EFFECTS AND CONSEQUENCES OF ORGANIZATIONAL SIZE: A STUDY OF LAND-GRANT INSTITUTIONS

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ABSTRACT

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This study examines the role of organizational size in comparative organizational research. Using data on 65 land-grant colleges and universities, multivariate statistical techniques are employed to explore how size affects the relations between organizations and their environment, organizational efficiency, and variations in organizational structure. The study shows that size of land-grant institutions influences their enrollment patterns and growth, determines the degree to which they are dependent on particular resource providers, affects efficiency in service provision, and is an important predictor of variations in personnel compositions. Yet despite the seemingly ubiquitous effects of organizational size, it is argued that size is not a theoretically meaningful variable. Rather, it is a contextual variable that masks changes in technological and environmental factors that are inextricably bound up with changes in organizational size.

In addition to the exploration of effects and consequences of organizational size in general, the study also provides evidence for the existence of economies of scale in land-grant institutions challenging the assumption that public, non-profit institutions are inherently inefficient.

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INTRODUCTION

Organizational size has become a central variable of comparative organizational research (Hall, 1972; Scott, 1975). Even when researchers do not assign it any causal status, it is customarily included as a correlate of other variables that may be deemed more important, such as complexity, structural differentiation, or technology employed (Kimberly, 1976). Relations between organizations and their environments and, in particular, patterns of resource dependency, are also thought to vary with organizational size (Pfeffer & Salancik, 1978). Examining data on 65 land-grant colleges and universities, this study will attempt to throw some light on the importance of organizational size in different contexts: size and the interaction between organizations and their environments, size and organizational efficiency, size and variations in organizational structure. Organizational size will be treated as dependent and independent variable in order to highlight both its relationship to the organizational environment and internal organizational structure.

But while organizational size will be at the center of this investigation, it will also be argued that a satisfactory account as to why it plays such a prominent role must make reference to technological and environmental factors that are inextricably bound up with variations in organizational size.

CHAPTER I

A. THEORETICAL CONSIDERATIONS

1. Organizational Research on Size, Technology, and Environment

Recent research on determinants and consequences of organizational structure has primarily focused on three major factors. A first group of studies treats size of an organization as its most important characteristic (Blau & Schoenherr, 1971; Blau, 1973; Child & Mansfield, 1972; Pugh et al., 1968 and 1969) elevating this variable to a causal antecedent of most other organizational characteristics. In particular, structural attributes of organizations such as differentiation into subunits, specialization of tasks, average span of control of supervisors, number of hierarchical levels or proportionate size of the administrative component are all seen as depending directly or indirectly on variations in size. One limitation of this approach is that organizational size is rarely treated as a dependent variable. Consequently, this literature has little to say about why organizations grow, decline or remain stable in size, a shortcoming, that also affects the analysis of impacts of organizational size (Ford, 1980a; Ford, 1980b).

An alternative perspective sought to demonstrate that the technology employed by an organization influences its internal structure and work procedures (Woodward, 1965; Rushing, 1968; Perrow, 1965; Thompson, 1967). Authors espousing this view tend to think of organizational

structure as an instrument to cope with various technological contingencies that are considered as given. That is to say, they see organizations adapting to technology rather than technology to organizations. As in the case of theorists that stress the causal importance of organizational size, researchers who put primary emphasis on technology rarely treat it as a variable to be explained. Specifically, they neglect to ask what factors make for the selection of one or the other technology by an organization. Yet it is likely that organizational size plays an important role in the adoption and assimilation of technologies by organizations.

The controversy as to which factor has precedence in explaining structural variations in organizations has never been satisfactorily resolved (Aldrich, 1972; Scott, 1975; Scott, 1981). Instead, interest of organizational researchers gradually shifted away from focusing on internal structural attributes to include interorganizational relations and variations in environmental characteristics as new and/or additional determinants of organizational structure (Thompson, 1967; Pfeffer & Salancik, 1978; Aldrich, 1979; Aldrich and Whetten, 1981). Starting from the (somewhat trivial) assumption that all organizations depend on resources supplied by their environments in order to survive, the environmental perspective emphasizes that certain structural configurations within an organization are better or worse adapted to the efficient exploitation of a given environment. One part of this research tradition stresses the selective power of environments (Hannan & Freeman, 1977; Aldrich, 1979), another part mainly focuses on the strategic choices available to organizations (Child, 1972; Pfeffer &

Salancik, 1978). To some degree, however, emphasis on choice of organizational decision-makers loosens the link between environmental characteristics and organizational structure. After all, if organizations are considered to have choices (Astley & Van de Ven, 1983) this may also include the choice as to which part of the environment they want to depend on most.

It may not be necessary to choose between these three major perspectives in organizational research. Indeed, they can be seen as complementing each other rather than being mutually exclusive. However, it would surely be nice if one could say something about the relative importance of size, technology, or environment in molding organizational structure. Part of the reason why theoretical arguments about causes (and effects) of structural characteristics of organizations are hard to settle is that operationalizations and measurements of concepts vary from study to study. Yet it is difficult to see how they could be standardized, given the enormous variety of organizational forms. For example, commonly used measures of size for business firms, such as sales volume and assets (Bain, 1968; Scherer, 1980), have no meaningful counterpart in most human service organizations. Measures of size used in research on colleges and universities such as enrollment and number of employees (Blau, 1973; Verry & Davies, 1976) are often not applicable to business firms. (The main reason, why number of employees is of limited usefulness in research on business firms, is that capital/labor ratios or the degree to which firms utilize machinery in the production process vary widely between industries.) Incidentally, when a particular size measure has different meanings for different organizational

types, one can expect that size effects are not consistant across organizational types (Hall, Haas & Johnson; 1967). Compared to size, technology is even more elusive a concept. If it is defined in terms of particular pieces of hardware employed by an organization, one encounters the problem that very few organizations are dominated by one particular technology throughout their subunits (Woodward 1965; Scott, 1975). But if technology is defined in a broader sense, it is no longer conceptually and empirically distinct from many aspects of organizational structure. Finally, typologies of environments (Emery & Trist, 1965; Jurkovich, 1974) suffer from excessive generality. Not surprisingly, operationalizations and measurements of variables differ from study to study.

What these problems suggest is that, at the moment, it seems advisable to narrow down the range of problems to some manageable scope by concentrating on particular classes of organizations that share a number of characteristics in common. It is true that such an approach excludes the investigation of a number of interesting problems relating precisely to the variables held constant. It is also true that any general theory of organizations will, at best, find only partial confirmation with the confirmed relationships to be contingent upon the particular type of organizations investigated. But that is a necessary price to be paid, especially when organizations are the unit of analysis, and it is difficult to obtain data on large samples of organizations.

2. Organizational Properties of Colleges and Universities

Since this study will focus on colleges and universities, it is necessary to pay attention to certain pecularities of these organizations that may not be shared by other types of organizations. Educational organizations, in general, and universities, in particular, have variously been described as "organized anarchies" or "loosely coupled systems" (Cohen et al., 1972; Cohen & March, 1974; March & Olson, 1976; Weick, 1976). These terms are meant to draw attention to the fundamental ambiguity that is involved in the definition of goals, in the high degree of decentralized decision-making, the lack of clearly recognized performance standards or the ill-defined technology. Accordingly, the literature on educational organizations emphasizes the lack of predictability and control on the part of administrative decision-makers. Two qualifications have to be made though: It seems likely that the description of colleges and universities as "loosely coupled systems" becomes increasingly less accurate, given that resource availability will probably be more restricted in the forseeable future (Lutz, 1982). Traditionally, the implicit assumption has been that organizations are expanding or are, at least, interested in expanding (Cyert, 1980). Yet declining enrollment and revenues are likely to reduce the margin of slack (Cyert & March, 1963; Hirschman, 1970) that colleges enjoyed in the past decades. Thus, emphasis on accountability and control will inevitably increase.

The second qualification for using the descriptor "organized anarchy" to describe colleges and universities has to do with the

emphasis on decision-making. That college presidents often lack the power to control the course of their institution and that they more often respond to rather than shape events should not be surprising (Cohen & March, 1974). But this does not imply that there are no predictable patterns of change in organizational structure, patterns that can emerge only if one abstracts from the mayhem of daily decision processes. On the other hand, even if one takes the long view, it cannot be denied that colleges and universities share certain properties with other human service organizations (Hasenfeld & English, 1974) that pose special problems for analysis. In particular, the goals, outcomes and products of such organizations may vary widely, leading to the lack of any generally agreed upon measures for organizational assessment (Lawler et al., 1980; Kanter & Brinkerhoff, 1981). But if there are no "reliable and valid measures of effectiveness" (Hasenfeld & English, 1974; p. 21) not only does organizational control become tenuous, because management cannot judge the performance of "production-workers", but it also weakens the role of competition as environmental constraint, because customers, consumers or clients of the organizations' services have no way of rationally comparing the quality of services in relation to the price they are paying. Incidentally, such problems of weakened market discipline arise regardless of private or public control of a service organization, because they are a result of information deficits on the part of the consumer (Williamson, 1975).

3. Blau's Theory of Organizational Structure

Despite these ambiguities and problems in analyzing human service organizations in general, and institutions of higher education in particular, Blau (1973) has advanced a theory to account for systematic structural variations in colleges and universities. In particular, he starts with two fundamental theorems derived from his study of employment agencies (Blau & Schoenherr, 1971): 1) Increasing organizational size is accompanied by increasing differentiation, and 2) increases in differentiation occur at decelerating rates with increasing size (Blau, 1973; pp. 49-50). Among the many implications that follow from these propositions, Blau procedes to show that the ratio of administrators to faculty (the proportion of the administrative component) declines with increasing size of the organization, whether size is measured in terms of number of faculty or student enrollment. Blau has been criticized for using a cross-sectional study design to corroborate a theory that implies dynamic relationships (Scott, 1975). And, indeed, the evidence concerning a declining administrative component with increasing organizational size has been mixed, when studies relied on longitudinal data (Holdaway & Blowers, 1970; Meyer, 1972; Ford, 1980a). As a matter of fact, the empirical support Blau himself musters for his proposition, that the proportion of the administrative component declines with increasing size of the organization, is actually quite weak. Both the scatterplot and multiple regession tables presented indicate a rather poor fit of the regression curve, with most of the variance unaccounted for (Blau 1973; pp. 63,

65). But the major problem seems to be that Blau gives an inadequate theoretical justification for his empirical generalizations.

Blau invokes the concept of "economies of scale" to explain the declining administrative component accompanying increasing size. "The larger the volume of productive work and the number of persons engaged in it, the smaller is the proportion of administrative personnel needed, because the administrative investments in organizing the work can be amortized, as it were, over a larger volume of work" (Blau, 1973; p.68). Such a view implies two assumptions: 1) Small colleges are inefficient in their utilization of the resource "administration" because indivisibilities of this input prevent optimal factor adjustments (Gold, 1981); and 2) when colleges grow in size, they will actually move towards a more efficient input mix. But why should they? The economist's answer concerning adjustments made by business firms relies on two closely related propositions. Managers of business firms are assumed to act rationally. That is to say, they are believed to attempt to minimize costs in order to produce a given output. An alternative explanation refers to competition between firms as the force that will pressure them to find ways of reducing costs, otherwise they would not survive. Thus, reference to "economies of scale" can serve as a sufficient explanation for declining administrative ratios only if one assumes that college administrators are motivated to reduce costs or that there is sufficient competition between colleges to induce such behavior (see also Khandwalla, 1981). Yet, there is some evidence that competition between institutions of higher education is limited (Hoenack, 1982; Rowse & Wing, 1982). Colleges and universities operate in segmented markets

(Garvin, 1980). Community colleges do not fully compete with universities. Some highly visible institutions draw on a nationwide reservoir of students while others cater to state or local populations. Especially in the case of public research universities, there may not be many in-state alternatives while tuition barriers limit out-of-state competition.

Thus, environmental pressures need not be strong enough to enforce structural adjustments, and the existence of organizational slack (Cyert & March, 1963: Hirschman, 1970) may give administrators some leeway in choosing various adjustment processes. Evidence for this may be seen in the finding that the relationship between size of the administrative component and overall size of the organization depends on the growth pattern of organizations (Freeman & Hannan, 1975). It is, of course, perfectly rational for administrators to cut back on administrative positions only as a matter of last resort when organizational survival is threatened. As long as organizational slack exists "economies of scale" in the administrative component may not be easily achieved.

There is another objection to using the notion of "economies of scale" in order to explain the behavior of administrative ratios. Strictly speaking, "economies of scale" refer to the decline in the unit cost of production as output increases (Scherer, 1980). Applied to the administrative ratio this would entail that economies of scale exist when the unit or average cost of administration declines with increases in output. (There are, of course, considerable problems in measuring "outputs" of educational institutions. For example, enrollment is often used as a measure of output, as it -- presumably -- reflects

instructional load. But, obviously, research and public service functions are also outputs.) In any case, there is no necessary relationship between the actual personnel ratios of administrators to faculty (or some other employee category) and cost of administration. This is so mainly for two reasons.

In the first place, the use of personnel ratios assumes that "administrators" in small colleges do the same thing as those in large universities. But that is, in fact, highly unlikely. If differentiation and specialization increases with size, the meaning of the term "administrator" is also changed. Probably, in larger organizations, the dividing line between administrative and clerical work is drawn somewhat differently. This points to an important issue, namely, in what sense do "economies of scale" refer to scale effects rather than changes in the division of labor and technology (Gold, 1981)? If changes in administrative overhead result from changes in the intra-organizational division of labor, an alternative explanation for "administrative economies of scale" may be adopted: Administrators in large organizations concentrate more and more on the decision-making function and less and less on clerical tasks, which can be left to lower level personnel. There is, of course, the possibility of defining administrators as "all personnel not engaged in teaching or research". But even that definition does not necessarily solve the problem that functional distributions of tasks between teaching and research personnel and all other personnel may change as colleges and universities grow in size.

A second reason why declining administrative ratios with increasing size of organizations may not result in economies of scale is that the

cost of administration may not vary proportionately with the number of administrators. If salaries of administrators in larger universities are higher than those of smaller institutions, then a decline in the proportion of administrators will not result in a corresponding decline of administrative cost.

4. Organizational Environment and Organizational Structure

This last argument opens up new possibilities of explaining variations in organizational structure. Structural adjustments as reflected in the changing proportions of various personnel categories are likely to respond not only to changes in the intrinsic properties of organizational relations but also to changes in the relative cost of various personnel components. This is all the more probable since personnel costs represent the bulk of expenditures incurred by the labor-intensive colleges and universities (Brinkman, 1981). But personnel costs reflect labor market conditions, that is to say, conditions in one (important) segment of the environment of colleges and universities.

Starbuck (1965, p.468) stresses that environments impose constraints on organizational growth and development because "adaptation is an obvious precondition for survival, and survival is an obvious precondition for growth." But survival is not always the pressing problem it is often made out to be. Rather, environmental impacts are filtered and selective (Pfeffer and Salancik, 1978) and organizations may deliberately establish buffer mechanisms to protect themselves

against sudden changes in important sectors of the environment (Thompson, 1967). (A case in point would be the use of inventories by business firms to smoothe out fluctuations in demand.) Such possibilities suggest that there is an element of strategic choice involved in organizational actions (Child, 1972) and that strict environmental determinism can be rejected as inadequate. Unfortunately, this complicates matters in the sense that environmental typologies, based on objective characteristics (Emery & Trist, 1965) do not have much meaning. A particular environment may be "rich" in resources for one organization and "poor" for another as can be illustrated in the following simple example. A few decades ago the desert land of Saudi Arabia was resource poor. Now new technologies have made possible the efficient exploitation of one (formerly latent) rich environmental sector. Thus, the argument has come full circle. It may not be objective characteristics of the environment, but characteristics of the organization that do or do not allow it to exploit a particular niche. On the other hand, few would go so far as to deny that there are "limits to strategic choice" (Aldrich & Pfeffer, 1976; Aldrich, 1979). Organizations are not infinitely adaptable, as is exemplified by the persistent correlation between an organization's date of foundation and its structure (Stinchcombe, 1965). But we do not have a theory that explains when and why organizations have reached or will reach the limits of adaptability.

In the case of colleges and universities, certain limits to adaptability are apparent. They cannot easily drop a major program or discipline without offending important constituencies whose generalized support for the institution may be crucial in attracting all kinds of

resources. In contrast, a business firm may drop an unprofitable product line entirely, without -- as a rule -- having to fear carry-over effects.

In order to fulfill the task of instructing students, colleges and universities are locked into a particular pattern of resource dependency. That pattern has changed over recent decade, resulting in less reliance on direct student contribution in the form of tuition and fees and greater reliance on revenues from third parties such as state governments, federal agencies, private foundations, etc., (Gross & Grambsch, 1974; Goodall (ed.), 1976; Frey, 1977). A complete enumeration of the organization set (Evan, 1966; Aldrich & Whetten, 1981) of a particular college would also have to include regulatory agencies such as accreditation associations or federal and state agencies that can enforce compliance with certain standards although they may not themselves provide the resources for such actions.

Finally, colleges operate in a general environment of legal, cultural, and demographic changes that all may put constraints on freedom of action (Frey, 1977). It is true, the particular environment a college operates in is partly a matter of choice. Colleges may opt to build up graduate programs and try to enhance their reputation of educational quality in order to draw on a regional, if not national, student population. This would make them less dependent on local conditions (Garvin, 1980). But on the other hand, today's choices become tomorrow's constraints. Suppose, administrators of a college want to expand enrollment through adding graduate curricula to the college's program offerings. The initial decision would require a host

of secondary decisions including the upgrading of faculty, lessening of the teaching load, provision of research facilities and others. If the drive for graduate training programs is to be successful, these secondary decisions are no longer a matter of "free choice". In particular, colleges and universities are not free to decide what kind of personnel they want to hire, once a decision about the basic mission of an institution has been made. But since a college is a labor-intensive production organization, spending most of its revenues on wages and salaries (Brinkman, 1981), labor market conditions must be considered an especially important segment of the environment. It would also appear that most individual institutions are too small in order to significantly influence labor market conditions. For most colleges and universities, personnel costs must, therefore, be considered a "given" to which they have to adapt.

In sum, while organizations often are in a position to make choices from among a limited range of alternatives, organizational structure is a result not only of these choices but also of environmental constraints.

B. PLAN OF STUDY

This study will focus on land-grant colleges and universities to explore some issues concerning the relations between organizations and their environment, organizational efficiency, and variations in organizational structure. In particular, the research will be guided by four major questions.

1) What are some of the determinants of enrollment size and growth of land-grant colleges and universities?
2) What are some of the consequences of institutional size for the organization-environment relationship?
3) Are larger institutions more efficient, i.e. do economies of scale exist in colleges and universities?
4) Can internal structural variations in land-grant institutions that are associated with variations in size be explained in terms of changes in environmental conditions?

Treatment of the first three questions will be largely exploratory because existing theoretical and empirical work is insufficient to develop a firm set of expectations. For instance, while much has been written about "demand" for education in general, there are few attempts to actually measure demand for specific institutions of higher education and link it to growth and decline patterns of these institutions. This problem will be taken up in chapter 3. Likewise, if organizational size alters the relationship between organizations and their environments it must be possible to show measurable differences in behavioral consequences between smaller and larger land-grant institutions. While the

organizational literature abounds in assertions about greater independence of larger organizations from their environment, rarely are these assertions put to the empirical test. Chapter 4 will deal with this question.

Internal organizational consequences of variations in organizational size have been explored much more thoroughly in the literature. However, as has been pointed out earlier, whether or not one should expect economies of scale to obtain among colleges or universities cannot be answered unambiguously. If one emphasizes the technical possibilities (e.g. division of labor) that are generally assumed to be associated with organizational size, one would expect larger land-grant universities to be more efficient in providing a given service. On the other hand, public or non-profit service organizations in general, and educational institutions in particular, are often held to be exposed to only weak competitive pressures. If this assumption is correct, larger organizational size should not make for more efficient service provision. This issue will be discussed in chapter 5.

The exploration of the fourth major question to be addressed is on firmer empirical grounds. There is abundant empirical evidence that internal structural arrangements of organizations systematically vary with organizational size. Here the issue is one of finding a satisfactory explanation for this phenomenon. To see structural changes as evidence for economies of scale requires assumptions about the existence of environmental pressures. By explicitly introducing variables that represent environmental conditions, it is hoped that an alternative account can be provided as to why structural arrangements vary with

organizational size. This problem will be taken up in chapter 6.

In the following, a list of specific research hypotheses will be presented. They represent elaborations of the basic questions and will be examined in detail in later chapters.

1) Size and growth of colleges and universities both depend on external forces beyond an institution's control and are, in part, the result of administrative choices. Because the land-grant institutions included in the sample are all public and draw heavily on state support, variations in demographic and economic development between the states should also be reflected in enrollment growth of these institutions. In addition, efforts by institutions to attract new groups of students represent administrative choices to "widen demand".

Hypothesis # 1: Variation in the growth rates of student enrollment among land-grant institutions depend on:

a) growth rates of state populations;

b) growth rates of per capita personal income;

c) changes in state appropriations to higher education;

d) changes in the proportion of blacks of state populations;

e) changes in the proportionate size of the following occupational groupings: 1) professionals, managers, and administrators, 2) manual workers, 3) farmers and farm-laborers;

f) growth in the number of four-year public colleges; and

g) the enrollment size of the LGI at the beginning of the growth period in question (1968).

Hypothesis #2: The larger the increase in enrollment of women, part-time students, and graduate students relative to the increase in the traditional student group of full-time male undergraduates, the larger will be the overall enrollment increases.

2) Organizational size shapes the relationships between the organization and its environment. Larger organizations usually have more contact points with their environment. They also tend to have greater power over any particular member of their organization set as implied by the following hypotheses.

Hypothesis #3: Larger colleges and universities receive funding from a larger set of sources than smaller institutions.

Hypothesis #4: The contribution of the largest donor is a smaller proportion of total revenues in larger schools than in smaller schools.

Hypothesis #5: Large schools are able to extract disproportionately larger state funds per student from the state legislature.

3) Economies of scale exist, when unit costs of production decline as the scale of production (or output) increases. If one assumes that incentives to economize are present among colleges and universities the following relationships can be expected to hold:

Hypothesis #6: a) Larger universities spend more money per student than smaller institutions (because of their greater complexity and quality).

b) After controlling for output diversification (greater academic specialization) and emphasis on graduate education and research, expenditures per student should be somewhat lower in larger schools.

Hypothesis #7: a) Up to a point, average instructional expenditures decline with enrollment size, but rise again in very large institutions.

b) When the proportion of graduate students and average faculty salaries are controlled for, average instructional expenditures continue to decline with institutional size, albeit at a decelerating rate.

Hypothesis #8: Library expenditures per student are expected to decline at a decelerating rate as enrollment grows.

Hypothesis #9: Net of academic specialization and increased graduate enrollment, economies of scale in library expenditures should continue to be realized at a constant rate.

Hypothesis #10: a) Average cost of plant operation and maintenance at first declines but ultimately rises with institutional size.

b) After controlling for wages of maintenance personnel and physical plant complexity, large economies of scale in plant operation and maintenance should be observable.

Hypothesis #11: a) Average costs of central administration decline with institutional size at a decelerating rate.

b) In institutions of similar complexity that pay comparable salaries for administrators, economies of scale can be realized at a constant rate.

4) Under the assumption that colleges and universities have less control over labor markets where they have to compete with many other organizations and are "pricetakers", the following predictions about changes in personnel ratios are expected to hold:

Hypothesis #12: a) The ratio of full-time faculty to full-time equivalent student enrollment declines with increases in institutional size.

b) Covariation between the faculty/student ratio and institutional size is due to two intervening variables: faculty salaries and school affluence.

Hypothesis #13: a) The faculty/student ratio increases with rising graduate enrollment.

b) The faculty/student ratio decreases with increasing employment of teaching assistants.

c) The employment of teaching assistants varies positively with faculty salaries (substitution effect) and with graduate enrollment (availability).

d) The effects of institutional size on the faculty/student ratio are all indirect.

Hypothesis #14: Independent of organizational size, the larger the salary differential between professional administrators and clerical staff, the lower the ratio of administrators to clerks.

Hypothesis #15: Independent of organizational size, the larger the salary differential between professional librarians and non-professional library staff, the lower the ratio of librarians to other staff.

Before these hypotheses are examined in detail, it is necessary to describe the data collection procedures and to provide some basic descriptive information on the unique characteristics of land-grant institutions. This task will be undertaken in the next chapter.

CHAPTER II

DATA COLLECTION AND DESCRIPTIVE INFORMATION ON LAND-GRANT COLLEGES AND UNIVERSITIES

This study is based on data from 65 land-grant colleges and universities. A major reason for this choice was the concern of being able to obtain sufficient data on both large and small organizations. Data on small organizations are usually more difficult to obtain; however, the reporting requirements for land-grant institutions eliminate this possible bias.

Today there are altogether 72 Land-Grant Institutions (LGI's). They divide into two groups, one established under the first Justin Morrill Act of 1862 and the other established under the second Justin Morrill Act of 1890. The first Morrill Act authorized the transferral of federal land to the states, the use of which was to support a public college primarily devoted to agricultural and industrial training. Initially, many states were reluctant to act upon this legislation, because it was feared that the federal endowment would not suffice to cover the cost of running the college (Johnson, 1981). Some eastern states gave the land-grant endowment to already established private schools to administer. Thus, it was hoped, future burdens to the state treasury could be avoided. For instance, the Massachusetts Institute of Technology and Yale University were the original LGI's of Massachusetts and Connecticut. Only later were the land-grants transferred to the University of Massachusetts at Amherst and the Univesity of Connecticut

at Storrs. New York's land-grant endowment is still administered by the (private) Cornell University. Other states converted already existing public colleges into their land-grant school. Still others waited decades until they finally established their land-grant school. But despite the sluggish beginnings, eventually every state established a LGI under Morrill Act I. Additional LGI's have been founded in the District of Columbia, Puerto Rico, Guam, and the Virgin Islands. Since MIT never relinquished its land-grant status there are now 55 LGI's established under Morrill Act I.

During Reconstruction Congress passed the second Morrill Act of 1890 which launched the establishment of agricultural and mechanical colleges for blacks in the Old South and bordering states such as Delaware, Maryland, Missouri, Oklahoma, and Texas. Today 16 southern states have such a college as their second LGI. In addition, the Connecticut Agricultural Experiment Station was founded as a seperate institution under the auspices of Morrill Act II.

Not all LGI's have been included in this study. It is confined to only public institutions, because the financial support system and other institutional characteristics of the few private LGI's differ markedly from the public schools, and there are not enough cases to allow for a meaningful comparison. Consequently, Cornell University and the Massachusetts Institute of Technology have been excluded as private schools. Furthermore, the 4 LGI's in U.S. overseas territories and the University of the District of Columbia, only recently established in the 1960's, have been dropped. This leaves 49 schools under Morrill Act I in as many states with the exception of New York (Cornell University).

An additional complication arises from the fact that the land-grant endowment in the state of California has recently been transferred from the original land-grant institution (University of California at Berkeley) to the University of California system and is now administered both at Berkeley and at Davis. Because this information became available only long after the data collection had begun, the University of California at Davis is not included in the sample although it is increasingly becoming the major land-grant institution of California. Still, Berkeley remains a major center for agricultural research as indicated by the $1.6 million research funds it received from the USDA in 1978/79. Of the 17 institutions under Morrill Act II only the Connecticut Agricultural Experiment Station has been excluded, as it is not a full-fledged college.

As already mentioned, the 65 LGI's were chosen because data for them were relatively accessible. In other words, the selection of these institutions, rather than other public colleges and universities, has no deeper theoretical meaning. It will be shown below that LGI's do not differ very much from other public institutions. But it cannot be claimed that they are a representative sample of some larger universe of organizations, be it public four-year colleges and universities or even public service organizations in general. Since the sample was not derived through random sampling from an identifiable larger population of organizations, significance tests would seem to be of questionable value. The statistics to be presented will be treated as population parameters (for 65 LGI's), rather than estimates of unknown population

parameters. One may, of course, consider any and all sets of data as generated through some (unknown) random process. But if that random process is unknown and unspecifiable, it appears as if assuming its existence only serves the purpose of justifying the use of significance tests (Morrison & Henkel, 1970). There is no question that, without significance tests, researchers lack a formal criterion that allows them to decide when to reject or accept a statistical hypothesis. But the desire for such a formal criterion should not obscure the fact that significance tests serve only one purpose: They help answer the question how likely (or unlikely) it is that differences between statistics calculated from the sample data will, in fact, prevail in the population from which the sample was drawn, presumably in a random procedure. But since in this study no claims are made that the results will be generalizable (in a statistical sense) beyond the examined land-grant institutions, it is hard to see what informational value would be added if significance tests were used.

An attempt was made to collect data that refer only to characteristics of the major campus of an institution, since a number of the land-grant schools are single campus institutions. In a few cases of multi-campus institutions some variable measures had to be excluded because they were only available at the system's level. The principal unit of analysis is thus the single major campus of each institution.

A major problem encountered during the data collection stage of this study was finding measurements for all the variables in comparable time periods. Most of the data refer to the academic years 1968/69 and

1978/79. But for a number of variables data from earlier or later time periods had to be accepted. However, deviations from the focal periods never exceeded more than two years, and comparisons in some cases show that the variables in this study do not change very much over such time periods.

The Higher Education Information Survey (HEGIS), conducted since 1966 by the U.S. Department of Education (or its organizational predecessors), served as the major data source for this study. Enrollment data on both the institutional and state level stem from the Fall Enrollment Surveys from 1968 and 1978. Data on numbers and salaries of faculty came from the Survey on Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty 1978-79, while revenue and expenditure figures were taken from the Survey of Financial Statistics of Institutions of Higher Education, Fiscal Year 1979. Also as part of HEGIS, the National Center of Education Statistics (NCES) conducts a survey of Employees in Institutions of Higher Education. The two surveys utilized in this study were carried out during the academic years 1966/67 and 1976/77. Although these employee data are not synchronous with the other data, they will be treated as cross-sectional variable measurements. It is hoped that the cross-sectional treatment of the employee data will not introduce major distortions. Some support for such expectations can be seen in the fact that the number of faculty on the 1976/77 employee survey correlates $r=.95$ with the corresponding number of faculty on the salaries, tenure and fringe benefits survey of 1978/79.

Data on federal research grants disbursed to land-grant institu-

tions in fiscal years 1968 and 1978 were taken from National Science Foundation (NSF) reports that covered 95% of all federal grants to colleges and universities.

Additional data on institutional characteristics were obtained from miscellaneous sources. Information on degree programs offered was provided by the College Blue Book, 1979 edition. The number of departments, schools and colleges for each institution was assembled from college catalogs dated from 1976 to 1979; and information on admissions competitiveness was obtained from the 1979 editions of Barron's and Peterson's college guide books.

Finally, some data on basic state characteristics such as population numbers and occupational composition of the labor force, average personal income, population mobility, or state support for higher education relied on the 1970 and the 1980 Census of the Population as well as publications of the National Association of State Universities and Land-Grant Colleges (NASULGC) and the American Council on Education (ACE).

A list of all variables used in the study, including their respective data sources, is provided in Appendix A.

There is a bewildering variety of institutional arrangements under which LGI's operate. For the purposes of this study they have been classified in the following way: 1) Independent institutions (N=26). These are single campus schools whose chief executive (usually called president) directly negotiates state appropriations with the legislature. 2) Main campus of a multicampus institution (N=12). In this

case there are one or more branch campuses associated with the main campus which is the original LGI. As with the independent schools, the chief executive deals directly with the legislature. (All data on LGI's in this category refer only to the main campus.) 3) Branch campus of a multicampus institution. In one case -- the University of Arkansas at Pine Bluff -- the original LGI is headed by an executive who reports to the administration of a larger campus. This main campus -- the University of Arkansas at Fayetteville -- is also a LGI and negotiates directly with the legislature. (In this case, branch campus data are treated as data from a seperate LGI.)

21 states coordinate some or all of their public colleges and universities in a state system of higher education. (A few states have two seperate upper- and lower-level systems.) If a LGI is a member of such a system, its chief executive reports to the state system's office headed by a different executive. There are four major variations on this theme: 1) The LGI is the main campus (defined as the largest campus offering graduate education) located at the system's office (N=13). 2) The LGI is not the main campus of the system, but is located at the system's office (N=2). 3) The LGI is not the main campus and is not located at the system's office (N=8). 4) The LGI is the main campus, but is not located at the system's office (N=3).

In order to place the land-grant institutions in the universe of all colleges and universities of the 49 relevant states, Table 1 compares them to other institutions of higher education in those states.

Table 1

Table 1 clearly shows that LGI's are unusually large compared to the average college or university in the 49 states (17,505 vs. 3,615 average enrollment). If one rank-orders all colleges and universities by enrollment size, 27 land-grant universities turn out to be the largest institutions of higher education in their respective states. Another 14 LGI's are second largest and 7 are third largest in their states. On the other hand, most of the land-grant colleges are considerably smaller and their size rank-orders range from 2nd to 37th largest institutions in their respective states. In general, though, it cannot be doubted that LGI's have achieved a dominant position in the American higher education system. The 65 schools under study together enrolled 1,137,832 students in the fall of 1978, a figure that represents 11.2% of the total enrollment in the relevant 49 states. Viewed from the individual states, the central position of LGI's is even more apparent. The average LGI enrolled 14.2% of its respective state's student population, although there is considerable variation as this percentage ranges from .5% to 60.7%.

If one compares land-grant universities only to other public universities and land-grant colleges to other public four-year colleges in the 49 states, differences between them and these other public institutions are much less apparent, as the following table shows.

TABLE 1: BASIC CHARACTERISTICS OF INSTITUTIONS OF HIGHER EDUCATION IN 49 STATES (ACADEMIC YEAR 1978/79)

INSTITUTIONAL CHARACTERISTICS:	AVERAGE VALUES FOR: ALL SCHOOLS (N=2,823)	PRIVATE SCHOOLS (N=1,441)	PUBLIC SCHOOLS (N=1,382)	ALL LGI'S (N=65)
Enrollment	3,615	1,383	5,942	17,505
% Women Enrolled	49.9%	46.9%	50.5%	45.7%
% Part-time Enrollment	41.3%	25.8%	45.0%	21.0%
% Undergraduate Enrollment	77.0%	72.6%	78.0%	77.7%
Current Funds Revenues per Student	$4,401	$4,959	$3,819	$6,927
Tuition and Fees per Student	$884	$1,260	$492	$760
State Appropriations per Student			$1,757	$2,981
Current Funds Expenditures per Student	$4,277	$4,837	$3,693	$6,793
Instructional Expenditures per Student	$1,444	$1,527	$1,357	$1,917
Research Expenditures per Student	$373	$413	$331	$1,138

Data Sources:
1) Fall Enrollment in Higher Education 1978, NCES
2) Financial Statistics of Institutions of Higher Education: Fiscal Year 1979, State Data, NCES
3) Education Directory, Colleges & Universities 1978-79, NCES

Table 2

From Table 2 it can be inferred that land-grant universities have more or less lost their special character that used to distinguish them from other public universities. To be sure, agricultural research continues to be concentrated in LGI's as they received more than 95% of the federal funds for such research in Fiscal Year 1978/79. But these funds represented no more than 22.9% of all federal research funds going to LGI's, not to speak of private research funds with their even smaller emphasis on agricultural research. In general, the similarities between the 49 land-grant universities and the other 43 public universities (as defined by the National Center of Education Statistics, a university offers Ph.D. programs in, at least, two departments and places "considerable" emphasis on research) are quite striking. There are hardly any differences with respect to average enrollment size (22,034 in LGU's vs. 21,858 in PU's) overall revenues per student ($7,427 vs. $7,380) or expenditures per student ($7,272 vs. 7,142). Land-grant universities do receive somewhat larger state appropriations and charge slightly lower tuition than other public schools. There is also greater emphasis on research in LGU's but, as can be seen from the figures for non-agricultural research expenditures, this difference is almost solely due to the emphasis on agricultural research in LGU's. Land-grant colleges differ somewhat more from other public four-year colleges. In particular, their average enrollment is smaller (3,057 in LGC's vs. 6,380 in PC's) and their revenues per student are higher ($5,397 vs. $4,465). But other differences do not appear large. Again, the greater

TABLE 2: COMPARISON OF LAND-GRANT INSTITUTIONS WITH OTHER PUBLIC INSTITUTIONS IN 49 STATES (ACADEMIC YEAR 1978/79)

INSTITUTIONAL CHARACTERISTICS:	AVERAGE VALUES FOR: MORRILL I LGI'S (N=49)	PUBLIC UNIVERSITIES (N=43)	MORRILL II LGI'S (N=16)	PUBLIC 4-Y. COLLEGES (N=392)
Enrollment	22,034	21,858	3,057	6,380
% Women Enrolled	44.0%	48.4%	50.8%	51.3%
% Part-time Enrollment	20.3%	27.0%	23.0%	35.3%
% Undergraduate Enrollment	75.4%	71.6%	84.8%	85.9%
Current Funds Revenues per Student	$7,427	$7,380	$5,397	$4,465
Tuition and Fees per Student	$833	$961	$539	$576
State Appropriations per Student	$3,138	$2,546	$2,502	$2,322
Current Funds Expenditures per Student	$7,272	$7,142	$5,325	$4,324
Instructional Expenditures per Student	$2,029	$2,220	$1,574	$1,641
Research Expenditures per Student	$1,319	$980	$582	$257
Non-agricultural Research Expenditures per Student	$997	$954	$287	$231

Data Sources: 1) Fall Enrollment in Higher Education 1978, NCES
2) Financial Statistics of Institutions of Higher Education: Fiscal Year 1979, Institutional Data, NCES
3) Education Directory, Colleges & Universities 1978-79, NCES

research expenditures can almost solely be attributed to the fact that LGC's are centers of agricultural research. Overall, the largest differences between land-grant insitutions and other public institutions appear to be their lesser reliance on part-time students.

It must be emphasized that the two groups of LGI's (49 Morrill I schools and 16 Morrill II schools) are quite distinct in their characteristics. By the academic year 1978/79 all Morrill I schools had developed into full-fledged universities that offered Ph.D. programs in, at least, a few fields. In contrast, none of the Morrill II schools grants a Ph.D. degree. They are, essentially, four-year colleges, some of which have added a limited number of graduate curricula leading to a Master's or a professional degree. Reflecting their origin, the two types of LGI's still differ substantially in racial composition of their student body. In the academic year 1978/79 only 2.2% of all academic degrees conferred by Morrill I schools went to blacks, whereas 81.7% of all academic degrees conferred by Morrill II schools were given to blacks. (These figures probably overestimate enrollment differences in racial composition of the student body, but the latter were not available.) The following table summarizes some of the important differences in institutional characteristics between Morrill I and Morrill II LGI's.

TABLE 3

The table easily conveys some of the typical differences between

TABLE 3: COMPARISON OF MORRILL I AND MORRILL II LAND-GRANT INSTITUTIONS (ACADEMIC AND FISCAL YEAR 1978/79)

INSTITUTIONAL CHARACTERISTICS:	ALL LGI'S (N=65)	MORRILL I LGI'S (N=49)	MORRILL II LGI'S (N=16)
Enrollment (Fall 68)			
Mean	14,016	17,594	3,057
Range	717-60,291	4,030-60,291	717-9,978
St.Dev.	12,021	11,749	2,213
Enrollment (Fall 78)			
Mean	17,505	22,034	3,634
Range	942-62,791	4,314-62,791	942-8,061
St.Dev.	13,185	12,061	2,000
% Graduate Students (Fall 78)			
Mean	13.6%	15.3%	8.4%
Range	0.0%-28.2%	5.2%-28.2%	0.0%-24.9%
St.Dev.	6.6%	5.3%	7.7%
Current Funds Revenues per FTE Student (FY 78/79)			
Mean	$8,077	$8,667	$6,269
Range	$4,149-$29,438	$5,188-$29,438	$4,149-$8,943
St.Dev.	$3,231	$3,451	$1,338
State Appropriations as % of Revenues of LGI (FY 78/79)			
Mean	43.5%	42.6%	46.4%
Range	19.6%-56.2%	19.6%-55.6%	34.2%-56.2%
St.Dev.	8.6%	8.8%	7.6%
State Appropriations per FTE Student (FY 78/79)			
Mean	$3,457	$3,636	$2,907
Range	$1,604-$9,178	$1,604-$9,178	$2,030-$4,929
St.Dev.	$1,215	$1,272	$830
Current Funds Expenditures per FTE Student (FY 78/79)			
Mean	$7,919	$8,487	$6,180
Range	$4,111-$29,063	$5,134-$29,063	$4,111-$9,677
St.Dev.	$3,167	$3,385	$1,363
NSF Grants per Full-Time Faculty (FY 78/79)			
Mean	$2,525	$3,273	$234
Range	$0-$34,685	$97-$34,685	$0-$1,695
St.Dev.	$4,660	$5,154	$466
Research Expenditures as % of Total Expenditures (FY78/79)			
Mean	17.0%	19.1%	10.5%
Range	3.8%-53.6%	8.9%-53.6%	3.8%-26.2%
St.Dev.	8.1%	7.3%	7.0%

Data Sources:
1) Fall Enrollment in Higher Education 1968, NCES
2) Fall Enrollment in Higher Education 1978, NCES
3) Financial Statistics of Institutions of Higher Education Fiscal Year 1979, Institutional Data, NCES
4) Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1978-79, Institutional Data, NCES

the two types of LGI's. Morrill I schools tend to be larger and to concentrate more on graduate education than Morrill II schools. They are also richer and more research oriented. Of particular interest are the figures on state appropriations. For all but four LGI's, state appropriations represent the single largest source of funds. (For two schools tuition is the largest source, for another two it is federal grants and contracts.) But there is considerable variation in the importance of state appropriations for a LGI. At the low end, they account for only 19.6% of the budget of a LGI, at the opposite end it is 56.2%. A similar range of variation applies to state appropriations on a per student basis. The data also show that Morrill II land-grant colleges do not fare as well with the state legislatures as Morrill I land-grant universities. This statement is supported by the fact that, in 12 of the 16 states with two LGI's, Morrill I land-grant universities received higher per student appropriations than Morrill II land-grant colleges. On the other hand, comparison of the two LGI groups should not obscure the fact that most of the variations on the measures presented in Table 3 occur within rather than between these two groups.

Growth in enrollment in land-grant institutions has not kept pace with the expansion of the U.S. higher education system as a whole during the decade of 1968 to 1978. This decade was the last of eight continuous growth decades in this century with enrollment actually peaking in fall 1979. Enrollment in institutions of higher education of the 49 states relevant to this study grew by 51.1% from 6,724,323 in fall 1968 to 10,157,752 in fall 1978. By comparison, total enrollment in the 65

land-grant institutions grew at the much lower rate of 24.9% from 911,019 to 1,137,832. Most of the growth in overall enrollment occurred in community colleges. The growth rate for enrollment in public four-year colleges and universities amounted to 30.0%, a figure that is much closer to that for the LGI's. But even from this comparison one cannot draw the conclusion that enrollment in LGI's lagged behind that of other comparable schools since there was also an increase in the number of institutions of higher education in general and public four-year colleges and universities in particular. In the latter category the number of institutions rose by 32.2% from 379 in fall 1968 to 501 schools in fall 1978 within the 49 states under study. While data on the appropriate comparison group for LGI's -- all public four-year colleges and universities already established in 1968 -- could not be obtained, the combination of growth rates for overall enrollment and number of institutions strongly points to the conclusion that growth in enrollment in LGI's did not differ very much from the patterns in other public schools during the decade of 1968-1978. The following table summarizes some of the major enrollment trends from 1968 to 1978.

TABLE 4

Table 4 conveys the shift in enrollment patterns that occurred in the last decade. In particular, the group with the lowest growth rates consisted of full-time undergraduate male students while non-traditional groups such as women and part-time students grew the fastest. This pattern, although on a lower level, was also reflected in the LGI's with

TABLE 4: GROWTH IN THE AGGREGATE STUDENT POPULATIONS OF 49 STATES AND 65 LAND-GRANT INSTITUTIONS (FALL 1968 TO FALL 1978)

ENROLLMENT CATEGORY:	STATES (N=49)	ALL LGI'S (N=65)	MORRILL I LGI'S (N=49)	MORRILL II LGI'S (N=16)
All Students	51.1%	24.9%	25.2%	18.9%
Women	87.3%	50.4%	53.1%	17.5%
Part-time Students	110.3%	36.1%	33.5%	98.1%
Graduate Students	59.5%	23.7%	22.8%	62.3%
Undergraduate Students	46.8%	15.8%	16.3%	7.0%
Full-time Undergradute Men	3.2%	7.6%	7.8%	3.5%

Data Sources: 1) Fall Enrollment in Higher Education 1968, NCES
2) Fall Enrollment in Higher Education 1978, NCES

the sole exception of women's enrollment in the 16 Morrill II schools. The major reason for this deviation seems to have been the already large women's enrollment in these colleges in 1968, when women already accounted for 52.4% of the student body in these schools as opposed to 36.1% in the Morrill I universities. In 1978 women's enrollment represented 51.8% of the land-grant colleges and 44.1% of the land-grant universities.

TABLE 5

Comparing growth rates of student populations of all LGI's combined to average growth rates of student populations of individual institutions is instructive. Average growth rates are presented in Table 5 for the same enrollment categories as in Table 4. In all cases average growth rates exceed growth rates of the total student populations. This result is, of course, due to the fact that enrollment in smaller land-grant institutions grew faster than enrollment in larger ones.

To some degree though, average or mean growth rates convey only limited information. As indicated by the ranges and standard deviations in Table 5 many schools did not grow at all during the 1968-1978 period with some schools dropping in enrollment. The tremendous variation in growth and decline rates may easily be recognized by looking at the standard deviations for the change rates: In all cases, standard deviations in Table 5 exceed mean values -- in some cases by more than twice as much.

TABLE 5: AVERAGE GROWTH RATES IN STUDENT POPULATIONS OF LAND-GRANT INSTITUTIONS (FALL 1968 TO FALL 1978)

ENROLLMENT CATEGORY:	ALL LGI'S (N=65)	MORRILL I LGI'S (N=49)	MORRILL II LGI'S (N=16)
All Students			
Mean	34.3%	35.4%	31.0%
Range	-29% to +235%	-8% to +235%	-29% to +137%
St.Dev.	44.0%	43.7%	46.2%
Women			
Mean	91.8%	111.1%	32.7%
Range	-43% to +1008%	-7% to +1008%	-43% to +158%
St.Dev.	181.7%	204.3%	49.1%
Part-time Students			
Mean	146.7%*	87.8%	356.9%**
Range	-59% to +2046%	-59% to +448%	-30% to +2046%
St.Dev.	311.2%	124.0%	586.8%
Graduate Students			
Mean	75.4%***	62.6%	138.3%****
Range	-100% to +1340%	-36% to +1340%	-100% to 586%
St.Dev.	205.5%	197.6%	242.1%
Undergraduate Students			
Mean	22.9%	24.7%	17.4%
Range	-46% to +243%	-46% to +243%	-29% to +79%
St.Dev.	41.9%	43.7%	36.5%
Full-time Undergraduate Men			
Mean	10.6%	9.4%	14.0%
Range	-43% to +127%	-27% to +67%	-43% to +127%
St.Dev.	28.3%	19.3%	47.1%

* N=63, ** N=14, *** N=59, **** N=10

Data Sources: 1) Fall Enrollment in Higher Education 1968, NCES
2) Fall Enrollment in Higher Education 1978, NCES

The data presented in this chapter seem to indicate two things: Firstly, land-grant institutions are by no means a uniform lot. They include small four-year colleges as well as very large research universities. They differ greatly with respect to such characteristics as the proportion of graduate enrollment, research funds attracted by faculty, dependence on state appropriations, or educational expenditures per student.

Secondly, land-grant institutions resemble other public institutions in their basic characteristics. This result does not warrant the conclusion that LGI's are in some way "representative" of these other schools. At least, the similarities do not justify the presumption that statistical inferences be drawn from the sample of LGI's to the larger universe of public colleges and universities. But they do strengthen one's confidence in assuming that patterns observable among LGI's may not be much different from those that would be found among these other schools.

CHAPTER III

DETERMINANTS OF ENROLLMENT IN STATES AND COLLEGES

It is difficult to ascertain in what way and to what degree variations in characteristics of environments of colleges and universities determine both their enrollment size and enrollment growth. The difficulties are both conceptual and methodological.

As a first task, it would be necessary to identify those environmental characteristics that are favorable or unfavorable to growth in college enrollment. Examples would include demographic and social trends in the population at large. Limits to potential college enrollment may result from purely demographic developments (for instance, the supply of trainable students), from economic conditions (the capacity of a population to send a certain proportion of its members to college), or from normative considerations (the value various population segments place on formal college education). All these variables are subject to continual change, but it is doubtful whether any individual college or university has much influence over them.

Social and economic characteristics of a population of a state may be good predictors of overall enrollment ratios (e.g. the proportion of the population in college age - 18 to 24 - that is enrolled in institutions of higher education), but they are clearly less of a limiting factor with respect to enrollment in individual colleges. To explain why individual colleges grow or decline, it is necessary to specify additional variables, such as the competition they face (e.g. how many

other colleges compete for the same student population in a state or region?). Contrary to Aldrich's assertions "that external constraints severely limit" stategic choice (Aldrich, 1979; p. 149), there does seem to be ample room for "strategic choice" (Child, 1972) as may be inferred from the fact that variations in growth and decline rates of individual colleges are quite substantial (see Table 5, previous chapter), yet state enrollment growth rates account for only a small proportion of the variance in growth rates of individual institutions (2% in the case of Morrill I LGI's and 27% in the case of Morrill II LGI's -- these figures are not shown in tables). And for every school that grows faster than the average state enrollment there must be, at least, one other school that grows slower or did not manage to survive at all. But in order to explain these differences in enrollment growth in terms of "strategic choice", a full account of the adaptive strategies of the focal colleges -- and of those with which they compete -- would be required: a truly staggering task of empirical analysis.

It is, of course, possible that changes in state enrollment are poor predictors of changes in enrollment of individual colleges because state enrollment does not represent the relevant environment. This problem of correctly identifying the boundaries of the environment that may affect enrollment in a focal college is quite analogous to that of defining the relevant market for a particular firm or product (Scherer, 1980). In both cases it would be necessary to specify the geographical spread of the population from which "demand" issues and to include in the analysis all those organizations (colleges or firms) that offer a product or service that competes directly for this demand. Thus, the

use of measures pertaining to social and economic characteristics of state populations as predictors of enrollment in individual colleges encounters problems. Many small colleges compete for students in more restricted areas that may extend only over a few counties. In such a case, the relevant population characteristics (environment) are those of the counties' population rather than the state's. At the other extreme, large and prestigious research universities sometimes have (mostly graduate) programs that appeal to a national audience of potential applicants. At least with respect to enrollment patterns in these types of programs, national population characteristics would be the appropriate reference point. What complicates matters even more is the fact that a single institution of higher education may participate in several "segmented markets" (Garvin, 1980). The same institution, that may compete on a national level for certain graduate students as, for example, in a field like physics, may only face state or regional competition for most of its undergraduate programs, or a graduate specialty like education.

Like all other organizations, colleges and universities take part in a generalized competition for resources (Yuchtman & Seashore, 1967). Ideally, it would be necessary to define areas of competition ("markets") for each type of resource that colleges are competing for. For instance, competition for clerical personnel involves mostly local labor markets where private firms as well as government agencies in addition to other schools may be important employers. Securing of funds appropriated by state legislatures involves competition between all public schools of a state. In order to receive grants and gifts from

private citizens (usually alumni) colleges must compete against other non-profit organizations. In this case, the "munificence" of the relevant environment (Pfeffer & Salancik, 1978) does not only depend on the average socio-economic status of a college's alumni, but also on the geographical dispersion of these alumni. Greater dispersion may lessen the dependence of private grant monies on the economic fortune of a particular state. In short, the "environment" of colleges is multi-dimensional, and it would be difficult to capture its complex characteristics in a single measure.

Since this study does not include measures on many of the mentioned aspects of environment, determinants of enrollment size and growth can only be explored in a very rudimentary fashion. In particular, measures on the environment exclusively rely on state data. This procedure is more or less dictated by the easy availability of data. But in the case of land-grant universities, it can also be justified on substantive grounds. Given that all 65 land-grant institutions in this study are public and depend to a large degree on state financing (the average LGI receives 43.5% of its current funds from state sources compared to 11.4% contributed through tuition and fees), it seems reasonable to assume that demographic and economic conditions in the 49 states strongly affect enrollment patterns in these institutions. It is obviously not likely that the state with the smallest population cohort in college age (Alaska with 56,000) would support a university of the size of the University of Minnesota (62,791 students). But, of course, even this extreme example cannot be taken at face value, since institutions of higher education can expand their potential market through offering of

graduate programs or adult education courses that appeal to older age cohorts beyond the typical college age of 18 to 24. Or -- as was mentioned earlier -- more prestigious schools may be able to attract a larger contingent of out-of-state students despite the students' financial disincentives of studying in such a school. But nonetheless, state economic and social conditions should be one important limiting factor in the development of land-grant institutions.

Before discussing some of the factors that may affect enrollment in land-grant institutions, it seems advisable to look at factors that influence enrollment in institutions of higher education in general. The results of such a discussion should later lead to an appreciation of the similarities and differences of LGI's from other colleges and universities.

Table 6

As the data presented in Table 6 show, during the academic year 1978/79 enrollment in all institutions of higher education averaged 37.5% of the 49 states' college age populations. There was considerable variation though as suggested by a range of 25.5% for the state with the lowest enrollment ratio to 57.0% for the state with the highest enrollment ratio (St.Dev. = 7.3). Enrollment in public colleges and universities accounted, on the average, for 30.1% of the college age populations in the states and variation between the states was even greater (St.Dev. = 7.5). In order to explain some of this variation in enrollment ratios, census data on occupational groupings, personal

TABLE 6: ENROLLMENT RATIOS IN 49 STATES AND THEIR LAND-GRANT INSTITUTIONS (ACADEMIC YEAR 1978/79)

Proportions (%) of State Populations in College Age (18-24) Enrolled in:	All Institutions	Public Institutions
Mean:	37.5%	30.1%
Range:	25.5% - 57.0%	19.7% - 55.3%
St.Dev.	7.3%	7.5%

Enrollment in LGI's as a Proportion (%) of State Enrollments:	All LGI's (N=65)	Morrill I LGI's (N=49)	Morrill II LGI's (N=16)
Mean:	14.2%	18.1%	2.4%
Range:	.5% - 60.7%	1.8% - 60.7%	.6% - 8.1%
St.Dev.:	12.2%	11.6%	2.1%

Data Sources: 1) Fact Book for Administrators 1980, American Council on Education
2) Fall Enrollment in Higher Education 1978, NCES

income, residential mobility, and state appropriations to higher education were obtained for all 49 states. The basic idea behind this procedure was the assumption that certain characteristics of population groups would lead them to emphasize college education more so than some other population groups with different characteristics. In particular, the assumptions included that state populations with larger proportions of professionals, higher average income and greater mobility would provide a "natural" constituency for higher education. In general, these expectations are borne out by the data.

Table 7

As can be seen from Table 7, states where professionals, managers, and administrators represent a larger proportion of the labor force, also tend to have more college students enrolled in proportion to the college age population (r=.44). Similarly, the proportion of sales, clerical, and technical workers in the labor force is also positively related to the enrollment ratio (r=.37). On the other hand, states with many unskilled workers (non-farm operatives) also tend towards lower college enrollment ratios (r=-.28). The same can be said about farmers and farm-workers (r=-.23) as well as craft and precision workers (r=-.15). Only variations in the proportion of service workers do not seem to affect college enrollment. Looking at the correlations between the prevalence of the broad occupational groupings in the states and state enrollment in higher education clearly suggests an (expected) pattern. The larger the proportion of manual labor among a state's

TABLE 7: ZERO-ORDER CORRELATIONS OF ENROLLMENT RATIOS IN 49 STATES AND 65 LAND-GRANT INSTITUTIONS WITH STATE POPULATION CHARACTERISTICS (ACADEMIC YEAR 1978/79)

State Population Characteristics:	% Population in College Age (18-24) Enrolled in: All Colleges of State	Public Colleges	LGI Enrollment as % of State Enrollment in Higher Education: All LGI's	Morrill I LGI's	Morrill II LGI's
% Minority Population	-.19	.12	-.17	-.08	.14
% Black Population	-.39	-.22	-.45	-.32	.24
% Life-long Residents	-.40	-.63	-.16	-.11	.02
Personal Income per Capita	.23	.21	.12	-.02	-.11
State Taxes per Capita	.03	.16	.03	-.02	.48
State Appropriations to Higher Education per Capita	.13	.51	.13	.09	.15
State Appropriations to Hi. Ed. per $1,000 Personal Income	-.04	.33	.02	.06	.14
Occupational Groupings as % of State Employment:					
% Professionals, Managers, Administrators	.44	.34	.03	-.01	-.10
% Sales and Clerical Workers	.37	.31	-.14	-.21	-.16
% Craft and Precision Workers	-.15	-.10	.00	.03	.16
% (non-farm) Operatives	-.28	-.41	-.28	-.26	.10
% Service Workers	.00	.12	.24	.20	.09
% Farmers and Farm-Workers	-.23	-.08	.26	.28	.01

Data Sources:
1) Statistical Abstract of the United States 1980 (101st ed.)
2) Statistical Abstract of the United States 1981 (102nd ed.)
3) Appropriations: State Tax Funds for Operating Expenses of Higher Education 1978-79, NASULGC
4) 1980 Census of Population, Detailed Population Characteristics, U.S. Department of Commerce

employed people, the lower the enrollment in colleges and universities. On the other hand, greater concentration of a state's employment in white collar jobs increases the likelihood of college attendance among its college age population. This same pattern can also be observed with respect to enrollment in public colleges and universities.

It should be kept in mind that the observed correlations can be interpreted in two ways. The greater prevalence of white collar workers among a state's labor force may be seen to generate more demand for college education as children of white collar families tend to be raised in an environment that values college education. On the other hand, greater enrollment in colleges or universities raises the proportion of people with the educational credentials necessary for many white collar jobs. Simple (cross-sectional) correlations between enrollment patterns and the occupational composition of a state's labor force does not allow to distinguish between these two (equally plausible) causal sequences.

It was assumed that higher per capita personal income would indicate a state population's ability to pay for college, just as higher per capita state appropriations to colleges and universities would indicate a state's commitment to higher education that would facilitate the enrollment of larger population groups. Yet both of these variables are only modestly related to the overall enrollment ratio ($r=.23$, for personal income as independent variable and $r=.13$, for state appropriations as independent variable). The modest correlation of per capita personal income with state enrollment may, in part, be the result of incomplete information. After all, affordability of higher education depends not only on income but also on cost, but data on average cost

per student in the 49 states were not available. In the case of per capita state appropriations to higher education it needs to be added that, while it does not seem to affect overall enrollment levels in higher education, it does affect greatly the proportion of students enrolled in public schools (r=.51). Apparently, private and public schools are largely substitutes for each other, i.e. these different modes of financing higher education do not affect overall enrollment levels. In fact, correlating the proportion of students enrolled in public colleges with the proportion of the college age population enrolled in all institutions of higher education yields a coefficient of r=-.13 for the 49 states. This even suggests that states with larger public enrollment have slightly lower overall enrollment levels.

The proportion of people in college age that are enrolled in higher education institutions also varies with mobility: The larger the percentage of the state population that resided in the state for its entire life, the lower the college enrollment (r=-.40). Racial composition of a state's population also matters: The larger the proportion of blacks in the state population, the lower the college enrollment ratios (r=-.39).

It was shown earlier that land-grant institutions are unusually large compared to the average institution of higher education in the 49 states under study. In the context of this discussion it is more important, though, that enrollment size differs greatly among LGI's. Part of this variation is due to differences in the population size of the states as well as differences in state enrollment. Larger LGI's

tend to be located in larger states (r=.40, population size; r=.37, state enrollment). But overall, the relationship between state enrollment and LGI enrollment is not that close as is exemplified by the still large variation of the relative enrollment size of the LGI's (see Table 6). In 1978/79 the 65 LGI's accounted -- on the average -- for 14.2% of their respective state enrollment with one school comprising only .5% of the state's student population and another having 60.7% of the state's enrollment in higher education. (The parallel figures for 1968/69 were: mean: 17.9%, minimum: .6%, maximum: 70.6%.) If one takes LGI enrollment as a proportion of overall state population or state population in college age, similar variation is observable. Thus the question arises, what factors not related to the size of a state's student population favor or disfavor enrollment in LGI's? Again, it seems reasonable to ask what are the special constituencies of LGI's that would favor them as opposed to other colleges or universities. A look at Table 7 reveals certain differences between the apparent constituencies of LGI's and higher education in general. While a larger proportion of professionals, managers, and administrators among a state's employed people seems to lead to larger enrollment in higher education, LGI's do not get an extra boost from this group. On the other hand, a strong farm population in a state does seem to provide additional support to the LGI's over other institutions of higher education. (The latter statement applies only to Morrill I LGI's.)

Table 7 also suggests small, but characteristic differences between Morrill I universities and Morrill II colleges. The land-grant colleges are less likely to attract children of professionals, service workers,

and farmers and more likely to attract children of craft and precision workers as well as (non-farm) operatives, when compared to Morrill I universities.

The analysis of growth and decline patterns among individual LGI's is based on assumptions similar to those for the previous analysis of enrollment size. Enrollment growth or decline is expected to be linked to the growth and decline of constituencies that favor higher education in general and LGI's in particular. It has already been established that LGI's exhibited large differences regarding their growth rates in student enrollment from 1968 to 1978 (see Table 5, previous chapter). To explain some of the observed variation in enrollment growth or decline, it is important to distinguish "demand" changes that depend on factors over which an individual institution has little or no control from "demand" changes that reflect an institution's policies designed to recruit additional students. As previously discussed, changes in the social composition of a state population may increase or diminish the chances of a college to attract students. They will be treated as "demand" changes beyond the control of an individual institution. The recent nationwide decline in the size of the population cohort in college age is a case in point. Unless special efforts are made to attract non-traditional students, many colleges will inevitably face shrinking enrollment.

There is an additional complication that must be addressed in discussing the impact of changes in state economic and social conditions on enrollment changes in land-grant colleges and universities. While

all LGI's rely on state appropriations as a major source of revenue, there is considerable variation in the degree of dependence or independence from state resources (see data in Table 3, previous chapter). But it is to be expected that schools that receive lower proportions of their revenues from state appropriations and attract larger contingents of out-of-state students are less subject to economic and demographic changes within a state. Thus it can be assumed that growth patterns in Morrill I LGI's, which are generally large research-oriented institutions that receive comparatively less state support, are less dependent on changes in state economic and social conditions than growth patterns of the smaller Morrill II LGI's. Despite these differences between the two groups of LGI's, both school types should find it easier to expand enrollment when demand for higher education increases in general. Such increased demand may result from growth in the state population. It may be due to growth in state appropriations to higher education that go beyond state enrollment increases, thus diminishing the costs of education to be borne directly by the students. Or it may be the result of increases in average personal income in a state, since this would improve the average family's ability to finance a college education.

A changing occupational composition of a state's labor force can also be expected to influence enrollment patterns. In particular, children of people with college education are more likely to attend college than children of parents without college training. Since the amount of college training varies between occupational categories such that manual workers are the least college trained and professionals

exhibit the highest degree of academic training, increases in the proportion of professionals in a state's labor force should lead to greater enrollment in higher education while growth (or relatively slow decline) in the proportion of manual workers should have just the opposite effect. However, changes in the occupational composition of a state's labor force cannot be expected to have a uniform effect on enrollment in all institutions of higher education, because these institutions appeal to different kinds of students. In particular, Morrill I LGI's with their greater emphasis on research and graduate education are more likely to attract academically oriented students while Morrill II LGI's are four-year colleges that appeal to students who are more interested in practical and occupational training. Assuming that children of professionals are better prepared for and are more likely to aspire to academic training, an increase in the proportion of professionals in a state's labor force should benefit the land-grant universities more than the land-grant colleges. Finally, LGI's have special ties to the farm interests in a state, thus growth in this sector can also be expected to benefit their enrollment. Most of the previous discussion may be summarized in the following hypothesis.

Hypothesis #1: Variations in the growth rates of student enrollment among land-grant institutions depend on:

a) growth rates of state populations;

b) growth rates of per capita personal income;

c) changes in state appropriations to higher education;

d) changes in the proportion of blacks of state populations;

f) changes in the proportionate size of the following occupational groupings: 1) professionals, managers, and administrators, 2) manual workers, 3) farmers and farm-laborers;

g) growth in the # of 4-year public colleges; and

h) the enrollment size of the LGI at the beginning of the growth period in question (1968).

A test of this hypothesis will be carried out in several stages. Firstly, data analysis will be performed seperately for the 49 Morrill I LGI's and the 16 Morrill II LGI's with the independent variables referring to the respective 49 and 16 states. This procedure is necessary not only because changes in state characteristics are expected to exert somewhat different influences on the two types of institutions, but also because in a pooled data analysis state variables for the 16 states with both a Morrill I and a Morrill II LGI would be introduced twice. Secondly, in order to gauge the loss of predictive power when crossing aggregation levels from the level of state to that of the individual institution, effects of changes in state characteristics on enrollment changes in LGI's are compared to the effects of the same state characteristics on changes in state enrollments as a whole. In keeping with the assumptions, these latter effects are expected to be much stronger.

Finally, a more technical note: All the change variables are presented as ratios of two values. The figure in the numerator refers to a measured characteristics for 1978, 1979, or 1980. The figure in the denominator refers to the equivalent measure for 1968, 1969, or 1970 a decade earlier. Such ratios have the following properties: If Measure(78-80)/Measure(68-70) > 1, then growth has occured during the decade. If Measure(78-80)/Measure(68-70) < 1, then a decline has occurred. If this ratio = 1, no change is observable. One advantage of such ratios is that they are always positive even in cases when variables have declining values over time. This avoids the problems of non-interpretability that occur when percent change ratios have negative denominators.

Table 8

Table 8 displays zero-order correlations between changes in state population characteristics and enrollment changes that are expected to depend on them. A look at columns 1 and 2 seems to confirm the expectation that changes of population characteristics have stronger impacts on state enrollment patterns than on enrollment in individual institutions. Only in one case does a population characteristic -- the proportion of professionals, managers, and administrators in the labor force -- affect enrollment in the Morrill I universities to a greater degree than enrollment in all colleges of a state. Columns 3 and 4 show a somewhat different pattern. Changes in state population characteristics generally have greater effects on enrollment in the Morrill II

TABLE 8: ZERO-ORDER CORRELATIONS BETWEEN ENROLLMENT CHANGES IN STATES AND LAND-GRANT INSTITUTIONS AND CHANGES IN STATE POPULATION CHARACTERISTICS (1968/1970 TO 1978/1980)

Changes in State Population Characteristics:	Enrollment Changes (1968-1978) in: Morrill I States (N=49)	Morrill I LGI's (N=49)	Morrill II States (N=16)	Morrill II LGI's (N=16)
Population growth (1969-1979)	.58	-.04	.37	-.13
Growth in per capita personal income (1969-1979)	.11	.02	-.02	-.29
Growth in per capita state appropriations (1969-1979)	.48	.14	.48	.54
Changes in the proportion of black population (1969-1979)	.43	-.16	.14	.37
Growth in the proportion of professionals, managers, and administrators (1970-1980)	.09	.18	.58	.14
Changes in the proportion of (non-farm) operatives (1970-1980)	-.37	-.10	-.59	-.36
Changes in the proportion of farmers and farm-workers (1970-1980)	.16	-.12	-.22	.19
Growth in # of 4-year public colleges over state enrollment growth (1969-1979)		-.17		-.37
State enrollment 1968	-.14		.07	
LGI enrollment 1968		-.35		-.39

Data Sources:
1) Statistical Abstract of the United States 1970 (91st ed.) and 1980 (101st ed.)
2) 1970 and 1980 Census of Population, Detailed Population Characteristics, U.S. Department of Commerce
3) Education Directories 1968-69 and 1978-79, NCES
4) Fall Enrollment in Higher Education 1968 and 1978, NCES
5) State Tax Funds for Higher Education 1978-79, The Chronicle of Higher Education

colleges confirming the assumption that the greater dependence of these colleges on state resources makes them also more dependent on such changes. Changes in three state characteristics seem to evoke greater enrollment responses among Morrill II colleges than other schools of the same states. Enrollment changes in these colleges are particularly sensitive to changes in the proportion of blacks in a state population -- a fact that is not surprising given that blacks make up the majority of students in the Morrill II schools. Enrollment in the 16 colleges also seems to benefit more strongly than in other colleges from growth in state appropriations. At first sight somewhat surprising though, is the negative correlation between growth in per capita personal income and enrollment changes in the 16 4-year LGI's. It looks as if increases in prosperity in the 16 southeastern states lead to declining enrollment in these colleges. A comparison with the 16 Morrill I universities in the same states helps to clarify the picture. Enrollment increases in these institutions are greater the larger the growth in personal income ($r=.46$). Apparently, growth in prosperity in the 16 states leads to an enrollment shift from the predominantly black 4-year colleges to the predominantly white universities.

Most of the signs of the correlation coefficients in Table 8 indicate relationships of an expected direction. However, the negative correlation between changes in the proportion of farmers and farm-workers and enrollment changes in the Morrill I universities (weakly) implies that LGI's in states with the fastest growing agricultural labor force faced lower increases or even declines in enrollment. One reason for this unexpected finding might be the unreliability of one of the

involved measures. Since farmers and farm-workers in many states comprise only a very small proportion of the labor force, changes in this occupational grouping may have no discernable impact on enrollment in land-grant institutions.

Table 8 also shows that larger colleges and universities grow at a slower pace. The correlations between the initial enrollment size in 1968 and enrollment growth from 1968 to 1978 are r=-.35 for the land-grant universities and r=-.39 for the land-grant colleges. It is interesting to note that this negative relationship between initial enrollment size and enrollment growth does not seem to hold on the state level (r=-.14 for all 49 states and r= .07 for the 16 Southeastern states). Apparently, individual institutions encounter limits to growth not present in state higher education systems as a whole. As a result, when state enrollment in higher education increases, there is a tendency towards decentralization of the state system. New schools are likely to be founded in addition to enrollment expansion in existing institutions. Not surprisingly, greater competition from additional colleges tends to lower the growth rate of a given school. Yet as the data in Table 8 show, competition from new 4-year public colleges has greater effect on the Morrill II colleges (r=-.37) than on the Morrill I universities (r=-.17).

Table 9

Table 9 gives the results of multiple regression analyses that include all the mentioned predictor variables of state and college

TABLE 9: MULTIPLE REGRESSION ANALYSIS TO PREDICT CHANGES IN ENROLLMENT FROM CHANGES IN STATE POPULATION CHARACTERISTICS (1968 TO 1978)

1) Dependent Variable: Growth in Stud. Enrollment in 49 Morrill I LGI's

Independent Variables:	Beta	R(squared)
Growth in the proportion of professionals	.04	.033
Changes in the proportion of blacks	-.19	.062
Growth in per capita state appropriations	.19	.085
Changes in the proportion of operatives	-.17	.091
Population growth	-.11	.094
Changes in the proportion of farmers	-.10	.097
Growth in per capita personal income	.00	.097

2) Dependent Variable: Growth in Stud. Enrollment in 16 Morrill II LGI's

Independent Variables:	Beta	R(squared)
Growth in per capita state appropriations	1.12	.296
Growth in per capita personal income	-.94	.568
Changes in the proportion of farmers	-.09	.608
Changes in the proportion of operatives	-.69	.644
Growth in the proportion of professionals	-.65	.656
Changes in the proportion of blacks	-.85	.724
Population growth	-.15	.732

3) Dependent Variable: Growth in Stud. Enrollment of 49 States

Independent Variables:	Beta	R(squared)
Population growth	.66	.335
Changes in the proportion of blacks	.26	.541
Growth in per capita state appropriations	.31	.633
Changes in the proportion of operatives	-.06	.684
Growth in the proportion of professionals	.18	.693
Changes in the proportion of farmers	.19	.708
Growth in per capita personal income	.01	.708

4) Dependent Variable: Growth in Stud. Enrollment of 16 States

Independent Variables:	Beta	R(squared)
Changes in the proportion of operatives	-.61	.352
Growth in per capita state appropriations	.42	.665
Population growth	.27	.780
Growth in the proportion of professionals	.31	.793
Growth in per capita personal income	.41	.803
Changes in the proportion of farmers	.21	.811
Changes in the proportion of blacks	-.17	.813

enrollment growth. The order in which predictor variables were entered into the regression equations depended on their contribution to the variance accounted for in the dependent variable. This procedure was chosen because no theoretical considerations suggested a particular order. The choice of low tolerance levels allowed for the inclusion of all predictor variables under consideration, even if in some cases the inclusion of an additional independent variable only minimally contributed to reducing the error variance.

The seven measures of state population characteristics together seem to be remarkably strong predictors of enrollment changes in a state's institutions of higher education. The variables account for 70.8% of the variance in enrollment changes in all 49 states and 81.3% of the variance among the 16 southeastern states with two land-grant schools. (Note: One of the standardized regression coefficients in the second equation equation presented in Table 9 exceeds unity: Beta = 1.12. Given the small number of cases (N=16) and the large number of independent variables (8) there is an obvious multicollinearity problem here. But since the purpose of the procedure is to measure overall predictive power of the independent variables combined, rather than to ascertain the relative contributions of individual variables, this problem may be disregarded.)

In contrast to the foregoing, the seven measures of state population characteristics are fairly poor predictors of enrollment changes in the case of Morrill I LGI's. All independent variables together here account for only 9.7% of the variance in the dependent variable. On the other hand, a look at the second regression in Table 9 shows that

enrollment changes in the 16 land-grant colleges closely follow changes in social and economic characteristics of state populations. In this case, all the predictor variables account for 73.2% of the variance in school enrollment changes. The reduction in predictive power compared to the case of state enrollment changes (81.3%) is not very large. Again, this conforms to the initial assumption that the land-grant colleges are more subject to changes in the state environment than the land-grant universities.

The first and second regressions in Table 9 do not include all the independent variables that were included in Hypothesis # 1. The addition of a variable representing the growth in the number of public 4-year schools in a state raises the predictive power of the first regression equation from 9.7% to 12.2% of the accounted variance. For the second regression equation R(squared) changes from 73.2% to 79.8%. For both land-grant colleges and universities, increased competition within a state make enrollment expansion more difficult, but it is noteworthy that the effect is somewhat stronger in the case of the Morrill II colleges -- again confirming their vulnerability to changes in the state environment. Finally, the further inclusion of the 1968 enrollment size of LGI's does not yield important changes in the case of the 16 colleges as variance accounted for is raised from 79.8% to 80.3%. Yet enrollment size in 1968 is an important predictor of growth in the case of the 49 land-grant universities. The overall predictive power of the first regression (including the growth-in-number-of-colleges variable) is raised from 12.2% to 28.5%. There seem to be two major interpretations of this finding. A first interpretation would stress

that all the environmental variables were measured at the state level. The fact that they together can hardly explain enrollment changes in the land-grant universities (12.2% of the variance is all they can account for) only implies that the relevant environment was misspecified. But enrollment size in 1968 can itself be interpreted as a measure of "market-penetration" of an unspecified environment. Looked at it this way, a negative correlation indicates that larger universities find it increasingly difficult to grow in the face of more "hostile" environments, i.e. they experience "diminishing returns" in their efforts to expand enrollment (Boulding, 1953). Another way of looking at the same facts would stress that -- maybe -- environmental constraints on the growth of large research universities are indeed not severe because dependence on any one source of support is limited thus leaving more room for strategic choices. In this context, large size of a university should be negatively correlated with growth, because internal barriers -- such as increased differentiation and complexity -- make expansion increasingly difficult (Blau, 1973; Boulding, 1953).

Earlier in this chapter, a distinction was made between "demand" changes that are beyond the control of an individual institution and "demand" changes that are, at least in part, a response to policies adopted by an institution. Although this study contains no data that can be used as direct evidence concerning institutional policies, some indirect evidence is available. As the data in Table 4 (previous chapter) show, enrollment of non-traditional students such as women, part-time students, and graduate students has grown faster from 1968 to

1978 than enrollment in the traditional category of full-time male undergraduate students. This fact can also be expressed somewhat differently. In fall 1968, enrollment of full-time male undergraduate students accounted for 38.9% of total enrollment in all colleges and universities of the 49 states under study. By fall 1978, the proportion of students in this category had fallen to 31.2%. In the same period, women's enrollment rose from 40.4% to 49.9%, part-time enrollment from 29.8% to 41.3%, and graduate enrollment from 12.7% to 13.4%. It must be emphasized that, while these figures refer to aggregate changes in the 49 states, they reflect a nationwide trend that was similar in all states. As has already been pointed out in the last chapter, this shift in enrollment patterns is also apparent in the land-grant institutions. The figures in Table 5 (previous chapter) showed that, on the average, enrollment in every non-traditional student category grew faster than enrollment of full-time male undergraduates. However, for every student category the standard deviations of enrollment changes are a multiple of the mean enrollment changes, suggesting large variations among the LGI's. Apparently, some institutions have been better able to capitalize on growth markets than other schools. Since these differences in the ability to attract new kinds of students do not seem to be the result of differences in the environment, it is reasonable to assume that they reflect policy choices, i.e. they reflect differences in efforts to recruit new student groups. If this assumption is valid, the readiness with which colleges have embraced new categories of students can be measured in terms of ratios of enrollment growth in non-traditional student groups to enrollment growth for full-time male undergra-

duates. This measure would then allow for testing the proposition that enrollment in colleges and universities grows faster, if policies are geared towards recruiting non-traditional students. The following hypothesis summarizes the expectations:

Hypothesis #2: The larger the increase in enrollment of women, part-time students, and graduate students relative to the increase in the traditional student group of full-time male undergraduates, the larger will be the overall enrollment increases.

To test this hypothesis, double ratios analogous to the ones employed in the previous section were used. For example, one independent variable consists of the following ratio: (Women's Enrollment 78/ Women's Enrollment 68)/(FT Male Undergraduates 78 /FT Male Undergraduates 68). This ratio has the same properties as the simple ratios, i.e. a value > 1 indicates women's enrollment grew faster than enrollment of full-time male undergradutes, a value < 1 indicates the opposite, and a value = 1 indicates equal growth rates in both student categories. As previously, the ratios must always be positive.

Table 10

Table 10 gives the results of separate analyses for the Morrill I and Morrill II LGI's. The analysis for the 49 land-grant universities confirms the hypothesis. The zero-order correlations show that those

TABLE 10: ZERO-ORDER CORRELATIONS AND MULTIPLE REGRESSIONS TO PREDICT CHANGES IN OVERALL ENROLLMENT FROM RELATIVE CHANGES IN ENROLLMENT SUBCATEGORIES (1968 TO 1978)

a) ZERO-ORDER CORRELATIONS

Relative Changes (1968-1978) in Non-Traditional Enrollment Categories:	Enrollment Changes (1968-1978): Morrill I LGI's (N=49)	Morrill II LGI's (N=10)*
Change in Women's Enrollment/ Enrollment Change of Full-Time Undergraduate Men	.83	-.18
Change in Graduate Enrollment/ Enrollment Change of Full-Time Undergraduate Men	.41	-.08
Change in Part-Time Enrollment/ Enrollment Change of Full-Time Undergraduate Men	.40	-.07

* Missing values for independent variables reduce # of cases from 16 to 10

b) MULTIPLE REGRESSIONS

Dependent Variable: Change in Stud. Enrollment of 49 Morrill I LGI's

Independent Variables:	Beta	R(squared)
Relative change in women's enrollment	.78	.684
Relative change in graduate enrollment	.20	.761
Relative change in part-time enrollment	.00	.761

Dependent Variable: Change in Stud. Enrollment of 10 Morrill II LGI's*

Independent Variables:	Beta	R(squared)
Relative change in women's enrollment	-.18	.031
Relative change in graduate enrollment	.01	.032
Relative change in part-time enrollment	.00	.032

* Missing values for independent variables reduce # of cases from 16 to 10

institutions that attracted more non-traditional students also enjoyed higher than average expansion in overall enrollment. As can be seen from the multiple regression, increased enrollment of part-time students does not show any seperate effect, as most of this enrollment increase is due to the greater enrollment of women. Thus, universities that have been slow to open up to women and to expand their graduate programs suffered a relative decline in enrollment growth. The pattern for the Morrill II LGI's is quite different and does not confirm the analysis. Because of missing data for two of the independent variables, only 10 cases could be included in this analysis making the results highly unreliable. Nonetheless, the pattern that emerged does show consistency with other results and is highly suggestive. A major difference between the land-grant universities and the land-grant colleges is the already high proportion of women enrolled in the colleges by 1968. Women's enrollment in fall 1968 accounted for 50.9% of enrollment in the average Morrill II college, and that proportion fell slightly to 50.8%. The differences in enrollment patterns between the land-grant colleges and the land-grant universities can be traced to the differences in the racial composition of the student bodies of the two types of schools. The colleges mainly enroll black students, but black women have traditionally achieved better educational training than black men. This fact is, for example, reflected in the graduate enrollment of the Morrill II colleges, where women make up a larger proportion than men, whereas graduate students in the predominantly white Morrill I universities are mostly male. One result of these different patterns is that, among black students, women's college enrollment was not a particular growth

market in the 1970's as black women had already obtained "parity" with black men. Thus, in the context of student enrollment of predominantly black colleges, women cannot be considered a non-traditional student category. However, part-time students and graduate students are non-traditional student categories for the Morrill II land-grant colleges. Yet even when the effects of changes in women's enrollment are partialled out, disproportionate increases in the number of part-time students or graduate students do not lead to overall increases in enrollment of Morrill II schools. The argument underlying Hypothesis #2 thus does not seem to apply to the 10 colleges.

A comparison of the two types of land-grant institutions with respect to Hypotheses #1 and #2 yields some additional insights. Enrollment changes in land-grant universities cannot be predicted well from changes in state population characteristics (all state variables account for only 9.7% of the variance - see Table 9, equation 1), but differential recruitment of non-traditional students accounts for 76.1% of the variance in enrollment changes over the decade (Table 10b). The pattern for the Morrill II schools shows just the opposite. Here, enrollment changes are heavily dependent on changes in state population characteristics (they account for 73.2% -- see Table 9, equation 2), but differential recruitment of non-traditional students does not account for much (3.2% of the variance -- see Table 10b). If the regression analyses are reliable despite the very small number of cases for the Morrill II schools, it seems to suggest the following interpretation: The larger, research-oriented universities are less subject to environmental constraints, and policy choices made by their adminis-

trators largely influence their enrollment patterns. Smaller four-year colleges such as the land-grant colleges have less means to change enrollment patterns through their own policy choices. Instead, they are rather strictly limited by trends and developments in their environment.

CHAPTER IV

INSTITUTIONAL SIZE AND SOME CONSEQUENCES FOR RELATIONS TO THE ENVIRONMENT

In the previous chapter, it was argued that larger universities may be less dependent on their environments than smaller colleges. This proposition was put forward as one possible explanation for the fact that changes in population characteristics of states do not seem to influence enrollment patterns in the large land-grant universities. In this chapter the effects of organizational size on an organization's relations with its environment will be explored somewhat further.

All organizations are, of course, "dependent" on their environments in the sense that they are engaged in exchange relationships with other organizations or individuals that provide them with the resources necessary for survival. But such a statement is trivial and not very useful in distinguishing degrees of dependency that may be linked to variations in other organizational characteristics. Another reason why statements about environmental dependence -- or independence -- in general can be quite misleading is that they do not take into account the multi-dimensionality of relations between organizations and their environments. For instance, colleges and universities are generally in a more powerful bargaining position vis-a-vis faculty in the humanities than faculty in engineering or medicine. This is due to the fact that relatively few non-academic employment opportunities exist for people trained in the humanities whereas, in the case of engineers and medical

doctors, colleges must compete against well-paying private industry. As this example shows, the concept of dependence needs to be refined.

The more specific concept of dependence that is used in the literature on social exchange (Emerson, 1962 and 1975; Blau, 1964) seems to provide a better understanding of an organization's relationships with its environment (Cook, 1977). It is not claimed that all, or even most, relationships between colleges and their environments can be understood in terms of exchange relations. Often they lack the element of voluntariness as in the case of legally mandated actions. Or "exchange" involves benefits for third parties as in the case of students who are beneficiaries of state appropriations. Despite these complications, the definitions of dependence and power in the social exchange literature can be useful in understanding the relations of colleges and universities with their environments.

The degree to which an organization is considered dependent on any one organization or individual in its environment varies with:

a) the "importance" (i.e. substitutability) of the resource to the focal organization,

b) the proportion of the resource received from the particular provider, and

c) the substitutability of the provider (e.g. the availability of alternative providers of a particular resource).

It is important to keep in mind that "dependence" here refers to particular exchange relations with specific providers of clearly defined resources, not to general "dependence on the environment". And "environment" refers to all those organizations and individuals, not

subject to the focal organization's authority, with which or whom it maintains relationships. If the problem of properly weighting the "importance" of various resources to an organization could be solved, it should be possible, at least in principle, to construct an overall index of environmental dependence for any organization.

Using the foregoing concept of dependence, the relationship between organizational size and an organization's dependence on its environment can be further explored. The following empirical generalization -- despite its apparent triviality -- may serve to advance the argument.

Hypothesis #3: Larger colleges and universities receive funding from a larger set of sources than smaller institutions.

The importance of this hypothesis lies in the fact that it hints at a structural property (Blau, 1977) of large organizations in general. If such organizations rely on larger numbers of resource providers for most resources, the inevitable consequence is that the proportionate contribution of the average resource provider declines. According to the previous definition of dependency, this should lead to greater independence of larger organizations from their environment.

An empirical test of Hypothesis #3 appears straightforward. The only difficulty lies in finding a measure for the number of resource providers. Because there are no data containing a count of the number of all funding sources of a school, the measure chosen here is the number of departments of the federal government that have given grants to the 65 land-grant institutions during the academic years 1968/69 and

1978/79. Correlating this measure with the number of full-time and part-time students as a measure of size yields zero-order correlations of r=.73 for 1978/79 and r=.71 in 1968/69. This indicates that larger schools do indeed rely on a larger number of funding sources. Both the number and average size of grants provided by departments of the federal government depend to a large degree on an institution's capacity for research which, in turn, correlates positively with institutional size. It is, therefore, desirable to control for this confounding effect. When the proportion of graduate students in all LGI's is controlled for, the partial correlations between institutional size and number of federal fund providers amount to r=.56 for 1978/79 and r=.58 for 1968/69. Using academic specialization and diversification within the LGI as a control variable (the measure employed -- the number of academic fields in which degrees were conferred -- was available only for 1978/79) reduces the first-order partial correlation between institutional size and number of federal fund providers to r=.41. Finally, the second-order partial correlation -- controlling both for academic specialization and emphasis on graduate education in LGI's -- still yields a magnitude of r=.33. Thus the data appear to confirm the hypothesis that larger LGI's receive funds from more sources.

While a larger number of fund contributors, by necessity, reduces the proportionate contribution of the average contributor, the following hypothesis also assumes that the proportionate contribution of the largest donor declines.

Hypothesis #4: The contribution of the largest donor is a smaller proportion of total revenues in larger schools than in smaller schools.

This hypothesis about the power of the largest contributor is important because statements about the declining power of the average contributor may be misleading, if the support pattern turns out to be highly asymmetric and if one wants to draw inferences about a university's or college's independence from its "environment". In the case of land-grant institutions, appropriations by state legislatures are, by far, the largest single source of funds. 61 of the 65 institutions included in the study received more funds from their state than from any other source. In two schools tuition and fees provide the largest source of funds (with state funds being a close second), but it can be argued that the payment of tuition and fees does not bestow much power on students over their school. Unified collective action on the part of the students is generally difficult because of their large numbers and high turn-over rates (Olson, 1965). For two LGI's federal funds were the most important source of revenues. But most federal funds to colleges and universities come in the form of grants and contracts awarded for specific projects over a limited period of time. These funds are disbursed by a myriad of agencies and departments, each issuing its own set of regulations and establishing its own criteria for rules of compliance. It is precisely this decentralized -- some would say, haphazard -- approach to federal funding of higher education that has led to the inordinate complexity of federal rules and regulations.

Not surprisingly, bureaucracies had to be expanded within colleges and universities to cope with new administrative demands (Bender, 1977). But external control of colleges and universities in the sense of outside agencies usurping authority over decisions in areas such as personnel, budget, or program development is "most evident at the state level" (Ostar, 1977, p.16). This is clearly a result of differing funding methods by federal and state governments. Federal funds are not disbursed by a single policy body nor are they usually a long-term, continuous source of funding to a college or university. In contrast, state appropriations are not only a large, but also a steady source of funding for all land-grant institutions, a condition that should increase the donor's willingness and ability to impose policy preferences of its own.

Under these circumstances, Hypothesis #4 implies that state appropriations as a proportion of total revenues decline in larger institutions. The degree of independence from environmental pressures should thus increase with organizational size.

Correlational analysis for all 65 LGI's supports the hypothesis. The zero-order correlation between the proportion of current funds revenues provided through state appropriations (for the academic year 1978/79) and organizational size (fall enrollment 1978) yields r=-.18. Since larger schools with their stronger emphasis on graduate education can be expected to receive more state funds -- graduate training being more expensive -- controlling for the proportion of graduate students should yield a stronger negative correlation between institutional size and reliance on state appropriations. Indeed, the first-order partial

correlation increases to r=-.26. Thus, Hypothesis #4 appears confirmed: Larger LGI's rely (proportionately) less on state appropriations and, by implication, enjoy greater independence from their largest resource provider.

The basic assumption made in this chapter is that larger organizations in general, and larger LGI's in particular, enjoy greater independence from or greater power over specific segments of their environments. One possible measure of such power is the ability of a land-grant institution to extract funding from state legislatures. The following hypothesis attempts to address this problem:

Hypothesis #5: Large schools are able to extract disproportionately larger state funds per student from the state legislature.

This hypothesis needs to be clarified. The first problem in question concerns the appropriate comparison group. There is obviously not much sense in comparing LGI's across states, as state appropriations per students vary widely among the 49 states. In the academic year 1978/79 the 49 states appropriated, on the average, $2,039 for every student enrolled in a public college or university. But while the state with the lowest expenditures spent no more than $1,192 per student, one state allowed for a maximum of $3,075 per student (St.Dev. = $440). In order to compare land-grant institutions in their ability to extract funds from state legislatures, one needs a measure of their prowess relative to all other public colleges and universities within their

respective states. The following ratio may serve as such a measure: per student state appropriations to the LGI (1978/79)/average per student state appropriations to all public institutions of higher education (1978/79). Hypothesis #5 then implies that larger LGI's receive higher per student funding compared to other public schools in their states than smaller LGI's compared to other public schools in their respective states.

An additional problem arises because of differences in the organizational status of LGI's within the various state systems of higher education. In an earlier chapter it was mentioned that many LGI's do not directly negotiate appropriation levels with their respective state legislatures. In fact, only 26 land-grant schools are independent institutions whose presidents deal directly with the state legislatures. The test of Hypothesis #5 will be confined to these 26 schools, as only they can independently act as legislative interest group.

The zero-order correlation between the ratio measuring the relative success of an institution to obtain higher funding levels per student and organizational size (enrollment in fall 1978) yields r=.38. A possible intervening variable, that may account for all or part of this positive correlation, is emphasis on graduate education within an institution. As in all 65 LGI's, larger institutions among the 26 independent schools tend to have a higher proportion of graduate student enrollment (r=.66). And state legislatures tend to appropriate slightly more money per student to schools with greater emphasis on graduate education (r=.31). But even when this effect is taken into account,

there still remains a (modest) positive correlation between the size of an institution and its ability to secure relatively high state appropriations as exemplified by a first-order partial correlation of r=.25. While the size effect appears rather weak it does seem to lend some credence to Hypothesis #5.

A final point of possible confusion needs to be addressed. Hypotheses #4 and #5 do not necessarily contradict each other. It is possible for an institution to receive higher per student funding from the legislature and, at the same time, to finance a smaller proportion of its overall budget out of these state funds. This is, indeed, the case for the 26 independent LGI's. As has just been shown, the larger ones among them enjoy higher state appropriations but size is, nonetheless, negatively correlated with the proportion of revenues received from the state legislature (r=-.20). This situation implies, of course, that larger schools receive even greater funds from other sources.

CHAPTER V

INSTITUTIONAL SIZE AND EFFICIENCY: ECONOMIES OF SCALE IN LAND-GRANT INSTITUTIONS

So far, the analysis has focused on determinants of institutional size (chapter 3) and consequences of institutional size for the relationship of organization to environment (chapter 4). While research on both of these topics is still somewhat sporadic, the literature on internal organizational impacts of organizational size has been rather voluminous. Mainly two types of impacts have been investigated. Internal structural changes that result from changes in institutional size have been the focus of a largely sociological literature (Blau & Schoenherr, 1971; Blau, 1973; Scott, 1975; Kimberly, 1976). The problem of changes in organizational efficiency as a result of changing organizational size has mainly been treated by economists in the industrial organization literature (Bain, 1956; Bain, 1968; Scherer, 1980; Gold, 1981).

Structural change refers to changes and adjustments in organizanal components. Examples of such components include organizational subunits like departments or colleges in universities or personnel categories like faculty, clerical staff or administrators. Structural change then implies changes in the relative size or proportion of various organizational components.

Organizational efficiency must be treated seperately from the problem of structural change, even though changes in efficiency quite

typically involve structural changes. This is so, because enhanced efficiency is often the result of a new division of labor within an organization (Gold, 1981) which, by definition, implies structural change. On the other hand, not every structural adjustment will result in greater efficiency.

Efficiency denotes a comparative performance standard. It refers to the ability of a productive organization to convert inputs into outputs with relatively little waste. Degrees of efficiency are "measured by the relationship of attained unit costs to the minimum attainable unit costs of production" (Bain, 1968: p.165). But contrary to this definition, there are no absolute standards of efficiency as implied by the reference to "minimum" costs. An organization A is more efficient than an organization B if it produces a given output with less resources (inputs) or if it produces a larger output with a given amount of inputs. "Economies of scale" obtain when efficiency gains can be realized because of factors associated with increases in organizational output or production.

While these theoretical definitions of efficiency and economies of scale seem clear enough, it is actually not easy to compare different organizations with respect to their efficiency. One problem to be overcome is the lack of a common physical index of efficiency applicable across organizations (Gold, 1981). One could, for instance, study the relative energy efficiency of two steel mills by comparing the ratios of steel output for a given period to energy input for that same period. If it turned out that the larger plant needed less energy input per ton of steel produced, one may talk of scale economies concerning energy

consumption. Yet if, in order to achieve those economies, the larger plant had to rely on more capital equipment and/or more personnel the problem arises as to how to weight savings in energy against the additional need for machines or personnel. The answer is, of course, that one needs a measure of inputs that would allow one to express the various quantities of heterogeneous inputs in a single index number. Economists use input prices or costs as the basis for comparing different inputs on the assumption that prices reflect the relative scarcity of all the inputs (Samuelson, 1980). On this assumption, lowering costs entails economizing on relatively scarce (i.e. expensive) inputs. Economies of scale would occur, if the average or unit cost of production fell with increasing production.

As in the case of inputs, it is also necessary to find a measure of "scale of production" or output that is applicable to all the production organizations one wants to compare. Only then is it meaningful to calculate unit or average costs. But as with inputs, outputs may also be quite heterogeneous. For instance, it would not make much sense to compare the average (per car) production costs of two automobile manufacturers if there are large differences in the design and quality of the cars. Strictly speaking, only firms (or organizations in general) that produce fairly similar outputs are comparable (Gold, 1981).

To determine whether or not economies of scale exist among colleges and universities (i.e. whether larger schools are more efficient than smaller ones) poses both conceptual and measurement problems. While it is possible to conceive of the activities of educational institutions as a "production process" (Hough, 1970), a major difficulty lies in

specifying what exactly these institutions produce. For one thing, outputs of colleges and universities are quite heterogeneous (Astin, 1970). They train students, produce research, offer public services or sell products and services through dairy facilities, veterinary clinics or hospitals. But there is no easy way to determine the value of these outputs as many are not sold at the market (Adams et al., 1978). Especially in the case of instructional and teaching outputs the valuation problem is quite severe. Ideally, one would like to have an institutional performance measure that reflects the contribution of the college or university (or "value added") to the students' later "success" in life. But no unequivocal measures exist. The use of earnings differentials between college graduates and people without college training as indicators of value added requires the assumption that the benefits from college education will be fully reflected in later earnings. In addition, this research approach encounters a difficult problem of empirical analysis: College graduates and non-graduates are also likely to differ on other characteristics that are relevant for their respective economic chances (Verry & Davies, 1976). Achievement tests administered before and after the college education may, indeed, measure a school's capacity to improve a student's ability to perform well on the tests. But there is no strong indication that test scores are good predictors of later "success" in life (Jencks et al., 1970). Another problem associated with the use of tests is that standardized tests become less and less useful the more advanced and specialized an educational program becomes.

Whatever output measure is used, comparing different institutions

is also complicated by the fact that output mixes vary widely among schools. In particular, output mixes are likely to vary systematically with size of an institution. Larger schools tend to have a more diversified output engaging in more fields of study. They are more likely to have professional schools some of which, like medical and dental schools, are very expensive to maintain. They concentrate more on graduate education and, at least among the land-grant institutions, larger schools tend to be of somewhat higher quality.

Assuming for the moment that adequate output measures are available and that most of the mentioned complicating factors can be controlled for, one basic question still needs to be addressed. Why should economies of scale occur among colleges and universities? What are the sources of greater efficiency available to larger institutions but not to smaller ones? The literature on industrial organization is quite emphatic on the occurrence of economies of scale (Bain, 1968; Scherer, 1980). Especially intra-plant economies of scale are seen to result from increased specialization of the work process which entails the division of the work flow into ever simpler tasks. This process would allow for a more efficient utilization of labor (since individuals could achieve greater proficiency at simpler tasks) as well as give rise to greater opportunities for automation. However, the extent to which such routinized production processes can be employed does not only depend on the scale of production but also on the stability of the environment as detailed division of labor entails a loss of flexibility (Scherer, 1980; Thompson, 1967). It has been argued that increases in scale will ultimately result in diseconomies generated by more organizational

complexity and the need for greater coordination efforts (Blau & Schoenherr, 1971). In the same spirit, conventional economic analysis assumes that at some point unit or average cost of production increases with further expansion of production facilities (Gold, 1981). But as the case of General Motors shows, organizational innovations may stave off the point of diminishing returns to scale and allow even a very large organization to be efficient (Chandler, 1962). Whether universities, even the largest among them, are anywhere close to this point of diminishing returns cannot be determined a priori.

Specialization may be a source of increased efficiency in manufacturing or service organizations where subdividing the work flow can simplify the individual production task. But it is doubtful whether this model of efficiency gains due to specialization and automation can readily be transferred to the academic setting. Specialization in academics is an aspect of the product itself and not simply a characteristic of the production process. Greater academic specialization at a university means more curricular options from which the student can choose. It is therefore less a source of greater efficiency as it does not involve the simplification and routinization of given tasks. It also does not necessarily lead to greater functional interdependence as specialized academic work has a tendency to isolate rather than integrate academicians (Blau, 1973; Birnbaum, 1981) and team-work on research projects rarely involves more than a handful of researchers.

This is not to say that there are no sources of economies of scale in colleges and universities. For example, teaching can be rationalized

through the use of video equipment, the benefits of which are likely to be greater in larger schools since a single recorded lecture may reach many more students. Larger schools, with generally larger graduate enrollment, are also in a better position to substitute (cheaper) teaching assistants for (more expensive) faculty labor in the instruction of undergraduate students. Finally, the industrial model of economies of scale that explains greater efficiency in larger plants in terms of enhanced subdivision of the work process still seems applicable to the non-academic activities in academic organizations. Just as larger banks and retail firms may benefit from greater specialization of clerical tasks colleges and universities can lower costs through rationalizing administrative procedures or maintenance work.

An exploration of economies of scale in institutions of higher education needs to come to grips with two kinds of problems. As was previously discussed, the opportunities for efficiency gains in larger universities may vary according to the type of activity under consideration. Thus, economies of scale are least likely to be realized in research activities as individual researchers continue to be the basic "unit of production". Instruction shows somewhat greater promise of being amenable to more efficient organization, while administration appears most likely to benefit from division of labor and automation. It is therefore advisable to test for the presence of economies of scale both on an aggregated and somewhat disaggregated level of analysis.

A second problem arises from a consideration of organization-environment relations of colleges and universities. The arguments in favor of economies of scale are usually couched in terms of technical

feasibility: Large scale enables organizations to employ production methods that are more efficient than any methods available to smaller organizations. But what is technically feasible need not be adopted, unless there are compelling reasons to do so. In the case of private industry, "market-discipline" should usually provide the necessary incentive. But in the case of public universities, the matter is far from resolved. If -- as was indicated in a previous chapter -- larger land-grant institutions enjoy relatively greater freedom from environmental pressures, they may not be forced to adopt more efficient procedures.

Despite these ambiguities, a number of hypotheses concerning economies of scale in land-grant institutions will be formulated and tested. As already stated, economies of scale occur when unit or average costs of production decline as the scale of production (or output) increases. Ideally, average costs are computed by dividing the total of each expenditure or cost category by the number of units associated with the cost objectives or output (Adams et al., 1978). The output category, or measure of scale, chosen in the following analysis is the number of full-time equivalent (FTE) students. The main virtue of this measure is its easy availability which certainly accounts for its widespread use (Maynard, 1971; Verry & Davies, 1976; Hoenack, 1982). But it is necessary to keep in mind some of its shortcomings. The number of FTE students represents a rough measure of instructional load. It is a measure of institutional effort rather than performance. And it represents only a part of the total output of a college or university.

The main problem in using this measure in cross-sectional analysis stems from the fact that student populations of different schools vary widely in terms of the student categories they comprise. While an FTE measure already controls for varying ratios of full-time to part-time students, it does not control for differences in the composition of student populations by academic field, thus assuming that the training of a medical student and that of an English major are equally resource intensive. But only if there are systematic relationships between the size of a college or university and a tendency to invest in resource intensive academic programs and projects would an analysis of economies of scale be affected. While adequate data on differences in curricular emphasis among institutions were not available, casual observation does, indeed, suggest systematic variation by size. Expensive academic programs as offered by medical, dental, or veterinary schools tend to be concentrated in rather large institutions. Thus, any estimates of economies of scale that do not take these differences into account are likely to underestimate their true magnitude.

The cost data utilized in the following analysis are also somewhat problematic. They refer to the broad expenditure categories on the financial survey of HEGIS. While the HEGIS data for current funds expenditures generally exclude physical plant costs, other capital costs may well be subsumed under current funds expenditures, e.g. equipment is often financed out of these funds. Thus the data do not allow for distinctions between fixed and variable costs, operating and capital costs (Jenny, 1979).

The first hypothesis concerning economies of scale summarizes some of the arguments made earlier concerning the special properties of academic organizations with respect to the division of labor. Economies of scale in overall expenditures per student would appear to be small and should easily be offset by the higher quality of the larger land-grant institutions.

Hypothesis #6: a) Larger universities spend more money per student than smaller institutions.

b) After controlling for output diversification (greater academic specialization) and emphasis on graduate education and research, expenditures per student should be somewhat lower in larger schools.

The rationale for this hypothesis is twofold. In the case of colleges and universities, overall efficiency gains from a more detailed division of labor in larger organizations are expected to be modest because the latter may only be realizable in the organization of routine administrative tasks but not in "academic production". Because graduate education and research are activities that cannot be easily rationalized possible economies of scale in administration or plant maintenance may easily be offset. Hypothesis #6 does imply though that, among institutions with similar levels of emphasis on graduate education and research and a similar degree of academic diversification, larger schools should experience cost advantages as a result of more efficient utilization of resources. Whether or not such economies of scale

continue to be realized over the whole size range of land-grant institutions is an open question. In order to specify the particular nature of scale effects, three alternative regression models are compared. If a given increase in scale reduces average expenditures at a constant rate, a linear model ($Y=a+bX$, $b<0$) would yield the highest predictive power. If economies of scale are realized at a decelerating rate, implying that institutional growth for small schools leads to larger savings in average expenditures than institutional growth for larger schools, a semilog function ($Y=a+b(\ln)X$, $b<0$) should provide a better fit of the data. Finally, if economies of scale obtain in the lower size ranges, but diseconomies drive up average expenditures once an institution has grown beyond a certain size, a quadratic polynomial ($Y=a+bX+cX$(squared), $b<0$ and $c>0$) would best reflect this relationship (Kmenta, 1971; Archibald & Lipsey, 1976).

Data for testing Hypothesis #6 were obtained from the HEGIS Enrollment Survey (1978) and the HEGIS Financial Survey (FY 1979). In addition, the measure of academic specialization -- a count of all academic fields offered by an institution -- is based on data from the College Blue Book (17th ed., 1979). This measure appears to be biased in the sense that it overstates diversification in small colleges. Cross-checks with college catalogs lead to the conclusion that many smaller schools apply the designations "degree programs" or even "departments" to what turn out to be course offerings in a particular field by sometimes a single faculty member. Consequently, the following economies of scale estimates, after controlling for academic diversification, should err on the conservative side.

Table 11

Table 11 presents the major results of the data analysis. During the academic year 1978/79 average expenditures per full-time equivalent student amounted to $7,119 in the 65 land-grant institutions. But while one school managed to get by on $4,111 per FTE student, another school spent as much as $29,063 per FTE student. That average expenditures among LGI's vary a great deal is also conveyed by the standard deviation of $3,167. A first clue concerning the reasons for such large variations is presented in the table of zero-order correlations. The single most important factor that explains variations in average expenditures appears to be research orientation of an institution (r=.67). This is not surprising, as research orientation reflects, to some degree, the overall quality of a school. (For example, the zero-order correlation between research orientation, measured in terms of the proportion of current funds expended on research, and test scores on the SAT admissions test amounts to r=.35 for the 40 LGI's for which such data were available.) The other variables included in Table 11b do not seem to be good predictors of average expenditures. But the correlations do show the expected signs implied by Hypothesis #6. Institutions with larger proportions of graduate students also tend to spend slightly more per FTE student (r=.14), and greater academic diversification is likewise associated with higher average expenditures (r=.19). But while both academic diversification and graduate enrollment increase with institutional size (r=.84 and r=.64 are the respective correlations with

TABLE 11: ECONOMIES OF SCALE IN 65 LAND-GRANT INSTITUTIONS FOR OVERALL EXPENDITURES (ACADEMIC YEAR 1978/79)

a) VARIABLES

	MEAN (N=65)	ST.DEV.
Dependent Variable:		
V1: average expenditures (current funds expenditures/full-time equivalent enrollment)	$7,119	$3,167
Independent Variables:		
V2: # of academic specialties taught	92.7	47.3
V3: research exp. as proportion of total exp.	17.0%	8.1%
V4: graduate as proportion of total enrollment	15.0%	7.5%
V5: FTE enrollment	15,283	11,336
V6: FTE enrollment (squared) = V5(squared)		
V7: FTE enrollment (natural logarithm) = (ln)V5	9.26	.99

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6	V7
V1	.19	.67	.14	.13	.15	.07
V2		.15	.58	.84	.77	.79
V3			.07	.07	.01	.14
V4				.64	.52	.70
V5					.94	.89
V6						.72

c) REGRESSION MODELS (dependent variable: V1 = average expenditures)

1) Independent Variable: (linear model)	Beta	R(squared)
V5: FTE enrollment	.13	.017
2) Independent Variable: (semilog model)	**Beta**	**R(squared)**
V7: (ln)V5 (semilog	.07	.005
3) Independent Variables: (quadratic model)	**Beta**	**R(squared)**
V5: FTE enrollment	-.08	.017
V6: V5(squared)	.22	.023
4) Independent Variables:	**Beta**	**R(squared)**
V2: # of academic specialties	.06	.038
V3: prop. of research exp.	.65	.456
V4: prop. of graduate enrollment	.06	.458

TABLE 11 (cont'd):

5) Independent Variables: (linear m.)	Beta	R(squared)
V2: # of academic specialties	.08	.038
V3: prop. of research exp.	.65	.456
V4: prop. of graduate enrollment	.06	.458
V5: FTE enrollment	-.02	.458
6) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V2: # of academic specialties	.29	.038
V3: prop. of research exp.	.67	.456
V4: prop. of graduate enrollment	.20	.458
V7: (ln)V5	-.39	.501
7) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V2: # of academic specialties	.10	.038
V3: prop. of research exp.	.70	.456
V4: prop. of graduate enrollment	.17	.458
V5: FTE enrollment	-.85	.458
V6: V5(squared)	.78	.514

d) REGRESSION EQUATION BASED ON REGRESSION MODEL 7
(unstandardized regression coefficients)

V1 = 3,358 + 6.9(V2) + 27,202(V3) + 7,069(V4) - .23698997(V5)

+ .0000051841(V5)(squared)

e) FTE ENROLLMENT (V5) AT WHICH AVERAGE EXPENDITURE PER FTE STUDENT (V1) IS AT A MINIMUM

Conditions for minimum V1 with respect to FTE enrollment (V5):

1) first derivative: .0000103681(V5) - .23698997 = 0

2) second derivative: .0000103681 > 0

Enrollment scale with minimum average expenditure:

V5 = .23698997/.0000103681 = 22,857

the linear size measure V5), the expectation that research emphasis is stronger in larger LGI's is hardly born out: The proportion of current funds spent on research does not seem to rise with institutional size (r=.07), nor does it seem to be related to the proportionate size of graduate enrollment (r=.07).

The main thrust of Hypothesis #6 is, however, its concern with economies of scale in overall expenditures. Equations c1 through c3 in Table 11 give the regression results for the three models specifying alternative functional relationships. As is evident, none of the regression coefficients indicate the existence of economies of scale with respect to overall expenditures. Rather, the results support Hypothesis #6: Variations in size do not seem to explain variations in average expenditures as indicated by the fact that the equation of "best fit" (the quadratic polynomial) accounts for a negligible 2.3% of the variance in the dependent variable. On the other hand, the results hardly confirm the stronger contention that large universities spend more per student than small colleges. While the signs of the regression coefficients are in the expected direction, this effect appears to be extremely small.

According to Hypothesis #6b, the reasons for the absence of economies of scale in overall expenditures are the counteracting effects of larger graduate enrollment, increased academic diversification, and greater research emphasis in larger institutions. Thus, among LGI's of similar quality and complexity, larger schools should enjoy some cost advantages over smaller ones. Equation c4 in Table 11 first examines the combined effects of academic specialization, research emphasis, and

graduate enrollment on average expenditures. The three factors account for 45.8% of the variance in average costs and influence those costs in the expected direction: They raise them. Equations c5 through c7 in Table 11 examine scale effects among schools of similar quality and complexity. Again the three regression models with different functional specifications are contrasted. All the coefficients for the relevant size variables are negative, suggesting the presence of economies of scale. But while the simple linear model does not contribute to the reduction in error variance, the U-shaped quadratic function provides the best fit accounting for 51.4% of the variance in average expenditures per FTE student. The interpretation of this finding is straightforward: Among LGI's with similar emphasis on research and graduate education as well as comparable academic specialization, growth in enrollment from small to medium size leads to reductions in average expenditures per students. Beyond a certain size though, further growth in enrollment is accompanied by a rise in average expenditures per student. The enrollment size at which average expenditures per student are minimized (the most "efficient" scale) can be calculated on the basis of the quadratic regression equation. As shown in sections d and e of Table 11, average expenditures in LGI's are minimized at an enrollment size of 22,857 full-time equivalent students.

Table 12

Additional confirmation for the U-shaped average expenditure function can be derived from seperate analyses of the 49 Morrill I

TABLE 12: ECONOMIES OF SCALE IN OVERALL EXPENDITURES (ACADEMIC YEAR 1978/79): SEPERATE REGRESSIONS FOR 49 MORRILL I UNIVERSITIES AND 16 MORRILL II COLLEGES

a) REGRESSIONS FOR 49 MORRILL I UNIVERSITIES
(dependent variable: V1 = average expenditures)

1) Independent Variables: (linear m.)	Beta	R(squared)
V2: # of academic specialties	.13	.000
V3: prop. of research exp.	.75	.494
V4: prop. of graduate enrollment	.14	.509
V5: FTE enrollment	-.01	.509

2) Independent Variables: (semilog m.)	Beta	R(squared)
V2: # of academic specialties	.27	.000
V3: prop. of research exp.	.68	.494
V4: prop. of graduate enrollment	.25	.509
V7: (ln)V5	-.33	.552

3) Independent Variables: (quadratic m.)	Beta	R(squared)
V2: # of academic specialties	.06	.000
V3: prop. of research exp.	.70	.494
V4: prop. of graduate enrollment	.25	.509
V5: FTE enrollment	-.94	.509
V6: V5(squared)	.95	.566

b) REGRESSIONS FOR 16 MORRILL II COLLEGES
(dependent variable: V1 = average expenditures)

1) Independent Variables: (linear m.)	Beta	R(squared)
V2: # of academic specialties	.03	.044
V4: prop. of graduate enrollment	.12	.070
V3: prop. of research exp.	.13	.215
V5: FTE enrollment	-.63	.412

2) Independent Variables: (semilog m.)	Beta	R(squared)
V2: # of academic specialties	-.03	.044
V4: prop. of graduate enrollment	.18	.070
V3: prop. of research exp.	.14	.215
V7: (ln)V5	-.62	.401

TABLE 12 (cont'd):

3) Independent Variables: (quadratic m.)	Beta	R(squared)
V2: # of academic specialties	.01	.044
V4: prop. of graduate enrollment	.14	.070
V3: prop. of research exp.	.12	.215
V5: FTE enrollment	-.82	.412
V7: V5(squared)	.19	.414

universities and the 16 Morrill II colleges. Since the latter are all considerably smaller than the optimal size, the largest among them should enjoy clear cost advantages over the smaller ones. As the regression results in Table 12 show, the linear model (equation b1) -- implying reductions in expenditures due to increasing scale at a constant rate -- provides as good a fit to the data as the quadratic model of equation b3 and a better fit than the semilog model of equation b2. Clearly, schools with less than 8,000 students do not yet encounter diseconomies of scale when they expand. The 49 Morrill I universities on the other hand range in enrollment size from less than 5,000 to more than 60,000 students. Consequently, smaller schools among them should still experience cost reductions when they grow, whereas the largest schools should experience diminishing returns to scale. As the equations a1 through a3 in Table 12 show, the implied U-shaped average cost function represented by the quadratic polynomial does, indeed, best describe the relationship between average expenditures and enrollment for the 49 Morrill I universities.

Earlier it was argued that opportunities for economies of scale vary according to the organizational activity under consideration. Instruction and teaching of students was held to be an area in which only modest economies of scale are achievable. However, the existence of institutional rules concerning faculty's instructional load and restrictions on class size leads one to surmise that savings occur only in the lower size ranges. On the other hand, any savings in average instructional costs are more than offset by the larger proportion of

graduate students and the higher faculty salaries that are typical for larger institutions. In sum, the following relationships are expected to hold:

Hypothesis # 7: a) Up to a point, average instructional expenditures decline with enrollment size, but rise again in very large institutions.

b) When the proportion of graduate students and average faculty salaries are controlled for, average instructional expenditures continue to decline with institutional size, albeit at a decelerating rate.

Data on instructional expenditures in the land-grant institutions were obtained from the HEGIS financial survey of 1979. While institutions are urged to include "expenditures for all activities that are part of an institution's instruction program" (HEGIS Financial Reporting Guide, 1980) in the category "instructional expenditures", two types of problems may impair interinstitutional comparability of this measure. Departmental research and public service are included in this classification unless they are budgeted seperately -- a decision for which there are no common guidelines among institutions. And instructional costs connected with extension service activities are subsumed under general instructional expenditures which poses the problem that average cost per FTE student may be distorted as students in extension classes are not counted as regular full-time or part-time students. However, both sources of error should not produce large systematic distortions in

a cross-sectional comparison. There is no reason to assume that interest in over- or underreporting of departmental research or service activities varies with size. And since this study includes only land-grant institutions, all of them pay for extension classes.

Table 13

Table 13 presents the main results of the analysis. At first sight, economies of scale in instruction do not seem to obtain. On the contrary, the simple regressions of instructional expenditures per student on the size measures (equations c1 through c3) appear to indicate that instruction is more expensive in larger schools. Yet this apparent positive correlation between instructional costs and institutional size results from lumping together the small Morrill II colleges (most of are which four-year colleges offering a few master's programs) with the larger Morrill I universities. After introducing a dummy variable (equations c4 through c6) to distinguish these two institutional groups, a different pattern emerges. Now the U-shaped quadratic polynomial appears to be the function that best describes the behavior of average instructional cost with respect to institutional size (equation c6). Medium-sized institutions seem to enjoy a cost advantage in instruction over smaller colleges. But very large institutions with an enrollment of more than 18,025 FTE students (see Table 13e) again face higher instructional expenditures. As stated in Hypothesis #7, the reasons are that in large institutions higher faculty salaries and greater emphasis on graduate training outweigh other economies of scale. Indeed, after

TABLE 13: ECONOMIES OF SCALE IN INSTRUCTIONAL EXPENDITURES OF 65 LGI'S (ACADEMIC YEAR 1978/79)

a) VARIABLES

	MEAN (N=65)	ST.DEV.
Dependent Variable:		
V1: Instructional expenditures per FTE student	$2,216	$603
Independent Variables:		
V2: graduate as proportion of total enrollment	15.0%	7.5%
V3: average faculty salaries	$27,209	$4,329
V4: FTE enrollment	15,283	11,336
V5: FTE enrollment (squared) = V4(squared)		
V6: FTE enrollment (natural logarithm) = (ln)V4	9.26	.99
V7: group-dummy: Morrill I schools = 0, Morrill II schools = 1		

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6	V7
V1	.32	.71	.38	.38	.28	-.38
V2		.55	.64	.52	.70	-.49
V3			.70	.62	.70	-.72
V4				.94	.89	-.62
V5					.72	-.42
V6						-.80

c) REGRESSION MODELS (N=65)
(dependent variable: V1 = average instructional expenditures)

1) Independent Variable: (linear m.)	Beta	R(squared)
V4: FTE enrollment	.38	.145
2) Independent Variable: (semilog m.)	**Beta**	**R(squared)**
V6: (ln)V4	.28	.078
3) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V4: FTE enrollment	.16	.145
V5: V4(squared)	.23	.150
4) Independent Variables: (linear m.)	**Beta**	**R(squared)**
V7: group-dummy	-.24	.146
V4: FTE enrollment	.23	.180
5) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V7: group-dummy	-.44	.146
V6: (ln)V4	-.07	.149

TABLE 13 (cont'd):

6) Independent Variables: (quadratic m.)	Beta	R(squared)
V7: group-dummy	-.49	.146
V4: FTE enrollment	-.82	.180
V5: V4(squared)	.95	.241
7) Independent Variables: (linear m.)	**Beta**	**R(squared)**
V2: prop. of graduate students	-.01	.102
V3: average faculty salaries	1.00	.515
V7: group-dummy	.22	.543
V4: FTE enrollment	-.18	.556
8) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V2: prop. of graduate students	.12	.102
V3: average faculty salaries	.98	.515
V7: group-dummy	-.03	.543
V5: (ln)V4	-.52	.607
9) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V2: prop. of graduate students	.05	.105
V3: average faculty salaries	.94	.515
V7: group-dummy	.05	.543
V4: FTE enrollment	-.84	.556
V5: V4(squared)	.59	.576

d) REGRESSION EQUATION BASED ON REGRESSION MODEL 6
(unstandardized regression coefficients)

V1 = 2,614 - 677(V7) - .043697233(V4) + .0000024242332(V4)(squared)

e) FTE ENROLLMENT (V4) AT WHICH AVERAGE INSTRUCTIONAL COSTS PER FTE STUDENT (V1) ARE AT A MINIMUM

Conditions for minimum V1 with respect to FTE enrollment (V4):

1) first derivative: .0000024242332(V4) - .043697233 = 0

2) second derivative: .0000024242332 > 0

Enrollment scale with minimum average instructional costs:

V4 = .043697233/.0000024242332 = 18,025

controlling for these two factors (equations c7 through c9), the semilog model (equation c8) best describes the pattern in the data. No upturn in cost of instruction would occur in large institutions, if it were not for the fact that these universities pay higher faculty salaries and train more graduate students.

It was argued earlier in this chapter that some activities in colleges and universities are more amenable to being rationalized (e.g. administration) than others (e.g. research). The provision of library services and the administration of library facilities would appear to be an area in which economies of scale should be easily realized. There seem to be two major reasons for this. Firstly, technical possibilities for automating library services are quite large. Secondly, libraries provide an academic support service so that larger student enrollment is likely to offer an opportunity to spread this "overhead cost". These considerations lead to the following expectations:

Hypothesis #8: Library expenditures per student are expected to decline at a decelerating rate as enrollment grows.

According to this hypothesis, prospects for additional economies of scale tend to decline when institutions are already large. This result is expected because the spreading of overhead cannot continue forever. Larger enrollment also places higher demands on library services as the greater variety of disciplines that usually prevails in larger institutions (specialization) requires more variegated library collections.

Hypothesis #9: Net of academic specialization and increased graduate enrollment, economies of scale in library expenditures should continue to be realized at a constant rate.

The rationale for this hypothesis is straightforward. Once the need for more complex library collections in larger institutions is taken into account, the only other major source of technical diseconomies may be administrative complexity. But since even the largest research libraries employ, at the most, only a few hundred librarians and non-professional staff, no diseconomies from administrative complexity should arise.

Table 14

Data from the HEGIS Library Survey of fall 1979 were used to test the two hypotheses. One school had to be omitted because of missing data leaving 64 cases for the analysis. Table 14 presents some of the results. Library expenditures per student do decline at decelerating rates as can be inferred from the fact that the semilog equation c2 achieves the highest predictive power compared to the linear model of c1 and the quadratic model of c3. Thus, some support for Hypothesis #8 can be found in the data. But even after controlling for variations in academic specialization and graduate enrollment, the semilog model remains the comparatively best predictor of average library expenditures. Equation c4 shows that the expanded semilog model accounts for 15.7% of the variance in the dependent variable. This compares to 3.7%

TABLE 14: ECONOMIES OF SCALE IN LIBRARY EXPENDITURES OF 64 LAND-GRANT INSTITUTIONS (ACADEMIC YEAR 1978/79)*

a) VARIABLES	MEAN (N=64)	ST.DEV.
Dependent Variable:		
V1: Library expenditures per FTE student	$212	$113
Independent Variables:		
V2: # of academic specialties	93.5	47.2
V3: graduate as proportion of total enrollment	14.9%	7.5%
V4: group-dummy: Morrill I schools = 0 Morrill II schools = 1		
V5: # of books, periodicals added in 1978/79	57,425	54,157
V6: average salary of library staff	$13,853	$2,755
V7: FTE enrollment	15,463	11,331
V8: V7(squared)		
V9: (ln)V7	9.28	.99

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6	V7	V8	V9
V1	.02	.03	-.11	.29	.68	-.04	-.02	-.10
V2		.62	-.65	.64	.14	.84	.77	.79
V3			-.55	.65	.13	.68	.55	.74
V4				-.50	-.13	-.61	-.41	-.80
V5					.19	.76	.67	.70
V6						.14	.20	.06
V7							.94	.89
V8								.72

c) REGRESSION MODELS (N=64)
(dependent variable: V1 = average library expenditures)

1) Independent Variables: (linear m.)	Beta	R(squared)
V4: group-dummy	-.22	.013
V7: FTE enrollment	-.18	.021

2) Independent Variables: (semilog m.)	Beta	R(squared)
V4: group-dummy	-.52	.013
V9: (ln)V7	-.51	.096

* 1 Morrill II college has been excluded because of missing data

TABLE 14 (cont'd):

3) Independent Variables: (quadratic m.)	Beta	R(squared)
V4: group-dummy	-.45	.013
V7: FTE enrollment	-1.16**	.018
V8: V7(squared)	.89	.069
4) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V4: group-dummy	-.54	.013
V2: # of academic specialties	.19	.014
V3: prop. of graduate students	.26	.019
V9: (ln)V7	-.86	.157
5) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V4: group-dummy	-.64	.013
V2: # of academic specialties	.02	.014
V3: prop. of graduate students	.06	.019
V5: # of books and periodicals added	.76	.171
V9: (ln)V7	-1.20**	.417

** Note: A few standardized regression coefficients have values exceeding unity -- see equations c3 and c5. Again, this indicates the presence of multicollinearity among some of the independent variables. The problem can only be handled by either increasing the sample size or dropping some of the independent variables. Since the primary concern here is with overall predictive power, all variables have been left in the equations.

and 10.2% of the variance accounted for by the linear and quadratic models respectively (these equations are not shown in Table 14). On the basis of this test, Hypothesis #9 must be rejected: When larger institutions grow, they do not realize additional economies of scale in library expenditures on the same order as smaller schools.

Another expectation has not been borne out. Economies of scale in library expenditures do not seem to be especially large. The size variables, both alone and in the presence of other control variables, do not account for much of the variation in library expenditures per student. As further analysis showed, the major reason for the weak predictive power of the examined models was the lack of a control for variations in library quality. In order to correct for this effect a new variable was introduced: the number of all book volumes and periodicals added to a library's collection during the academic year 1978/79. (Among the 28 LGI's that are members of the Association of Research Libraries, this measure correlates highly -- r=.86 -- with the quality index of that association.) Equation c5 shows the semilog model including the quality measure. This model now accounts for 41.7% of the variance in average library expenditures. The alternative linear and quadratic models account for 28.5% and 38.1% of the variance respectively (equations not shown). Thus, Hypothesis #9 is still unconfirmed: Economies of scale in library expenditures decline rather than remain constant when institutions grow in size. Further analysis revealed that, only after the inclusion of a variable measuring average salary of library staff, did differences between the predictive power of the linear and semilog models disappear. (The model with a linear size

variable accounted for 67.9% and the model with the logarithmic size variable accounted for 68.5% of the variance in the dependent variable.) Apparently, average library costs would continue to go down at a constant rate in larger institutions, if these institutions did not (have to?) pay higher salaries.

The final two activity areas that will be considered here are plant operation and maintenance and central administration. The work flow in plant operation and maintenance resembles in many ways that of activities in industrial establishments. At the same time, central administration involves a lot of routine clerical tasks for which the traditional bureaucratic form of organization seems most appropriate (Blau, 1973). In both cases, work processes can be made more efficient through routines and specialization. In addition, if the volume of work is large enough further benefits can be derived from automating relatively simple tasks that do not require the intervention of a human decision-maker.

Concerning economies of scale in plant operation and maintenance, one would expect the per student cost of these activities to be lower in larger institutions. However, while a large plant is likely to allow for technical economies of scale, this potential for savings may (partly) be offset by increased complexity of the physical facilities (e.g. laboratories) and the usually higher wages of the non-professional employees in larger institutions. In short, the following relationships can be expected to hold:

Hypothesis # 10: a) At first, average cost of plant operation and maintenance declines, but ultimately rises, with increases in institutional size.

b) After controlling for wages and physical plant complexity, large economies of scale in plant operation and maintenance should be observable.

In testing this hypothesis, the data analysis made use of the following variables. The dependent variable is the ratio of total expenditures for operation and maintenance of plant over full-time equivalent student enrollment. The expenditure figure, taken from the HEGIS Financial Survey of 1978/79, includes the costs of the following types of activities: physical plant administration, building maintenance, custodial services, utilities, landscape and ground maintenance, major repair and renovations (HEGIS Financial Guide Report, 1980). For two of the independent variables proxy measures had to be used. Since no direct measures for complexity and extent of research facilities were available, it was decided to use grants from the NSF to a land-grant institution as a proxy. This seems justified on the grounds that NSF grants are a good indicator of the total volume of natural science research in an institution. The latter, in turn, should closely correlate with the complexity and scale of research facilities. Since figures for average wages of all non-professional employees in a LGI could not be obtained, average salaries of library staff may serve as a substitute. The problem with this measure is that the library staff includes both professional librarians and non-professional

personnel in varying ratios. But nonetheless, alternative options such as county-level census data on average salaries of clerical and technical workers did not seem less error prone, so that easy availability of data became the factor in favor of using library staff salaries as a proxy for salaries of non-professional employees in LGI's.

Table 15

The results of the analysis are presented in Table 15. As regression models c1 through c3 show, plant operation and maintenance is subject to economies of scale. The quadratic model (equation c3) appears to be a slightly better predictor than the semilog model (equation c2), suggesting that at very large institutional sizes average maintenance costs are again higher. According to Hypothesis #10b, this should occur because complex facilities and higher worker salaries can offset savings resulting from specialization and automation. When the former factors are held constant economies of scale are quite large. The semilog model (equation c5) accounts for 57.2% of the variance indicating a continuous decline in maintenance cost with larger scale, albeit at a decelerating rate.

Administrative costs in colleges and universities are difficult to assess. It all depends on what definition of administration is adopted. The HEGIS Financial Survey reports expenditure figures by organizational functions rather than organizational units (HEGIS Financial Reporting Guide, 1980). For instance, the catgory labelled "institutional sup-

TABLE 15: ECONOMIES OF SCALE IN PLANT OPERATION AND MAINTENANCE OF 64 LAND-GRANT INSTITUTIONS (ACADEMIC YEAR 1978/79)*

a) VARIABLES

	MEAN (N=64)	ST.DEV.
Dependent Variable:		
V1: Maintenance costs per FTE student	$626	$317
Independent Variables:		
V2: total $ of NSF grants awarded to LGI	$2,503,156	3,471,728
V3: average salary of library staff	$13,853	$2,755
V4: FTE enrollment	15,463	11,331
V5: V4(squared)		
V6: (ln)V4	9.28	.99
V7: group-dummy: Morrill I schools = 0 Morrill II schools = 1		

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6	V7
V1	.24	.56	-.13	-.01	-.33	.15
V2		.36	.69	.65	.57	-.40
V3			.14	.20	.06	-.13
V4				.94	.89	-.61
V5					.72	-.41
V6						-.80

c) REGRESSION MODELS (N=64)
(dependent variable: V1 = plant operation and maintenance costs per student)

1) Independent Variables: (linear m.)	Beta	R(squared)
V7: group-dummy	.10	.021
V4: FTE enrollment	-.07	.024
2) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V7: group-dummy	-.32	.021
V6: (ln)V4	-.59	.148
3) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V7: group-dummy	-.26	.021
V4: FTE enrollment	-1.61**	.024
V5: V4(squared)	1.40**	.156

* 1 Morrill II college has been excluded because of missing data

TABLE 15 (cont'd):

4) Independent Variables: (linear m.)	Beta	R(squared)
V7: group-dummy	.13	.021
V3: average salary of library staff	.49	.358
V2: NSF-grants	.38	.377
V4: FTE enrollment	-.38	.434
5) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V7: group-dummy	-.29	.021
V3: average salary of library staff	.39	.358
V2: NSF-grants	.47	.377
V6: (ln)V4	-.85	.572
6) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V7: group-dummy	-.13	.021
V3: average salary of library staff	.39	.358
V2: NSF-grants	.44	.377
V4: FTE enrollment	-1.47**	.434
V5: V4(squared)	.96	.487

** cf. Note under TABLE 14, p.106

port" comprises expenditures for executive management, fiscal operations, general administration and logistical support, administrative computing support, public relations, and development. The costs of "academic administration" however, are subsumed under a category labelled "academic support". But since the latter also includes expenditures for such things as museums and educational media services it cannot be considered an accurate reflection of the costs of academic administration. It was therefore decided to rely on the expenditures for "institutional support" only as an indicator of administrative cost. The administrative functions included under "institutional support" either address themselves to organization-environment relations or refer to problem areas that concern the institution as a whole. In short, these are usually tasks performed by the central administration of a college or university. Many of these tasks involve routinized activities. Accordingly, the potential for economies of scale, from the point of view of technical feasability, seems quite large. Consequently, per student costs of central administration should be lower in larger institutions than in smaller ones. But while larger size may allow for more efficient use of physical resources, the greater complexity of and higher administrative salaries in larger schools should diminish economies of scale.

Hypothesis # 11: a) Average costs of central administration decline with institutional size at decelerating rates.

b) In institutions of similar complexity that pay comparable salaries for administrators, economies of scale can be realized at a constant rate.

The following test of this hypothesis assumes that expenditures for "institutional support" divided by the number of full-time equivalent students is an adequate measure of average administrative cost. Greater organizational complexity is measured by the number of instructional units in a LGI (departments and other instructional programs with seperately budgeted full-time faculty under a chairperson; data source: college catalogs). This measure is not unproblematic, as organizational complexity of non-instructional units will be disregarded despite the fact that student services, residence hall facilities, or auxiliary enterprises are increasingly more important activity areas in larger schools. And, in the absence of salary figures for central administrators, salaries for full professors with 9-month appointment were chosen as a proxy (HEGIS Survey of Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1978-79).

Table 16

Table 16 presents the results of the analysis. The dummy variable distinguishing Morrill I universities from Morrill II colleges was dropped from the analysis, as there are no differences in the behavior

TABLE 16: ECONOMIES OF SCALE IN CENTRAL ADMINISTRATION OF 64 LAND-GRANT INSTITUTIONS (ACADEMIC YEAR 1978/79)*

a) VARIABLES	MEAN (N=64)	ST.DEV.
Dependent Variable:		
V1: Administrative costs per FTE student (total institutional support expenditures/full-time equivalent enrollment)	$552	$314
Independent Variables:		
V2: # of instructional units	58	30
V3: mean salary of professors (9-month app.)	$32,756	$5,042
V4: FTE enrollment	15,509	11,277
V5: V4(squared)		
V6: (ln)V4	9.30	.95

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6
V1	-.34	.01	-.33	-.21	-.50
V2		.68	.88	.80	.86
V3			.69	.61	.68
V4				.95	.90
V5					.73

c) REGRESSION MODELS
(dependent variable: V1 = average administrative cost)

1) Independent Variable: (linear m.)	Beta	R(squared)
V4: FTE enrollment	-.33	.107
2) Independent Variable: (semilog m.)	**Beta**	**R(squared)**
V6: (ln)V4	-.50	.251
3) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V4: FTE enrollment	-1.19**	.107
V5: V4(squared)	.91	.196

* 1 Morrill II college has been excluded because of missing data

TABLE 16 (cont'd):

4) Independent Variables: (linear m.)	Beta	R(squared)
V2: # of instructional units	-.40	.119
V3: mean salary of professors	.50	.224
V4: FTE enrollment	-.31	.245
5) Independent Variables: (semilog m.)	**Beta**	**R(squared)**
V2: # of instructional units	.11	.119
V3: mean salary of professors	.62	.224
V6: (ln)V4	-1.02**	.475
6) Independent Variables: (quadratic m.)	**Beta**	**R(squared)**
V2: # of instructional units	-.26	.119
V3: mean salary of professors	.56	.224
V4: FTE enrollment	-1.46**	.245
V6: V4(squared)	1.04**	.351

** cf. Note under TABLE 14, p.106

of administrative costs between the two groups. As is evident, economies of scale in administrative cost seem to be quite large. Regressing average administrative costs on enrollment size alone (in logarithmic transformation) accounts for 25.1% in the variance of the dependent variable (equation c2). When complexity and salaries are taken into account the semilog function is still the most powerful. While the inclusion of the two additional explanatory variables (equation c5) raises the predictive power of the regression model quite a bit (variance accounted for increases from 25.1% to 47.5%) the type of functional relationship between enrollment size and average administrative costs does not change. Additional economies of scale in administrative costs are harder to realize for larger institutions and, contrary to Hypothesis #11b, this pattern does not appear to be the result of greater institutional complexity (assuming that the number of instructional units is a valid indicator of overall complexity) or higher salaries.

One difficult issue remains to be addressed. The relations between the different expenditure categories and enrollment size alone (not controlling for such factors as institutional complexity or salaries) show that average costs of library services, of plant operation and maintenance, and of central administration are lower in larger institutions. This result was anticipated on the grounds that those three activity areas can most easily be rationalized, whereas instruction and research are less likely to become more efficient as a result of greater division of labor. At the same time though, it was

also argued earlier that technical feasability is not a sufficient explanation for economies of scale. Rather there must be, in addition, incentives for larger institutions to adopt more efficient procedures. But in the previous two chapters it was concluded that environmental pressures on larger universities are less severe than those on smaller colleges. Thus, it would seem reasonable to expect that larger universities are not compelled to become more efficient. But this is not the case. In fact, given that the previous analysis of economies of scale did not sufficiently control for variations in the quality of institutions as well as differences in the scale of non-instructional output, the actual efficiency advantages of larger institutions appear to be quite substantial. Apparently, there are incentives to economize even in public universities such as the land-grant institutions. But why should that be the case? If external pressures are not sufficient to generate greater efficiency then it may, quite possibly, be internal conflict over resource distribution that accounts for this result. Two facts can be cited in support of this speculation. As has already been shown, economies of scale in library services, maintenance, and administration do not result in overall lower expenditures per student (see Hypothesis #6) suggesting, indeed, that large universities are not forced to pass along savings due to more efficient organization. Instead, larger institutions spend a greater proportion of their total funds on instruction. This internal shift in expenditure pattern is indicated by the zero-order correlations between instructional expenditures as a proportion of total expenditures and FTE enrollment. The correlations amount to r=.27 for the Morrill I universities and

r=.33 for the Morrill II colleges.

The findings in this chapter clearly suggest that economies of scale are quite large among land-grant institutions. The cost advantages of larger institutions showed up despite the fact that no controls for expensive professional schools (usually located in the larger universities) were introduced. Among institutions of comparable quality, an enrollment size of about 23,000 FTE students tends to be optimal, i.e. overall per student expenditures are minimized at this size. Only in very large institutions are average costs somewhat higher, a circumstance that is mainly due to the higher salaries paid to faculty and other professional personnel in these schools. Significantly, possibilities for efficiency gains tend to be larger for non-academic support activities. This means that larger institutions spend higher proportions of their funds on the primary missions of teaching and research.

CHAPTER VI

DETERMINANTS OF ORGANIZATIONAL STRUCTURE

At the beginning of the last chapter (chapter 5), it was argued that the issue of economies of scale (lower average costs due to larger scale of operations) must be distinguished from the problem of structural changes that result from organizational growth. While economies of scale usually imply prior structural adjustments, not all structural changes need lead to economies of scale. For example, if the relative size of a particular personnel category declines in larger organizations, this decline cannot be equated with economies of scale. There is no necessary relationship between size and total expenditures for a personnel category as average salaries may offset any size effects. This point can be illustrated by the following example from among the 65 land-grant institutions. Among these schools, the ratio of full-time faculty to full-time equivalent students declines dramatically with increasing enrollment. This relationship is indicated by correlations of r=-.55 (when both variables are based on linear scales) and r=-.58 (when enrollment size is transformed to a logarithmic scale). Yet the cost of full-time faculty per full-time equivalent student does not at all decline with increasing institutional size. If the number of full-time faculty in each institution is multiplied by their average salary and then divided by the number of full-time equivalent students, the correlations between this measure and enrollment size are r=.02 (when both variables are based on linear scales) and

r=.03 (when enrollment size is transformed to a logarithmic scale). Evidently, higher faculty salaries in the larger schools have completely offset any savings that might have resulted from the more efficient use of faculty labor in larger institutions. Consequently, in this case structural change (the variation in the faculty/student ratio) does not result in overall economies of scale. Why, then, should structural change occur?

Answers to this question have involved three competing theoretical perspectives. They are distinguished according to their emphasis on the role of size, technology, or the environment as major causal agent of structural changes within organizations. Here it will only be noted that there is a certain overlap among these approaches. For example, the boundaries are often blurred (Stanfield, 1976) between theories that emphasize the importance of organizational size in determining organizational structure (Blau & Schoenherr, 1971; Blau, 1973; Child & Mansfield, 1972) and theories that stress the importance of technology (Perrow, 1965; Woodward, 1965). In part, this is due to the fact that variations in organizational size are inextricably bound up with variations in technology, especially, when technology is conceptualized as operations technology (Scott, 1975). In fact, the whole argument about the occurrence of economies of scale implies that larger organizations make changes in the operations technology when they introduce more specialization and automation of the work process. Likewise, the school of thought that argues that environmental pressures can produce structural changes within organizations (Thompson, 1967; Pfeffer & Salancik, 1978; Aldrich, 1979) cannot abstract from organizational

size, as the latter itself determines, in part, the degree of dependence or independence from the environment (see chapter 4 above). In sum, a sufficient explanation as to why structural changes occur in the wake of organizational growth must make reference to both the new technical possibilities and the different environmental constraints that larger organizations typically experience.

The problem of environmental constraints has been touched upon in previous chapters. It was shown that enrollment patterns in larger institutions do not closely respond to changes in the population composition. It was also argued that larger LGI's enjoyed greater freedom of action vis-a-vis their financial contributors (including the state legislatures). At the same time, per student costs of central administration, of maintenance operations, and of library services do exhibit varying degrees of economies of scale. It was speculated that pressures towards more efficiency in colleges and universities are primarily generated by internal conflicts over resource distribution. But even this "explanation" is based on the tacit assumption that resources are limited, in other words, that environments matter. What distinguishes colleges and universities from many other organizations is the asymmetry of environmental pressure they are exposed to. On the one hand, institutions of higher education offer their "product" in a "market" characterized by rather pronounced product differentiation (Garvin, 1980). The lack of standardized outputs and the difficulty of interinstitutional comparison of academic programs should soften competitive pressures. Furthermore, most schools can draw on a substantial reservoir of good will in the form of alumni allegiance and

community support. Because of this good will, actual deterioration in the "product" is not likely to produce immediate consequences for enrollment, unless the deterioration is rather drastic (Hirschman, 1970). Thus, with respect to outputs and revenues colleges and universities appear to be somewhat insulated against environmental pressures. On the other hand, they have less control over their input markets where they are "pricetakers" (Stigler, 1968) that have to compete with many other organizations.

Colleges and universities have to buy materials and hire personnel at prices they cannot much influence. This is, for instance, obvious in the case of clerical personnel whose services are also sought after by numerous private businesses and government agencies. But even in the case of faculty, colleges often have to compete with other organizations as well as each other. In addition, faculty are a highly mobile labor group. Thus a large public university that may not face much competition in the state in which it is located must, nonetheless, pay faculty salaries that are competitive nationwide. In short, salaries to be paid to faculty of a certain quality are largely a given for the individual institution. If that is so, colleges have an incentive to economize on those inputs that are comparatively expensive (such as high-priced faculty). Structural adjustments (in terms of varying ratios of personnel categories) will then not only come about as a direct result of scale changes (i.e. changes in the intrinsic possibilities of new divisions of labor), but also as a result of personnel costs that reflect general labor market conditions.

In order to examine the question why structural changes occur within organizations, the following model proposes to investigate both size and cost effects on changes in the faculty/student ratio. The ratio of full-time faculty to full-time equivalent student enrollment is expected to decline in larger institutions. Two alternative explanations are offered for this phenomenon.

According to the size-perspective, large enrollment allows schools to economize on faculty as instruction can be rationalized through a more efficient division of labor. Changes may, for instance, involve the use of more technical aids in instruction, greater substitution of faculty through teaching assistants, or larger average class size (even though the latter is usually limited by institutional guidelines about maximum class size).

According to the environmental perspective, variations in environmental constraints exert independent influence on structural changes and, in fact, may be responsible for apparent size effects. In the case of land-grant institutions, larger size involves greater program specialization and greater emphasis on graduate education. This, in turn, necessitates the hiring of better (and more expensive) faculty. Since average salaries cannot be reduced, there is an incentive to economize on the number of faculty as much as possible. This negative effect of faculty salaries on the faculty/student ratio should be especially strong when differences in the affluence of schools are taken into account. Consequently, the impact of school size on the faculty/student ratio should be of an indirect nature. Larger schools are somewhat more affluent (a condition that should raise the

faculty/student ratio) and have to pay higher faculty salaries (thereby lowering the faculty/student ratio). Average faculty salaries themselves are, of course, strongly dependent on the affluence of a school.

This discussion can shortly be summarized in the following hypothesis:

Hypothesis #12: a) The ratio of full-time faculty to full-time equivalent student enrollment declines with increases in institutional size.

b) Covariation between the faculty/student ratio and enrollment size is due to two intervening variables: faculty salaries and school affluence.

The hypothesized relationships can be presented in a simple recursive model (Land, 1969; Kerlinger & Pedhazur, 1973). Table 17 offers the model as well as the results of the statistical analysis. Under the strong assumptions of Hypothesis #12b, a reduced recursive model that drops the size variable (V3) from equation 1 (Table 17c) should still produce a correlation matrix close to the original zero-order correlation matrix. "Close to" is arbitrarily interpreted to mean that none of the coefficients in the correlation matrix derived from the reduced model should deviate more than .05 from the corresponding coefficients of the full model. In substantive terms, if most or all of the size effect on the faculty/student ratio is due to greater affluence of larger institutions and higher faculty salaries

paid by them, the path coefficient p(14) would be close to zero and the zero-order correlation between enrollment size and the faculty/student ratio would equal $r(14) = p(13)p(34) + p(12)p(23)p(34) + p(12)p(24)$.

Table 17

Before discussing the results of the analysis, a few words about the data seem in order. One variable in the model -- average faculty salaries in land-grant institutions -- poses some problems. The figure used is not adjusted for differences among faculty by academic rank or seniority. Even more problematic may be the lack of control by academic field. Faculty salaries vary substantially across academic fields as suggested by the following data from four departments at Michigan State University (MSU Budgetary Information & Salary Schedules 1982 - 1983): Average salaries (annualized rate) of full professors amounted to $67,197 (Obstetrics & Gynecology), $41,286 (Electrical Engineering), $37,676 (Sociology), and $31,319 (Humanities). These figures seem to support the idea that labor market opportunities outside academic employment greatly affect the salary levels that colleges and universities must pay. In any case, it is clear that, under such circumstances, institutional averages can be quite misleading. But since break-downs by academic fields are not available on a nation-wide basis, this study follows the practice of using overall institutional average salaries (e.g. Blau, 1973; Brinkman, 1981).

TABLE 17: PREDICTION OF FACULTY/STUDENT RATIO IN 60 LAND-GRANT INSTITUTIONS WITH GRADUATE PROGRAMS (ACADEMIC YEAR 1978/79): PATH MODEL

a) VARIABLES

	MEAN (N=60)	ST.DEV.
V1: full-time faculty per 100 FTE students	5.69	1.01
V2: average faculty salaries (in 1,000's)	$27.62	$4.20
V3: affluence (revenues per FTE students)	$8,178	$3,022
V4: FTE enrollment	16,367	11,120

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4
V1	-.22	.05	-.48
V2		.76	.67
V3			.39

c) PATH MODEL

Equation 1: V1 = p(12)V2 + p(13)V3
Equation 2: V2 = p(23)V3 + p(24)V4
Equation 3: V3 = p(34)V4

d) REGRESSION RESULTS (N=60)

1) Equation 1 (dependent variable: V1 = faculty/student ratio)

p(12)=-.61, p(13)= .52; R(squared): .163

2) Equation 2 (dependent variable: V2 = average faculty salaries)

p(23)= .58, p(24)= .44; R(squared): .737

3) Equation 3 (dependent variable: V3 = affluence)

p(34)= .39; R(squared): .154

e) ZERO-ORDER CORRELATION BETWEEN V1 AND V4 BASED ON PATH MODEL

r(14) = p(12)r(24) + p(13)r(34) = -.21

f) REGRESSION EQUATION FOR FULL MODEL

Equation 4: V1 = p(12)V2 + p(13)V3 + p(14)V4

g) REGRESSION RESULTS (N=60)

Equation 4 (dependent variable: V1 = faculty/student ratio)

p(12)=-.16, p(13)= .38, p(14)=-.52; R(squared): .302

The data analysis is based on 60 LGI's rather than all institutions in the study. Schools that did not offer any graduate programs were excluded because the substitution of teaching assistants for faculty was considered one major mechanism by which the faculty/student ratio can be reduced. Obviously, such substitution requires the availability of graduate students.

Table 17 presents the results of the data analysis. As can be inferred from the zero-order correlation matrix, the faculty/student ratio is lower in larger institutions (r=-.48). This decline appears to occur at a constant rate as the logarithmic transformation of the enrollment size variable (V4) hardly increases the correlation (r=-.49). According to Hypothesis #12b , the negative correlation between enrollment size and the faculty/student ratio can solely be explained by the circumstance that larger, more affluent institutions must pay higher faculty salaries. Thus, the proposed recursive model (Table 17c) omits the direct path p(14) from variable V4 (FTE enrollment) to V1 (faculty/student ratio). If this model is correct, it must be possible to reproduce, on its basis, the original zero-order correlation matrix. The model is estimated using ordinary-least-squares regression (Land, 1969) where the path coefficients equal the standardized regression coefficients. The path coefficients show the expected pattern. Higher faculty salaries reduce the faculty/student ratio (equation 1: p(12)=-.61). That is to say, when institutions of comparable affluence face higher faculty salaries they apparently try to economize on the number of faculty. More affluent institutions, on the other hand, can afford to hire more faculty at a given salary level

(equation 1: p(13)=.52). The other path coefficients also confirm previous expectations. Average faculty salaries are higher in more affluent (equation 2: p(23)=.58) as well as larger (equation 2: p(24)=.44) institutions. Finally, among the 60 LGI's under consideration, larger schools also tend to be more affluent (equation 3: p(34)=.39). But nonetheless, as is evident from the zero-order correlation between enrollment size and the faculty/student ratio that was computed on the basis of the proposed path model (Table 17e), the original zero-order correlation cannot be reproduced within the acceptable limits of a .05 deviation. For the reduced path model, r(14)=-.21 compared to r=-.48 for the full model. As this difference shows, the indirect size effects only partially explain the negative correlation of r=-.48 between enrollment size and the faculty/student ratio. Larger schools economize on the number of faculty regardless of the salaries they pay them. On the basis of this test, Hypothesis #12b must therefore be rejected. Even after accounting for the effects of average salaries and affluence, there is a substantial direct effect of enrollment size on the faculty/student ratio. The full regression model (Table 17f and g: equation 4) shows the direct effect of enrollment size on the faculty/student ratio. Incidentally, this equation accounts for 30.2% of the variance in the dependent variable which compares to 16.3% of the explained variance for the reduced model (equation 1). But while enrollment size alone accounts for 22.8% of the variance in the faculty/student ratio, the inclusion of average faculty salaries and affluence raises explained variance to 30.2%: Average faculty salaries do seem to have some independent effect on

structural adjustments of personnel categories, but they do not supersede the size effects.

One reason for the meager explanatory power of average faculty salaries may be that the previous model does not adequately trace the mechanism by which faculty salaries affect the faculty/student ratio. It was assumed earlier that one major way for LGI's to economize on the number of faculty is to substitute teaching assistants for faculty in the training of undergraduate students. But the ability to employ teaching assistants depends on their availability, more specifically, the availability of graduate students. While the previous analysis was already confined to schools with graduate programs, it made no allowance for the substantial variation in graduate enrollment among schools (mean: 14.8%, st.dev.: 5.4%, minimum 2.1%, maximum: 28.2%). A more complete model would therefore be based on the following reasoning. In addition to affluence and size, the proportionate size of the graduate student enrollment also affects the faculty/student ratio: Large graduate enrollment should directly increase the faculty/student ratio as graduate training tends to be more (faculty) labor-intensive. On the other hand, graduate students provide a pool of labor that can serve as a substitute for many faculty functions in undergraduate education. The overall net effect on the faculty/student ratio depends on the economic attractiveness of such substitution: The higher the average faculty salary, the more teaching assistants will be employed and the lower will be the faculty/student ratio.

The expected relationships may be summarized in the following hypothesis:

Hypothesis #13: a) The faculty/student ratio increases with rising graduate enrollment.

b) The faculty/student ratio decreases with increasing employment of teaching assistants.

c) The employment of teaching assistants varies positively with faculty salaries (substitution effect) and with graduate enrollment (availability).

d) The effects of institutional size on the faculty/student ratio are all indirect.

In addition to the variables used in testing Hypothesis #12, a test of Hypothesis #13 calls for the inclusion of two more independent variables: the proportion of graduate students enrolled in an institution and the number of teaching assistants per student. All but one variable in the model are represented by data from various HEGIS surveys of the academic year 1978/79. For the data on teaching assistants though, figures from the 1976 HEGIS Employee Survey had to suffice, since the employee survey is conducted only every ten years. But the correlation between the number of faculty in this survey and the parallel number on the 1978 Faculty Survey (r=.95) appears to justify confidence in using the teaching assistant data for cross-sectional purposes.

Table 18

TABLE 18: PREDICTION OF FACULTY/STUDENT RATIO IN 60 LAND-GRANT INSTITUTIONS WITH GRADUATE PROGRAMS (ACADEMIC YEAR 1978/79*): EXPANDED PATH MODEL

a) VARIABLES

	MEAN (N=60)	ST.DEV.
V1: full-time faculty per 100 FTE students	5.69	1.01
V2: teaching assistants (1976) per 100 FTE students (1978)	1.64	1.59
V3: average faculty salaries (in 1,000's)	$27.62	$4.20
V4: graduate students per 100 students	14.76	5.43
V5: affluence (revenues per FTE students)	$8,178	$3,022
V6: FTE enrollment	16,367	11,120

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3	V4	V5	V6
V1	-.23	-.22	-.13	.05	-.48
V2		.51	.35	.33	.49
V3			.42	.76	.67
V4				.23	.50
V5					.39

c) EXPANDDED PATH MODEL

Equation 1: $V1 = p(12)V2 + p(13)V3 + p(14)V4 + p(15)V5$

Equation 2: $V2 = p(23)V3 + p(24)V4 + p(25)V5 + p(26)V6$

Equation 3: $V3 = p(34)V4 + p(35)V5 + p(36)V6$

Equation 4: $V4 = p(45)V5 + p(46)V6$

Equation 5: $V5 = p(56)V6$

d) REGRESSION RESULTS (N=60)

1) Equation 1 (dependent variable: V1 = faculty/student ratio)

p(12)=-.13, p(13)=-.55, p(14)= .03, p(15)= .50;

R(squared): .175

2) Equation 2 (dependent variable: V2 = teach. assistants/students)

p(23)= .37, p(24)= .10, p(25)=-.05, p(26)= .21;

R(squared): .309

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* Data for teaching assistants are from 1976.

TABLE 18 (cont'd):

3) Equation 3 (dependent variable: V3 = average faculty salaries)

p(34)= .08, p(35)= .58, p(36)= .40; R(squared): .742

4) Equation 4 (dependent variable: V4 = graduate students/students)

p(45)= .04, p(46)= .48; R(squared): .252

5) Equation 5 (dependent variable: V5 = affluence)

p(56)= .39; R(squared): .154

e) ZERO-ORDER CORRELATION BETWEEN V1 AND V6 BASED ON EXPANDED PATH MODEL

$$r(16) = p(12)r(26) + p(13)r(36) + p(14)r(46) + p(15)r(56) = -.22$$

f) REGRESSION EQUATION FOR FULL MODEL

Equation 6: $V1 = p(12)V2 + p(13)V3 + p(14)V4 + p(15)V5 + p(16)V6$

g) REGRESSION RESULTS (N=60)

Equation 6 (dependent variable: V1 = faculty/student ratio)

p(12)=-.05, p(13)=-.18, p(14)= .15, p(15)= .39, p(16)=-.56;

R(squared): .320

Table 18 presents both the model and the data analysis. Equation 1 again omits the direct path from enrollment size (V6) to the faculty/student ratio (V1) under the assumption that all size effects on the faculty/student ratio are mediated through faculty salaries, affluence, and varying graduate enrollment. The results do support the assumption that higher faculty salaries make it more attractive for LGI's to employ teaching assistants (equation 2: p(23)= .37). The employment of teaching assistants also contributes directly to the reduction in the faculty/student ratio (equation 1: p(12)=-.13). But as the magnitude of the direct path from faculty salaries (V3) to the faculty/ student ratio (V1) clearly indicates (equation 1: p(13)=-.55), substituting teaching assistants for faculty is not the only way to economize on faculty. And the zero-order correlation (Table 18e: r(16)=-.22) between enrollment size (V6) and the faculty/student ratio (V1), computed on the basis of the expanded path model, shows that the indirect effects of size cannot alone explain the strong negative correlation (r=-.48) between enrollment size and the faculty/student ratio. Rather, substantial direct effects remain (Table 18f and g: equation 6). On the whole, then, it must be said that changes in the ratio of faculty to students are far more responsive to changes in institutional size than to changes in faculty salaries. This result seems to suggest that there are few possibilities to economize on the number of faculty in colleges and universities of a given size. Under such conditions, institutions will have no choice but to absorb the cost of higher faculty salaries.

In the previous chapter it was shown that the per student cost of

administration is lower in larger universities despite the higher salaries of professional administrators in these institutions (r=.68). But since personnel costs represent the bulk of the administrative costs in colleges and universities, overall savings in administrative costs can only be achieved through reductions in the utilization of, at least, some personnel. In particular, if substantial savings are to be achieved personnel changes should involve the substitution of cheaper for more expensive personnel categories. According to the theme of this chapter, such substitutions occur more as a result of changes in cost ratios than as a result of changes in organizational size. Since the total administrative task is performed by both professional administrators and clerical employees, institutions that pay higher administrators' salaries relative to clerical salaries would have an incentive to use administrators more exclusively for those tasks which clerical staff cannot perform. Or if clerical salaries rise incentives to automate routine tasks should lead to comparatively lower employment of clerical staff. Expectations concerning changes in personnel ratios can be summarized in the following hypothesis:

Hypothesis # 14: Independent of organizational size, the larger the salary differential between professional administrators and clerical staff, the lower the ratio of administrators to clerks.

While this hypothesis calls for a test on cross-sectional data, some of the variables involved are represented by data from fall 1976, others by data from fall 1978. Again, the basic argument in defense of such procedures is the assumption that organizational structure is sufficiently stable over a time period of just two years. Data on professional administrators and clerical staff, the ratio of which forms the dependent variable, come from the 1976 HEGIS Employees' Survey. "Clerical staff" is actually represented by a proxy, the number of all non-professional employees, which also includes maintenance and other blue-collar workers on campus. One of the independent variables, institutional size measured in terms of all full-time equivalent employees, is also represented by data from the 1976 HEGIS Employees' Survey. This variable is used in its logarithmic transformation which improved zero-order correlations with all other variables in the regression model by .05 to .10. Of course, the implication is that effects of changes in size are more pronounced in the transition from small to medium scale than in the transition from medium to large scale (Kimberly, 1976). Finally, the second independent variable, the ratio of administrators' to clerical salaries, is based on 1978 data from the HEGIS Faculty and Library Surveys. As in the previous chapter, salaries of full professors will serve as proxy for administrators' salaries and average salaries of library personnel will serve as proxy for clerical pay.

Table 19

TABLE 19: EFFECTS OF SALARY DIFFERENTIALS AND INSTITUTIONAL SIZE ON A PERSONNEL RATIO IN 63 LAND-GRANT INSTITUTIONS* (ACADEMIC YEARS 1978/79 AND 1976/77)

a) VARIABLES

	MEAN (N=63)	ST.DEV.
V1: # of professional administrators*100/ # of non-professional employees	10.96%	7.38%
V2: average salary of full professors/ average salary of library staff	2.42	.46
V3: (ln) # of FTE employees	7.92	1.08

b) ZERO-ORDER CORRELATION (Pearson's r)

	V2	V3
V1	-.22	-.34
V2		.47

c) MULTIPLE REGRESSION (N=63)
(dependent variable: V1 = administrors/non-professional employees)

Independent Variables:	Beta	R(squared)
V2: salary differential	-.07	.048
V3: (ln)FTE employment	-.31	.123

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* N=63 because of missing data for two LGI's

Table 19 presents the results of the analysis. As the zero-order correlation matrix shows, the salary differential between top administrators and clerical personnel (V2) increases at decelerating rates with size (V3) of an institution (r=.47). This pattern is to be expected as the larger, more prestigious land-grant institutions draw their professionals from a nationwide market, while clerks and other non-professional personnel continue to be recruited locally. At the same time, the ratio of administrators to clerks (V1) declines (also at decelerating rates) when institutions grow in size (r=-.34). Furthermore, larger salary differentials between administrators and clerical staff (V2) do seem to provide incentives for lowering the administrator/clerk ratio (r=-.22). But is there a causal connection? The results of the multiple regression (Table 19c) seem to suggest that changes in the salary differential between administrators and clerical staff only have a weak direct effect on the administrator/clerk ratio (beta=-.07). In contrast, the size effects turn out to be much stronger (beta=-.31).

A final attempt will be made to compare the relative importance of salaries and institutional size for changes in organizational structure. Just as the ratio of administrators to clerical staff varies among institutions as a whole, so does the ratio of professional to non- professional library staff among libraries of these institutions. Under the assumption that salary differentials influence libraries in their hiring practices the following hypothesis, analogous to Hypothesis #14 should hold:

Hypothesis #15: Independent of organizational size, the larger the salary differential between professional librarians and non-professional library staff, the lower the ratio of librarians to other staff.

A test of this hypothesis can be performed on data that were all gathered during the academic year 1978/79. The number of professional librarians, of full-time equivalent non-professional library personnel, of all FTE library employees (=organizational size), and the average salary of library staff were provided by the HEGIS Library Survey of 1978/79. Average faculty salaries in 1978/79 (HEGIS Faculty Survey) serve as a proxy for salaries of professional librarians. This seems defensible on the grounds that the quality of faculty (and hence faculty salaries) tends to vary positively with the quality of libraries and librarians (and hence their salaries).

Table 20

Table 20 gives the results of the analysis. As expected, the ratio of professional librarians to non-professional library personnel (V1) declines when salary differentials (V2) widen (r=-.43) and library employment (V3) grows in size (r=-.56). Salary differentials themselves are strongly correlated with library size (r=.50). And they widen faster from small- to medium-scale schools than from medium- to large-scale schools. Consequently, the logarithmic transformation of the scale variable (V3) provides a much better fit of the data than its

TABLE 20: EFFECTS OF SALARY DIFFERENTIALS AND INSTITUTIONAL SIZE ON A PERSONNEL RATIO IN LIBRARIES OF 63 LAND-GRANT INSTITUTIONS* (ACADEMIC YEAR 1978/79)

a) VARIABLES

	MEAN (N=63)	ST.DEV.
V1: # of professional librarians*100/ # of FTE non-professional library personnel	59.52%	22.60%
V2: average salary of all faculty/ average salary of library staff	2.01	.39
V3: (ln) # of all FTE library employees	4.40	.96

b) ZERO-ORDER CORRELATIONS (Pearson's r)

	V2	V3
V1	-.43	-.56
V2		.50

c) MULTIPLE REGRESSION (N=63)
(dependent variable: V1 = librarians/non-professional employees)

Independent Variables:	Beta	R(squared)
V2: salary differential	-.20	.184
V3: (ln)library employment	-.46	.346

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* N=63 because of missing data for two LGI's

linear version. Also as in the case of the previous analysis, the multiple regression again provides evidence that salary differentials exert a small independent effect on the personnel ratio (beta=-.20), but that size effects once more turn out to be stronger (beta=-.46).

All hypotheses in this chapter have been designed to shed some light on the importance of environmental factors for adjustments in intra-organizational structure. More precisely, personnel ratios (=measures of organizational structure) were assumed to be responsive to labor market conditions as reflected in average salaries for various personnel groups. Yet the data analyses consistently show that variations in salary levels and/or differentials only seem to play a minor part in changes of personnel ratios. On the other hand, variations in organizational size consistently account for larger proportions of the variance in the personnel ratios examined. Should the claim that salaries influence LGI's in their personnel decisions (and thus their internal structure) therefore be rejected? One (evasive) answer to this question would be to point to the flaws in all the salary data used. For example, frequently it was necessary to substitute salary data from other personnel groups than those under consideration as better data were not available. In addition, as pointed out earlier, average salary figures can be problematic if appropriate controls for the particular composition of a personnel group are lacking. But on the other hand, the consistency of the results seem to warrant a different conclusion. The ratios of administrators to clerical staff, of faculty to teaching assistants,

and of professional librarians to non-professional library personnel all decline (at decelerating rates) with size (FTE enrollment) of the land-grant institutions. The respective correlations are r=-.37, r=-.23, and r=-.48. These relationships actually cloak two opposite trends in larger institutions. While, on a per student basis, the number of administrators, faculty, and professional librarians declines with larger enrollment (r=-.25, r=-.22, r=-.49), the opposite is true for the non-professional personnel (see also Rushing, 1966). Larger universities have more clerical staff, more teaching assistants, and more non-professional library employees on a per student basis (r=.20, r=.52, r=.05). The general pattern seems quite clear. Larger institutions achieve economies of scale because they increasingly substitute (cheaper) non-professional personnel for (more expensive) professional personnel.

In this chapter it has been shown that, for a given institutional size, possibilities for personnel substitutions are limited. That is to say, faculty/student ratios and ratios of professional to non-professional employees vary more with organizational size than with salary differentials among the respective personnel categories. But it is nonetheless reasonable to conclude that personnel costs are instrumental in leading institutions down the road of personnel substitution as soon as technical and organizational conditions allow it. Since these necessary conditions are tied to organizational size, cost and scale effects may not be seperable.

CHAPTER VII

CONCLUSION

The central concern of this study has been twofold: 1) to explore the connections between organizational size and aspects of the organization-environment relationship, and 2) to discuss in what way size affects efficiency and structural adjustments in organizations. In general, the results of the analysis confirm an often observed fact in organizational research: Almost all aspects of organizational relations seem to be affected by organizational size. In this sense, Blau's (1973) emphasis on organizational size as the central variable in research on organizational structure is justified.

In chapter 3 it was established that changes in enrollment of the 49 land-grant universities were not very responsive to changes in basic social and economic characteristics of state populations. In contrast, the fortunes of the 16 smaller land-grant colleges seemed to depend very much on these demographic and economic changes in their states. And while the larger universities are able to influence enrollment growth through their own policies such as recruitment efforts geared towards particular subgroups of potential students, the smaller colleges apparently do not possess such options. As far as enrollment patterns are concerned, this study appears to confirm an assertion made by Pfeffer and Salancik (1978; p. 139): "Organizations that are large have more power and leverage over their environment. They are more able to resist immediate pressure for change and, moreover, have more time in

which to recognize external threats and adapt to them." In the case of land-grant universities it is evident that environmental pressures to adjust their enrollment patterns to changes in the population are limited. But it is not clear whether or not sheer institutional size accounts for this pattern. A major reason for relative independence from changes in the environment seems to be the existence of some kind of buffer mechanism (Thompson, 1967). Until recently, the growth in the demand for college education exceeded available capacity at many institutions of higher education. But most public institutions -- receiving substantial funds from state legislatures -- did not limit demand through raising of tuition and fees. Rather, excess demand allowed them to impose non-price selection criteria such as academic admissions standards (Garvin, 1980).

All the land-grant universities in the study have some kind of minimum admissions standard of varying rigor. Under these circumstances, changes in population characteristics need not immediately result in changes of enrollment patterns as (especially higher-quality) institutions have some control over the composition of their student body. The situation is quite different for the 16 land-grant colleges. All of them have open admissions policies which limit their ability to respond selectively to changes in general enrollment patterns. As a result, the analysis in chapter 3 needs some qualifications: Enrollment size alone may not fully explain the difference between the universities and colleges regarding their reponsiveness to changes in state population characteristics. But since -- at least in the case of the public land-grant institutions -- variations in admissions criteria are

strongly related to institutional size, these two effects could not be examined seperately.

One interesting aspect of this differential responsiveness to changes in the population is that the social transformation of the student body in the larger and more prestigious institutions lags behind -- a case of social change initiated from the bottom.

The results of the analysis presented in chapter 4 are less ambiguous concerning the importance of organizational size: They provide unequivocal support for the notion that larger organizations have greater leverage over their environment. In particular, larger land-grant universities accomplish their comparative independence from resource providers through the spreading of risk: They have more contributors with each providing a lower proportion of total revenues. As has been shown, larger universities are able to translate this condition into greater bargaining power vis-a-vis their state legislatures. In addition, larger institutions face a more stable environment. When the number of contributors is large, short-term fluctuations in their support levels tend to cancel each other out. Only a prolonged, general decline in donors' largesse -- resulting, for example, from changes in the business cycle -- should leave their mark on larger institutions. The obvious conclusion is that large universities are in better control of their destiny, supporting Starbuck's (1965) contention that the desire for stability and control is a major reason why organizational decision-makers might want to favor organizational growth.

The analysis of economies of scale in land-grant institutions,

presented in chapter 5, clearly shows that organizational size affects efficiency. But the results presented in that chapter also suggest that it is technological factors that are instrumental in the realization of economies of scale. This conclusion is buttressed by the fact that the magnitude of scale economies achieved varies across major activity areas in colleges and universities. While average instructional costs hardly showed any signs of declining in larger LGI's (at least not as long as quality differences among institutions were not controlled for), per student costs of library services, of plant operation and maintenance, and of central administration exhibited increasingly substantial economies of scale. To put this same fact somewhat differently: Larger universities spend a larger proportion of their resources on the primary mission of teaching. (They also spend proportionately more on research and public service activities such as broadcasting.)

The data analysis in chapter 5 was handicapped by the lack of adequate controls for institutional quality and differences in emphasis on resource-intensive curricula, e.g. medical, dental, or natural science disciplines -- all of which make for higher costs in larger institutions. Furthermore, the output measure used -- FTE enrollment -- may serve as an approximate measure of instructional load. But since research and public service outputs tend to be disproportionately higher in larger universities FTE enrollment alone underestimates the total output of these larger institutions. The inescapable conclusion is that economies of scale are, indeed, quite large among land-grant institutions.

This result is somewhat surprising. One of the traditional

assumptions about public service organizations in general and institutions of higher education in particular is that they are inefficient because they lack performance standards that would allow for competitive comparisons (Lawler et al., 1980; Kanter & Brinkerhoff, 1981). What is more, since the data on which this study is based still refer to a period of general growth in higher education when resources were relatively plentiful, one would assume that most of the land-grant institutions were not under pressure to be more efficient. Only in declining organizations should resource pressures lead to an emphasis on efficiency (Cameron, 1983; Whetten, 1981). Yet the analysis of scale effects in land-grant institutions clearly suggests that larger institutions move towards a more efficient "mode of production". While it is, of course, impossible to say what levels of efficiency could have been achieved if these institutions operated like firms in a competitive market, the usual assumption about lack of sufficient environmental pressures does not seem to hold. One reason, why this assumption may no longer be valid with regards to colleges and universities, is the spread of uniform accounting practices in higher education. It was noted earlier that efficiency refers to a comparative performance standard. In private business, such a performance standard has always existed in the form of the "bottom line", i.e. profitability. In higher education, federal and state governments have imposed ever more exacting data collection requirements in recent decades. The very existence of such data facilitates comparibility. In the future, they may serve as a major input to budgetary decisions of legislatures, even though the use of appropriation powers to achieve greater efficiency seems to be quite

rare so far (Hoenack, 1982). Nonetheless, the mere availabilty of nationwide data has improved college administrators' sense of where their institution stands in relation to other schools. But thinking in comparative terms already heightens emphasis on efficiency.

The analysis in chapter 5 indicates another important result: A major reason why economies of scale do not continue for ever is that rises in salaries paid by the very large institutions tend to outweigh savings in personnel or other structural or technical adjustments. There seem to be two plausible interpretation for this fact. One is, that larger universities pay their personnel better salaries simply because they can afford to do so: Resource pressures are not as intense for these institutions. But this interpretation is not consistent with the foregoing remarks that these larger institutions also face environmental pressures to improve upon their efficiency. Instead, a second explanation seems more plausible: As organizations grow in size they need a higher caliber of personnel to tackle the problems associated with larger size and complexity. In particular, if coordination of the activities in larger universities requires superior administrative talents, then, higher salaries are -- so to speak -- a technological requirement and should be considered an intrinsic cost of organizational expansion.

A further interesting fact emerges from the attempt to gauge the optimal size of land-grant institutions. Considering only instructional costs, land-grant institutions with an enrollment of about 18,000 full-time equivalent students appear to make the most of their resources, i.e. in those schools instructional costs per student are lowest. But

since library and especially maintenance and administrative costs continue to decline when institutions grow beyond that size, an enrollment size of about 23,000 FTE students is needed to reach the size of greatest overall efficiency. But as the analysis of administrative cost behavior showed, the reason for rising overall costs in very large organizations does not seem to be the often cited diseconomies arising from greater administrative complexities in very large organizations. (After all, average administrative costs continue to decline with increasing scale, albeit at a decelerating rate.) Rather, next to higher salaries, it is larger instructional and research expenditures and additional public services provided by the larger schools that drive up their costs. In short, smaller and larger schools perform different functions in the educational system with research and most public services concentrated in the larger institutions. Such a division of labor among institutions seems to call into question the appopriateness of efficiency comparisons as they involve organizations that not only vary in size but also produce different kinds of output. Yet, larger institutions do not abandon the basic instructional mission of smaller institutions, they simply widen their activity fields. As was pointed out above, this should make observed economies of scale all the more impressive.

In chapter 6 the analysis focused on reasons for variations in personnel ratios within land-grant institutions. The major purpose was to demonstrate that structural changes within organizations can be explained in terms of changing environmental constraints. By and large, the results gave only weak support to the notion that -- independent of

organizational size -- labor market conditions affect structural adjustments in personnel categories. While larger salary differentials between professional and non-professional personnel appear to accelerate substitution of faculty through teaching assistants, librarians through non-professional library staff, and administrators through clerks these substitutions occur predominantly in the wake of changes in institutional size. Larger institutions clearly economize on higher-priced professionals. That they do so, seems to be the result of two converging trends: Labor market conditions provide the incentives and technological conditions (in the form of a changing division of labor) open up the possibilities.

One general conclusion to be drawn from the findings is that arguments about the importance of changes in organizational size invariably turn out to be arguments about changes in technological and environmental constraints. This raises the question whether "size" should be at all considered a theoretically useful category in organizational research. To juxtapose size effects and the effects of technology and environment on organizational structure suggests that we are dealing with alternative conceptualizations on an equal footing. But whatever measures of organizational size one might choose, it is hard to imagine how variations in size could be independent of variations in technology and environment. Kimberly (1976) for example, distinguished four aspects of organizational size because of their differing theoretical implications for research on organizational structure: physical capacity, personnel, inputs and outputs, discretionary resources available to an organization. All of these may

also serve as operationalizations of technological and environmental factors. In short, organizational size cannot be varied while technology and environment are held constant. That is to say that a larger organization has, by definition, more contact points with its environment as well as a more complex internal division of labor. (For instance, as the number of personnel increases, it is a logical necessity that either the number of hierarchical levels rises or the average span of control widens -- both of which affects internal specialization and thus technology.) Furthermore, just as in most industries larger firms do not simply produce multiples of the same output that smaller firms produce, so it has been shown that larger land-grant institutions offer more diversified -- and, in part, different -- services compared to those of smaller schools. Again, the usual assumptions about uniform outputs in most investigations of scale effects do not apply. In sum, to ask whether size effects are stronger or weaker than effects of technology or environment may not be a meaningful question in the first place.

A final issue needs to be raised regarding certain theoretical assumptions adopted in this study. The approach taken proceeds from the assumptional basis of the rational systems perspective in organizational research (Scott, 1981). Whether rational action is defined as "utility-maximizing" in the traditional economic sense (Henderson & Quand, 1980) or as "satisficing" (Simon, 1979), it is consistent with the process of "natural selection" (Winter, 1964). Even more important, rational action is the subjective side or the behavioral reflection of the objective process of natural selection. As long as organizational

efficiency is the only concern, the assumptional basis will yield the necessary behavioral predictions. When economists investigate economies of scale or efficiency, they are only interested in input/output relations and essentially treat organizations as "black boxes". Thus, from the point of view of efficiency considerations it does not matter whether unit costs of production decline as a result of lower wage rates or as a result of the elimination of certain personnel positions. But for researchers interested in explaining changes of organizational structure these are very different cases. This problem has, of course, been the central reason for criticizing Blau's explanation of structural change (Blau, 1973) as incomplete. Attributing rational motives to administrators, i.e. assuming they are concerned about efficiency, cannot alone explain changes in organizational structure. Rather, because organizational researchers do not treat organizations as "black boxes", they need to specify in some detail how technological and environmental constraints affect structure.

It is no easy task to identify the set of major constraints under which various organizations operate. The constructs of "technology" and "environment" are all-encompassing and provide only very general guides to the identification of specific constraints faced by organizations under investigation. In particular, the sets of constraints vary according to organizational type with those of colleges and universities differing from those of private business firms, for example. The problem is that most research introduces constraint variables on the basis of ad hoc plausibilities and data availability considerations. In this respect, this study has not progressed very far. Technological

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factors have not been measured at all, in part, on the assumption that they may not vary much among land-grant institutions. Environmental factors have been introduced in the form of basic state population characteristics and in the form of salary data for a few personnel categories. Much needs still to be done in this area.

To fully appreciate the impact of labor market conditions on organizational structure, it would be necessary to study internal changes in personnel ratios in conjunction with changes in average salaries for the respective personnel category. But there are no convenient data sources for such an undertaking, although the necessary data can probably be obtained directly from most institutions. Such data may also help to answer the vexing question as to whether or not colleges and universities are subject to competitive pressures. Since competition itself is hard to measure, one may look at its effects by estimating how responsive colleges and universities are to changing wage rates in comparison to such private enterprises as, say, insurance companies and banks that should have similar technical opportunities for substitution. It may, after all, turn out that the often asserted inefficiency of non-profit organizations is nothing but an assumption perpetuated because of our past inability to measure efficiency of performance in these organizations.

BIBLIOGRAPHY

Adams, Carl R., Hankins, Russell L., and Schroeder, Roger G. A Study of Cost Analysis in Higher Education, Vol. 1. Washington, D.C.: American Council on Education; 1978.

Aldrich, Howard E. "Technology and organizational structure: a re-examination of the findings of the Aston-Group." Administrative Science Quaterly, Vol. 7, No. 1 (1972): 26-43.

Aldrich, Howard E. Organizations and Environments. Englewood Cliffs, N.J.: Prentice-Hall, Inc.; 1979.

Aldrich, Howard E. and Pfeffer, Jeffrey. "Environments of organizations." Annual Review of Sociology, Vol. 2. (1976): 79-105.

Aldrich, Howard D. and Whetten, David A. "Organization-sets, action-sets and networks: making the most of simplicity" pp. 385-408 in Paul C. Nystrom and William H. Starbuck (eds.) Handbook of Organizational Design, Vol. 1. New York: Oxford University Press; 1981.

Archibald, G. C. and Lipsey, Richard G. An Introduction to Mathematical Economics: Methods and Applications. New York: Harper & Row, Publishers; 1976.

Astin, Alexander W. "Measuring student output in higher education." pp. 75-83 in Ben Lawrence, George Weathersby, and Virginia W. Patterson (eds.) Outputs of Higher Education: Their Identification, Measurement, and Evaluation. Boulder, Colorado: Western Interstate Commission of Higher Education; 1970.

Astley, W. Graham and Van de Ven, Andrew. "Central perspectives and debates in organizational theory." Administrative Science Quarterly, Vol. 28, No. 2 (1983): 245-273.

Bain, Joe S. New Barriers to Competition: Their Character and Consequences in Manufacturing Industries. Cambridge, Massachusetts: Harvard University Press; 1956.

Bain, Joe S. Industrial Organization. New York: John Wiley and Sons; (2nd ed.) 1968.

Baldridge, J. Victor, Curtine, David V., Ecker, George P. and Riley, Gary L. "Diversity in higher education: professional autonomy." pp. 42-63 in Gary L. Riley and J. Victor Baldridge (eds.) Governing Academic Organizations. Berkeley, California: McCutchon Publishing Corporation; 1977.

Bender, Louis W. "Federal regulations and institutional autonomy." pp. 24-42 in Arthur T. Grant (ed.) The Impact of Federal Policies on Higher Education Institutions. University of Arizona; 1977.

Birnbaum, Philip H. "Integration and specialization in academic research." Academy of Management Journal, Vol. 24, No. 3 (1981): 487-503.

Blau, Peter M. Exchange and Power in Social Life. New York: John Wiley and Sons; 1964.

Blau, Peter M. The Organization of Academic Work. New York: John Wiley and Sons; 1973.

Blau, Peter M. Inequality and Heterogeneity. New York: The Free Press; 1977.

Blau, Peter M. and Schoenherr, Richard A. The Structure of Organizations. New York: Basic Books; 1971.

Boulding, Kenneth E. The Organizational Revolution. New York: Harper and Brothers; 1953.

Brinkman, Paul T. "Factors affecting instructional costs at major research universities." Journal of Higher Education, Vol. 52, No. 3 (1981): 265-279.

Cameron, Kim "Strategic responses to conditions of decline: higher education and the private sector." Journal of Higher Education, Vol. 54, No. 4 (1983): 359-380.

Chandler, Alfred D. Jr. Strategy and Structure: Chapters in the History of the American Industrial Enterprise. Cambridge, Massachusetts: The M.I.T. Press; 1962.

Child, John. "Organizational structure, environment and performance: the role of strategic choice." Sociology, Vol. 6 (1972): 1-22.

Child, John and Mansfield, Roger. "Technology, size and organization structure." Sociology, Vol. 7 (1973): 369-380.

Cohen, Michael D. and March, James G. Leadership and Ambiguity. New York: McGraw-Hill Book Company; 1974.

Cohen, Michael D., March, James G. and Olson, Johan P. "A garbage can model of organizational choice." Administrative Science Quaterly, Vol. 17, No. 1 (1972): 1-25.

Cook, Karen S. "Exchange and power in networks of interorganizational relations." in J. Kenneth Benson (ed.) Organizational Analysis: Critique and Innovation. Beverly Hills, California: Sage Publications, Inc.; 1977.

Cyert, Richard M. "The management of universities of constant or decreasing size." Current Issues in Higher Education, Vol. 2, No. 6 (1980): 38-46.

Cyert, Richard M. and March, James G. A Behavioral Theory of the Firm. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.; 1963.

Emerson, Richard M. "Power-dependence relations." American Sociological Review, Vol. 27, No. 1 (1962): 31-40.

Emerson, Richard M. "Exchange theory." Annual Review of Sociology, Vol. 1 (1976): 335-362.

Emery, F.E. and Trist, E.L. "The causal texture of organizational environments." Human Relations, Vol. 18 (1965): 21-32.

Evan, William M. "The organization-set: toward a theory of inter-organizational relations." in James D. Thompson (ed.) Approaches to Organizational Design. Pittsburgh, Pennsylvania: University of Pittsburgh Press; pp. 174-191; 1966.

Ford, Jeffrey D. "The administrative component in growing and declining organizations: a longitudinal analysis." Academy of Management Journal, Vol. 23, No. 4 (1980a): 615-630.

Ford, Jeffrey D. "The occurrence of structural hysteresis in declining organizations." Academy of Management Review, Vol. 5, No. 4 (1980b): 589-598.

Freeman, John H. and Hannan, Michael T. "Growth and decline processes in organizations." American Sociological Review, Vol. 40 (1975): 215-228.

Frey, James H. An Organizational Analysis of University-Environment Relations. Washington, D.C.: University Press of America, R.F. Publishing Inc.; 1977.

Garvin, David A. The Economics of University Behavior. New York: Academic Press, Inc.; 1980.

Gold, Bela. "Changing perspecitives on size, scale, and returns: an interpretive survey." Journal of Economic Literature, Vol. 19 (1981): 5-33.

Goodall, Leonard E. (ed.) State Politics and Higher Education. Dearborn, Michigan: LMG Associates; 1976.

Gross, Edward and Grambsch, Paul V. Changes in University Organization, 1964 - 1971. New York: McGraw-Hill, Inc.; 1974.

Hall, Richard H. Organizations: Structure and Process. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.; 1972.

Hall, Richard H., Haas J. Eugene and Johnson, Norman J. "Organizational size, complexity, and formalization." American Sociological Review, Vol. 32, No. 6 (1967): 903-912.

Hannan, Michael T. and Freeman, John H. "The population ecology of organizations." American Journal of Sociology, Vol. 82, No. 5 (1977): 929-964.

Hasenfeld, Yeheskel and English, Richard A. (eds.) Human Service Organizations. Ann Arbor, Michigan: The Univerisity of Michigan Press; 1974.

Henderson, James M. and Quandt, Richard E. Microeconomic Theory: A Mathematical Approach. (3rd ed.) New York: Mc-Graw-Hall, Inc.; 1980.

Hirschman, Albert O. Exit, Voice, and Loyalty. Cambridge, Massachussetts: Harvard University Press; 1970.

Hoenack, Stephen A. "Pricing and efficiency in higher education." Journal of Higher Education, Vol. 53, No. 4 (1982): 403-418.

Holdaway, E. A. and Blowers. T. A. "Administrative ratios and organization size: a longitudinal examination." American Sociological Review, Vol. 36, No. 2 (1971): 278-286.

Hough, Robin R. "The outputs of undergraduate education." pp. 93-103 in Ben Lawrence, George Weathersby, and Virginia W. Patterson (eds.) Outputs of Higher Education: Their Identification, Measurement, and Evaluation. Boulder, Colorado: Western Interstate Commission for Higher Education; 1970.

Jenny, Hans H. "Specifying financial indicators: cash flows in the short and long run." New Directions for Higher Education, Vol. 7, No.2 (1979) 15-30.

Jencks, Christopher et al. Inequality: A Reassessment of the Effect of Family and Schooling in America. New York: Basic Books; 1972.

Johnson, Eldon L. "Misconceptions about the early land-grant colleges." Journal of Higher Education, Vol. 52, No. 4 (1981): 333-351.

Jurkovich, Ray. "A core typology of organizational environments." Administrative Science Quarterly, Vol. 19, No. 3 (1974): 380-394.

Kanter, Rosabeth M. and Brinkerhoff, Derick "Organizational performance: recent developments in measurements." Annual Review of Sociology, Vol. 7 (1981): 321-349.

Kerlinger, Fred N. and Pedhazur, Elazar J. Multiple Regression in Behavioral Research. New York: Holt, Rinehart and Winston, Inc.; 1973.

Kimberly, John R. "Organizational size and the structuralist perspective: a review, critique and proposal." Administrative Science Quarterly, Vol. 21 No. 4 (1976): 571-597.

Khandwalla, Pradip N. "Properties of competing organizations." in Paul C. Nystrom and William H. Starbuck (eds.) Handbook of Organizational Design, Vol. 1. New York: Oxford University Press; 1981.

Kmenta, Jan Elements of Econometrics. New York: Macmillan Publishing Co., Inc.; 1971.

Land, Kenneth C. "Principles of path analysis." pp. 3-37 in Borgatta, Edgar F. (ed.) Sociological Methodology. San Francisco, California: Jossey-Bass; 1969.

Lawler, Edward E. III, Nadler, David A. and Cammann, Cortlandt. Organizational Assessment: Perspectives on the Measurement of Organizational Behavior and the Quality of Work Life. New York: John Wiley and Sons; 1980.

Layard, P. R. and Verry, D. W. "Cost functions for university teaching and research." The Economic Journal, Vol. 85 (1975): 55-74.

Lutz, Frank. "Tightening up loose couplings in organizations of higher education." Administrative Science Quarterly, Vol. 27, No. 3 (1982): 653-669.

Maynard, James. Some Microeconomics of Higher Education. Lincoln, Nebraska: University of Nebraska Press; 1971.

Meyer, Marshall W. "Size and structure of organizations: a causal model." American Sociological Review, Vol. 37, No. 3 (1972): 434-441.

Morrison, Denton E. and Henkel, Ramon E. (eds.) The Significance Test Controversy - A Reader. Chicago, Illinois: Aldine Publishing Company; 1970.

Olson Jr., Mancur The Logic of Collective Action. New York: Schocken Books; (revised edition) 1971.

Ostar, Allen W. "External control and institutional governance." in Arthur T. Grant (ed.) The Impact of Federal Policies on Higher Education Institutions. University of Arizona; 1977; pp. 15-23.

Pfeffer, Jeffrey and Salancik, Gerald R. The External Control of Organizations. New York: Harper and Row, Publishers; 1978.

Pugh, Derek S., Hickson, D. J., Hinings, C. R. and Turner, C. "Dimensions of organization structure." Administrative Science Quaterly, Vol. 13, No. 1 (1968): 65-91.

Pugh, Derek S., Hickson, D. J., Hinings, C. R. and Turner, C. "The context of organization structures." Administrative Science Quaterly, Vol. 14, No. 1 (1969): 91-114.

Rowse, Glenwood L. and Wing, Paul. "Assessing competitive structures in higher education." Journal of Higher Education, Vol. 53, No. 6 (1982): 656-686.

Rushing, W. A. "Organizational size and administration." Pacific Sociological Review, Vol. 9, No. 1 (1966): 100-108.

Samuelson, Paul A. Economics. Tokyo, Japan: McGraw-Hill-Kogahusha, Ltd.; (10th ed.) 1976.

Scherer, F. M. Industrial Market Structure and Economic Performance. Boston, Massachusetts: Houghton Mifflin Company; (2nd ed.) 1980.

Scott, W. Richard. "Organizational structure." Annual Review of Sociology, Vol. 1 (1975): 1-20.

Scott, W. Richard. Organizations: Rational, Natural, and Open Systems. Englewood Cliffs, New Jersey: Prentice-Hall, Inc; 1981.

Simon, Herbert A. "Rational decision making in business organizations." The American Economic Review, Vol. 69, No. 4 (1979): 493-513.

Smart, John C. "Diversity of academic organizations." Journal of Higher Education, Vol. 49, No. 5 (1978): 403-419.

Starbuck, William H. "Organizational growth and development." pp. 451-533 in James G. March (ed.) Handbook of Organizations. Chicago, Illinois: Rand McNally; 1965.

Stigler, George J. "Competition." pp. 5-22 in George J. Stigler (ed.) The Organization of Industry. Chicago, Illinois: The University of Chicago Press; 1968.

Stinchcombe, Arthur L. "Social structure and organizations." pp. 142-193 in James G. March (ed.) Handbook of Organizations. Chicago: Rand McNally and Company; 1965.

Thompson, James D. Organizations in Action. New York: McGraw-Hill; 1967.

Verry, Donald and Davies, Bleddyn University Costs and Outputs. Amsterdam, Netherlands: Elsevier Scientific Publishing Company; 1976.

Weick, Karl E. "Educational organizations as loosely coupled systems." Administrative Science Quarterly, Vol. 21, No. 1 (1976): 1-19.

Whetten, David A. "Organizational responses to scarcity: exploring the obstacles to innovative approaches to retrenchment in education." Educational Administration Quaterly, Vol. 17, No. 3 (1981): 80-97.

Williamson, Oliver E. Markets and Hierarchies: Analysis and Antitrust Implications. New York: The Free Press; 1975.

Winter, Sidney G., Jr. "Economic 'natural selection' and the theory of the firm." Yale Economic Essays, Vol. 4 (1964): 225-272.

Woodward, Joan. Industrial Organization. New York: Oxford University Press; 1965.

Yuchtman, Ephraim and Seashore, Stanley E. "A system resource approach to organizational effectiveness." American Sociological Review, Vol. 32, No. 6 (1967): 891-903.

APPENDICES

APPENDIX A

LIST OF VARIABLES

Source: Fall Enrollment in Higher Education 1978, NCES:

# of full-time undergraduate men
# of full-time undergraduate women
# of part-time undergraduate men
# of part-time undergraduate women
# of full-time graduate men
# of full-time graduate women
# of part-time graduate men
# of part-time graduate women
# of full-time first-professional men
# of full-time first-professional women
# of part-time first-professional men
# of part-time first-professional women
# of unclassified male students
# of unclassified female students
# of all female students
# of all male students
# of all full-time students
# of all part-time students
# of all undergraduate students
# of all graduate students
# of all first-professional students
Total # of students in land-grant institution
# of full-time equivalent (FTE) part-time students
Total # of FTE students in land-grant institution

Source: Fall Enrollment in Higher Education 1968, NCES:

# of all undergraduate men (incl. occupational programs)
# of all female students
# of all male students
# of all full-time students
# of all part-time students
# of all undergraduate students
# of all students in (undergrad.) occupational programs
# of all graduate students
Total # of students in land-grant institution

Source: Data on Earned Degrees Conferred By Institutions of Higher Education By Race, Ethnicity And Sex, Academic Year 1978-1979, NCES:

# of all academic degrees earned by black women

# of all academic degrees earned by black men

Source: Library Statistics of Colleges and Universities 1978-1979, NCES:

Total # of book volumes - Fall 1979
# of added book volumes - 1978-1979
Periodical subscriptions -1978-1979
Salaries, wages of library personnel - 1978-1979
Expenditures on books, materials, binding - 1978-1979
Total library expenditures - 1978-1979

Source: Selected Statistics on Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty 1978-1979, NCES:

# of full professors (9-month appointment)
# of associate professors (9-month appointment)
# of assistant professors (9-month appointment)
# of instructors (9-month appointment)
# of other faculty (9-month appointment)
# of full professors (12-month appointment)
# of associate professors (12-month appointment)
# of assistant professors (12-month appointment)
# of instructors (12-month appointment)
# of other faculty (12-month appointment)
Total # of (full-time) faculty
% women among (full-time) faculty
% tenured faculty
% faculty with 12-month appointment
Average compensation (salary & fringe benefits) for the following faculty groups:
Full professors (9-month appointment)
Associate professors (9-month appointment)
Assistant professors (9-month appointment)
Instructors (9-month appointment)
Other faculty (9-month appointment)
Full professors (12-month appointments)
Associate professors (12-month appointment)
Assistant professors (12-month appointment)
Instructors (12-month appointment)
Other faculty (12-month appointment)
All (full-time) faculty
Fringe benefits as % of average compensation

Source: Financial Statistics of Colleges and Universities Fiscal Year 1979, NCES:

Tuition and fees
Federal appropriations
State appropriations
Local appropriations

Federal grants and contracts
State grants and contracts
Local grants and contracts
Private gifts, grants, and contracts
Income from sales and services of educational activities
Income from sales and services of auxiliary enterprises
Income from sales and services of hospitals
Income from other sources
Income from independent operations
Total current funds revenues
Instructional expenditures
Research expenditures
Public service expenditures
Expenditures for academic support functions
Library expenditures
Expenditures for student services
Expenditures for institutional support
Expenditures for operation and maintenance of plant
Scholarships and fellowships (restricted)
Scholarships and fellowships (unrestricted)
Education and general mandatory transfers
Total educational expenditures
Expenditures of auxiliary enterprises
Hospital expenditures
Total current funds expenditures

Source: Data on Federal Obligations to Colleges and Universities 1979, NSF:

Total obligations in 1979
Funds for academic science
Funds for research and development
Funds for non-scientific activities
Funds from USDA
Funds from DOD
Funds from HEW
Funds from NSF
Funds from other federal departments
# of major federal departments that had financial obligations to land-grant institutions in 1979

Source: Employees in Institutions of Higher Education 1976-77, NCES:

# of full-time executives, administrators, managers
# of full-time faculty engaged in teaching or research
# of full-time teaching- and research-assistants
# of full-time professional support employees
Total # of full-time professional employees
# of full-time non-professional employees
Total # of all full-time employees
# of part-time executives, administrators, managers

# of part-time faculty engaged in teaching or research
# of part-time teaching- and research-assistants
# of part-time professional support employees
Total # of part-time professional employees
# of part-time non-professional employees
Total # of all part-time employees
# of full-time equivalent of part-time (FTE) executives, administrators, managers
# of FTE faculty engaged in instruction or research
# of FTE teaching- and research-assistents
# of FTE professional support employees
Total # of FTE professional employees
# of FTE non-professional employees
Total # of all FTE employees

Source: Peterson's Annual Guide to Undergraduate Study, 1979:

Average SAT-score of incoming freshman-class - Fall 1978
Average ACT-score of incoming freshman-class - Fall 1978

Source: Education Directory of Colleges and Universities 1978-1979, NCES:

Level of highest degree offered by land-grant institution - 1978/79 (1=BA/S, 2=1st Prof., 3=MA/S, 4=Ph.D.)
Organizational status of Land-grant institution - 1978/79 (1=independent single campus, 2=main campus of multicam- pus institution, 3=branch campus of multicampus institu- tion, 4=main campus of system located at system's office, 4=other campus of system located at system's office, 5= other campus of system not located at system's office, 6= main campus of system not located at system's office)

Source: College Catalogs:

# of first-level instructional units (76-79)
# of complex instructional units headed by deans (76-79)
# of schools and colleges headed by deans (76-79)

Source: College Blue Book, 1979:

# of certificate degree programs offered by LGI's - 1979
# of associate degree programs - 1979
# of bachelor's degree programs - 1979
# of master's degree programs - 1979
# of doctoral degree programs - 1979
# of other (mostly professional) degree programs - 1979
Total # of degree programs - 1979
# of all academic fields in which degrees are conferred - 1979

Source: 1980 Census of Population, U.S. Department of Commerce:

Total employment in state - 1980
# of professionals, managers, administrators - 1980
# of of sales, clerical, and technical workers - 1980
# of craft and precision workers - 1980
of (non-farm) operatives - 1980
of servive workers - 1980
# of employed in farm occupations - 1980

Source: 1970 Census of Population, U.S. Department od Commerce):

Total employment in state - 1970 (in 1000's)
# of professionals, mangers, administrators - 1970
# of sales, clerical, and technical Workers - 1970
# of craft and precision workers - 1970
of (non-farm) operatives - 1970
of service workers - 1970
# of employed in farm occupations - 1970

Source: Fact Book for Administrators 1980, American Counsel on Education:

Enrollment in state's public colleges - Fall 1978
Enrollment in all colleges of state - Fall 1978
Enrollment in all colleges of state - Fall 1968
State population in college age (18-24) - 1978

Source: Statistical Abstract of the United States 1980:

State resident population - 1979
% minorities in state population - 1979
% black in state population - 1979
% of state pop. residing in state for entire life - 1976
Total state tax collection - 1979 (in millions of $)
Total state expenditures - 1979 (in millions of $)
State educational expenditures - 1979 (in millions of $)

Source: Appropriations: State Funds for Operating Expenses of Higher Education 1978-79, NASULGC:

State appropriations for higher education - 1979
State higher education appropriations per capita - 1979
State higher education appropriations per $1,000 of personal income - 1979
% change in state appropriations for higher education from 1968/69 to 1978/79 (in constant $)

Source: Education Directory, Colleges & Universities 1978-79:

# of all institutions of higher learning in state - 1979
# of all four-year institutions and universities - 1979
# of all public institutions - 1979
# of all public four-year institutions and universities - 1979

Source: Education Directory, Colleges & Universities 1968-69:

# of all institutions of higher learning in state - 1969
# of all four-year institutions and universities - 1969
# of all public institutions - 1969
# of all public four-year institutions and universities - 1969

Source: Association of Research Libraries Statistics 1980-81

ARL library index

APPENDIX B

LIST OF LAND-GRANT INSTITUTIONS INCLUDED IN THE STUDY

1) Land-Grant Universities:

Auburn University; Auburn, Alabama
University of Alaska; Fairbanks, Alaska
University of Arizona; Tucson, Arizona
University of Arkansas; Fayetteville, Arkansas
University of California; Berkeley, California
Colorado State University; Fort Collins, Colorado
University of Connecticut; Storrs, Connecticut
University of Delaware; Newark, Delaware
University of Florida; Gainesville, Florida
University of Georgia; Athens, Georgia
University of Hawaii; Manoa, Hawaii
University of Idaho; Moscow, Idaho
University of Illinois; Urbana-Champaign, Illinois
Purdue University; Lafayette, Indiana
Iowa State University; Ames, Iowa
Kansas State University; Manhattan, Kansas
University of Kentucky; Lexington, Kentucky
Louisiana State University and A & M College; Baton Rouge, Louisiana
University of Maine; Orono, Maine
University of Maryland; College Park, Maryland
University of Massachusetts; Amherst, Massachusetts
Michigan State University; East Lansing, Michigan
University of Minnesota; Minneapolis, Minnesota
University of Mississippi; State College, Mississippi
University of Missouri; Colombia, Missouri
Montana State University; Bozeman, Montana
University of Nebraska; Lincoln, Nebraska
University of Nevada; Reno, Nevada
University of New Hampshire; Durham, New Hampshire
Rutgers, the State University of New Jersey; New Brunswick, New Jersey
New Mexico State University; Las Cruces, New Mexico
North Carolina State University; Raleigh, North Carolina
North Dakota State University; Fargo, North Dakota
Ohio State University; Columbus, Ohio
Oklahoma State University; Stillwater, Oklahoma
Oregon State University; Corvallis, Oregon
Pennsylvania State University; University Park, Pennsylvania
University of Rhode Island; Kingston, Rhode Island

Clemson University; Clemson, South Carolina
South Dakota State University; Brookings, South Dakota
University of Tennessee; Knoxville, Tennessee
Texas A & M University; College Station, Texas
Utah State University; Logan, Utah
University of Vermont; Burlington, Vermont
Virginia Polytechnical Institute and State University; Blacksburg, Virginia
Washington State University; Pullman, Washington
West Virginia University; Morgantown, West Virginia
University of Wisconsin; Madison, Wisconsin
University of Wyoming; Laramie, Wyoming

2) Land-Grant Colleges:

Alabama A & M University; Normal, Alabama
University of Arkansas; Pine Bluff, Arkansas
Delaware State College; Dover, Delaware
Florida A & M University; Tallahassee, Florida
Fort Valley State College; Fort Valley, Georgia
Kentucky State University; Frankfort, Kentucky
Southern University; Baton Rouge, Louisiana
University of Maryland; Eastern Shore, Maryland
Alcorn State University; Lorman, Mississippi
Lincoln University; Jefferson City, Missouri
North Carolina A & T State University; Greensboro, North Carolina
Langston University; Langston, Oklahoma
South Carolina State College; Orangeburg, South Carolina
Tennessee State University; Nashville, Tennessee
Prairie View A & M University; Prairie View, Texas
Virginia State College; Petersburg, Virginia