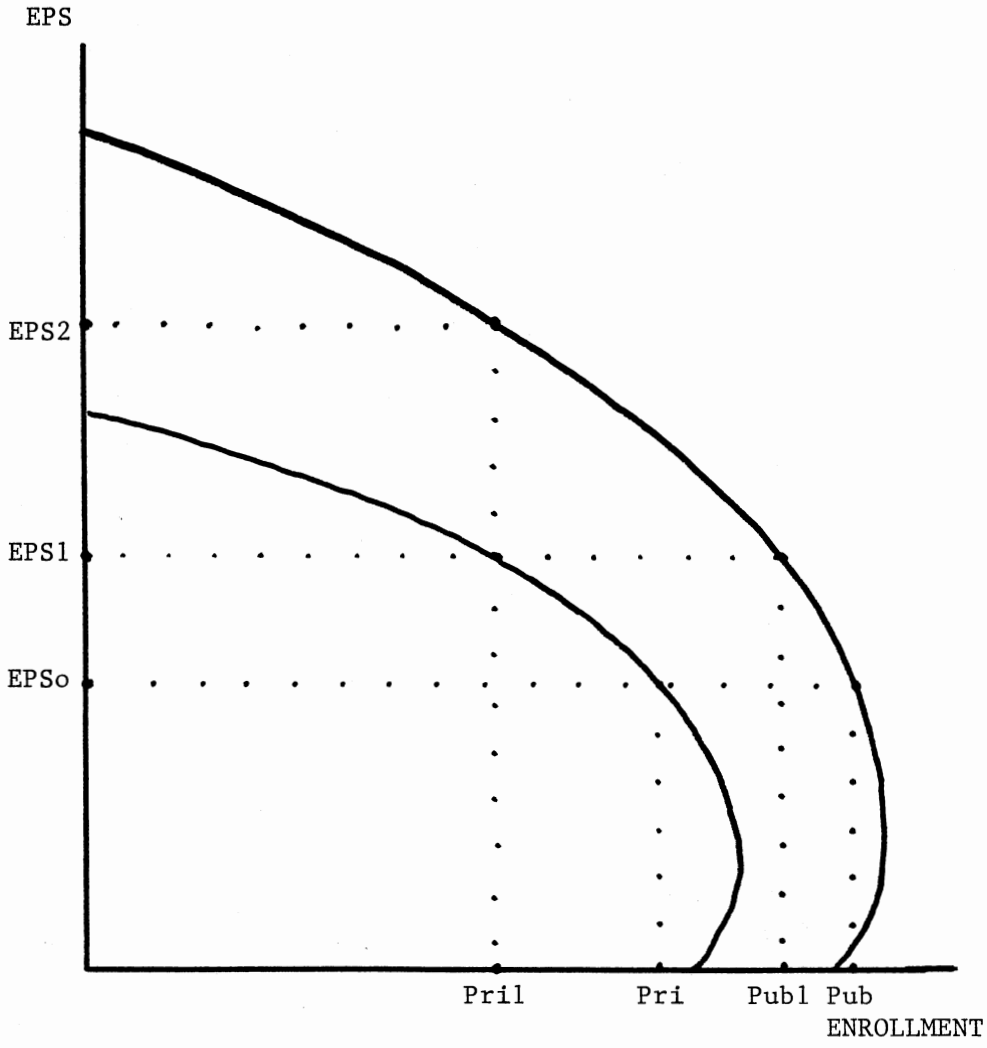



Figure 5. EPS-Enrollment Frontiers for Two IHLs that Differ in Source of Revenue

Since private colleges with EPS equal to that of public colleges are smaller at the initial level of "quality" and tuition rates are expected to rise more for a given increase in EPS at private schools, these IHLs that place greater reliance on students for revenues will have greater reductions in enrollment for equal increases in EPS. This conclusion is subject to the assumption that the demand for the two types of institution's services responds equally to perceived quality increases brought about by an EPS increase and the resulting tuition hikes. Under these demand response conditions, the EPS-size frontier for the private and state supported IHLs will differ. The typical private institution's frontier will be inside that of the state supported IHL and the private IHL will suffer greater enrollment losses with equal per student expenditure increases. This conclusion is demonstrated mathematically below.

$$N = n(t, EPS, SBQ) \tag{1}$$

This equation represents the demand for educational services by students, with t being the tuition charged at the IHL, EPS the expenditure per student, and SBQ the quality of the institution's student body. The expected partial derivatives with respect to t and EPS are: $\partial N/\partial t < 0$, and $\partial N/\partial EPS > 0$, where the former illustrates the law of demand, and the latter implies a rightward shift of the demand curve caused by an increase in quality associated with an increase in EPS. As mentioned earlier, the effect that increased student body quality has on demand is uncertain as higher student quality makes the institution more desirable therefore increasing demand on the one hand,

but may tend to reduce enrollment demand via more stringent admission standards, on the other. Thus, the sign of $\partial N/\partial SBQ$ is unknown.

Equation (2) assumes a simple linear relationship between the tuition charged at an IHL and the EPS.

$$t = k * EPS \tag{2}$$

where k is equal to the proportion of the IHL's total revenue that is obtained from student tuition payments and fees. A full-cost college or university would have a k equal to unity. Cohn's (9) aggregate data suggest k is about .12 for state supported IHLs and about .36 for private institutions. From (2) $dt/dEPS = k$. An increase in EPS increases the tuition charged to students by k times the expenditure increase.

Totally differentiating (1), the demand function, yields

$$dN = (\partial N/\partial t)dt + (\partial N/\partial EPS)dEPS + (\partial N/\partial SBQ)dSBQ \tag{3}$$

Assuming that EPS and tuition are directly linked according to (3), k*dEPS can be substituted for dt. A change in EPS may also have an effect on the quality of an institution's student body. More able students may be attracted to the more expensive "quality" IHLs. If greater EPS does attract better students, and the higher caliber of the IHL's student body makes the institution more attractive to other students, then the demand for the IHL's services will be further affected. $(\partial N/\partial SBQ)(\partial SBQ/\partial EPS)dEPS$ represents the increase in education demand associated with an increase in student body quality caused by an increase in EPS. The substitution of k*dEPS for dt, and including the effect that changing EPS has on student quality provides

$$dN = (\partial N/\partial t)k^{*}dEPS + (\partial N/\partial EPS)dEPS + (\partial N/\partial SBQ)(\partial SBQ/\partial EPS)dEPS \quad (3')$$

This equation shows the net effect of a change in EPS which causes a change in tuition of k*dEPS and a change in student quality of $(\partial SBQ/\partial EPS)dEPS$.

The first term on the right side of (3') is the change in the quantity of educational services demanded as a result of a total tuition change of k times the change in EPS. This term is negative for $dEPS > 0$. The second term in the right side of (3') is the change in demand brought about by a change in EPS, this being positive for $dEPS > 0$. The last term on the righthand side of (3') is the change in demand caused by the effect that a change in EPS has on the quality of an institution's student body. Solving (3') for the EPS-size tradeoff (dN/dEPS) yields

$$dN/dEPS = (\partial N/\partial t)k + \partial N/\partial EPS + (\partial N/\partial SBQ)(\partial SBQ/\partial EPS) \quad (4)$$

This illustrates that the rate at which EPS and size can be exchanged along the frontier in Figure 5 has four determinants.

First, the tradeoff depends upon the slope of the demand function, $\partial N/\partial t$. As costs and tuition increase with EPS, the quantity demanded falls. The amount by which tuition changes with dEPS, k, is the second determinant of the tradeoff, a larger k meaning a greater tuition increase and a greater reduction in quantity demanded, given dEPS and the slope of the demand function. Third, the shift in the demand function in response to a change in EPS, $\partial N/\partial EPS$, tends to increase the quantity of educational services provided. Finally, the effect that student body quality changes have on demand $(\partial N/\partial SBQ)$, and the influence of EPS on student body quality $(\partial SBQ/\partial EPS)$, will affect demand, and therefore, enrollment, as EPS changes.

Under conditions where $\partial N/\partial t$, $\partial N/\partial EPS$, $\partial N/\partial SBQ$, and $\partial SBQ/\partial EPS$ are equal for both types of institutions, the tradeoff between quality and quantity will differ as k, the fraction of per student expenditures that students pay, differs. The greater reliance of private IHLs on students for operating revenues implies that private institutions will be made more aware of the "Law of Demand", that is, greater quality will be achieved only at the expense of greater relative enrollment losses. Public institutions, with their greater non-student sources of revenue, can generally pass on a larger proportion of expenditure increases to taxpayers and relatively less to students and therefore will not suffer as great a loss in enrollment.

This differential in the EPS-size tradeoff is illustrated in Figure 5. Consider two institutions, one receiving a large part of its revenues from government grants or private gifts and the other relying more heavily on students for revenues. For simplicity, the institution obtaining the larger part of its revenues from non-students will be referred to as the "public" IHL, the other labeled a "private" institution. These institutions are assumed to have equal EPS (EPSo) and are of sizes Pub and Pri respectively. If both institutions increase EPS from EPSo to EPS1, the private institution increases tuition more than the public one for the same increase in EPS, and the private school loses more enrollment; its enrollment falling to Pri1, compared to the enrollment loss at the state IHL, to Pub1. Equation (4) shows that dN/dEPS will be greater in absolute value the greater the value of k. Under the assumptions that $\partial N/\partial EPS$, $\partial N/\partial t$, $\partial N/\partial SBQ$, and $\partial SBQ/\partial EPS$ are equal for both institutions, $\partial N/\partial EPS$ will be larger in absolute value if negative (or smaller if positive) for a college that

places greater reliance on students for revenue (larger k). More size is sacrificed by the institution that relies more heavily on students for revenue for equal increases in EPS. As shown in Figure 5, the institution that charges a tuition rate that covers a greater proportion of its per student expenditure (larger k), will have a lower EPS than the IHL of equal size that receives greater government and private gift support. The frontiers illustrate that an IHL with the greater K value and the lower frontier would have an EPS of EPS1 at a size of Pri1 while an equal size IHL with the lower k, and a frontier which lies to the right of the other institution's, could have an EPS of EPS2.

This analysis implies that two institutions with similar demand conditions, differing only in sources of revenue, will have different EPS-size frontiers as shown in Figure 5. The administrators of an IHL which relies more heavily on the student as a source of revenue will face a tradeoff frontier that lies inside of and has a lower slope than that faced by the administrators of an IHL that obtains a greater proportion of its revenue from non-students. These differences in the constraints that the administrators face suggest a difference in IHL behavior. IHLs of equal size and demand conditions but alternative sources of revenue will have different EPS, the institution receiving greater non-student revenues as a percentage of the institutions total revenues will have greater EPS.

The following chapter will develop the methodology that will be employed to test the implications of the model. The data sources and sampling procedures used will also be explained.

# CHAPTER IV

## THE HYPOTHESES

The Prestige Maximization model of IHLs presented above suggests that systematic differences between private and public colleges exist because of the differences in their sources of revenue. The hypothesis to be tested was developed in the previous chapter and stated that IHLs of equal size and demand conditions will have different EPS depending upon the sources of revenue for the institution. This hypothesis will be tested by employing multiple regression techniques to estimate an expenditure per student, or average cost, function for different samples of institutions of higher learning.

The variables assumed to have an influence on an IHL's EPS are the size of the institution, the institutions adminissions standards, differences in the institution's sources of revenue, the per capita income of the state where the IHL is located, and the onwership (public or private) of the institution. Variations in these determinants are expected to alter the constraints that the administrators of the institutions face, and such alterations will be reflected in the administrators' choices and the institutions' behavior.

The model presented in Chapter III suggests that, ceteris paribus, larger institutions will have lower EPS. After controlling for other determinants of EPS, an inverse relationship between EPS and enrollment is expected.

The selectivity of an institution in its admissions policies is expected to affect an institution's EPS; however, the impact that differences in admissions standards and the quality of an IHL's student body have on an institution's EPS-size frontier is uncertain. A change in the quality of an IHL's student body brought about by a change in admissions standards could either increase or decrease the demand for the institution's services. More stringent admissions standards could shift an IHL's EPS-size frontier inward because of the reduction in demand associated with these higher admissions standards. In this case there would be an inverse relationship between EPS and admissions standards, ceteris paribus. While the more stringent admissions policies would reduce demand, the greater student quality associated with the higher standards could be expected to increase the demand for the IHL's services. If this effect were to outweigh that of the more stringent admissions policies, the institutions EPS-size frontier would shift outward and greater ESP would be associated with any enrollment level. As specific institutional data measuring admissions standards could not be obtained, no admissions policy or student quality variable will be included in the estimation of the EPS functions. A discussion of the biases that this omission could introduce into the results is included in the following chapter.

As shown in Chapter III, the revenue sources for an IHL may have a great impact on EPS. The ease with which an IHL can obtain funds from parties other than students will affect the IHL's ability to attain large size (by keeping tuition low) and maintain high quality education (via high EPS). The more government and private grant and gift revenues an IHL receives, the greater the institution's ability to

increase EPS without a loss of students. The greater the proportion of total revenues that the institution obtains from non-students, the greater the institution's EPS, ceteris paribus. The expected relationship between an institution's non-student revenues as a percentage of total IHL revenues and EPS is positive.

Per capita income will affect EPS as income is the most important determinant of the ability of students (or their families) and taxpayers to pay for higher education. Higher per capita personal income is expected to have a positive influence on EPS. Higher per capita income will also increase the ability of the state government to levy taxes for the purpose of funding education, thus having a positive influence on EPS. Higher personal income will also increase private gifts and grants to institutions of higher learning.

IHL behavior is expected to be influenced by the objectives of and the constraints faced by the administrators of the institution. There are no reasons to expect differences in the overall objectives of the administrators of private IHLs compared with those of public institutions; however, the difference in the ownership of the institutions is expected to affect the constraints faced by administrators. The behavior of the administrators of private and public IHLs is expected to differ as a result of these differences in constraints.

The theory of property rights and related empirical work suggest that the difference that exists between the degree of separation of the owners and the manager-administrators of institutions will have an impact on the relative behavior of private and public IHLs (Furubotn and Pejovich (14), Davies (12), Newhouse (27), Clarkson (9)). In the case of the state supported (public) IHL, the owners of the

institution (taxpayers) have no rights to any benefits or residual income created by efficient operation of the institution that their tax dollars support. Taxpayers will receive no benefits from any increased value of the institution. The taxpaying owners of the public IHLs are completely removed from the management of these institutions. The managers of a public institution have a relatively free hand in the purchase of and use of the inputs in the education production process as the owners of the institution would not be expected to engage in any monitoring of management. Managers are assumed to engage in the pursuit of pecuniary and non-pecuniary sources of utility to a greater extent than would the managers of a privately-owned institution.

The owners of private IHLs are less removed from the managers-administrators of the institution and therefore face lower monitoring costs. These owners also have private property rights over the institution and will benefit by engaging in the monitoring of management as the rewards from efficient operation are capitalized in the value of the institution. For these reasons, the managers of the private IHL are expected to face more stringent constraints over the use of inputs. The managers of the private institutions are not as free to use school resources to increase their utility as are the administrators of public institutions. Public institutions are therefore expected to have greater EPS, ceteris paribus, than private institutions as the managers of private IHLs are, to a greater extent, constrained to use school resources in a manner more consistent with efficient operation.

The existence of these relationships is an empirical question. The implications of the model, as described above, were tested by

using regression techniques to estimate a linear specification of the general function

$$EPS = f(\text{Enrollment, Type of Ownership, Non-student Revenue as a Percentage of Total IHL Revenue, Per Capita Income}) \quad (5)$$

The relationships between the independent variables and EPS are assumed to be linear such that standard multiple regression can be used.

The sign and significance of the revenue variable provides a test of the most important implication of the model developed in the third chapter; namely, that the relationship between the percentage of an IHL's total revenues that are obtained from non-students and the institutions EPS is positive. If the non-student revenue variable has a significant and positive coefficient, the hypothesis based on the model cannot be rejected. This result would imply that non-student sources of an IHL's revenues provide the administrators of the institution with the opportunity to use more resources per student than they could in the absence of non-student sources of revenue. This outcome would contradict the stereotype that private schools are of greater "quality" than public IHLs. It is true that the average EPS for private schools is greater than that of state supported IHLs but this may be due to the fact that the average private IHL is smaller than the public IHL and cannot take advantage of the economies associated with larger size. It is also possible that the administrators of private IHLs place more emphasis on the EPS component of prestige and obtain a prestige maximizing combination of EPS and size at a point farther to the northwest on their EPS-size frontier. The Prestige Maximization

Model is consistent with an observed high EPS at private schools, given that these schools are generally much smaller than their public counterparts.

The test of the hypothesis that property rights arrangements will affect the constraints faced by the administrators of IHLs and, therefore, influence IHL behavior as reflected in EPS is accomplished by testing the sign and significance of the type of ownership variable. The type of ownership variable is a non-continuous dummy variable with a value of one if the observation is from a private school and zero if from a state supported IHL. If the coefficient of this dummy variable is found to be significantly different than zero, the hypothesis that private and public IHLs have different EPS cannot be rejected. If the coefficient is significant and negative, the hypothesis suggested by the theory concerning the effect of property rights on enterprise performance cannot be rejected. A statistically significant and negative type of ownership dummy variable will provide evidence that private IHLs, because of the more stringent constraints placed on managers (administrators) by owners that have property rights in the private institutions, have lower EPS or average costs. This result would be consistent with previous findings on the effect of differences in property rights.

Data for the estimation of the EPS function were obtained from a Department of Education data tape. The tape contains information from the Higher Education General Information Survey (HEGIS XI) which includes financial and enrollment statistics for a large number of private and public IHLs of many types. In addition to differences in IHLs based on the factors discussed in the previous chapter, there are important differences in the types of programs available, the level of

degree offerings, and the emphasis placed on vocational versus liberal education and research. The institutions in the HEGIS data file are classified by the National Center for Education Statistics according to such differences in institutional program content, emphasis, and level of degree offerings. These classifications are used in this study to partition the samples of institutions to obtain greater homogeneity for the estimation of the EPS functions.

The model as developed in the previous chapter suggests that the EPS at an institution would be affected by the institution's admissions standards. Although no information was available concerning any differences between student body characteristics at different types of institutions as classified by the NCES, studies have been done suggesting that private IHLs may attract and enroll more able students than do public colleges and universities.

Anderson (1) used data from the 1964-65 and 1972-73 National Merit Scholarship Qualifying Tests to construct an index of an institution's attractiveness to able student. An able student was defined as a high school junior that scored among the top one-third of the students taking the test. The attractiveness index was computed as the number of able students that selected an IHL in either year, divided by the number of entering freshmen for that year. After comparing these indices for private and public colleges and universities, Anderson concluded that the average private IHL was more attractive to able students than the average public school in both years, but the gap between the attractiveness of the two types of schools was narrowed.

Lehr and Newton (21) found evidence that freshmen at private IHLs have higher high school GPSa than do the entering classes at public

institutions. Student profiles were constructed for different types of IHLs using linear discriminant analysis with data from the Oregon Student Resource Survey of a random sample of 2,100 students attending the state's two and four-year institutions. The discriminant function coefficients for the three classes of IHLs indicated that private four-year colleges were more likely to enroll students with greater high school GPAs and higher family income than the two-year or four-year public colleges.

A positive relationship between student ability and family income was detected in a study of the distributional aspects of enrollments in higher education by Corazzini, Dugan, and Grabowski (11). Data from a 10 percent sample of the high school senior taking the SAT by December of 1969 indicated a strong positive relationship between family income and the students score on the verbal section of the SAT. The 3,200 students in the sample were classified according to income quartile, and the percentage of the students in each of these quartiles that scored between 200 and 400, 400 and 600, and 600 to 800 on the SAT was calculated. While only 6.8 percent of the students in the lowest income quartile scored in the 600 to 800 range on the SAT, 24.1 percent of the students in the highest income group scored in that SAT range. Almost one third (30 percent) of the students in the lowest income quartile scored in the lowest range of the SAT, but only 15 percent of the most well-to-do students scored in this range. This income-SAT relationship provides an alternative explanation for the apparent "preference" that high ability students have for private IHLs. Higher income families can more easily afford to send their children to the more expensive private IHLs, and the students from these affluent

households are generally of greater ability as measured by college entrance exam scores.

These studies suggest that scholastic differences do exist between the student populations at private and public institutions. Unfortunately, no studies could be found concerning student quality differences that may exist between the other classifications of institutions that are used by the NCES and employed in this study. The only operational measures of student characteristics or admissions standards that could be found were minimum entrance exam requirements such as minimum scores on the ACT and SAT exams, and GPA requirements for admission to an institution. The ideal study would include an index of the average SAT or ACT score for the entering freshman class. These data are needed on an institution-by-institution basis, and the testing agencies will not provide this information for individual institutions. For this reason, a student quality or admissions standards variable is not included in the estimation of the EPS functions. These admissions differences, it is hoped, will be somewhat accounted for by the partitioning of the data samples by the NCES classifications discussed above.

A linear specification of equation (5) was estimated with cross sectional samples for the DOE financial and enrollment data file. The survey data are for the 1977-78 academic year. The financial statistics used to measure the variables included in the EPS function, the partitioned samples used, and the results of the estimation of the EPS functions for the different samples are discussed in the following chapter.

# CHAPTER V

## STATISTICAL RESULTS

Data for the estimation of the EPS function were obtained from the Department of Education on a tape that includes financial and enrollment data for over 3,000 institutions of higher learning. Samples were drawn from four different NCES classifications of institutions: comprehensive institutions, general baccalaureate institutions, multiprogram two-year institutions, and doctoral level institutions. Attempts were made to draw additional samples from other NCES classifications, such as specialized institutions (includes schools of religion and theology, medical schools, engineering schools, and business and management schools), but the number of observations in the samples were either too small for meaningful statistical analysis or there were too few private or public school observations to allow for comparisons between institutions on the basis of differences in type of ownership.

The NCES classifies IHLs according to the number of degrees granted and the types of programs offered during the academic year in question. These classifications are assigned on the basis of the degree data that the institutions provide to the NCES on the "Degrees Conferred" portion of the HEGIS survey. IHLs are partitioned using these NCES classifications in this study for two reasons. First, IHLs are so heterogeneous in program offerings and degree emphasis that partitioning of the samples is necessary to control for the variety of IHL product

characteristics. Differences in academic programs will obviously affect an IHL's expenditures per student. Second, evidence exists which suggests that student quality may differ between different types of institutions (Anderson (1), Corazzini et al. (11), Lehr and Newton (21)). The model developed in Chapter III suggests that student characteristics may influence EPS.

IHLs that are included in the NCES classification "Comprehensive Institutions" are institutions that offer a number of different post-baccalaureate programs but are not heavily involved in doctoral granting programs. This category contains institutions that grant fewer than 30 doctoral degrees per year or offer fewer than three doctoral programs while granting at least 30 post-baccalaureate (masters) degrees. These IHLs also must have an inter-disciplinary program at the post-baccalaureate level or grant degrees in three or more post-baccalaureate areas. A sample was drawn from this classification of IHLs with 198 observations including 72 private institutions and 126 public IHLs.

Institutions classified by NCES as "General Baccalaureate Institutions" have programs that are primarily at the undergraduate level. Either 30 or fewer post graduate degrees are offered or less than three post graduate programs are available at these institutions. Degrees are granted in at least three program areas or a program at the under-graduate level in interdisciplinary studies is offered at these IHLs. The sample drawn from this classification has 149 observations, 74 from public and 75 from private institutions.

A third sample was drawn from the NCES classification of "Multiprogram Two-Year Institutions". These institutions are schools that offer degrees or awards in two or more program areas with 75

percent of these for work below the bachelor's level. Forty-four of the 100 observations from this classification were from private institutions, the remaining 56 being government-owned institutions.

The fourth and last sample was made up of doctoral level institutions which are those institutions that grant a minimum of 30 doctoral-level degrees in three or more different program areas or, alternatively, have an inter-disciplinary program at the doctoral-level. These institutions are further classified by NCES into those with and without medical schools. A sample of 75 IHLs without medical schools was selected, containing 25 private IHLs and 50 public institutions.

The general function that was estimated for each of these four samples is

$$EPS = f(ENROLL, D, k, SPCY) \qquad (6)$$

The ENROLL variable is the full-time graduate and undergraduate enrollment at a specific IHL. The square of the enrollment variable was also included in the estimation of the EPS function to detect any nonlinearity in the relationship between EPS and the size of the institution.

The type of ownership variable, D, is a dummy variable equal to 1 if the observation is from a private institution and set equal to zero otherwise. All institutions in the DOE file were assigned this type of ownership variable.

k is the fraction of the IHLs total revenues that are obtained from non-students; it was calculated by subtracting student tuition and fees (adjusted for monies remitted through scholarships and fellowships) from an institution's total current funds revenues and dividing that difference

by total current funds revenues. Total current funds revenues are the sum of tuition and fees; federal, state and local appropriations, grants and contracts; private gifts, grants and contracts; endowment incomes; sales and services of educational activities, auxiliary enterprises, hospitals and independent operations; and other sources of income. The sum of these revenue sources was provided as a separate variable, total current funds revenues, in each institution's financial record. k could range from 0 to 1; however, all institutions received some revenue from students and non-students alike and no values of 0 or 1 were found. The highest k value calculated was .99 and the lowest value was about 10 percent.

State per capita personal income (SPCY) measures for 1978 were obtained from the July, 1977 issue of The Survey of Current Business. The SPCY variable measures the per capita personal income in thousands of dollars in the state where the IHL is located. Each IHL record on the DOE data tape includes a state variable which was used to match SPCY with the institutions in each state.

The independent variable, expenditure per student (EPS), was calculated by dividing the IHL total current educational and general expenditures by full time undergraduate and graduate enrollment. This expenditure measure includes expenditures for instruction, research, public service, academic support, student services, institutional support, operation and maintenance of plant, and scholarships and fellowships.

Except for the enrollment-EPS relationship, the relationships between the independent variables and EPS were assumed to be linear. The assumption of linearity is necessary so that standard linear

regression techniques can be employed to estimate the relationships between the dependent and independent variables. Nonlinearity in the enrollment-EPS relationship was incorporated into the estimation of the EPS function in the same fashion that was employed by Maynard (26). This is done by including the square of the enrollment variable as an additional independent variable. If the relationship between EPS and enrollment is not linear, the coefficient of this variable will be nonzero. The equation that was estimated is

$$EPS = Bo + B1*ENROLL + B2*ENROLL2 + B3*D + B4*k + B5*SPCY + e \quad (7)$$

where EPS = expenditure per student,

ENROLL = full time enrollment,

ENROLL2 = ENROLL*ENROLL

D = 0 if the observation is from a public IHL, 1 if private,

k = fraction of IHL total revenues obtained from non-students,

SPCY = per capita personal income in state where IHL is located, and

e = random disturbance term with expected value of 0 and constant variance.

The Prestige Maximization Model suggests that specific relationships exist between these independent variables and the dependent variable EPS. Of particular interest is the size, significance, and sign of the regression coefficient B4 which provides an estimate of the partial derivative of EPS with respect to a change in k, the source of revenue variable. The model suggests that $\partial EPS/\partial k > 0$, or that B4 will be positive.

The sign and significance of B3, the coefficient of the type of ownership variable, provides a test of the hypothesis that EPS differs between IHLs that are subject to different types of ownership, private or public. Although the model developed in Chapter III provides little insight into the expected relationship between type of ownership and EPS, economic theory and the related empirical work suggests that a negative coefficient should be anticipated. If this is found to be the case, the empirical evidence would be consistent with the hypothesis that private IHLs, ceteris paribus, are more "cost-effective" than their public counterparts. The value of the estimate of B3 can be interpreted as a measure of the shift in the IHL EPS function due to differences in the type of ownership. B3 is expected to be negative and significant, indicating that lower EPS is associated with private ownership. It needs to be pointed out, however, that there can be other influences of the type of ownership on IHL behavior besides those expected as consequences of different constraints placed on IHL administrators.

Microeconomic theory suggests that B1 and B2, the regression coefficients on the enrollment and the squared enrollment variables, will have negative and positive values respectively. If IHL EPS (or cost) functions are consistent with those suggested by theory, EPS should fall over an initial range where economies of size are present. This result would be reflected in a statistically significant and negative regression coefficient on the ENROLL variable. The existence of diseconomies of size would lead to the EPS function ultimately turning upward at some larger size. The presence of diseconomies of size would be reflected in a significantly positive coefficient for the variable ENROLL2. State by state estimates of cost functions for state

supported institutions by Maynard (26) confirmed the existence of U shaped long-run average cost functions for IHLs and these results are anticipated here.

SPCY is assumed to measure the strength of the private and public demand for higher education services, with greater demand reflected in higher EPS at IHLs located in states with greater per capita personal income. Thus, it is anticipated that the regression coefficient B5 will be significantly greater than zero.

The results from the estimation of the expenditure per student function (6) for the four samples are summarized in Table I. In the first three regression equations, all regression coefficients are of the expected sign except for the type of ownership variable, and all of the regression coefficients are significant at the .05 level or better, except for the parameter associated with ENROLL in the EPS function for doctoral and general baccalaureate institutions. All of the estimated regression equations, save the equation estimated for the two-year institutions, are significant at the one percent level. The equation for the two-year institutions is insignificant, with only one explanatory variable, state per capita personal income, significant at the five percent level.

For all three of the significant EPS functions, evidence of economies of size exists. However, only the EPS function for Comprehensive Institutions indicates the presence of significant diseconomies associated with larger size. B2, the coefficient on the enrollment squared variable, is statistically positive for that class of institutions. The regression coefficients on ENROLL2 for the Doctoral and Baccalaueate functions have the expected positive signs

TABLE I

THE REGRESSION RESULTS

| Sample | Number Obs. | Number Pri. | Number Pub. | ENROLL | ENROLL2 | D | k | SPCY | RSQR | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Doctoral | 75 | 25 | 50 | -.4133<br>(-2.19)a | 7.19 10-6<br>(1.75) | 11,404<br>(7.73)b | 39,426<br>(6.96)b | 1,711<br>(3.66)b | .76 | 46.25 |
| Comprehensive | 198 | 72 | 126 | -1.069<br>(-3.65)b | 4.60 10-5<br>(2.43)a | 2,954<br>(2.41)a | 8,124<br>(3.32)b | 1,583<br>(5.03)b | .27 | 14.49 |
| Baccalaureate | 149 | 75 | 74 | -.747<br>(-2.48)a | 4.85 10-5<br>(1.22) | 1,645<br>(3.22)b | 5,960<br>(4.84)b | 939<br>(5.76)b | .32 | 13.65 |
| Two-Year | 100 | 44 | 56 | -.876<br>(-1.54) | 6.81 10-5<br>(.97) | -427<br>(-.35) | 509<br>(.21) | 630<br>(2.04)a | .06 | 1.22 |

Note: t statistics are in parentheses; a = significant at .05 level; b = significant at .01 level.

but are not significant at the .05 level. Not only does the EPS function for Comprehensive Universities suggest significant diseconomies, but it also exhibits the greatest initial cost savings due to size economies as enrollment increases from low levels. B1 for the Comprehensive Institutions is larger in absolute value (1.069) than the coefficients for either Doctoral (.4133) or Baccalaureate (.767) cost functions.

These results are consistent with Maynard's (26) findings of size economies, but they do not confirm the slight diseconomies associated with very large enrollments except in the case of the Comprehensive Universities. Maynard found that minimum per-student costs were obtained at an enrollment level of 5,300 students for the four-year state supported IHLs in his sample. The results of the estimation of the EPS function for private and public Comprehensive Universities suggest that minimum EPS is not achieved until enrollment reaches 11,000.

In the three significant regression equations, the coefficients on the type of ownership variable are significant and positive. These results do not support the hypothesis that private IHLs have lower EPS after controlling for size and other differences. The significant and positive value of the B3 coefficients suggest that private IHLs have higher costs per student than do their public counterparts. The values of B3: 11,404, 2,954, and 1,645 measure the upward shift in the EPS functions associated with private ownership of Doctoral, Comprehensive, and Baccalaureate institutions respectively. The results suggest that an average private doctoral institution has expenditures per student that are approximately $11,000 greater than the EPS at a state supported doctoral institution. The cost differences are not so startling at the

Comprehensive and Baccalaureate institutions, only approximately $3,000 and $1,600, respectively.

The major hypothesis offered by the Prestige Maximization Model is that EPS is influenced by the sources of revenue available to an IHL. Specifically, institutions that receive more financial support from non-students are expected to have greater EPS or costs per student. The estimates of the EPS functions provide a test of this hypothesis. The regression coefficient on k, the fraction of total IHL current fund revenue that is obtained from non-students, is expected to be greater than zero, and the regression results confirmed this. The estimate of B4 in all four regression equations is positive, and in the three significant equations the estimates of B4 are significant at the .01 level. The B4 values provide an estimate of the increase in per student cost associated with a one unit increase in k. A one unit increase in k, however, implies the comparison of an IHL that receives absolutely no revenues from non-students with an institution that is totally dependent on public and private gifts and grants for current fund revenues. A more intuitive interpretation of B4 is obtained by dividing these estimates by 100, which provides an estimate of the increase in EPS related to a one percent increase in k. Ceteris paribus, a one percent increase in IHL reliance on non-students for revenues raises EPS by 394, 81, and 60 dollars at doctoral, comprehensive, and baccalaureate institutions, respectively. These results are consistent with the hypothesis suggested by the model, that non-student sources of revenue cause the EPS-size frontier that IHL administrators face to shift outward, thus allowing greater EPS for an IHL of a given size.

The hypothesis that a positive relationship exists between state per capita personal income and EPS is also supported by the regression results. A positive and statistically significant coefficient on SPCY was found for each of the four regression equations estimated, three of which are significant at the .01 level. The B5 parameter in the estimated EPS function for the sample of two-year institutions was significant at the .05 level. This coefficient provides an estimate of the increase in EPS associated with a $1,000 increase in per capita personal income in the state where the IHL is located. A $1,000 increase in SPCY is associated with a $1,700, $1,600, $900, and $600 increase in EPS for doctoral, comprehensive, baccalaureate, or two-year institution, respectively.

These results are consistent, of course, with the accepted proposition that higher education is a normal good. The doctoral and comprehensive institutions show larger increases in spending per student with greater SPCY than do the generally smaller baccalaureate and two-year institutions.

Before the results of the three "good" EPS function estimates are accepted without qualification, some likely problems associated with the estimation of these functions, and the interpretation of the results need to be discussed. Some of the common problems encountered with this type of microeconometric analysis, such as multicollinearity, heteroscedasticity, and model misspecification, are considered below.

The regression results for three of the four samples of IHLs are consistent with the implications of the Prestige Maximization Model developed in Chapter III, however, one should explain the poor performance of the model in describing the behavior of the two-year

institutions. The empirical evidence obtained from the estimation of the EPS equation for the sample of two-year institutions does not support the implications of the model. Two-year institutions are predominantly community colleges, and it seems reasonable to argue that they may be more concerned with financial survival than they are with the size and quality factors that are emphasized in the model developed here. In any event, the Prestige Maximization Model must be rejected as an adequate explanation of the behavior of this special class of institutions.

Multicollinearity can create a situation where an estimated regression equation has a high R-square, indicating that the equation explains a large proportion of the variance of the dependent variable, while none or few of the explanatory variables in the equation are significant. This is caused by the high standard errors for the regression parameters of the variables that are correlated with one another (Pindyck and Rubinfeld (29)). Although the regression results themselves do not indicate a multicollinearity problem, there is reason to suspect correlation between some of the independent variables used in the EPS function estimation. One would expect a strong correlation between the type of ownership variable, D, and the revenue source variable, k, as private schools tend to place greater reliance on students for revenues than do state supported institutions. Greater values of D (one as opposed to zero) should be associated with lower k values. It is also likely that larger institutions rely to a greater extent on non-student revenue sources than would small institutions so a positive correlation between ENROLL and k is anticipated.

Least squares estimates of the function k = Ao + A1*D + A2*ENROLL confirms the existence of multicollinearity. D and ENROLL were found to be significantly related to k with $R^2$s of .41 and .75 for the sample data for the doctoral and comprehensive institutions, respectively. In both cases, D was significantly inversely related to k with t statistics of -6.61 and -17.7. Enrollment was inversely related to k in the doctoral sample data (t = -2.72) but for the comprehensive institutions, it was positively correlated to k (t = 2.67). Multicollinearity was also detected in the independent variables from the sample of baccalaureate institutions with D and SPCY being inversely related to k with t statistics of -11.7 and -4.17 respectively and a $R^2$ of .61.

When independent variables move together, it becomes difficult to estimate and interpret the regression coefficients. Regression coefficients are estimates of partial derivatives which are the effects of a one unit change of an independent variable on the dependent variable with all other explanatory variables held constant. When regression coefficients are estimated with independent variables that tend to move together, there may remain little data in the sample with which to accurately estimate the effect that a single independent variable has when others are not changing (Pindyck and Rubinfeld (29)). When strong multicollinearity exists, caution is necessary in interpreting regression results. In the author's judgment, multicollinearity was not a fatal problem in this analysis as the correlated independent variables were still highly significant. Severe multicollinearity is usually indicated by a high $R^2$ along with no or few independently

significant variables (Pindyck and Rubinfeld (29)). This was not the case with the regression estimates of the EPS functions.

Another modeling problem that is usually associated with cross sectional studies is heteroscedasticity. A necessary condition for the efficient (least variance) estimation of regression coefficients is that the disturbance term in the regression equation is homoscedastic, or has a constant variance. The ordinary least squares estimates of the regression coefficients are still unbiased in the presence of heteroscedasticity, but the estimated variances of the coefficients will be biased (Pindyck and Rubinfeld (29)).

Constant error variances may be an unreasonable assumption in a cross sectional expenditure study such as this. Consider cross-sectional studies of industry sales or family spending patterns. It seems reasonable to suspect greater volatility in sales and spending for larger firms and higher income households, respectively. In the same fashion, it may be reasonable to suspect that the variance of the error term for smaller IHLs is less than the error variance for larger institutions. This type of error variance behavior can be quite common in family budget or industrial cross sectional studies (Pindyck and Rubinfeld (29)), so as a precaution, a test for heteroscedasticity was performed.

Correcting for heteroscedasticity is very simple if the error variances are known. Weighted least squares, employing the known standard deviation of the error terms to weight each observation, results in a transformed error term with a constant variance, and estimation of the model with the transformed variables provides unbiased and efficient estimates of the regression coefficients and their

variances. Unfortunately, the error variances are not known and assumptions must be made about the true characteristics of the disturbance terms.

It is assumed that the error variances in the EPS equation are related to the size of the institution in question such that the variance of the error term is equal to some constant, C, times the square of IHL enrollment. This type of error distribution can be detected with the Goldfeld-Quandt test (29, 15) for heteroscedasticity. This test was performed for each of the significant regression equations. The data for each sample was sorted from smallest to largest by enrollment and divided into two equal sized subsamples, one with the smaller IHLs and the other containing the larger institutions.

Equation (7) was then estimated for the large and small institutions separately, and the F statistic, ESS1/ESSs, was calculated. ESS1 and ESSs are the error sum squares for the regression equations estimated with the partitioned samples. If this test statistic, with degrees of freedom in the numerator and denominator equal to the degrees of freedom for the partitioned samples, has a value in excess of the critical value of F at the .05 level of significance, then the hypothesis that the error terms have constant variance must be rejected. A large calculated F statistic indicates that the error variance for the equation estimated for the larger IHLs is greater than that for the smaller IHLs. An F statistic in excess of the critical value implies that these error variance differences are statistically significant and heteroscedasticity is present. In none of the tests were the calculated F statistics greater than the critical F value so the hypothesis that the error variance is positively related to the size of the IHL was rejected.

A final complication that should be kept in mind when interpreting the results of the estimates of the IHL EPS functions is that of specification error. It is assumed in any regression analysis that the underlying model has been correctly specified. This assumption allows the researcher to accept the resulting estimates of the regression coefficients as unbiased and consistent estimates of the true model parameters. If, however, relevant variables have been omitted or irrelevant variables have been included in the analysis, the subsequent parameter estimates may be biased in the case of omitted variables or inefficient in the case of included irrelevant variables (29).

It is unlikely that any irrelevant variables were included in the estimated EPS functions (except, of course, for the two-year institution's EPS equation) as the independent variables were generally significant. Inefficiency, where the estimates of the variances are larger than their true variances, is probably not a problem.

Unfortunately, the bias associated with the omission of relevant explanatory variables might be present, as a variable that the model developed in Chapter III suggested as being important was not directly included in the EPS function estimation due to a lack of data. A measure of student quality was not available on an institution by institution basis so this variable was omitted. It was assumed that the partitioning of the data into NCES classifications would account for any student quality differences, but this may have been an unreasonable assumption.

If the omitted variable is correlated with any of the independent variables in the model, a bias may be introduced into the estimation of the remaining variables. For example, assume that the omitted

variable, a measure of student quality, is positively correlated with the type of ownership variable, D. As D changes from zero to one for public and private institutions respectively, student quality also varies, greater student quality being associated with private IHLs (by assumption). Assume that the relevant but omitted student quality variable is inversely related to EPS. The presence of an additional effect on EPS as D changes from zero to one biases the estimate of the regression parameter on D. The estimated coefficient on D would be measuring two effects on EPS, the greater EPS due to private onwership and the lower EPS due to greater student quality which moves with D. This would bias the estimate of the coefficient on D downward.

Since the relationship between the omitted student quality variable and the dependent variable, EPS, is uncertain, it is impossible to estimate the bias that may be present in the parameter estimates. Studies do suggest that a relationship exists between student quality and type of ownership (Anderson (1), Corazzini et al. (11), Lehr and Newton (21)), but without knowledge about the way that the omitted variable affects EPS, the direction of the bias is unknown. It is always possible that the omitted variable is not correlated with any of the included independent variables in which case no bias is introduced.

Econometric problems aside, one can draw the conclusion that the Prestige Maximization Model developed in Chapter III is supported by the empirical evidence provided in this chapter. All of the anticipated relationships between the independent variables and EPS suggested by the model were confirmed. The main hypothesis that EPS is positively influenced by non-student sources of revenue cannot be rejected. The

only hypothesis that is inconsistent with the evidence provided in this chapter is that of a negative impact of private ownership on IHL expenditure per student. This erroneous prediction, however, was not made on the basis of the model developed here but instead was suggested by the theory and empirical studies of the effect of different property rights arrangements on industry behavior.

# CHAPTER VI

## SUMMARY AND CONCLUSION

The purpose of this research was to develop and test a micro-economic model of institutions of higher learning (IHLs). The introductory chapter discussed the size and importance of the education industry. Although higher education is a source of economic growth and provides human capital investment that may help alleviate poverty by enhancing earning power, little is known about the allocative and technical efficiency aspects of the industry.

IHL cost studies and theoretical and empirical work on non-profit and publicly owned institutions were reviewed in Chapter II. The model that was developed in Chapter III is similar to a model of non-profit hospital behavior developed by Newhouse (27). In his model, Newhouse stressed hospital size, in terms of the number of patients served, and service quality, measured by per patient expenditures, as two important components of a hospital administrator's utility function. The administrator is assumed to pick, subject to the constraints that he faces, a combination of size and quality that maximizes his utility.

In Chapter III, Newhouse's model was extended to apply to IHLs. The model was modified to include a third factor, the quality of an IHL's student body, as an additional component of an IHL administrator's objective function. An administrator is expected to pursue combinations of instructional quality, as indicated by expenditure per student (EPS),

institutional size (enrollment), and student quality that maximize the administrator's utility. The combinations of these IHL characteristics that the administrator chooses will depend on the tradeoffs between these components of his utility function and his marginal rates of substitution between EPS, size, and student quality.

The hypothesis that was developed and tested in this research concerns the effect that different sources of IHL revenue have on IHL behavior. The Prestige Maximization Model suggested that IHL behavior, as measured by EPS, will differ between IHLs with different sources of revenue. It was demonstrated in Chapter III that the administrator of an institution that obtained a greater proportion of its total revenue from students would have an EPS-size frontier which lies inside that for an administrator of an IHL that gets a greater part of its revenue from non-students, ceteris paribus. Thus, the IHL that relies to a greater extent on students for revenue is expected to have lower EPS that an IHL of equal size which receives greater non-student revenue support.

The hypothesis that revenue sources will affect IHL behavior, as measured by EPS, was tested by estimating an EPS function using cross-sectional data on different classifications of IHLs. These data were obtained from the United States Department of Education. Four samples of IHL financial and enrollment data were drawn for IHLs classified by the NCES as doctoral, comprehensive, baccalaureate, and two-year institutions. Linear regression analysis was employed to estimate an EPS function for each of these four types of IHLs.

Three of the four regression equations were significant. An F test for the significance of the equation estimated for the two-year

institutions indicated that the independent variables were collectively not significantly different from zero. The regression equations for doctoral, comprehensive, and baccalaureate institutions were significant at the .05 level. In each of the three significant regression equations, the hypothesis that revenue sources will affect IHL behavior could not be rejected as a significant positive relationship between non-student revenue as a proportion of total revenue and EPS was found. The results are consistent with the implication of the Prestige Maximization Model that a greater ratio of non-student revenues to total IHL revenues will be associated with greater expenditures per student.

The results were consistent with previous studies (26, 6) of IHL costs as the estimated regression equations provided evidence that economies of size exist in the production of higher education at doctoral, comprehensive, and baccalaureate institutions. Slight diseconomies of size were found for comprehensive IHLs. The analysis contradicted previous theoretical and empirical work (Davies (12), Furubotn and Pejovich (14), Lee (20), Clarkson (9), Niskanen (28), Newhouse (27)) that has been done on the effects that different property rights arrangements have on firm behavior. A significant positive relationship between private ownership of an IHL and EPS was detected.

Although the statistical results were consistent with the implications of the Prestige Maximization Model, there is reason to suspect that these results may have been biased due to the omission of a relevant explanatory variable. The model suggested that student quality would have an impact on EPS, but due to a lack of operational data the EPS functions were estimated without a student quality

variable. To the extent that this omitted variable was correlated with any of the other explanatory variables in the regression equation, the estimates of the regression coefficients on these variables were biased. The direction of this bias is unknown as the relationship between the omitted student quality variable and EPS is uncertain.

The results suggested that either other relevant explanatory variables are missing from the model or that the relationships between the dependent and explanatory variables are not linear. The low $R^2$s, .27 and .32 for the equations estimated for comprehensive and baccalaureate IHLs respectively, indicated that the explanatory variables only explained about one-third of the variance of the dependent variable. The assumption of linear relationships between EPS and the independent variables could be incorrect, thus leaving a large proportion of the variance in EPS unaccounted for.

There could be many other factors that were not included in the model that have an influence on IHL expenditures per student. Differences in technical efficiency between different IHLs that produce the same "quality" of service would allow the more efficient institution to operate with lower EPS. Since higher education is not a perfectly competitive industry, the lack of "do-or-die" competition can allow technically inefficient IHLs to survive. This, combined with the lack of knowledge about the most efficient method of producing education, implies the existence of different input mixes, and therefore different costs per student, at different IHLs. Measures of the qualitative aspects of IHL outputs and inputs are necessary before these sources of differences in EPS can be evaluated. Future improvements in the identification and measurement of higher education

inputs and outputs will provide the information needed for better estimation of the sources of differences in IHL behavior.

The Prestige Maximization Model developed and tested here provides theoretical support and empirical evidence suggesting that differences in sources of revenue play an important role in determining IHL behavior. As government policy can have a strong impact on the means of funding IHLs, policy can be used to alter IHL behavior with respect to per student resource expenditure. If it is determined that greater or fewer resources per student should be consumed in the higher education industry, public policy can be devised to influence this resource use by controlling the availability and use of taxpayer dollars and the tax treatment of private gifts to IHLs. Greater EPS can be obtained by increasing the taxpayer funding of colleges and universities and by liberalizing the tax treatment of private gifts to higher education. Lower EPS could be achieved by implimenting policies that require students and their families to pay a greater proportion of their college costs. Additional research is needed before the appropriate policy line can be ascertained.

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VITA

Steve Dalton Mullins

Candidate for the Degree of

Doctor of Philosophy

Thesis: A PRESTIGE MAXIMIZATION MODEL OF INSTITUTIONS OF HIGHER LEARNING

Major Field: Economics

Biographical:

Personal Data: Born in Honolulu, Hawaii, June 15, 1955, the son of Col. and Mrs. James A. Mullins.

Education: Graduated from Jones High School, Jones, Oklahoma, in May, 1973; received the Bachelor of Science degree from Oklahoma State University in May, 1977; received the Master of Science degree from Oklahoma State University in May, 1980; completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in July, 1983.

Professional Experience: Graduate assistant, Oklahoma State University, College of Business Administration, 1977-1979; Graduate instructor, Oklahoma State University, College of Business Administration, 1979-1982; Economics instructor, Texas Lutheran College, summers of 1980-1982; Assistant Professor of Economics, Drury College, Breech School of Business Administration and Economics, 1982-1983.