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A STUDY OF THE INFLUENCE OF SIZE AND ECONOMY OF SCALE IN MICHIGAN PUBLIC COMMUNITY COLLEGES

By

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ABSTRACT

A STUDY OF THE INFLUENCE OF SIZE
AND ECONOMY OF SCALE IN MICHIGAN
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This study investigates the relationship of structural characteristics in organizations of varying size. A central concern is the relationship between organization size and economy of scale. The twenty-nine public community colleges in the State of Michigan comprise the population of the study which is post hoc in design. Using data obtained from the State of Michigan Activities Classification Structure, correlation and multivariate statistical analysis is used to examine the size of personnel components in relation to enrollment, resource allocation in relation to size and efficiency measures, and resource allocation in relation to available resources. In addition the effects of curricular differentiation on student-faculty ratios and average class size are investigated. The study indicates that economy of scale is present in reductions of expenditures per full-year-equated student. Total operating expenditures per full-year-equated student decrease with increases in college size. Administrative expenditures

per student decline with increases in college size, even though administrative expenditures are related more to available resources than to college size. Economy of scale is not significantly influenced by increases in differentiation in personnel components including faculty and administrative professionals. Increases in curricular differentiation have no adverse effects on student-faculty ratios or average class size. These findings accurately describe the population of the study, but due to the population size, no inferences regarding causal relationships can be made. In the context of the given size, the foregoing relationships were observed. It cannot be concluded that size is a causal variable.

To Scott, Jeffrey, and Judith

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CHAPTER I

CONCEPTUAL FRAMEWORK AND STATEMENT OF PROBLEM

Introduction

The foundation for consideration of organizations from the structuralist point of view was established in Weber's definition of bureaucracy (1947). His focus upon the formal structure of organizations stressed the importance of departmental units connected in a pyramidal hierarchy of authority regulated by rules. First in importance in this bureaucratic view of organizations is the dimension of differentiation (Blau, 1970; Weber, 1946), but Weber gave little consideration to organization size beyond its implications for differentiation. Increases in differentiation will correlate with increases in size; however, the relationship of size to organization efficiency is not so clear.

During the rapid postwar industrial expansion, researchers of the 1950's began to question the effect of size upon other organizational variables. Organizations were accused of over-bureaucratization with disproportionate resources allocated to administrative components (Parkinson, 1957). Contradictory findings were reported in major research of the 1950's. Melman (1951) and Bendix (1956) showed that the administrative component often decreased with increases in organizational size. Baker and Davis (1954) and Terrien

and Mills (1955), however, found disproportionate increases in the administrative component as the organization increased in size. Thus the debate for economy of scale began.

Definition of Economy of Scale

Economists typically relate measures of input to measures of output in order to determine efficiencies in cost of production per unit produced (Osborn, 1951; Bain, 1954; Silberston, 1972; Gold, 1981). Scale in this concept relates to production capacity while economy relates to production efficiency. Optimum economy of scale results when maximum production capacity is matched with maximum efficiency (Bain, 1954).

Organizational researchers, on the other hand, depend less on cost measures and more upon structural considerations of organizations (Kimberly, 1976). In this approach scale is frequently measured in number of employees and the differentiation or complexity of operations, (Blau and Schoenherr, 1971; Blau, 1973). Additional dimensions of scale include organizational formalization characteristics such as levels of authority and span of control. In this context economy of scale may be measured by relating scale factors against some output measure consistent with the organizational mission. Organizational studies of economy of scale might also be purely theoretical investigations of the effects of size on characteristics of the organization

itself (Meyer, 1972).

Approaches to the Study of Economy of Scale

Studies of economy of scale tend to concentrate on cross-sectional examinations rather than longitudinal studies. Cross-sectionial studies suffer for lack of attention to changes in size over time, and longitudinal studies are complicated by changes in variables due to time alone. Further difficulties lie in the selection of organizations for study. The generalizations of the research on single organization types such as Blau's examination of employment security agencies (1970) and universities and colleges (1973) may be limited. On the other hand, studies including a variety of organizational types, such as Hall, Haas, and Johnson's multi-organizational analysis (1967) or Pugh, Hickson, Hinings, and Turner's examination of fifty-two different work organizations in England (1968) may suffer for failure to recognize occupational differences (Rushing, 1966) or environment differences (Osborn, 1951; Pfeffer and Salancik, 1978). In addition important differences in the operations of product producing organizations as compared to service organizations may be present.

The influence of size has been the subject of many organizational researchers since Melman's 1951 study of the manufacturing industry. Most of these researchers investigated the relationship between organizational size and the

size of the administrative component. Organizational size has been measured most often in terms of the total number of employees and the administrative component has been defined as a percentage or proportion of the total number of employees assigned at or above a predefined organizational level. At issue, however, is the definition of size as well as the division of labor.

Blau holds that "in a study of social structure, a measure of size based on people who occupy positions in the structure is preferable to one based on dollars or some other units" (1973, 28). However, considerations of size based on costs of operation or populations served may provide additional contexts for investigating questions of efficiency and economy of scale. Therefore, economy of scale might be better understood if it were examined in the theoretical constructs of both social and fiscal contexts.

In both social and fiscal contexts the concept of division of labor requires definition. Specialization is that dimension of organization structure that is related to the division of labor and the distribution of individual responsibilities within an organization (Pugh, Hickson, Hinings, and Turner, 1968). The administrative component is a category of personnel that most broadly defined might include all employees in a role supportive of the primary organizational mission rather than one directly related to it (Haas, Hall, and Johnson, 1963). From this view, both the chief executive officer and the custodian might be

included in the administrative component in their mutual support of an organizational mission. The complexity of the administrative component might be better addressed in Rushing's three part identification of managerial, clerical, and professional groups within the administrative component (1967). This division of the administrative component is particularly appropriate in studies of higher education organizations since traditional roles in higher education fall more clearly into these categories. Additional categories in the division of labor in higher education include the faculty and the support staff.

In the fiscal context the issue of economy of scale involves considerations of efficiency. Doubt was cast on some accepted assumptions regarding size and efficiency in a study of the relative efficiency and profitability of manufacturing corporations (Osborn, 1951). Following examination of profit-loss statements in small and large corporations representing major industrial groups, Osborn declared, "Considering all the uncertainties involved, the unsatisfactory conclusion is reached that we do not know very much about relative efficiency in relation to size" (1951, 92). He found little to support the generalization that small and medium-size corporations are more efficient than large ones. On the other hand, no evidence for greater efficiency in large corporations was found. Similar findings were reported in a study of twenty manufacturing industries in 1954 (Bain).

In the public sector, however, evidence was found in a study of economies of scale in Iowa public schools in partial support of optimum size (Cohn, 1968). Cohn found that costs per student decreased in larger schools; however, this benefit was most evident in efficiencies gained in moving from small to large rather than from large to larger. In 1979 McLaughlin evaluated Blau's conclusion (1974) that complexity more than size, influences per student costs. Like Blau, McLaughlin found that effects of size are negligible when compared to changes in staffing ratios and changes in complexity of curricula (1979).

Subject of Investigation

This study is based on data from the twenty-nine public community colleges in the State of Michigan. The primary reason for this choice is twofold. Since 1979 officials in Michigan public community colleges have complied with a uniform statewide reporting system, the Activities Classification System (ACS). At the same time they have continued to maintain a high degree of autonomy at the local district level. Therefore, programs and services directed by local governance boards vary greatly from one college to another; however, cost and efficiency comparisons can be determined at the statewide level due to the uniform reporting system. This unique circumstance provides an opportunity for organizational research in a setting in which structural components and differentiation are uniformly defined in a universe

of organizations.

The community college is a relatively new organization. A description of its emergence, growth, and role follows in order to provide a broader perspective in which the specific system investigated in this study may be viewed.

Two-Year College Origins

Proposals to create an organization that would relieve the university of freshman and sophomore instruction date back to 1851 when Henry Tappan, president of the University of Michigan, called for the creation of junior colleges (Cohen and Brawer, 1982). Early in the twentieth century William Rainey Harper, president of the University of Chicago, Edmund J. James, of the University of Illinois, and David Starr Jordan, of Stanford, all advocated the European model which extended secondary school curricula leaving "higher-order scholarship" for the university. In addition, Harper proposed that some four-year colleges might convert weak four-year programs into strong two-year junior college programs (Cohen and Brawer, 1982).

While some universities might have thrived as upper division and graduate institutions without lower division studies, few gave up freshman and sophomore instruction. In general, university officials were not inclined to relinquish this level of instruction nor were the secondary system officials willing to accept the responsibility of adding grades 13 and 14. Nevertheless, in this climate of debate the

opportunity for the emergence of two-year colleges led to the establishment of twenty junior colleges by 1909 and to 170 ten years later. Thirty-seven of forty-eight states contained junior colleges in 1922. By 1930 the number of junior colleges increased to 450, and they were present in all but five states (Cohen and Brawer, 1982).

Cohen and Brawer (1982) suggest that the underlying impetus for the acceptance and rapid expansion of the two-year college was the American faith in the benefits of education, measured in years of schooling. This faith coupled with egalitarian ideals provided the rationale to support the establishment and growth of the two-year college. Access to education was expanded, and "more than any other single factor, access depends on proximity" (1982, 10). Therefore, once started this organization would flourish.

Two-Year College Growth

By 1980 more than half of all students in higher education were enrolled in two-year colleges (Cohen and Brawer, 1982). In 1984 two-year college enrollments exceeded 100,000 students in fourteen states. Six of these states (Arizona, Maryland, Ohio, Pennsylvania, Texas, and Washington) predicted enrollment increases, and eight (California, Florida, Illinois, Michigan, New Jersey, New York, North Carolina, and Virginia) predicted enrollment decreases. Enrollments nationwide entered a no-growth or slightly declining status with a likely one to two percent decrease

nationwide (AACJC, 1984). Table 1 shows by decade the rapid expansion in both the number of two-year colleges and credit enrollments. While the number of public two-year colleges doubled since 1964, enrollments increased by more than 500 percent.

Cohen and Brawer (1982) cite the work of M.J. Cohen in 1972 that investigated the relationship between population density and the number of two-year colleges.

> He found that community colleges tended to be built so that 90-95 percent of the state's population lived within reasonable commuting distance, about 25 miles. When the colleges reached this ratio, the state had a mature community college system, and few additional colleges were built. As that state's population grew larger, the colleges expanded in enrollments, but it was no longer necessary to add new campuses. Cohen identified seven states that in the early 1970s had mature systems: California, Florida, Illinois, New York, Ohio, Michigan, and Washington. In these states, the denser the population, the smaller the area served by each college, and the higher the per-campus enrollment. Applying this formula of the relations among numbers of colleges, state population, and population density, he showed that 1,074 public community colleges would effectively serve the nation (Cohen and Brawer, 1982, 12).

Table 1 indicates that in 1984 1,064 public two-year colleges were established. Cohen's projections would support both the stabilization in enrollments as well as the decline in private colleges. Furthermore, Cohen's identification of Michigan as a state with a "mature system" enhances the selection of that state's system as the focus of this study.

TABLE 1: Fifty Years of Growth in Two-Year College Credit Enrollments* 1933-34 to 1983-84.

Year	Public	Private	Total	Public	Private	Total
1933-34	223	309	532	77,111	33,138	110,249
1943-44	261	323	584	74,853	32,954	107,807
1953-54	327	267	594	533,008	69,856	602,864
1963-64	503	268	771	913,057	120,346	1,033,406
1973-74	910	231	1,141	2,729,685	136,377	2,866,062
1983-84	1,064	155	1,219	4,799,768	148,207	4,947,975
1984-85 (est.)	1,064	155	1,219	4,720,000	150,000	4,870,000

*Does not include an estimated 4.5 million noncredit enrollment.

Data Source: AACJC Letter, 1984

Role of the Two-Year College

The "junior college" has been defined as "an institution offering two years of instruction of strictly collegiate grade" (Bogue, 1950, p.xvii); however, that 1922 American Association of Junior Colleges definition has since been broadly expanded. In the 1950s and 1960s the term "junior college" was commonly used in reference to church supported two-year colleges and to university branches providing lower-division instruction. The term "community college" came into being as an identification of publicly supported two-year colleges with comprehensive programs. (Cohen and Brawer, 1982).

Comprehensive programming expanded the role of the two-year college. In addition to providing traditional academic programs designed for students intending to transfer to the university, the comprehensive community college also provides vocational and technical education. These programs are designed to provide students with entry level job skills gained through vocational training in combination with general education requirements.

The role of community education is another dimension of the comprehensive community college. A Texas college's slogan summarizes this role: "We will teach anyone, anywhere, anything, at any time whenever there are enough people interested in the program to justify its offering" (Bogue, 1950, p. 215). Cultural, recreational, and hobbicraft

courses are common noncredit offerings in most community colleges. In addition, continuing education courses designed to provide units of credit to be applied toward continuing licensure or certification requirements are commonplace for such groups as realtors, pharmacists, and other allied health practitioners. Community colleges are also involved in economic development activities through participation in economic development councils and through training and consulting services in direct technical assistance programs designed for business and industry.

Finally, because the community college, an open admission institution, admits all students regardless of previous academic success, remedial or developmental programs are commonplace. Basic skills courses, tutorials, learning labs, study skills centers, special counseling, and peer-group assistance activities are designed to enable low ability students to acquire the prerequisite skills needed for successful program completion.

Most two-year colleges, public and private, have developed comprehensive programs. Since the 1970s the term "community college" is usually applied to both "junior" and "community" colleges (Cohen and Brawer, 1982). There is no doubt that the rapid growth in two-year colleges is in part due to the comprehensive role of the community college.

Purpose of the Investigation

In this study hypotheses will be tested to investigate the influence of size on efficiency and economy of scale in the Michigan community college system.

The community college system in the State of Michigan is a complex organization in operation and size. The programs of the twenty-nine community colleges in the system vary from traditional academic study to unique programs serving specific populations such as concrete technology in Alpena and ski lift maintenance in Gogebic.

Variations in size are also great (see Table 2). In fiscal year 1984 general fund expenditures ranged from a low of $2,625,152.00 in Glen Oaks Community College to a high of $39,399,704.00 in Macomb Community College. Student enrollments ranged from a low of 753 full-year-equated students (FYES) in Glen Oaks C.C. to a high of 15,831 FYES in Oakland Community College, and fiscal year credit hours generated ranged from 23,363 at Glen Oaks C.C. to 490,777 at Oakland C.C. Personnel employed were as few as 73.5 full-time-equated positions at Glen Oaks C.C. and as high as 1,283 at Macomb C.C. Physical plant size varied from 129,000 gross square feet at Glen Oaks C.C. to 1,645,748 at Oakland C.C. (Grobe & Root, 1985).

Another dimension of the diversity and complexity in size is the difference in measures of operating efficiency among the twenty-nine organizations. For example, cost of

instruction per FYES ranged from $1,182.00 in Southwestern Michigan College to $1,998.00 in Washtenau Community College. Energy costs in physical plant operation ranged

TABLE 2: Size Variables of Michigan Public Community Colleges in Fiscal Year 1984

Variable	Mean (n=29)	St.Dev.
Full-Year-Equated Students (FYES)	4285.34	4171.74
Full-Time-Equated Personnel FTE	216.59	180.40
Operating Expenditures	12,636,743	10,946,361
Operating Expenditures per FYES	3155.09	436.68
Instructional Expenditures per FYES	1580.21	218.72
Credit Hours Generated	132,862	129,327
Physical Plant (square feet)	464,066	361,607

Source: Grobe and Root, 1985

from a low of $125,339.00 in North Central Community College to a high of $2,036,752.00 in Oakland C.C. (Grobe & Root, 1985). A complete list of Michigan public community colleges may be found in Appendix A.

In view of these differences in size and costs of operation, a funding approach that provides equitable support given the mix of programs is difficult to achieve. Additional variations in tax rates, tax bases, tuition rates and political environments further complicate

development of an appropriate funding formula. The purpose of this study is to investigate the influence of size on organizational variables related to the problem of funding. Is there an optimum economy of scale in the Michigan community college system? What size and resource allocation factors contribute most to the achievement of greater efficiency? The purpose of this study is limited to questions of efficiency without regard for program effectiveness or quality of achievement. It cannot be assumed that maximum efficiency equates to maximum effectiveness; however, the results of this study may provide data for education decision-makers dealing with problems of efficiency.

Contribution of the Investigation

Since 1979 the legislature of the State of Michigan in cooperation with the Department of Education and the Department of Management and Budget has been seeking a formula funding model that will effect parity in the State support of Michigan's twenty-nine community colleges at the same time that it recognizes existing differences in size and local resources. This task is severely complicated by variations in size among the colleges and the assumed effects of those variations. The results of this study may provide empirical data for better decision making with respect to issues of economy of scale.

Organizational theory might also be advanced by

providing further support for the theories advanced by Blau (1973, 1974) and more recently by McLaughlin (1979) that differentiation and complexity more than size will affect economy of scale. Stommel's finding (1985) that a curvilinear relationship exists between expenditure per student and organization size in land-grant universities will be tested in Michigan public community colleges. Finally, additional contributions to resource dependence models (Pfeffer & Salancik, 1978) and environment and network theories (Perrow, 1979; Pfeffer & Salancik, 1978; Scott, 1981) may also be realized.

Overview of the Study

This study is organized into five chapters. The background, the theoretical framework, the purpose, and the anticipated contributions of the study were presented in Chapter I. A review of the literature related to investigations of organizational size and economy of scale is provided in Chapter II. The hypotheses of the study and the rationale underlying each hypothesis are set forth in Chapter III. Operational definitions and methodology are also contained in Chapter III. Findings and interpretations of statistical tests are reported in Chapter IV, and conclusions regarding the influence of size and economy of scale in Michigan public community colleges are presented in Chapter V along with implications for community college administrators and state level decision makers.

Chapter V concludes with recommendations for future research.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A review of the literature in three broad categories related to this study is presented in this chapter. These categories are organizational size and its influence, organizational size and efficiency, and the relationship of organizational size to economy of scale.

Organizational Size and Its Influence

Organizational size and its influence on the structure of the organization has been the subject of much inquiry. Among the first of these inquiries was Melman's study of manufacturing industries in 1951. Melman concluded in his examination that organization size and the organizational administrative component were inversely related. As the total number of personnel increased, the number in the administrative component decreased as a percentage of total personnel. Size in Melman's study was measured in terms of the total number of employees.

Using the same measure of size, total number of employees, Terrien and Mills found in a 1955 study of California schools that the administrative component increased in large schools. Their findings were consistent in elementary school districts, high school districts, and

unified and city school districts. In each group they found increases in the mean percentage of employees in the administrative component. In high school districts the increase was from 11.4% in small schools to as much as 17.6% in large schools (1955, 13). However, school size in this study is measured in terms of total personnel without regard for the number of students enrolled.

Organizational size was recognized in two dimensions in Anderson and Warkov's study of the administrative component in hospitals (1961). Organizational size was measured by the annual average daily patient load rather than the total hospital force; however, both measures were found to be essentially equivalent. Perhaps more important, Anderson and Warkov introduced a second independent variable, organizational complexity, into their study. Organizational complexity was measured in terms of the number and variety of tasks performed as well as the maximum number of specialized tasks that might occur simultaneously. In relationship to organizational size and complexity Anderson and Warkov found:

1. The relative size of the administrative component <u>decreases</u> as the number of persons performing identical tasks in the same place increases.

2. The relative size of the administrative component <u>increases</u> as the number of places at which work is performed increases.

3. The relative size of the administrative component <u>increases</u> as the number of tasks performed at the same place increases (or as roles become increasingly specialized and differentiated) (1961, 27).

In view of these findings, Terrien and Mills may be understood to confirm the second proposition without nullifying the first proposition since in their study of California school districts multiple sites were commonplace. Clearly the structural dimension of complexity was established in this study as an important consideration of size.

Structural considerations are expanded still further in the work of Haas, Hall, and Johnson in their 1963 study of the size of the supportive component in thirty organizations of various types. In their study the term "supportive component" is used in place of the administrative component in previous studies. The supportive component is a larger group inclusive of all personnel not directly related to the organizational goals. They believed that this broader category made comparisons among unlike organizations more applicable. The varying size of the supportive component was examined in relation to other organizational characteristics such as total employee size, number of operating sites, and organizational differentiation and function. The work of Haas, Hall, and Johnson clearly tests the conclusions of both Terrien and Mills and Anderson and Warkov; however, important differences exist. The previous studies examined a more narrowly defined employee component within a single organizational type. Haas, Hall, and Johnson sought generalizations applicable to a variety of organizations and the comparison group, "supportive component," was inclusive of more personnel

ranks than in studies of previous researchers.

Haas, Hall, and Johnson found that the percentage of employees in the supportive component decreased as organizational size increased (1963). This relationship was found across organization type; however, they also found that the supportive component in governmental and non-profit oganizations had even less personnel than in private, profit organizations of similar size (1963, 16), and they found that the larger the number of personnel in an organization, the more likely it will occupy multiple sites. No causal link was suggested. On the other hand, they found that organization size influenced the size of the supportive component more than differentiation or organization age, a conclusion in conflict with that of Anderson and Warkov (1961).

Haas, Hall, and Johnson, were the first to note that the relationship between organization size and the size of the supportive component may be curvilinear. They found that scattergrams showed larger proportions of personnel in supportive activity in small and large organizations than in medium size organizations. They concluded, however, that due to the small number of medium size organizations in their study "the curvilinear relationship should be taken as suggestive only at this time" (1963, 14). Later research was to find this relationship more important.

The first study of organizational size and its influence on higher education organizations was reported by Hawley,

Boland, and Boland in 1965. Organizational size in their study was defined as the number of full-time and part-time faculty reduced to full-time equivalents. Dependent variables included the number of professional administrators, the number of departments, and the operating budget. They found that faculty size and budget size influenced the administrative size more than differentiation as measured by the number of departments. This finding would appear to be inconsistent with Anderson and Warkov regarding the influence of differentiation or complexity; however, the larger number of faculty resulting from increased differentiation may overide the effect of differentiation alone in Hawley, Boland, and Boland. This study, however, affirms Anderson and Warkov in finding that "the ratio of administrators to faculty tends to decline as size of faculty increases" (1965, 253). Again as in Haas, Hall, and Johnson, slight attention is given to a tendency toward curvilinearity, but it "disappears when a scatter diagram is plotted on a log-log grid" (1965, 253).

Studies of the influence of organizational size on employee groups within the organization may be complicated by differences in occupations as well as by employee classification within the organization. Rushing (1966) postulated that the administrative component may vary by occupation so that it might increase or decrease with organizational size due to occupational differences rather than organizational size differences. Dividing the

administrative component into five groups - managers, clerical, professional, sales, and service - Rushing found that "firm size has quite different effects on different components of administrative personnel" (1966, 106). His findings called "into question the popular criticism that administrative personnel uniformly and systematically increase disproportionately as bureaucratic organizations increase in size" (1966, 107). Rushing's observations may explain in part the inconsistent findings of previous research which varies greatly in definition of the administrative component.

Rushing tested further the findings of Anderson and Warkov in light of his considerations regarding the administrative component (1967). In a study of forty-one industries Rushing examined the effects of industry size and the division of labor on the relative number of administrative personnel. He defined industry size in terms of the number of production personnel, not total personnel. The administrative component inclusive of managers, professionals, and clerical personnel was measured as a ratio of administrative personnel to production personnel. Industry complexity or division of labor was measured by the Gibbs-Martin formula based on the distribution of personnel among the different departments in the organization. Rushing found:

1. The relative number of administrative personnel is directly related to the division of labor among

production personnel, but inversely related to the total number of production personnel. This is true for all administrative groups.

2. Controlling for the effects of size and division of labor does not usually cause the relationship between the other variable and the relative size of the administrative groups to disappear. In fact, control for the division of labor increases the relationship between industry size and administration. To this extent, the effects of the two variables are independent.

3. At the same time, however, the variables interact. The effects of the division of labor are greater in smaller industries, while the effects of industry size are greater in industries where the division of labor is high. This finding, however, is not true for the relative number of professional personnel.

4. Finally, the ratio of clerical and professional personnel increases as the division of labor increases (1967, 293-294).

Thus, the hypotheses of Anderson and Warkov are affirmed; however, they do not account for all of Rushing's findings.

The relationship of organizational size to complexity is questioned in the study of Hall, Haas, and Johnson (1967). In their examination of a wide variety of both product and service organizations they found that complexity and formalization were not necessarily conditions of size, but rather they were structural characteristics dependent on the nature of the organization's work force and purpose. They suggested that the more professional the work force, the less formal the structure regardless of size. Little evidence was found in support of a causal link between size and organizational structure, and they, therefore, called into question the theory that expanding size produces greater differentiation (1967).

Hall, Hass, and Johnson reinforced the finding of Hawley, Boland, and Boland regarding economic influences on an organization. Hawley, Boland, and Boland found that budget size, more than complexity, may have influenced the size of the administrative component (1965). Hall, Haas, and Johnson argued that both size and complexity may be dependent on available resources and economic input (1967).

In 1970 Peter M. Blau set forth his formal theory of differentiation in organizations. Two major generalizations were deduced based on empirical findings in a study of government employment bureaus. Complete results were reported by Blau and Schoenherr in 1971. Blau's first generalization was "increasing size generates structural differentiation in organizations along various dimensions at decelerating rates" (1970, 204). The second generalization was "structural differentiation in organizations enlarges the administrative component" (1970, 213). The second generalization is in direct conflict with that of Hall, Haas, and Johnson (1967) reported above.

It should be noted that the terms "differentiation" and "complexity" vary in denotation among researchers. Blau (1970) used the term "differentiation" to refer to the number of structural components that are formally distinguished within the organization. For both Blau (1970) and Scott (1975) differentiation referenced the division of labor. On the other hand, Hall, Haas, and Johnson (1967) used the term "complexity" to reference the division

of labor and "differentiation" is used to reference the number of hierarchial levels. Scott however, argued that "complexity" of work should not be confused with "differentiation" of roles. The first is an aspect of technology; the second is a facet of structure (1975).

Differentiation is Blau's primary concern. He found that differentiation at first grows rapidly with increases in organizational size but more slowly when very large size is realized. Blau argued that economy of scale occurs in large organizations due to increases in the span of control within the hierachy of the organization. That is, increases in the work group size result in a decrease in the proportion of managers as a part of the total work force, thereby resulting in economy of scale in management. This finding is in direct contrast to Terrien and Mills (1955) who found that the percentage of the administrative component in California school districts increases in large districts. Blau argued that economies of scale exceed the expenses of differentiation. These economies decline rapidly, however, with continued expanding size (1970).

In a second major study based on 115 American colleges and universities Blau affirmed his earlier findings. In summarizing the process of differentiation Blau generated three "theorems":

1. Increasing organizational size generates differentiation at declining rates.
2. Increasing organizational size reduces administrative ratios at declining rates.

3. Structural differentiation in organizations enlarges administrative ratios (1973, 259-260).

Blau's measure of size was the number of faculty members. The third of these three theorems must be understood in the context of assumptions regarding economy of scale. Even though differentiation increases administrative ratios, the organization realizes economy of scale benefits due to overall increases in the total work force.

Recognizing the contrasting views on the effects of size represented by Hall, Haas, and Johnson (1967) who found minimal effects associated with size and those views of Blau (1970) and Blau and Schoenherr (1971) who attached great importance to size, Meyer (1972) chose to test the effects of size in a causal model. He concluded that size cannot be underestimated in its impact on other organizational characteristics. In his study of 194 city, county, and state departments of finance, Meyer determined that apparent relationships among organizational characteristics vanished when size as a variable was controlled. Size in Meyer's view was the unidirectional cause of other organizational characteristics (1972).

The findings of Terrien and Mills (1955) were tested again by Holdaway and Blowers (1971). They found in their examination of forty-one urban school systems that administrative ratios declined with increases in the size of the school system. Perhaps more noteworthy, however, is their finding regarding the professional group within the

administrative component which did show increases with increases in system size. This group, including psychologists, social workers, and teaching consultants, showed positive relationships with organization size while central office managerial personnel showed negative relationships (1971). Holdaway and Blowers affirmed Rushing (1966, 1967) in their findings regarding the variations in size of groups within a personnel component.

Still further support for this observed variation was provided in Kasarda's (1974) examination of the administrative component in 178 Colorado school systems. He reported that the managerial component was negatively related to system size, but like Holdaway and Blowers, he found increases in the clerical and professional groups. Based on this research, Rushing appears to be correct in his argument for variances in size of personnel groups commonly included in the administrative component.

Further support for Blau's findings (1970, 1971, and 1973) regarding differentiation were provided in 1979 by McLaughlin. Using a path analysis model, McLaughlin demonstrated that institutional size has a direct effect on cost per student; however, changes in staffing ratios and curricular complexity have far greater effects on cost per student. The positive effects of size in producing economy of scale can be completely erased by increased complexity and differentiation. Costs can be reduced if the number of curricula and degrees can be held constant

while enrollment is increased (McLaughlin, 1979).

In a comprehensive review of eighty empirical studies on organizational size and its structural influence, Kimberly noted that while the number of employees was clearly the most common measure of organizational size, "conceptual definitions of size are lacking" (1976, 574). Because of variations in measures of size based on varied concepts of size, results of studies are difficult to compare. The concept of size is ambiguous simply because it is too broad. Kimberly called for greater specification by limiting inquiry to some aspect of size and its theoretical role. Among the aspects of size cited are physical capacity, available personnel, inputs and outputs, and available discretionary resources. From these more differentiated aspects of size, relationships between organizational structure and aspects of its size might be tested with greater consistency among researchers. Efforts to resolve empirical contradictions such as those found in Terrien and Mills (1955) and Anderson and Warkov (1961) might then be based on "theoretical reformulation" rather than on "methodological refinement" (1976).

A second major problem in the study of organizations is the variety of organization types. Kimberly argued that there are different organizational types and that size may influence organizational structure differently from one type to another. The role of size may be independent of organizational type, and aspects of size may vary as a

function of organizational type (1976, 594). As noted previously, Haas, Hall, and Johnson (1963) found that the supportive component in government and service organizations was smaller than in private, profit organizations. Kimberly concluded from his literature review that problems of sampling and organizetional type are difficult and likely to continue as long as theoretical implications of differences in organizational type are ignored.

In summary organization researchers have sought to determine the influence of organization size upon the various components within the organization itself. This examination is complicated by both the variety of organizational components as well as how they might be defined. However, strong evidence is provided in support of the role of differentiation as a key size factor influencing all other components within the organization.

Organizational Size and Efficiency

An early inquiry into the relation of size to efficiency and profitability was conducted by Osborn (1951) who examined then accepted generalizations that medium and small size corporations may be more efficient and more profitable than large corporations. He considered efficiency in terms of costs of production and costs of marketing goods or services in a competitive environment. Efficiency, then, is relative to comparable conditions of business operations. Differentials in geographic location,

similarity of product, labor costs, and other variables complicate cost comparison. In light of these considerations Osborn found that, in large corporations, the ranges in profitability tend to be narrower than in small corporations. He did not find substantial support for the hypothesis that large corporations are less profitable or less efficient; however, he did conclude that large businesses frequently trade off increased profitability for increased stability. They grow conservative but stronger. He was unwilling to conclude that much is known about relative efficiency in relation to size (1951).

Other economists reached similar conclusions. In an investigation of twenty manufacturing industries, Bain sought to determine the "minimal plant size requisite for lowest unit costs" (1954, 18). Based on data gained in questionnaires especially designed for each of the respondents, Bain found that economies of scale in large multiplant firms varied among industries. No consistent empirical foundation for economies of scale was found, and in considerations regarding product concentration or market entry, the issue of economy of scale was generally unimportant (1954). Bain's findings are supported further by Shepherd who examined economy of scale as a determinant of corporate structure. Shepherd concluded that "research into economies of scale teaches one modesty" (1979, 259). Empirical findings are few and open to question (Shepherd, 1979).

Economic analyses of economy of scale suffer for lack of clarity in the basic concept of scale (Gold, 1981). After reviewing a variety of concepts of scale, Gold argued for a redefinition of the scale concept in terms of "the level of planned production capacity which determines the extent to which specialization has been applied to the subdivision of the component tasks and facilities of a unified operation" (1981, 15). On the basis of this more precise concept of scale a variety of models for assessing economy of scale might be developed. Variations in scale affected by technology and organizational complexity might be accounted for by considerations of specialization and the division of labor as organizational components affecting production capacity (Gold, 1981).

Economists such as Osborn, Bain, and Gold have been concerned for economy of scale and industrial efficiency. Little attention is given to nonprofit organizations such as educational institutions. Few, if any, of the researchers cited previously in this review examined educational organizations for operating efficiency. Until the 1970s a history of strong support for education existed in American society; however, with changes in student attitudes reflected in the rebellions of the 1960s mixed with diminishing resources in support of education, concerns for efficiency in educational consumption of resources arose. Organizations such as the National Center for Higher Education Management Systems (NCHEMS) and Western Interstate

Commission for Higher Education (WICHE) came into existence. In 1970 the staff of WICHE published a report including the papers of a national research training seminar on the outputs of higher education. Participants came together to justify expenditures in higher education in measurable outputs. Ironically the focus of the papers presented was less upon cost efficiencies and more upon ill-defined issues of cost effectiveness. Measures advocated tended to depend more on variables that were difficult to define and control such as added value in student earning capacity over time (Lawrence, Weathersby, and Patterson, 1970).

Bowen and Douglas (1971) were more particular in their consideration of educational efficiencies. They asserted that small colleges could realize greater efficiencies in average class size with increases in enrollment so long as the curricular options were held constant. They also noted, however, that in practice these economies are not typically realized because with increases in size, colleges tend not only to expand curriculum but also to upgrade facilities and staff (1971).

In a cost analysis of college curricula Meeth found that there was a high correlation between average class size and institution size (1974). He found increases in class size until enrollment of 850 were reached (1974, 30). On the other hand, Meeth found that "the cost per student is not related to institutional size" (1974, 42-43). Schools in his study spent according to resources available

rather than according to an optimum efficiency in cost per student. Expenditures were driven by administrative considerations not necessarily related to cost per student (1974).

The problem of measuring educational productivity was articulated very clearly by Priest and Pickelman in 1976. Citing such authorities as Ben Lawrence, Director of the National Center for Higher Education Management Systems, and Patrick Haggerty, former Chairperson of the Board of Texas Instruments, Priest and Pickelman acknowledged that productivity measures in education were "imperfect" and in a "primitive state." They proposed consideration of a number of institutional characteristics in a simple productivity model of output and input ratios, but for the most part they appealed for the development of scientific models rather than offered such models. "The elusive and ambiguous nature of the whole concept of productivity has been mind boggling" (1976, 35), but this fact should not detract from dealing with the problem (1976).

Among the first more definitive methods of cost analysis in higher education was that described by Gamso in 1978. He combined an activity classification system with program variables defined by instructional work load matrices and departmental personnel data forms. This format provided a cost analysis model that depended less on subjective judgment and more upon quantitative data. Through management information systems and quantitative

data based models of management science, decisions could be made with predictable results. McClenney (1980) noted that since 1970 the National Center for Higher Education Management Systems published more than seventy documents on planning and management in higher education. Emphasis on the measurement of educational outcomes was evident in publications on classification structures, management information systems, and cost analysis techniques such as those in Gamso. McClenney also noted that community colleges in particular were responsive to NCHEMS models and that they had taken the leadership role in advancing management sciences (1980, 19).

A comprehensive review of higher education efficiency studies was conducted by Paul T. Brinkman and reported in 1985. Brinkman examined fifty years of research on economy of scale in higher education. His purpose was "to integrate and synthesize the results of empirical studies of the size-cost relationship in higher education" (1985, 1). After noting the difficulties of dealing with the ambiguities surrounding costs, Brinkman concluded that most studies addressing the issue of efficiency were really concerned with determining if efficiencies vary with size. That is, do expenditures per student decrease with in creases in size, or in other words, is there economy of scale? Brinkman limited his search to studies of higher education in the United States. He found documents from the early 1920s, but he indicated that "almost all of the

usable studies" were produced since 1950 (1985, 6). Using enrollment intervals and percentage changes in unit cost, Brinkman sought to standardize the results of the various studies for comparative purposes. The studies were grouped into three major categories: two-year colleges, four-year colleges, and research universities. Brinkman found six conclusions based on his comprehensive review:

1. Two-year and four-year colleges, on average, do experience positive returns to size.

2. Substantive size-related economies are most likely to occur at the low end of the enrollment range.

3. The enrollment range over which such economies are likely to be found differs by type of institution.

4. The extent of such economies differs by function, with the administrative area typically experiencing the greatest reduction in unit cost and instruction the least.

5. For educational and general expenditures, the broadest category, a three- to four-fold difference in enrollment among small institutions is accompanied by a difference in cost per student, at the mean, of 25 percent for two-year institutions and 23 percent for four-year institutions.

6. The extent to which scale-related economies or diseconomies are demonstrated by a given set of institutions depends on variations among them in the scope and variety of the programs and services they offer, the salaries they pay, and the general disposition of their resources (1985, 28).

In general Brinkman found that institutional size as measured by the number of students enrolled is only one influence among a variety of influences upon the cost per student. That influence, however, is more likely to be found in small institutions of less than 1000 enrollment

than in larger institutions (Brinkman, 1985).

In summary, the approach to investigating the influence of organization size on efficiency varies dramatically between economists and organizational researchers. Economists seek to measure organizational productivity in a macroeconomic approach. In addition to a complex of variables within the organization, they are also concerned with market entry and concentration. On the other hand, organizational researchers investigating efficiencies in education tend to limit investigation to the distribution of resources within a single system and examine the consequent effects more often than not in terms of cost per student. In this latter case it might be argued that this approach is really an investigation of resource allocation rather than efficiency. Efficiency studies in education are severely encumbered by the problem of defining an output.

Organizational Size and Economy of Scale

Clearly Brinkman (1985) found substantial empirical support for the concept of economy of scale. He also found that the concept of economy of scale itself is not a clear cut one and identifed four "sources of ambiguity" associated with the concept.

First, the definition of scale is confused in theory and practice. Classic definitions relate scale to productive capacity, but most empirical studies define scale in terms of organization size or quantity of output. The

relationship between quantity of outputs and average cost per unit is the focus of many economy of scale studies (Brinkman, 1985).

Second, economy of scale studies may be influenced by "short-run" versus "long-run" behavior. Short-run effects may influence results in cross-sectional studies. On the other hand short-run effects might be minimized in longitudinal studies based on performance over time. Educational organizations may be particularly prone to wide fluctuations in important variables such as enrollment. Costs per student may at first decline with enrollment increases but later rise with the consequent addition of staff and services. Results of studies of educational organizations may be distorted by these fluctuations (Brinkman, 1985; Dickmeyer, 1982).

Third, empirical studies of economy of scale lack consistency "with respect to what is to be held constant when estimating the relationship between scale (or size) and average cost" (Brinkman, 1985). The broadest definition of economy of scale allows for variances in input and output measures. In studies of educational organizations this broad interpretation would allow for comparison of institutions even though they differed in ratios such as teaching assistants to professors or graduate to undergraduate students (Brinkman, 1985).

Fourth, economy of scale can be influenced by environmental factors that are regulatory in nature. Funding

formulas within some states, for instance may impose restrictions on institutional operations that, in fact, control expenditure patterns. In addition, rules based funding may result in expenditures made on the basis of resources available rather than on need or service provided. State coordinating agencies may also direct program development by political or demographic considerations beyond the control of local institutions. The influence of regulatory agencies on economy of scale considerations may be significant (Brinkman, 1985).

These ambiguities cannot be avoided entirely in higher education studies, but they need to be acknowledged. Brinkman found that in many studies, however, "the question being asked is not about the independent effects of scale or size on unit costs, but simply whether large institutions spend less per student (or per credit hour) than do small institutions without regard to intervening factors" (1985, 5).

Uniform support for a U-shaped average cost curve was not found by Brinkman. In two-year colleges economies of scale are likely to be greater in small than in large institutions; however, the relationship of economy to scale is for the most part linear. In four-year institutions U-shaped cost curves were found in large institutions by some researchers (Jenny and Wynn, 1970; Maynard, 1971; Stommel, 1985). Most researchers, however, found that after initial economies realized in moving from small to large that the

curve tended to remain flat (Metz, 1964; California Coordinating Council for Higher Education, 1969; Carlson, 1972, Brinkman, 1984 and 1985). On the other hand, the more typical finding of per pupil school costs in high schools supports the U-shaped average cost curve (Fox, 1981). In his review of more than thirty economy of scale studies for schools and school districts Fox concluded, "essentially all of the studies suggest that diseconomies will occur for large size schools, so the average cost curve appears U-shaped" (1981, 286).

The influence of the larger environment of educational organizations cannot be ignored. Brinkman (1985) identified the influence of state regulatory agencies on available resources in public institutions. Tolbert (1985) investigated the influence of two theoretical perspectives, resource dependence and institutionalization, on administrative structure in higher education. These perspectives are well grounded in the work of Pfeffer and Salancik (1978), Perrow (1978), and Scott (1981). From this view both organizational size and economy of scale may be influenced by decisions made in settings outside the institution.

Summary

The role of differentiation first formally advanced by Blau (1970) would appear to be a key factor in determining the influence of size on economy of scale. Studies

affirm the finding that if differentiation is held constant, greater economies of scale are to be realized with increases in organization size (Blau, 1970 and 1973; Blau and Schoenherr, 1971; McLaughlin, 1979; Brinkman, 1985). Similar findings are associated with organizational complexity. Economy of scale was found by Haas, Hall, and Johnson (1963) in the reduction of the supportive component resulting from increases in size. Administrative ratios declined with increases in size in most studies (Anderson and Warkov, 1961; Hawley, Boland and Boland, 1965; Rushing, 1967; Holdaway and Blowers, 1971; Kasarda, 1974; McLaughlin, 1979; Brinkman, 1985).

Some inconsistency persists in describing the average cost curve in economy of scale studies. Tendencies toward curvilinearity were noted but dismissed in studies of Haas, Hall, and Johnson (1963) and Hawley, Boland, and Boland (1965). Most researchers found greater economies of scale in organizations moving from small to large and less difference in organizations moving from large to larger (Rushing, 1967; Blau and Schoenherr, 1971; Blau, 1973; Brinkman, 1984 and 1985). Others have found diseconomies in large organizations suggesting that the average cost curve is U-shaped (Jenny and Wynn, 1970; Maynard, 1971; Fox, 1981; Stommel, 1985). Findings on this issue remain unclear.

Environmental influences on organizational size and economy of scale are considered in more recent studies.

Distortions may result in conclusions regarding economy of scale in organizations influenced by regulatory agencies. Educational organizations in formula funding states, for instance, may expend resources according to rules unrelated to scale (Brinkman, 1985). Political contexts and organizational networks may also influence organizational configuration (Pfeffer and Salancik, 1978; Perrow, 1979; Scott, 1981).

These summary comments are by necessity very general. The study of organizational size and its influence on economy of scale is complicated by many factors identified in this review. Methodology varies widely among researchers who operate primarily from an empirical base rather than a theoretical one (Kimberly, 1976). Among the many researchers reviewed only Blau established a theoretical foundation (1970) which was then tested in studies of employment agencies (1971) and colleges and universities (1973). In most studies the variables examined are specified in terms relevant to a particular problem investigated. Consequently, the synthesis of generalizations from study to study is very limited.

CHAPTER III

METHODOLOGY

The Population

In this study of organizational size and economy of scale the researcher has chosen to work within the limits imposed by a cross-sectional study of a single organization type and has selected to analyze the Michigan community college system inclusive of twenty-nine public community colleges. A complete list of Michigan public community colleges and their size in full-time-equated personnel and full-year-equated student enrollment may be found in Appendix A.

Data Source

The primary source of data is the Michigan Department of Education that gathers information from all Michigan community colleges as determined by the Michigan Community Colleges Activities Classification Structure, 1981 (ACS) and the Manual for Uniform Financial Reporting: Michigan Public Community Colleges, 1981. Fiscal year 1984 has been selected as the period for analysis since this represents the most recent data available through this source. The use of 1984 data is justified in that, in the judgment of state officials, the validity of uniform reporting is greater in this collection period than in any previous

period (Root, 1985). In addition the high quality of the data encourages replication studies in the future that will use 1984 as the base year.

Variables and Indicators

Organizational size in this study is investigated in two distinctly different contexts. The first examination is more consistent with organizational research that depends on structural considerations such as the number of employees and the differentiation or complexity of operations. The second is more consistent with economic interests in operating costs and efficiencies. A description of the variables examined in this study follows. Additional operational definitions and indicators may be found in Appendix B.

In the first context, total full-time-equated employees are distributed in a five part division of labor including executive administrators, administrative professionals, clerical staff, other support staff, and faculty. The faculty group includes all personnel, full and part-time, whose service is related to the provision of direct instruction and is computed on a full-time-equated basis. While librarians and counselors are sometimes included in the faculty category, in this study they are included in the category of professionals within the administrative group along with all other administrative professionals who do not serve in an executive capacity.

Placing librarians and counselors in the administrative professionals group frees considerations of student-faculty ratios from distortions produced by inclusion of personnel not functioning within the classroom setting. Student-faculty ratios are based on the pool of full and part-time faculty as measured by a full-time-equated formula.

The executive administrators group is determined by a count of personnel listed in the HEP 1985 Higher Education Directory with the following title or function: Chief Executive Officer, Executive Vice President, Chief Academic Officer, Chief Business Officer, Chief of Student Life Officer, and Deans. These titles or functions are consistent with those described by A Manual for Budgeting and Accounting Manpower Resources in Postsecondary Education, Technical Report Number 84 (pp. 47-54) by Dennis P. Jones of the National Center for Higher Education Management Systems and Theodore H. Drews of the National Center for Education Statistics and are inclusive of additional executive titles such as chancellor, president, and provost.

The remaining groups to be defined are the support staff and the clerical staff. The support staff is limited to staff personnel in maintenance, custodial, security, food services, and other support functions not clearly identified in other groups. The support group includes personnel whose services might otherwise be contracted rather than employed.

Functions such as snow removal or remodeling of facilities are examples of personnel activity included in this group. The clerical group, on the other hand, includes office based personnel whose performance is in support of executive administrators or administrative professionals. Secretaries, receptionists, bookkeepers, data entry operators, and switchboard operators are jobs typical of the clerical group.

In addition to structural considerations the issue of economy of scale involves considerations of efficiency. Efficiency is generally defined as the analysis of costs in relation to output(s). In higher education efficiency measures typically include considerations of costs per student, costs per square foot, and costs per faculty member (Meeth, 1974). The size of the administrative component in relation to organization size is an issue explored by many researchers (Terrien & Mills, 1955; Haas, Hall & Johnson, 1963; Rushing, 1966; Holdaway & Blowers, 1971; Blau, 1973). In this study efficiency measures are examined in community colleges varying in enrollment size from 753 full-year-equated students (FYES) to 15,831 FYES.

Personnel variables included in this study are: total college personnel, executive administration, administrative professionals, full-time-equivalent faculty, clerical personnel, and support personnel. Each of these variables is limited to personnel as described above and as reported on official ACS state records.

Expenditure variables included in this study are total personnel expenditures for each college as reported in ACS records for instructional support, student services, institutional administration, and instruction. In addition, some variables are pooled in order to examine total noninstructional expenditures in contrast to instructional expenditures.

Additional variables include measures of curricular differentiation as indicated by the number of different courses and course sections available. Efficiency measures such as student-faculty ratios and average class size are included as well as resource dependence variables such as property tax revenue, state appropriation revenue, and tuition and fee revenue. Finally physical plant variables including gross square feet and gross cubic feet are examined in comparison to enrollment size. Organization size is measured in terms of total personnel, the operating budget, and full-year-equated student enrollment.

Hypotheses and Rationale

Based on the concepts reviewed in Chapter II seven hypotheses are tested.

Hypothesis I: a. The proportion of executive administrators decreases in midsize and large colleges and is highest in small colleges.

b. The proportion of the remaining administrative component increases proportionately from small to midsize to large colleges.
c. The proportion of faculty remains constant regardless of college size.
d. The proportion of clerical personnel remains constant in small and midsize colleges but increases in large colleges.
e. The proportion of support personnel remains constant regardless of college size.

Correlation analysis may show proportionate personnel distributions according to size. In much of the literature of economy of scale in schools, the administrative or support component includes all nonteaching personnel and as a consequence does not provide for comparisons of different employee groups within the nonteaching component. Conclusions regarding increases in the administrative component may be distorted for failure to provide for this division of labor. Arguments for economy of scale are also frequently based on assumptions that limit the administrative component to executive officers only. A distortion may result from this assumption for failure to recognize that additional nonteaching professionals may swell

administrative ranks while the number of executive officers remains relatively constant. Separation of the support personnel from clerical personnel may provide some interesting variations since many of the services provided by nonclerical support personnel may be contracted through outside agencies rather than by employment. Election of this option may be a factor of size.

Hypothesis II:

a. Institutional administrative expenditures decrease as college size increases.

b. Instructional support and student services expenditures increase with increases in college enrollment.

c. The expenditure per student for total administrative cost including these three components is greater in large enrollment colleges.

Testing this concept examines administrative expenditures in relation to college size, but division of administrative expenditures by functions within this component provides support for the premise that the management required for college administration is a uniform cost regardless of size, and therefore, it will likely be a declining cost as size increases. On the other hand, this test also examines the premise that professional support services increase with increases in college size at a rate

great enough to result in lost economy of scale.

Hypothesis III: Expenditures per full-year-equated student (FYES) are greater in large than small colleges, but the increase is dependent upon noninstructional expenditure increases rather than faculty expenditures.

If one of the component variables consistently accounts for disproportionate variance more than any other variable, an influence accounting for expenditure increase might be indicated. A finding of this sort would be particularly important since it is suspected that instructional support and student services more than institutional administrative expenses will account for increased expenditures per student in large colleges.

Hypothesis IV: The student-faculty ratio is independent of college size when course differentiation and number of sections are taken into consideration.

Student-faculty ratios are less likely to be determined by college size and more likely to be influenced by institutional philosophy. Community colleges in particular have claimed advantages attendant to small class size. Still another major influence on student-faculty ratios is the widespread presence of collective bargaining in the

State of Michigan.

Hypothesis V: a. Average class size remains unchanged as college enrollment increases.

b. Increases in course differentiation and the number of multiple sections offered effects constant average class size.

c. Unduplicated student headcount increases with increased course differentiation, but FYES in proportion to unduplicated headcount declines.

Average class size is assumed to be a measure of efficiency in economy of scale. If course differentiation remained constant, increases in average class size could result in economy of scale, however, increases in college size are likely to be linked to increases in course differentiation with no gain in economy of scale. Increased differentiation may also increase headcount without proportionate increases in FYES. Increased headcount but declining FYES may result in declining efficiency in student services expenditures due to increases in costs of record maintenance, storage, and retrieval.

Hypothesis VI: Administrative expenditures per FYES increase as available resources increase independent of college enrollment increases.

It is anticipated that services beyond direct instruction are dependent upon available college resources more than the size of the enrollment served. Findings in confirmation of this expectation would suggest the need for an equalization factor in the state appropriation if student populations are to be served uniformly or according to need.

Hypothesis VII: Maintenance and energy expenditures are functions of physical plant size independent of enrollment and personnel size.

In the design of the physical plant, decisions affecting operating efficiencies are set in place as fixed costs of operation independent of enrollment. While the volume of use effected by personnel and students may have some influence on custodial expenditures, this influence is negligible in relation to physical features of the college plant. Economy of scale considerations in physical plant are likely to have been overridden by aesthetic considerations in the development of the physical plant particularly since most community college construction was completed in a less energy conscious era.

Statistical Analysis

The basic design of this study is to investigate the

relationship of structural characteristics in organizations of varying size. A central concern involves the investigation of the relationship between organization size and economy of scale if, in fact, such a relationship exists. While hypotheses have been stated in directional terms based on theoretical concepts, the nature of this study is more exploratory than disposed toward the demonstration of assumptions. Statistical tests have been designed to explore questions such as:

> What changes in the composition of personnel components are effected in community colleges of varying sizes?
>
> What changes in administrative expenditures are effected in community colleges of varying size?
>
> Will expenditures per student be greater in small colleges than in large colleges?
>
> Is the student-faculty ratio influenced more by college enrollment or by program differentiation?
>
> What is the influence of college enrollment and program differentiation on average class size?
>
> What is the relationship between available resources and administrative expenditures per student?
>
> What is the relationship between fixed costs of physical plant operation and the number of physical plant users?

Answers to these questions depend on <u>a priori</u> judgments of the relationships of variables. Descriptive as well as predictive models can be effectively tested through correlation and multiple regression analysis.

Pearson product moment correlation coefficients were

calculated to examine the relationships existing between the size of personnel components and organization size. Multiple regression analysis with stepwise selection of independent variables was used to investigate relationships among structural characteristics in community colleges of varying size.

Statistical tests were computed using the Statistical Package for the Social Sciences for the IBM PC/XT (Norusis, 1984). The research is post hoc in design and is free of problems of missing data or estimated data. The stepwise selection of independent variables in multiple regression analysis was elected in order to determine the relative influence of independent variables on the dependent variable in the order of their influence. Tables are provided that summarize by step the variable selected, the standardized and nonstandardized regression coefficients, the standard error of the estimate, the coefficient of determination, and the constant. The default limits of $p<.05$ for entry or $p<.10$ for removal of independent variables in the regression equation have been accepted in order to exclude from the equation those variables not meeting these levels of significance.

It is assumed that assumptions of linearity and normality may be violated due to small population size in this study. The population does, however, comprise the universe of organizations under study, and therefore consequences of these violations may not be severe if the

results are limited to descriptive rather than inferential conclusions. Disagreement exists in statistical literature regarding the seriousness of violating regression assumptions, however, at least some researchers (Kerlinger and Pedhazar) argue that "parameter estimates are not meaningfully influenced by violations of assumptions" (Lewis-Beck, 1980, 30).

In view of these concerns regarding the data and the assumptions underlying multiple regression analysis, the detailed format for reporting regression tests described above has been selected. Observations regarding the specific effects of the entry of a new variable on the variables already in the equation may be important in the final interpretation of the influence of independent variables on the dependent variable. In some cases the interpretation may be highly descriptive, while in others the results may be limited to a simple identification of a single variable of significant influence about which little else might be said.

The inclusion of the nonstandardized regression coefficient, B, permits measurement of the influence of the independent variable on the dependent variable in the metric terms of the variables. The standardized regression coefficient, Beta, allows for recognition of the influence of the independent variable on the dependent variable in standard score form. The standard error of the estimate, SE/B, is a useful measure of significance of the nonstandardized regression coefficient. If the nonstandardized

regression coefficient is greater than three times the standard error of the estimate, we can be 95% certain that a value of zero does not lie within the 95% confidence interval and the regression coefficient is significant; the slope estimate is significantly different from zero at the $p<.05$ level. The constant provides useful information regarding the trend of the intercept value. In economic considerations negative constants may signal built in costs of operation or overhead. Finally, the coefficient of determination R^2, is an important indicator of the amount of variance in the dependent variable accounted for by the indpendent variable.

Variables included in each regression model were first examined for high intercorrelations between independent variables. Pearson product moment correlations were calculated, and to reduce the potential for multicollinearity regression models were redesigned when intercorrelations above $r = .70$ were found. Subsets of highly correlated independent variables were tested in alternate regression models in order to investigate the influence of the variables in different configurations. In addition, scatterplots and measures of central tendency were examined for violations of assumptions underlying multiple regression analysis.

CHAPTER IV

EMPIRICAL FINDINGS

This chapter presents the results of statistical tests of seven hypotheses regarding efficiency and economy of scale in Michigan public community colleges.

Hypothesis I

Researchers have shown that the division of labor, a structural characteristic, varies in relation to organization size (Terrien and Mills, 1955; Anderson and Warkov, 1967; Blau, 1973; and McLaughlin, 1979). In this study community college personnel were assigned to one of five groups: executive administrators, administrative professionals, faculty, clerical, and support. In the case of part-time employees, full-time equivalents were determined. In the case of employees with responsibilities in more than one group, their time was allocated in fractional values of full-time equivalents. The number in each group were examined in a correlation matrix against the full-year-equated student enrollment as a measure of college size. The results of this test are reported in Table 3.

The results indicate ten positive correlations at the $p<.001$ level of significance and one correlation at the $p<.01$ level. The relationship between enrollment and faculty ($r=.96$) is the highest correlation related to enrollment, and, as expected, the executive administrators group ($r=.40$)

TABLE 3: Correlation Coefficients Relating the Division of Labor by College Size in Enrollment

Variables		Mean (n=29)	St.Dev.
V1:	College Enrollment in Full Year Equated Students	4285	4172
V2:	Executive Administrators	6.1	1.9
V3:	Administrative Professionals	58.4	60.6
V4:	Faculty	216.6	180.4
V5:	Clerical	70.0	78.3
V6:	Support	29.3	26.9

Zero-order Correlations (Pearson's r)

	V2	V3	V4	V5	V6
V1	.40	.91**	.96**	.84**	.90**
V2		.41	.46*	.38	.27
V3			.91**	.90**	.74**
V4				.87**	.86**
V5					.72**

*p<.01; **p<.001

is not significantly related to enrollment. As a group executive administrators are not significantly related to any other group except faculty (r=.46), and this relationship is weak in comparison to other intercorrelations. The clerical and support groups are highly correlated to all other groups except executive administrators. Administrative professionals are also highly correlated with all groups but executive administrators. Only the faculty are significantly correlated to all other groups.

The primary concern in this study, however, is the influence of enrollment on employee groups. While a number of high intercorrelations are found in the matrix, the correlations of employee groups and enrollment were examined further in order to determine if significant differences between these highly correlated groups existed. The matrix would indicate that only the executive administrators were not highly correlated with enrollment.

Differences between two population correlation coefficients using dependent samples can be tested for significance using a t test where:

$$t = \frac{(r_{xy} - r_{xz}) \sqrt{(n-3)(1 + r_{yz})}}{\sqrt{2(1 - r_{xy}^2 - r_{xz}^2 - r_{yz}^2 + 2 r_{xy} r_{xz} r_{yz})}}$$

The underlying distribution is the students t-distribution with n-3 degrees of freedom (Hinkle, Wiersma, Jurs, 1979, 227). In order to increase the robustness of this test, the numerator value was modified to include an n-5 factor

in place of n-3 to reflect the inclusion of five groups against the enrollment variable. In addition the critical value was selected at the .01 level. The results of this test are reported in Table 4.

TABLE 4: T Tests for Significant Difference of Correlation Coefficients in Dependent Sample of Groups Compared Against Full-Year-Equated Students.

Variables	Compared r	t
Faculty and Administrative Professionals	.96 - .91	2.106
Faculty and Support	.96 - .90	2.318
Faculty and Clerical	.96 - .84	4.123*
Administrative Professionals and Clerical	.91 - .84	1.870
Support and Clerical	.90 - .84	1.163
Clerical and Executive Administrators	.84 - .40	3.617*

*p<.01; critical value = 2.797

The results indicate that no significant difference was found between the correlation coefficients of the faculty, the administrative professionals, and the support group in relation to enrollment. A significant difference was found between the faculty and the clerical group but not between the administrative professionals, support, and clerical groups. Only the executive administrator group was independent of all other groups. These relationships

are presented in Figure 1.

The relationships depicted in Figure 1 suggest that with increases in enrollment, faculty will most certainly increase. Administrative professionals and support group

Figure 1: Representation of Significant Relationships Between Employee Groups.

personnel will increase without significant difference along with faculty; however, the link between these two groups and the clerical group suggests that their rate of increase may be held back slightly by clerical demands. That is, administrative professionals, in particular, are likely to require clerical support and increases in their number may be encumbered by economic constraints attendant to clerical increases. The executive administrator group is least likely to increase with increases in enrollment. They are independent of other personnel groups and only slightly correlated with enrollment.

Examination of scatterplots failed to reveal violations of the assumption of linearity. Definite linear relationships were evident; however, outliers among colleges over 6000 full-year-equated students were not uncommon. Some tendency toward curvilinearity was observed in the plot of administrative professionals with full-year-equated students. The line peaked at 11,250 FYES and fell

slightly with two cases above 13,500 FYES. Interpretation beyond general observation, however, is inconclusive due to small population size.

Hypothesis II

Efficiencies in administrative expenditures may be gained with increases in organization size (Anderson and Warkov, 1961; Hawley, Boland and Boland, 1965; Rushing, 1967; Holdaway and Blowes, 1971; Kasarda, 1974; and Brinkman, 1985). On the other hand, increases in organizational complexity and differentiation may have a negative effect on economy of scale (Blau, 1970 and 1973; Blau and Schoenherr, 1971; McLaughlin, 1979; and Brinkman, 1985). The second hypothesis in this study was designed to measure the influence of expenditures in administrative components on the administrative costs per student.

A match between personnel variables in hypothesis I (e.g. administrative FTE components) and expenditure variables in hypothesis II was not possible due to the format of the Activities Classification Structure (ACS) data. The executive administrative component in hypothesis I includes executive administrators from instructional support, student services support, and institutional administration; however, salary expenditures for the executives in each of these areas are pooled in ACS reports with all other administrative personnel in the same service component. Therefore, executive salary information exclusive of all

other administrative salaries is not available. This problem will be addressed further in Chapter V.

With these qualifications the following hypotheses were tested. Institutional administrative expenditures decrease as college enrollment increases. This personnel component includes, among others, the chief executive officer and the chief business officer. Instructional support and student service expenditures increase with increases in enrollment. These administrative components include executive instructional and student life officers. Finally, the expenditure per student for total administrative costs, including these three components, is greater in large enrollment colleges.

To test these hypotheses a multiple regression model was designed including administrative expenditures for instructional support, student services, and institutional administrators as independent variables, and the total administrative expenditure per student as the dependent variable. Also included as measures of institutional size were the independent variables of full-year-equated students and full-time-equated faculty This model was rejected, however, due to the high intercorrelations found among the independent variables evident in Table 5.

The results found in Table 5 are important for two reasons. While high intercorrelations among the independent variables are evident, very low correlations

TABLE 5: Correlation Coefficients Relating the Administrative Expenditures by Component, College Size in Enrollment and Employees, and Administrative Expenditure per Student.

Variables		Mean (n=29)	St.Dev.
Dependent Variable:			
V1:	Administrative Expenditure per FYES	1,066.4	253.8
Independent Variables:			
V2:	Instructional Support	1,531,376	1,624,145
V3:	Student Services	1,359,325	1,252,198
V4:	Institutional Administration	1,393,477	1,406,794
V5:	Full Year Equated Students (FYES)	4,285	4,172
V6:	Full Time Equated Employees (FTE)	216.6	180.4

Zero-order Correlations (Pearson's r)

	V2	V3	V4	V5	V6
V1	.03	-.18	.06	-.28	-.26
V2		.85**	.92**	.86**	.88**
V3			.88**	.98**	.95**
V4				.85**	.83**
V5					.96**

*p<.01; **p<.001

with the intended dependent variable are present, but three negative correlations in the dependent variable suggest an inverse relationship between enrollment and expenditures consistent with the hypothesis. Second, due to the high intercorrelations between the independent variables, multiple regression analysis would be too strongly influenced by multicollinearity to provide conclusive support for the hypothesis.

To adjust for these problems of potential multicollinearity a second multiple regression model was built with administrative expenditures expressed as expenditures per student. In addition the dependent variable was adjusted to express total operating expenditures per student. Calculating these variables as functions of full-year-equated students provided some adjustment for the previously observed multicollinearity. Correlations resulting from these adjustments are indicated in Table 6.

The results indicated in Table 6 provided a basis for examining independent variables expressed as functions of per student costs in a multiple regression model. Standardizing the independent variables reduced the correlations to a level that diminished the chances for multicollinearity in the regression model. Negative correlations associated with the enrollment variable (FYES) suggest that operating expenditures per student decline with increases in enrollment, an observation in support of economy of scale.

The significant correlation of r= -.50 between

TABLE 6: Correlation Coefficients of Administrative Component Expenditures per Student (FYES), College Size in Enrollment, and Total Operating Expenditure per Student.

Variables	Mean (n=29)	St.Dev.
Dependent Variable:		
V1: Operating Expenditure per Student (OE/FYES)	3,155	437
Independent Variable:		
V2: Instructional Support (IS/FYES)	361	115
V3: Student Services (SS/FYES)	341	94
V4: Institutional Administration (IA/FYES)	364	112
V5: Full Year Equated Students (FYES)	4,285	4,172

Zero-order Correlations (Pearson's r)

	V2	V3	V4	V5
V1	.45*	.46*	.53*	-.50*
V2		.31	.55*	-.03
V3			.44*	-.27
V4				-.37

*p<01; **p<.001

operating expenditures per full-year-equated student and the enrollment variable (FYES) shows that administrative expenditures decline with enrollment increases. The remaining negative correlations suggest that the administrative expenditures most influenced by changes in enrollment (V5) are institutional administration ($r = -.37$) and student services ($r = -.27$) expenditures. Instructional support expenditures per student appear to remain fairly constant regardless of enrollment size as indicated by the $r = -.03$ correlation coefficient.

Multiple regression analysis was used to test further these observations. The results are reported in Table 7. The stepwise method first identified the institutional administrative expenditure per student as the independent variable of greatest influence. With the addition of the full-year-equated student variable the $p<.05$ limits were reached.

The results found in Table 7 confirm the findings suggested by the correlations in Table 6. The institutional administrative expenditure per student is highly correlated with the operating expenditure per student; however, operating expenditure per student declines with increases in enrollment. The regression results indicate that beyond these two influences, the influence of administrative expenditures for instructional support and student services is not significant. The pooled variance ($R^2 = .39$) accounted for by the independent variables accepted in the regression indicates that a

substantial amount of the operating expenditures per student is not accounted for in this model.

TABLE 7: Stepwise Multiple Regression of Operating Expenditures per Student on Administrative Components and Enrollment (FYES).

Step	Variable	B	SE/B	Beta	R^2
1	Institutional Adm.	2.06	.64	.53	.28
	(constant)	2,403.94	243.34		
2	Institutional Adm.	1.54	.65	.39	.28
	FYES	-.04	.02	-.35	.39
	(constant)	2,752.19	280.70		

.05 limits reached $p<.05$

The hypothesis as first stated in this test is not supported by the alternate regression model due to changes in variables in the model. The findings do indicate that institutional administrative expenditures per student account for 28% ($R^2=.28$) of the operating expenditure per student; however, the enrollment variable (FYES) is negative. Therefore, high enrollments may diminish the influence of institutional administrative expenditures. The fairly small standard deviation in institutional administrative expenditures (112) and the large standard deviation in full-year-equated student enrollment (4,172) support the likelihood that the effects of enrollment extremes would have greater influence than institutional

administrative expenditure extremes. Therefore, partial support is provided for the hypothesis that institutional administrative expenditures will decrease as college enrollment increases. Findings regarding instructional support and student service expenditures are inconclusive. No support was found for the hypothesis that total administrative expenditure per student will be greater in large enrollment colleges.

Hypothesis III

In testing hypothesis II the effects of differentiation limited to administrative expenditures was investigated. In hypothesis III the expenditure per full-year-equated student was investigated in terms of the total college operating expenditure. Instructional salary and benefit expenditures and the total noninstructional expenditures were two variables added to the administrative components tested previously. Specifically the hypothesis tested is: expenditures per full-year-equated student are greater in large enrollment colleges than in small colleges, but that the increase is dependent upon noninstructional expenditure increases rather than faculty expenditures. The correlation matrix of these variables is reported in Table 8.

The results reported in Table 8 indicate an unacceptable number of high intercorrelations. All of the independent variables were intercorrelated at r=.83 or

TABLE 8: Correlation Coefficients Relating Gross Expenditure and College Size Variables to the Operating Expenditure per Student.

Variables		Mean (n=29)	St.Dev.
Dependent Variable:			
V1:	Operating Expenditure per Student (OE/FYES)	3,155	437
Independent Variables:			
V2:	Noninstructional Exp.	6,588,160	5,583,249
V3:	Instructional Exp.	6,048,584	5,446,806
V4:	Student Service Exp.	1,359,325	1,252,198
V5:	Instructional Support Exp.	1,531,376	1,624,145
V6:	Institutional Administration Exp.	1,393,475	1,406,794
V7:	Full Year Equated Students	4,285	4,172

Zero-order Correlations (Pearson's r)

	V2	V3	V4	V5	V6	V7
V1	-41	-.42	-.44*	-.37	-.36	-.50*
V2		.97**	.97**	.92**	.90**	.98**
V3			.97**	.83**	.81**	.98**
V4				.85**	.88**	.98**
V5					.92**	.86**
V6						.85**

*p<.01; **p<.001

above with a probability of $p<.001$. These high intercorrelations result from at least two factors. First, as in the previous test, the dependent variable was based on a per equated student expenditure while the independent variables are measures of expenditures without a per student consideration. Second, the noninstructional expenditure variable is highly correlated with administrative component variables because an examination of the mean administrative component expenditures indicates that they constitute about 65% of the mean noninstructional expenditures. Regardless of these problems, the negative correlations in the dependent variable strongly suggest an inverse relationshp between each of the independent variables and the dependent variable. An alternate model was designed to test these relationships further.

A second model was designed based on the alternate model developed in hypothesis II. Administrative components were combined and entered as a function of full-year-equated students. In like manner, the instructional expenditure variable was modified. Since administrative expenditures by component had already been examined in the previous hypothesis, it was now appropriate to look at the addition of the instructional expenditure variable in order to determine its influence on operating expenditures. The college size measure in full-year-equated students was retained. The noninstructional expenditure variable was omitted since about 65% of noninstructional expenditures

are expressed in the combined administrative expenditure. The correlation matrix of the variables in this configuration are reported in Table 9.

The results in Table 9 indicate that standardizing the variables in terms of full-year-equated students eliminated correlations above r=.70. Examination of the dependent variable in this matrix indicates significant correlations exist between instructional expenditures (r=.55) and administrative expenditures (r=.61) in relation to operating expenditures. No significant difference between these correlations, however, was found in a t test of correlation coefficients in a dependent sample (t = .3956; critical value = 2.479). The negative correlation of full-year-equated students and operating expenditures per FYES (r= -.50) does not support the hypothesis that expenditures per student will be greater in large enrollment colleges than in small colleges. These correlations suggest that as enrollment increases, operating expenditures per student for instruction and administration decline.

These observations based on correlations in Table 9 were tested further in an alternate regression model including the four variables identified in Table 9. Table 10 indicates the results of the multiple regression analysis.

Data in Table 10 indicate that the administrative components had very little influence on the dependent variable. When examined by component in hypothesis II the institutional admistrative component alone accounted for

TABLE 9: Correlation Coefficients Relating Expenditures Per Student and College Size Variables to the Operating Expenditure per Student.

Variables	Mean (n=29)	St.Dev
Dependent Variable:		
V1: Operating Expenditure per Student (OE/FYES)	3,155	437
Independent Variables:		
V2: Instructional Exp. (IE/FYES)	1,444	209
V3: Administrative Exp. (AE/FYES)	1,066	253
V4: Full Year Equated Students (FYES)	4,285	4,172

Zero-order Correlations (Pearson's r)

	V2	V3	V4
V1	.55*	.61**	-.50**
V2		.06	-.17
V3			-.28

*p<.01; **p<.001

TABLE 10: Stepwise Multiple Regression of Operating Expenditures per Student on Combined Administrative Component Expenditures, Instructional Expenditures and Enrollment (FYES).

Step	Variable	B	SE/B	Beta	R^2
1	Administration	1.05	.26	.61	.37
	(constant)	2,040.64	288.04		
2	Administration	1.10	.18	.64	.37
	Instruction	1.22	.22	.58	.71
	(constant)	216.61	385.48		
3	Administration	.97	.17	.57	.37
	Instruction	1.12	.21	.54	.71
	FYES	-.03	.01	-.26	.77
	(constant)	606.25	384.79		

.10 limits reached $p<.10$

28 percent (R^2=.28) of the variance in operating expenditure per student. The pooled influence found in Table 9 is 37 percent (R^2=.37). The introduction of the instructional expenditure variable accounts for an additional 34 percent (R^2=.34) leaving only 29% of the variance unaccounted for.

Data in Table 10 further indicate that administrative and instructional expenditures account for the major influence on operating expenditures per student. The non-standardized regression coefficients are significant. Their values exceed three times the standard error in each case; however, the small standard deviation associated with administrative and instructional expenditures (Table 9) in comparison to the large standard deviation in enrollment suggests that the influence of enrollment (FYES) is greater than administrative and instructional expenditures on operating expenditures per student. In colleges exceeding 10,000 full-year-equated students, reductions in operating expenditures per FYES would decline while administrative and instructional expenditures would remain relatively constant.

These findings in conjunction with those of hypotheses I and II strongly support the conclusion that enrollment increases result in economy of scale. Data found in Table 11 further confirm these findings.

Data in Table 11 indicate that the mean operating expenditure per student declines with increases in enrollment. In addition the decline in standard deviations indicates

that the range of differences in operating expenditures per student also diminishes with increases in enrollment size.

TABLE 11: Mean and Standard Deviation of Operating Expenditure per Full-Year-Equated Student in Michigan Public Community Colleges

College Enrollment (FYES)	n	Mean	St.Dev.
Less than 2500	15	3,284.87	455.60
Between 2500-6000	6	3,188.67	418.59
Greater than 6000	8	2,886.38	320.28

Based on these observations hypothesis III is rejected. No support is found to indicate that expenditures per full-year-equated student will be greater in large enrollment colleges than in small colleges. To the contrary, while the nonstandardized regression coefficient for the enrollment variable is small (-.03), the high standard deviation in enrollments (4,172) makes possible important differences in operating efficiencies based on enrollment.

Hypothesis IV

In hypotheses II and III the effects of differentiation were examined in terms of operating expenditures. In hypothesis IV the effects of differentiation were investigated in terms of curricular variations. The number of courses and course sections were examined for

the influence of these variables on the student-faculty ratio. In addition full-year-equated students were retained as a measure of college size. Specifically, the hypothesis tested is: the student-faculty ratio is independent of college enrollment size when course differentiation and number of sections are taken into consideration. The results of this investigation are reported in Table 12.

TABLE 12: Correlation Coefficients Relating the Number of Courses, Sections, Full-Year-Equated Students, and the Student-Faculty Ratio (SFR).

Variable	SEC	FYES	SFR
Courses (CO)	.87**	.66**	.34
Sections (SEC)		.92**	.55**
Full-Year-Equated Students (FYES)			.63**

*p<.01; **p<.001

Data in Table 12 indicate that enrollment in full-year-equated students is more highly correlated (r=.63) with the student-faculty ratio than either the number of courses or sections. The data do indicate a significant correlation between the number of sections (r=.55) and the student-faculty ratio. No significant difference between these correlations was found in a t test of correlation coefficients (t = 1.317; critical value = 2.479).

The number of sections clearly has some relationship with the student-faculty ratio; however, it is also clear that the student-faculty ratio is not independent of enrollment.

Due to the high intercorrelations seen in Table 12 multiple regression on the student-faculty ratio variable would be subject to problems of multicollinearity. Nevertheless, in the interest of determining which variable might have the greatest influence the test was run to investigate the step one variable selection in the regression model. The results of this test indicated that of the three independent variables influencing the student-faculty ratio, the enrollment variable (FYES) was more significant than differentiation of curriculum in terms of the number of courses or sections offered. The F value for the enrollment variable was 17.68 with a significant F = .0003. The coefficient of determination accounted for 40% of the variance (R^2= .395), and the stepwise selection limits of .05 were reached with step one.

Scatterplots did reveal two cases that deserve comment. The plot of courses with student-faculty ratio contained two outliers. In the first case one institution (Lansing Community College) reported offering 2,933 courses. That number is nearly three times the second largest number of courses (1,175). A comparision of means excluding the outlier case results in a decline from a mean of 689 courses to a mean of 609. This case is an influential anomaly. This case has not been excluded, however, because of the

small population size and the integrity of maintaining an accurate description of the population.

A second outlier is associated with the student-faculty ratio. One institution (Oakland Community College) reports a ratio of 30.2:1 which exceeds the second highest ratio (23.03:1) by 7.17:1. The standard deviation for this variable is 3.37; therefore, the case in question lies more than two standard deviations from the mean. Again this case was retained to maintain the integrity of the population description. Descriptive statistics for variables in this test are reported in Table 13.

TABLE 13: Means and Standard Deviations for Number of Courses, Sections, Full-Year-Equated Students, and the Student-Faculty Ratio.

Variable	Mean (n=29)	St.Dev.
Courses	689	531
Sections	2,642	2,172
Full Time Equated Students	4,285	4,172
Student-Faculty Ratio	18.6:1	3.4:1

Based on results of these tests it is evident that great differentiation in curricula was present. The mean number of courses offered was 689 with a standard deviation of 531. The number of multiple sections offered also varied greatly. Nevertheless, the enrollment variable was found to be the variable of greatest influence on the

student-faculty ratio. This observation is supported by both the significant correlation of r=.63 found in Table 12 and by the analysis of variance provided by multiple regression analysis. Therefore, no support was found for the hypothesis that the student-faculty ratio is independent of college enrollment size when curricular differentiation is considered. Correlation and regression analysis suggests that the enrollment variable more than the curricular differentiation variables influence student-faculty ratios. These results may be spurious, however, due to the high intercorrelations between independent variables.

While outliers were retained to maintain the integrity of the population description, the regression analysis was run a second time to examine the effect of removing the outliers. High intercorrelations between the independent variables remained; however, correlations of each of the independent variables with the dependent variable declined. Correlations between the student-faculty ratio and both the multiple section and enrollment (FYES) variables fell from significant levels, r=.55 and r=.63 respectively, to insignificant levels of r=.41 and r=.40 respectively. In the regression equation the constant was virtually unchanged from 16.41 in the first model to 16.66 in the second model; however, the stepwise selection method identified the multiple section variable as the influential variable rather than the enrollment variable. Only 17% of the variance (R^2=.166) was accounted for in these cases, and the

stepwise selection limits of $p<.05$ were reached with step one.

These findings are important. Some small influence of curricular differentiation is detected in this model, but perhaps more important is the finding that the constant in the regression equation remains unchanged. In addition, examination of the descriptive statistics in Table 14 indicates that some change in the relative value of means and standard deviations results when the outliers are removed, but the change in the student-faculty ratio values are extremely small by comparison to the other variables. The student-faculty ratio value appears to remain constant regardless of changes in the independent

TABLE 14: Means and Standard Deviations for Number of Courses, Sections, Full-Year-Equated Students, and the Student-Faculty Ratio with Outliers Removed.

Variable	Mean (n=27)	St.Dev.
Courses	591	306
Sections	2257	1669
Full-Year-Equated Students	3618	3397
Student-Faculty Ratio	18.1:1	2.6:1

variables. The possibility is raised that this ratio is influenced, if not controlled, by a variable not included in the model.

Political constraints such as the influence of

collective bargaining may result in the very small variance present in the dependent variable. If faculty instructional assignments are controlled by collective bargaining agreements, the independent variables in this model may be minor influences only. The loss of significant correlations of independent variables with the dependent variable resulting from the elimination of outliers supports this observation.

Hypothesis V

Curricular differentiation and enrollment were investigated for their influence on average class size in this test. The hypothesis tested is: average class size remains unchanged as college enrollment increases. Increases in course differentiation and the number of multiple sections offered affects constant average class size. Unduplicated student headcount increases with increased course differentiation, but full-year-equated students in proportion to unduplicated headcount declines.

Enrollment variables were established in terms of unduplicated headcount as well as full-year-equated students. Unduplicated headcount may be a stronger influence than enrollment measured in terms of full-year-equated students. Correlations between these variables are reported in Table 15.

Correlations in Table 15 indicate a significant relationship between headcount (r=.59), full-year-equated

students (r=.63) and average class size. This finding is contrary to the hypothesis stated above. No significant relatonship between number of courses (r=.26), number of

TABLE 15: Correlation Coefficients Relating the Number of Courses, Sections, Unduplicated Headcount, Full-Year-Equated Students, and the Average Class Size.

Variable	SEC	UH	FYES	Ave. Class Size
Courses (CO)	.87**	.78**	.66**	.26
Sections (SEC)		.97**	.92**	.41
Unduplicated Head-Count (UH)			.98**	.59**
Full-Year-Equated Students (FYES)				.63**

*p<.01; **p<.001

sections (r=.41), and average class size was found. On the other hand, unduplicated student headcount is significantly correlated with differentiation variables of both courses (r=.78) and sections (r=.97), but no decline in full-year-equated students in proportion to unduplicated headcount was found. The positive relationship between the curricular differentiation variables, number of courses and sections, and the headcount variable suggests that more courses and sections relate to increases in students. In addition, the correlations of unduplicated headcount and full-year-equated students with average class size demonstrate relatively no loss in average class size efficiency.

No significant difference was found in a t test of these correlations (t = 1.31; critical value = 2.479).

Problems of multicollinearity would again be present in multiple regression due to high intercorrelations. As in hypothesis IV, however, interest in the stepwise selection in the regresssion model was reason enough to run the test. The results of the regression analysis are reported in Table 16.

As in the previous model, the full-year-equated student variable was found to have the greatest influence on average class size. It accounted for 40% of the variance in average class size. In the second step the number of sections was entered, and in step three the number of courses was entered. The $p<.10$ limits were reached before entering the unduplicated headcount variable.

The constant established in this analysis is relatively unaffected by nonstandardized regression coefficients. Increases in full-year-equated students retains a positive influence in each step. The negative influence of differentiation in number of sections in step two is neutralized with the positive influence of the number of courses in step three. The assumption regarding the influence of unduplicated headcount as a greater influence than full-year-equated students was not satisfied. These observations may, however, be misleading due to problems of multicollinearity. In addition, political constraints such as those noted in hypothesis IV may exert

TABLE 16: Stepwise Multiple Regression of Average Class Size on the Number of Courses, Sections, Unduplicated Headcount, and Full-Year-Equated Students.

Step	Variable	B	SE/B	Beta	R^2
1	FYES	.00053	.00013	.63	.40
	(constant)	14.47	.74580		
2	FYES	.00138	.00027	1.64	.40
	SEC	-.00178	.00052	-1.10	.58
	(constant)	15.52	.70164		
3	FYES	.00214	.00032	2.54	.40
	SEC	-.00454	.00093	-2.81	.58
	CO	.00672	.00199	1.02	.71
	(constant)	14.93	.61791		

.10 limits reached p<.10

an important influence on average class size.

Based on these tests the hypothesis that average class size remains unchanged as college enrollment increases is rejected. The influence of enrollment is evident in both correlation and regression coefficients. Some negative influence of differentiation in course sections is indicated in regression analysis; however, these results are spurious due to the unknown effects of multicollinearity. Correlation coefficients did not support the hypothesis regarding increases in unduplicated headcount; therefore, it is rejected also.

Hypothesis VI

This hypothesis was designed to test the influence of revenue sources on administrative salaries. The hypothesis tested is: administrative expenditures per full-year-equated student vary as a function of available resources rather than college enrollment.

Independent variables including property tax revenue, state aid revenue, and tuition and fee revenue were examined for their influence on administrative salary and benefit expenditures per full-year-equated students. As a measure of college size the full-year-equated student enrollment was also included as an independent variable. The intent was to investigate whether services beyond direct instruction were dependent more upon available resources or on the size of the enrollment served. Each of

the revenue variables was factored on a per full-year-equated student basis in order to standardize the data. The correlation matrix, means, and standard deviations of these variables is reported in Table 17.

A high correlation between property tax and administrative salary was found, and the relationship between property tax and other revenue sources, state aid and tuition, is significant and negative. As tax revenue increases so do administrative salary expenditures; however, the state aid share and the tuition share decrease. An additional significant relationship was found between state aid and full-time-equated students. The per student contribution of state aid declines with increases in enrollment. Little evidence was found linking college enrollment and administrative salaries (r= -.19), but the relationship would appear to be inverse rather than direct. These findings suggest that college districts with high property tax revenues are likely to have either higher paid administrators or more administrative services than districts with low property tax revenue. This observation would hold true regardless of college enrollment size.

These observations are supported by multiple regression analysis reported in Table 18. The regression equation omits tuition (TU) as a factor influencing administrative salaries (SAL), and weights enrollment (FYES) as a minor influence (.02). Property tax (TAX) is the first variable selected in the regression analysis, and its

TABLE 17: Correlation Coefficients Relating Revenue, College Enrollment, and Administrative Salary and Benefits.

Variable		Mean (n=29)	St.Dev.
Dependent Variable:			
V1:	Administrative Salary and Benefits/FYES	773.34	186.38
Independent Variables:			
V2:	Property Tax/FYES	883.38	531.95
V3:	State Aid/FYES	1,247.38	271.46
V4:	Tuition & Fees/FYES	939.66	176.17
V5:	FYES	4,285	4,172

Zero-order Correlations (Pearson's r)

	V2	V3	V4	V5
V1	.69**	.01	-.41	-.19
V2		-.44*	-.46*	-.21
V3			-.03	-.48*
V4				.29

*p<.01; **p <.001

TABLE 18: Stepwise Multiple Regression of Administrative Salaries on Revenue and Enrollment.

Step	Variable	B	SE/B	Beta	R^2
1	Property Taxes	.24	.05	.69	.48
	(constant)	558.83	49.89		
2	Property Taxes	.30	.05	.86	.48
	State Aid	.27	.09	.39	.60
	(constant)	173.36	143.97		
3	Property Taxes	.37	.05	1.05	.48
	State Aid	.44	.12	.64	.60
	Full-Year-Equated Student	.02	.007	.35	.67
	(constant)	-166.09	203.55		

.05 limits reached $p<.05$

Note: An adjusted R^2 of .62 indicates that little if any bias is present due to the ratio of variables to cases.

significant influence is indicated by both the low SE/B (.05) and the high Beta (1.05). The equation provided is:

$$SAL = -166.09 + .37\,(TAX) + .44\,(AID) + .02\,(FYES)$$

The negative constant is produced when enrollment in full-year-equated students is taken into the formula further reinforcing the observation that enrollment size is small but negative in influence. The negative constant indicates an administrative overhead expenditure is present even at zero enrollment.

The R^2 coefficient of determination also supports the observation that enrollment accounts for little influence in salary. The percentage of variance accounted for with the inclusion of the full-year-equated students variable increases by only 7%, from $R^2=.60$ to $R^2=.67$. Furthermore the beta weight of property tax (1.05) is three times as great as the beta weight of full-year-equated students (.35).

Based on these findings this hypothesis is supported. Administrative expenditures per full-year-equated student vary as a function of available resources rather than college enrollment. Local property tax in particular exerts the strongest influence on administrative expenditures.

Hypothesis VII

This hypothesis was designed to investigate the influence of characteristics of physical plant size on college

operating expenditures. The hypothesis tested is: maintenance and energy expenditures are functions of physical plant size independent of enrollment and personnel size.

Due to limitations in available data physical plant size measures were limited to a single variable based on total square feet of building interiors. Data on acreage, miles of roadway, and miles of walkways were not available. The full-year-equated students variable and the full-time-equated positions variable were combined in a single variable as a measure of the user press on the physical plant. These independent variables were examined for their influence on the physical plant expenditures for maintenance, energy, and custodial requirements.

The results reported in Table 19 indicate that all three variables are very highly correlated.

TABLE 19: Correlation Coefficients Relating Physical Plant Size, Number of Users, and Physical Plant Expenditures (PPE)

Variable	US	PPE
Square Feet (FT)	.95**	.96**
Number of Users (US)		.97**

*p<.01; **p<.001

Correlation coefficients provided no basis upon which distinctions could be made. Stepwise multiple regression was run only to determine which variable was first selected.

The user variable was selected with an F value of 394.93 with a significant F = .00005. The coefficient of determination attached to this variable was R^2=.94. Due to problems of multicollinearity, however, these observations are spurious.

This hypothesis was neither accepted nor rejected. The results are inconclusive.

Summary

The findings of statistical tests regarding efficiency and economy of scale in Michigan public community colleges were presented in this chapter. Problems of multicollinearity were encountered frequently. In some cases models were redesigned in order to better test the available data. Most frequently it was necessary to standardize data by treating them in terms of an average determined by the full-year-equated students. Thus the units of measurement in the independent variables were standardized, and results were calculated with a common base. Further interpretation of the findings are provided with conclusions in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This research investigated the influence of structural characteristics of organization size on measures of efficiency and economy of scale. Based upon Blau's theorems on the process of differentiation, and the findings of more recent studies, this research examined the size of personnel components in relation to enrollment, resource allocation in relation to size and efficiency measures, and resource allocation in relation to available resources in the twenty-nine public community colleges of the State of Michigan. In addition the effects of curricular differentiation on student-faculty ratios and average class size were investigated.

In this theoretical framework hypotheses were tested using correlation analysis and multiple regression analysis. Variables were based on fiscal year 1984 data gathered by the Michigan Department of Education in the format of the Michigan Community Colleges Activities Classification Structure, 1981. The research design is post hoc and descriptive.

This chapter summarizes the results of the investigation, interprets the findings, and concludes with recommendations for further study.

Hypothesis I

Findings

The literature of organization research on economy of scale contains conflicting findings regarding the influence of size on the division of labor. A key problem exists in that the units of measurement within the division of labor are not consistent from one study to another. Therefore generalizations regarding the effects of size on a personnel component must be carefully qualified.

A central issue in the development of a funding model for Michigan public community colleges is the issue of economy of scale. Small college representatives argue that administrative costs are proportionately higher in small enrollment colleges. They argue further that large enrollment colleges realize instructional efficiencies based on larger average class size and higher student-faculty ratios.

In this study the first hypothesis was designed to examine the influence of size on personnel components in Michigan public community colleges. The results of correlation analysis support the argument for economy of scale. The number of executive administrators were not highly correlated with enrollment, and they were independent from other personnel groups that were found to be highly correlated with enrollment. Findings support hypothesis I-a: The proportion of executive administrators

decreases in midsize and large colleges and is highest in small colleges.

The linear regression of executive administrators on full-year-equated students results in an intercept of -1107 and a slope of 883. This finding suggests that enrollment increases of nearly 1000 full-year-equated students are required before the number of executive administrators is influenced. The negative intercept sets the minimum operating level at 1.25 executive administrators with zero enrollment. Substantial economies of scale may be associated with this personnel group and increases in enrollment.

High correlations of other personnel groups with enrollment increases support the position that changes in organization complexity and differentiation may diminish gains in economy of scale. Support was found for hypothesis 1-b: The remaining administrative component increases proportionately from small to midsize to large colleges. While the scatterplot suggests that increases in this component may stabilize in large enrollment colleges, the movement from small to midsize enrollment was found to be highly correlated (r=.91) with increases in administrative professionals. The slope of the linear regression was found to be 62.40 which suggests that increases in this component are strongly influenced by incremental enrollment increases of fewer than 100 full-year-equated students. This correlation was observed to hold true for enrollments up to 11,000

full-year-equated students. No increases in this component were observed in the two largest colleges with enrollments of 14,606 and 15,831 full-year-equated students. This stabilization may indicate that in community college structures, the saturation point for differentiation of services rendered by administrative professionals is reached at or slightly above enrollments of 10,000 full-year-equated students.

The strongest correlation (r=.96) was found between faculty and enrollment. Results strongly support hypothesis I-c: The proportion of faculty remains constant regardless of college size. The slope of the linear regression of these two variables is 22.28 indicating that this personnel component is most sensitive to changes in enrollment. An examination of correlations for significant difference, however, resulted in no significant difference between increases in administrative professionals, support personnel and faculty. The administrative professionals component is ignored if economy of scale is measured in terms of executive administrators only. Increases in both administrative professionals and support personnel result in expenditures that are not related to credit hour generation, the enrollment measure, in the manner of faculty expenditures; therefore, efficiencies effected through increased credit generation may be consumed in the differentiation of noncredit generating services rendered by increased support and professional staff.

The clerical component is also highly correlated with enrollment; however, scatterplot and regression data are not clearly definitive in describing the clerical relationship as linear or curvilinear. Some tendency in support of hypothesis I-d is provided: The proportion of clerical personnel remains constant in small and midsize colleges but increases in large colleges. Scatterplot examination indicates that the concentration of the clerical component tends to cluster tightly in colleges of less than 5000 full-year-equated students. Beyond this enrollment level, the trend line continues but with greater diffusion in higher enrollment colleges. Due to limitations in population size it is not clear what influence is present on clerical personnel in colleges with enrollment greater than 5000 full-year-equated students.

The support staff component is also highly correlated (r=.90) with enrollment. Scatterplot examination indicates a linear relationship in support of hypothesis I-e: The proportion of support staff remains constant regardless of college size. Two outliers with enrollments above 10,000 full-year-equated students do lie below the slope of the linear regression of the support component in relation to full-year-equated students. Again it is not clear due to limitations in population size what influence is present on support personnel in colleges with enrollment greater than 10,000 full-year-equated students.

Conclusions

This investigation of the influence of size on personnel components provides evidence in support of economy of scale particularly within the executive administrative group. Other personnel components remain proportionately constant with increases in organization size, but no component was found to increase disproportionately with increases in size.

Hypotheses II and III

Findings

These hypotheses were designed to investigate college expenditures associated with personnel components in relation to college size. Conclusions reached in hypothesis I suggested that economy of scale may be present in some components but diminished in others. An examination of expenditures associated with personnel components was designed to test further those conclusions.

Problems associated with the data source required redefinition of the variables tested in these hypotheses. The Activity Classification Structure format for reporting full-time-equated positions makes possible the determination of the number of employees in all major categories of employment. The administrator/supervisory/technical category (ACS 4 C32) lists all administrative or supervisory roles by area of activity such as instructional

support, student services, institutional support, physical plant and independent operations. From that total it is possible to determine the number of non-executive administrators by subtracting the number of executive administrators identified by college in the HEP 1985 Higher Education Directory. In this manner the executive administrator and the administrative professionals variables in hypothesis I were established.

General fund expenditures are reported in ACS 3. The major categories for reporting expenditures are instruction (1.00), public service (3.00), instructional support (4.00), student services (5.00), institutional administration (6.00), physical plant operation (7.00), and independent operations (9.00). Each of these categories may have administrative or supervisory personnel included. Some categories contain specific line item entries for administrative expenditures, but in no category is it possible to identify the inclusion of a specific administrator or a specific administrator's salary. Therefore, based on ACS data it is not possible to separate executive administrator salary expenditures from the total of administrator salary expenditures. Consequently, administrative expenditure variables in hypotheses II and III cannot be matched with administrative personnel components expressed as full-time-equated position variables in hypothesis I.

For purposes of this study the distortions resulting from these modifications in variables are not important.

Interest in expenditures within administrative components exceeded interest in the costs of executive administrators above; however, caution in relating the findings of hypotheses II and III to findings of hypothesis I is necessary.

Hypothesis II was designed to investigate the influence of expenditures in three administrative components on the total operating expenditure per full-year-equated student. Correlation coefficients and regression coefficients support the conclusion that operating expenditures per full-year-equated student decline with increases in college enrollment. Expenditures in the institutional adminstrative component are more closely associated with the decline in operating expenditures than are expenditures for instructional support or student services. Results regarding these latter two components are not conclusive; however, correlation coefficients suggest that student service expenditures ($r = -.27$) may decline more than instructional support expenditures ($r = -.03$).

Hypothesis III was designed to investigate further the influence of expenditures in additional personnel components on the total operating expenditure per student. As in the previous test no support was found for the hypothesis that operating expenditures per student were greater in large than small enrollment colleges. Regression analysis supports the conclusion that operating

expenditures per student decline with increases in college enrollment. The combined influence of all administrative expenditures and instructional expenditures accounted for 71% of the variance in operating expenditures. While coefficients of determination in a regression model clearly are not additive, the increase in an R^2 of .37 associated with administrative expenditures exclusively to an R^2 of .71 associated with the combined influence of administrative and instructional expenditures suggests the influence on operating expenditures may be balanced between instructional and noninstructional influences. Beta values of .57 (administration) and .54 (instruction) support this observation. Further reinforcement for this observation is provided in view of these variables reflecting personnel expenditures exclusively. Expenditures for instructional materials and supplies were not considered in this test.

Conclusions

This investigation of expenditures in relation to personnel components provides further evidence in support of economy of scale. Institutional administrative expenditures decrease as college size increases, and total operating expenditures per student decline with increases in college enrollment. Noninstructional administrative expenditures do not rise disproportionately with increases in instructional faculty expenditures. Economy of scale is not significantly influenced by increased differentiation

in personnel components including faculty and administrative professionals.

Hypotheses IV and V

Findings

These hypotheses were designed to investigate the influence of curricular differentiation on efficiency measures in terms of student-faculty ratios and average class size. No support was found for the hypothesis that the student-faculty ratio is independent of college enrollment size when curricular differentiation is considered. Enrollment was found to be more influential on the student-faculty ratio than the number of courses or multiple course sections in spite of substantial differences in these measures of differentiation. The number of courses offered ranged from a low of 242 to a high of 2933 and the number of sections ranged from 515 to 8759. Nevertheless, the student-faculty ratio was influenced more by enrollment than curricular differentiation.

Contrary to findings in studies of universities (McLaughlin, 1979; Stommel, 1985) the effects of curricular differentiation in community colleges do not result in lost efficiency when measured by the student-faculty ratio. Further insight into this phenomena was gained by testing the data a second time with the omission of two observed outliers. Some small influence of differentiation in place

of enrollment was realized; however, more importantly changes in independent variables produced no significant change in the dependent variable. The influence of a variable not accounted for in the model was suggested. Political constraints within the organization may account for the lack of variance in the dependent variable. The pervasive influence of collective bargaining in Michigan may account for a defined student-faculty ratio more than structural characteristics within the organization. Further research is needed to confirm this observation.

Hypothesis V was designed to investigate the effects of curricular differentiation on average class size. Correlation coefficients indicated that enrollment more than number of courses or course sections was related to average class size. Regression analysis resulted in very low coefficents; however, the influence of the enrollment coefficient was greatest due to the larger standard deviation in enrollment size than in course or section number. Some favorable influence on average class size may be realized without a substantial influence on the student-faculty ratio. Greater efficiency in enrollment per course section may be present in high enrollment colleges without affecting the student-faculty ratio even though maximum class size, like the student-faculty ratio, may be defined by collective bargaining agreements.

The mean student-faculty ratio was 17.30:1 in colleges with less than 2500 FYES, 18.61:1 in colleges between 2500

and 6000 FYES, and 17.23:1 in colleges with greater than 6000 FYES. On the other hand, the mean average class size was found to increase from 15.49 in colleges less than 2500 FYES to 16.08 in colleges between 2500 and 6000 FYES, and to 19.56 in colleges greater than 6000 FYES. These findings further support the conclusions stated below.

No evidence was found in support of the hypothesis that increases in differentiation result in disproportionate increases in unduplicated headcount in relation to full-year-equated students.

Conclusions

Tests of the influence of curricular differentiation indicate that the student-faculty ratio is not significantly influenced by increased curricular differentiation. Average class size increases with increases in enrollment, and it is not significantly influenced by curricular differentiation. The student-faculty ratio and average class size may be influenced by regulatory constraints of collective bargaining.

Hypothesis VI

Findings

In testing the influence of enrollment and revenue sources on administrative salary expenditures, only property tax revenue was significantly correlated with

administrative salaries. Regression analysis resulted in the identification of both property tax and state aid as the variables accounting for the greatest influence on administrative salaries. Enrollment and tuition variables were not influential.

These findings suggest that college districts with high property tax revenues are likely to have either higher paid administrators or more administrators than districts with low property tax. This observation holds true regardless of college enrollment size.

Correlation coefficients indicate a significant relationship between property tax revenue (r=.69) and administrative salaries but virtually no relationship between state aid revenue (r=.01) and administrative salaries. Coefficients of determination in the regression equation attribute 48% (R^2=.48) of the variance in administrative salaries to property tax revenue and 60% (R^2=.60) to property tax and state aid revenue combined. An additional 7% (R^2=.67) is attributed to the enrollment variable, but the tuition variable is not admitted to the equation. College enrollment size is not a strong influence on administrative salaries. The enrollment correlation coefficient is r= -.19 and the regression coefficient is .02 with a standard error of .007. On the other hand, regression coefficients for both property tax and state aid revenue are significant; each exceeds three times its standard error.

Conclusions

Administrative expenditures per full-year-equated student vary as a function of available resources rather than college enrollment.

The results leading to this conclusion may be accounted for in part by provisions in the current state aid funding formula. The gross operating need by college is adjusted by two equalization factors. First, the formula requires a deduction of one mill times the state equalized valuation of the college district. Second, a tuition deduction of $25.00 per credit hour is also required. The gross operating need is adjusted by these two deductions in order to determine the state aid share of the gross operating need.

In view of these deductions only districts with low state equalized valuation are likely to receive substantial state aid as a proportion of the operating budget. Districts with high state equalized valuation may realize greater revenue from local property taxes than from state aid. Therefore, the potential for greatest variance in college revenue rests in the property tax variable. Variance in the tuition variable is very small since little benefit is realized in tuition rates above or below $25.00 per credit. Consequently, colleges receive more state aid if property tax revenue is low, and while state aid may be lost if tuition is lower than $25.00 per credit, no state

aid is gained if tuition is greater than $25.00.

Hypothesis VII

Findings

Data available from the Activities Classification Structure are not sufficient to test the relationship of physical plant operating expenditures and enrollment and personnel size. Several important characteristics associated with physical plant operation need to be identified. Is the college a multi-campus college? Does it operate from one or many buildings? What percentage of exterior surfaces are glass? What geographic influences are present such as variations in snowfall? Are maintenance intensive units such as swimming pools present? Each of these characteristics may account for important differences in physical plant operating expenditures.

Conclusions

The simple test of comparing total square feet and total number of users to physical plant operating expenditures was inconclusive. It was found in hypothesis I, however, that increases in the support personnel component, which was limited to physical plant personnel and independent operators, were directly related to increases in enrollment. Regression analysis in hypothesis VII also identified the user variable as the more influential.

Apparently physical plant operating expenditures are linked more strongly to users than fixed features of the physical plant; however, further research would be necessary to support this observation.

Major Outcomes

The results of this study provide strong support for the theorems of Blau (1973). Due to limitations in population size and the presence of outliers particularly in colleges with enrollments greater than 10,000 full-year-equated students, conclusive evidence is not provided; however, no evidence in contradiction of Blau's theories was found.

Declining rates of increase in some personnel components were observed as organizations increased in size. Administrative professionals increased in a linear progression until enrollments in excess of 10,000 full-year-equated students were reached. The clerical component was clearly defined in a linear progression until enrollments exceeded 5,000 full-year-equated students. These results are consistent with the theory that with increases in organization size, differentiation increases at declining rates (Blau, 1973).

While exeuctive administrators remain relatively constant with increases in college size, all other personnel components increase. Increases in administrative professionals are strongly related to increases in faculty

and support personnel. Increases in the division of labor remain constant in faculty and support personnel components while increases in administrative professional and clerical components are less clearly defined in large colleges. Even though support was found indicating that administrative salary expenditures are dependent on available resources, administrative expenditures per full-year-equated student are less in high enrollment colleges than in low enrollment colleges. These results are consistent with the theory that with increases in organization size, administrative ratios are reduced at declining rates (Blau, 1973).

Increases in college size result in economy of scale benefits. Operating expenditures per full-year-equated student are less in large colleges than small colleges. Decreases in the administrative expenditure per student are most responsible for increased operating efficiency in spite of increases in the number of administrative professionals. Economy of scale is not diminished as a consequence of increased differentiation in curriculum. In fact, average class size increases with increases in enrollment even though curricular differentiation as measured by the number of different courses offered may vary greatly. In addition the student-faculty ratio remains unaffected by curricular differentiation.

These findings are consistent in part with those of Stommel (1985) in his study of land grant institutions.

While little comparison between the study populations is possible, economies of scale were found in both universities and community colleges. Substantial economies of scale are associated with administrative expenditures while instructional expenditures show little sign of decline with increases in size. Larger instructional and research expenditures in the university graduate level may drive operating expenditures per student upward, but in the absence of this specialization, operating expenditures per student decline in the university as they do in community colleges with increases in size. Some support for the U-shaped curvilinear relationship between size and economy of scale found in Stommel's study of land grant institutions is provided in this study; however, limitations in the small population of this study render this comparison inconclusive.

This research tested the theories of Blau by proposing that the notion of economy of scale would not be satisfied when the effects of differentiation in personnel components beyond executive administrators were investigated. With increases in the total administrative component, the clerical component, and the support component efficiency would diminish and economy of scale would not be realized. Traditional efficiency measures of student-faculty ratio and average class size would be negatively influenced by curricular differentiation. Based on the results of this study, these hypotheses are rejected.

Beyond these conclusions are major outcomes not anticipated in the design of this study. Collection of performance data in the format of the Activities Classification Structure provides a useful data base for ranking college performance for comparison purposes. On the other hand, the limitations of ACS data are such that little can be determined to account for the resulting comparative rankings. College size is an important characteristic accounting for some comparative rankings; however, operating constraints not present in ACS data limit the explanatory power of the data.

The community college organization exists in a network of constraints. Demography controls college population and programs. Collective bargaining regulates personnel practices. Local tax bases are highly correlated with discretionary resources, and at the state level provisions of the funding formula direct college administrators in their direction of college performance to gain maximum state support. Few of these constraints are recognized in ACS data. All of these constraints influence college performance.

Recommendations for Practicing Administrators

Practicing administrators need to be aware of operating constraints and resource dependencies. In the resource dependence model of Pfeffer and Salancik (1978) the administrator has two roles. First, as an "active

manipulator" the administrator must influence the environment in ways that may benefit the organization. Second, as a "processor" the administrator must adjust the operation of the organization to comply with the constraints imposed.

In this latter role the administrator must accurately assess the college district demography. In addition to high school completion projections, knowledge of levels of academic preparation in the adult population is important in identifying needed programs and services. The numbers of unemployed and their skill levels identify base points for retraining programs. Knowledge of business and industrial employment needs and hiring practices is essential if programs are to match training with successful placement. To what extent is the local economy dependent on agriculture, retail sales, resort activities, and basic services? What is the local quality of life? Are cultural programs needed to enhance the quality of life? What leisure time activities and personal interest learning opportunities are needed? Direction for administrative decisions regarding these issues lie in demographic data. So do the constraints.

One of the most severe constraints found in this study is the influence of the local tax base. Districts with high property tax revenues have greater discretionary resources than low tax revenue districts. State formula adjustments for low tax districts are not equal to the benefits in high tax districts. The college president

must cultivate local support through public services, and at the same time persuade or lobby for legislative recognition and support of public services whether these services are designed for programs of local skill development or for programs of international awareness and understanding. Without local and state support administrative creativity or creative leadership may be limited to inventive coping amidst resource constraints. If local and state support can be cultivated, the potential for innovation beyond coping is possible.

Administrators need to inform legislators better that the community college organization is community based in its services. The variety of community services needed include but exceed traditional academic and career training. The community college is a college of proximity that depends upon access for its success. Public access follows public service. If services are limited, so will access be limited.

Finally, the practicing administrator must be sensitive to constraints imposed by collective bargaining. Internal operations of the organizations are regulated by personnel provisions set forth in both formal and informal agreements. Terms of these agreements can restrict internal resource allocation as well as structural changes aimed at improving organizational efficiency. Measures such as student-faculty ratios and average class size vary little as a consequence of adopting common working

conditions within the network of community colleges. Changes in organizationl structure may have to begin at the bargaining table.

Recommendations for State Decision Makers

Activities Classification Structure data are limited in explanatory power but strong in descriptive power. Colleges can be ranked according to performance data reported, but little can be learned from the data to account for the ranked differences. This limitation results from the fact that variances in the data are dependent more on constraints not accounted for in the data than on actual differences in organizational performance.

On the basis of this study size cannot be said to be a causal variable, but it is an exceedingly important condition. The range of college programming is so constricted by size that just as some programs cannot be maintained until sufficient size is reached, other programs may not be eliminated once a given size has been reached. Local discretionary authority within college districts appears by comparison to many states to be liberal; however, in reality a network of constraints at the local and state levels restrict college autonomy severely.

Many of the constraints have already been described in terms of the college administrator in the previous section. At the state level the funding formula and the Activities Classification Structure are additional sources of important

operating constraints.

The formula differentiates instructional need based on five categories of instruction. Average costs of instruction are determined from aggregate costs reported by the twenty-nine community colleges, and funding levels are then set based upon average costs. Colleges then provide instruction within the limitations set by the formula. This process accommodates the continuation of instruction as it has been practiced, but instructional needs not accommodated in the past cannot be accommodated in the future within this constraint.

Differentiation presently recognized in the formula is appropriate and should continue; however, study is needed to determine what the cost of instruction should be as well as what it has been. Perhaps colleges could be called upon to propose costs of instruction by program based on demonstrable operating needs.

Further review of the influence of tuition deductions and tax equalization provisions is also needed. In the present formula little incentive is provided for a college district to be above or below the $25.00 deduction per credit hour. The effect of this provision results in very little variance in tuition revenue levels among community colleges. A de facto tuition rate is set by the formula. In the case of tax equalization, if parity among colleges is sought through tax equalization, guaranteed levels of support must be higher than the formula presently provides.

ACS data provide a basis for performance comparisions; however, since these comparisons are used to determine categories of funding and levels of funding, the data are subject to problems of measurement error. Organizations will strive to report performance to realize maximum funding benefits. Interpretation of reporting guidelines may vary from college to college to the extent that credibility of the ACS data is questioned. This condition, however, is more favorable than having no data, and continued collection of ACS data is recommended.

State decision makers must be cautious in the use of ACS data. The community college is embedded in a network of constraints. ACS data alone do not provide the data needed to solve the problem of equitable state funding. Beyond equity only a limited basis for appropriate levels of funding can be deduced from ACS data. Further recognition of size constraints, particularly among colleges of less than 2500 FYES, is needed. Community based needs and collective bargaining constraints must also be recognized.

Finally, access to ACS data should be broadened. This study was delayed twelve months from the date access to data was granted to the date that a successful data run was completed. Researchers and community college officials should have direct access to ACS data. Current progress in developing an interactive system for streamlined data input and access promises to relieve this problem and deserves high priority. Decision making processes at the local

community college level as well as at the state level will be greatly enhanced with comparative data from sister institutions readily available.

Recommendations for Further Study

This study does not purport to be an effectiveness study. The results are limited to conclusions regarding the influence of structural characteristics of organization size on measures of efficiency and economy of scale. Nevertheless, some links between these conclusions and observations on quality should be noted.

With increases in college size curricular differentiation also increases. The range in number of different courses offered varies from a low of 242 to a high of 2933. With more course options, overall quality of programs available may be enhanced by the inclusion of courses that could not be supported in low enrollment colleges. Advanced study options at the sophomore level may be limited or nonexistent in small enrollment colleges with the resultant effect of the college becoming primarily a freshman based, one-year college. Further study is needed to determine the validity of this observation.

A second connection to quality may exist in the finding that administrative salary expenditures are dependent more on available resources than enrollment. If high tax revenue districts have high administrative salary expenditures due to added professionals providing more support

services, the quantity of instructional support and student services provided may affect the quality of student support activities. Some support for the position that this personnel component increases with enrollment was found in hypothesis I. Hypothesis III demonstrated that decreases in operating expenditures per full-year-equated student are influenced most by decreases in administrative expenditures per student. Therefore, if reductions in administrative expenditures per student are realized in conjunction with increases in the administrative personnel group, it is reasonable to suspect that the higher expenditure for administrative salaries in high tax revenue districts is due to increased personnel rather than higher wages.

On the other hand, high tax revenue districts may be associated with high administrative expenditures due to higher salaries rather than more personnel. All organizations are connected to environmental dependencies, and in the context of resource dependence models local district resources linked with local autonomy in the allocation of resources may lead to disparities in wages as well as program support. If student populations are to be served uniformly or according to need, more study is needed to determine appropriate equalization factors in state appropriations.

The small population of this study makes conclusions regarding large colleges problematic. Only eight of the

twenty-nine colleges have enrollments above 6000 full-year-equated students and only four have enrollments above 10,000. (Fewer than 20% of the public community colleges in the United States have enrollments greater than 6000 FYES.) Linear relationships are clearly evident in colleges less than 6000 students; however, the small number of cases beyond this level deviate from the line of regression with greater frequency and may be indicative of the presence of heteroscedasticity. Some tendencies toward curvilinearity were observed, but instances are too few to be definitive. Further research on a longitudinal basis would help to clarify large college trends.

Future researchers need to be concerned for problems associated with the reporting format required in the Activities Classification Structure. As noted in the discussion of hypotheses II and III, some modification of variables was required to accommodate the data source. Usefulness of ACS data would be enhanced if greater specificity in salary expenditure data were present. Furthermore, researchers need to be aware of the limitations of ACS data. Considerations of environmental and political influences should be included in future research designs.

The Michigan community college organization is deeply embedded in economic and political constraints. Further study is needed to examine more closely the issue of economy of scale in community colleges. This study demonstrates that the effects of scale influence more organizational

characteristics than administrative overhead alone. Presently the funding formula for Michigan community colleges contains only one component in recognition of economy of scale. Important variations in curricular differentiation are not considered. Too many unknowns are associated with physical plant operations. Local tax equalization factors need to be re-examined. If decision makers at the state level seek to establish a funding formula that provides equitable support for colleges of varying size, further study of economy of scale in Michigan public community colleges is recommended.

APPENDICES

APPENDIX A

MICHIGAN PUBLIC COMMUNITY COLLEGES, ENROLLMENT AND PERSONNEL

This appendix lists the Michigan public community colleges included in this study, their size as measured by fiscal year 1984 full-year-equated students (FYES) and full-time-equated (FTE) personnel.

Community College	FYES	FTE
Alpena Community College	1419	115.4
Bay de Noc Community College	1262	114.1
C.S. Mott Community College	6413	668.1
Delta College	6840	724.2
Glen Oaks Community College	753	73.5
Gogebic Community College	1179	107.4
Grand Rapids Junior College	6428	436.0
Henry Ford Community College	7958	672.4
Highland Park Community College	2203	181.4
Jackson Community College	3676	372.7
Kalamazoo Valley Community College	3971	353.2
Kellogg Community College	2764	219.2
Kirtland Community College	1004	125.7
Lake Michigan Community College	1680	197.9
Lansing Community College	10,765	1111.5
Macomb Community College	14,606	1283.0
Mid Michigan Community College	1180	128.2
Monroe County Community College	1723	176.0
Montcalm Community College	785	78.1
Muskegon Community College	2741	279.0
North Central Community College	885	87.6
Northwestern Michigan College	2489	260.3
Oakland Community College	15,831	967.2
St. Clair Community College	2488	252.6
Schoolcraft College	5155	527.2

Community College	FYES	FTE
Southwestern Michigan College	1819	170.9
Washtenau Community College	4581	468.3
Wayne County Community College	10,917	805.0
West Shore Community College	760	101.3

APPENDIX B

OPERATIONAL DEFINITIONS AND BASIC STATISTICS OF VARIABLES

This appendix provides the operational definitions of all primary variables used in this study. The Michigan Department of Education Activity Classification Structure (ACS) codes are provided as indicators of the variables. The abbreviation for the variable is contained in parentheses and the mean and standard deviation for each variable is provided. Secondary variables based on standardizations of primary variables are defined in the contexts of hypotheses in which they were derived.

		Mean	Standard Deviation
1.	Full-Year-Equated Students (FYES) A measure of college size based on the total credit hours generated divided by a full-time-student equivalent of 31 credit hours. Indicator: ACS 6 Item 7	4285.34	4171.74
2.	Full-Time-Equated positions (FTE) A measure of college size based on full-time equivalents of full and part-time employees including those on sabbatical. Indicator: ACS 4 Item 36	216.59	180.40
3.	Executive Administrators (EXEC ADM) The number of executive administrators listed in the HEP 1985 Higher Education Directory with the title Chief Executive Officer, Executive Vice President, Chief Academic Officer, Chief Business Officer, Chief of Student Life Officer, and Deans.	6.10	1.88
4.	Administrative Professionals (ADM PROF) This number has been determined by subtracting the number of executive	58.40	60.60

		Mean	Standard Deviation
	administrators (EXEC ADM) from the combined totals reported in ACS 4 Item 30 Instructional Assistance, Item 32 Administrative/Supervisor/ Technical, and Item 33 Counselors/ Librarians.		
5.	Faculty (FAC) Total teaching personnel in full-time equivalents including ACS 4 Item 27 Full-time Faculty, Item 28 Part-time Faculty, and Item 29 Overload Faculty.	216.59	180.40
6.	Clerical personnel (CL) This number is determined by subtracting from the total reported in ACS Item 34 Office/Clerical/Trade those employees in ACS Unit 7.00 Physical Plant and those in ACS Unit 9.00 Independent Operations.	70.02	78.31
7.	Support personnel (SU) The number of physical plant and independent operator personnel. Indicator: ACS 4 Item 34 less clerical (CL) personnel.	29.34	26.95

		Mean	Standard Deviation
8.	Instructional Expenditures (I) Total salaries and benefits for faculty. Indicator: ACS 3 Unit 1.00 C1 + C2.	6,048,584	5,446,806
9.	Instructional Support Expenditures (IS) Total salaries and benefits for instructional support personnel (instructional deans, directors, coordinators, librarians, etc.) Indicator: ACS 3 Unit 4.00 C1 + C2.	1,531,376	1,624,145
10.	Student Services Expenditures (SS) Total salaries and benefits for student services personnel. Indicator: ACS 3 Unit 5.00 C1 + C2	1,359,325	1,252,198
11.	Institutional Administration (IA) Total salary and benefits for institutional administration (president, board of trustees, business office, etc.) Indicator: ACS 3 Unit 6.00 C1 + C2	1,393,477	1,406,794
12.	Total Administrative Expenditure (TAE) Combined salaries	1,066.36	253.78

		Mean	Standard Deviation
	and benefits of instructional support, student services, and institutional administration per FYES. Indicator: Total of variables 9, 10, & 11 divided by FYES		
13.	Operating Expenditures per FYES (OE) Total fiscal year expenditures divided by FYES. Indicator: ACS 3 Item 08	3,155.03	436.60
14.	Noninstructional Expenditures (NI) Total fiscal year expenditures. Indicator: ACS 3 Item 08 minus ACS 3 Unit 1.00 C1 + C2	6,588,160	5,583,249
15.	Physical Plant Operating Expenditure (PPO) Total expenditures for operation of the physical plant including energy expenditures. Indicator: ACS 2B Item 110 and ACS 7 Item 066	1,730,354	1,566,688
16.	Total Institution Population (PER) Combined FYES and FTE, variables 1 and 2	4502.63	4345.36

		Mean	Standard Deviation
17.	Number of Courses (CO) Total number of different courses in the college curricula. Indicator: ACS 6 Item 09	689.34	530.65
18.	Number of Sections (SEC) Total number of course sections offered. Indicator: ACS 6 Item 10	2641.55	2172.04
19.	Unduplicated Headcount (UH) Total number of different student enrollments. ACS 6 Item 26	47,200.90	44,555.37
20.	Student-Faculty Ratio (SFR) Total different enrollments divided by total full-time-equated faculty. Indicator: Variable 19 (UH) divided by Variable 5 (FAC)	18.58	3.37
21.	Average Class Size (AC) Total different student enrollments divided by the number of course sections. Indicator: Variable 19 (UH) divided by Variable 18 (SEC)	16.74	3.51

		Mean	Standard Deviation
22.	Revenue: Property Taxes (TAX) Total revenue gained from in-district property taxes. Indicator: ACS 2B Item 101	3,325,366	3,204,877
23.	Revenue: State Aid (AID) Total revenue gained from state appropriations. Indicator: ACS 2B Item 102	4,815,169	4,320,360
24.	Revenue: Tuition and Fees (TU) Total revenue gained from tuition and fees. Indicator: ACS 2B Item 100	4,279,464	4,168,026
25.	Gross Square Feet (F2) Total square feet in physical plant interior. Indicator: ACS 7 Item 070	464,066	361,607
26.	Gross Cubic Feet (F3) Total cubic feet in physical plant interior. Indicator: ACS 7 Item 071	6,661,116	5,729,719

APPENDIX C

DATA TRANSFORMATIONS

This appendix reports the influence of data transformations on the results of this study.

The findings of this study were tested further using data transformations in order to adjust for problems of multicollinearity and skewed distributions. Natural log, quadratic, squared, and cubic transformations failed to produce significant differences in the results of statistical tests reported in this study. Further support for findings reported in Chapters IV and V are listed below.

Hypothesis I: a. The proportion of executive administrators decreases in midsize and large colleges and is highest in small colleges.

Analysis revealed a significant quadratic trend indicated by the change in R^2 as tested by the t test for the squared FYES beta ($t = 4.103$, $df = 27$, $p < .0004$). This finding affirms the conclusion that the proportion of executive administrators does decrease in midsize and large colleges and is highest in small colleges and that the proportion of executive administrators and FYES is curvilinearly related.

Hypothesis I: b. The proportion of the remaining administrative component increases proportionately from small to midsize to large colleges.

Analysis revealed a significant linear trend, with insignificant quadratic and cubic trends. These analyses

suggest that the proportion of administrative professionals increases with increases in FYES following a linear trend.

Hypothesis I: c. The proportion of faculty remains constant regardless of college size.

A significant first order correlation between the proportion of FTE faculty and FYES ($r = -.1111$, $df = 28$, $p < .283$) suggests the proportion of FTE faculty does remain constant regardless of college size.

Hypothesis I: d. The proportion of the clerical component remains constant in small and midsize colleges but increases in large colleges.

The nature of this hypothesis suggests a curvilinear relationship where the function of clerical personnel with college size is a constant for small and midsize values of FYES and increases for large values of FYES. First order correlations between squared and cubed values of FYES with the clerical component were not significant. These analyses suggest that the proportion of clerical personnel remains constant regardless of college size.

Hypothesis I: e. The proportion of support personnel remains constant regardless of college size.

A significant first order correlation between the

proportion of support personnel and FYES ($r = -.1691$, $df = 28$, $p < .19$) suggests that the proportion of support personnel does remain constant regardless of college size.

Hypothesis II:
a. Institutional administrative expenditures decrease as college size increases.
b. Instructional support and student services expenditures increase with increases in college enrollment.
c. The expenditure per student for total administrative cost including these three components is greater in large enrollment colleges.

Analysis suggests three specific problems with the data set: 1) non-normal distribution, 2) high multicollinearity among independent variables, and 3) small number of cases reducing degrees of freedom. Correlations between total administrative expenditures and squared and cubed values of FYES were not significant, while a significant correlation between natural log transformed values of FYES and total administrative expenditures was found ($r = -.3792$, $df = 28$, $p < .021$). A subsequent stepwise regression for total administrative expenditures with independent variables in log values revealed that the greatest amount of variance was explained when the log values of FYES and instructional support were entered. Student

services and institutional administration variables were not entered because the probability to enter was not satisfied ($p < .05$).

One interpretation of these analyses might suggest that instructional support expenditures and college size are significantly co-related to total administrative expenditures, where total administrative expenditures decrease with increases in college size. Increases in total administrative expenditures are related more to instructional support expenditures than are student services expenditures or institutional administrative expenditures once the effect of college size has been partialed out of total administrative expenditures.

Hypothesis III: Expenditures per FYES are greater in large than small colleges, but the increase is dependent upon noninstructional expenditure increases rather than faculty expenditures.

All independent variables were significantly correlated with expenditures per student and intercorrelations between independent variables were high. Analysis revealed an insignificant quadratic trend for expenditures per student with FYES. A stepwise univariate multiple regression revealed that FYES accounted for the greatest proportion of variance in expenditures per student and that expenditures per student decreased as FYES increased.

Non-instructional expenditures accounted for the most variance in expenditures per student of all the remaining independent variables after FYES had been entered, and expenditures per student increased as noninstructional expenditures increased. Instructional support expenditures accounted for the greatest amount of variance in expenditures per student after the first two variables had been entered, and expenditures per student decreased as instructional support expenditures increased.

Hypothesis IV: The student-faculty ratio is independent of college size when course differentiation and number of sections are taken into consideration.

The section variable accounted for the greatest amount of variance in the student-faculty ratio when courses and sections were entered via a forward regression method. The change in R^2 was not significant at the $p < .05$ level when FYES was entered with sections already partialed out.

Hypothesis V:
a. Average class size remains unchanged as enrollment increases.
b. Increases in course differentiation and the number of multiple sections offered effects constant average class size.
c. Unduplicated student headcount increases with increased course

differentiation, but FYES in pro-
Portion to unduplicated headcount
declines.

Analysis showed an insignificant quadratic trend for average class size with FYES. FYES was found to explain the greatest proportion of variance in average class size, followed by sections and courses. Unduplicated headcount was never entered into the equation because it was highly correlated with FYES and never explained more variance in average class size than FYES. Average class size was found to increase as college size increased, and the number of courses and sections both affected constant average class size with the number of sections decreasing with average class size and the number of courses increasing as average class size increased.

Hypothesis VI: Administrative expenditures per FYES increase as available resources increase independent of college enrollment.

None of the independent variables were found to be significantly correlated with administrative expenditures at the $p < .05$ level. Tuition obtained the highest first order correlation with administrative expenditures ($r = -.2248$, $df = 28$, $p < .121$). There were high intercorrelations between all independent variables except for state aid and property tax revenue. The univariate

multiple regression was not attempted because of the insignificant first order correlations between the independent variables with administrative expenditures.

Hypothesis VII: Maintenance and energy expenditures are functions of physical plant size independent of enrollment and personnel size.

None of the independent variables were significantly correlated with physical plant operating expenditures at the $p < .05$ level. High correlations between the independent variables were present. The univariate regression analysis was not conducted because of the insignificant first order correlations with physical plant operating expenditures.

No important differences in the major findings of this study result as a consequence of using data transformations.

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