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ABSTRACT

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MANAGEMENT-ORIENTED APPROACHES TO ASSESS INPUT-OUTPUT RELATIONSHIPS IN SECONDARY SCHOOLS

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

National Institute of Education

PREFACE

This study presents further analysis of data on inputs and outputs in Pennsylvania secondary schools collected, in part, by the Bureau (now Division) of Educational Quality Assessment, Pennsylvania Department of Education, and, in part, by Rodney J. Kuhns, as part of his doctoral dissertation at The Pennsylvania State University (Kuhns, 1972). The current effort would not have been possible without the cooperation of the Division of Educational Quality Assessment and Dr. Kuhns. I therefore wish to express my gratitude to Dr. Thomas E. Kendig, Dr. J. Robert Coldiron (both of the Pennsylvania Department of Education), and Dr. Kuhns for their cooperation in making their data and other documents available for this study. I would also like to thank Professor Teh-wei Hu and Dr. Coldiron for reading and commenting on a previous draft of this report.

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CHAPTER 1

INTRODUCTION

There is increasing awareness of the need to apply rigorous management techniques to assist educational decision makers in allocating scarce resources. The need for greater educational productivity has been placed into a sharper focus by the fiscal problems confronting education. The basic reason for such fiscal problems has been the ever-increasing costs of education--despite a reduction in the rate of increase in enrollments and, in some cases, an absolute decrease in enrollments--which are related to higher input costs despite little or no improvement in educational productivity. When costs increase but productivity remains essentially constant, costs per unit of output must increase, and therefore schools must seek increased public support. In an effort to reduce the burden of government operations, economy minded legislatures and boards of education are reluctant to increase tax revenues in proportion to the increase in educational costs. Something, therefore, must "give." Either the level of production must decrease, or ways must be found to produce the same output from a smaller input base.

The assumption underlying this study is that there exist some possible ways to reduce input costs without reducing the level of educational output, or, alternatively, to produce a greater level of output utilizing the same amount of inputs. This means, of course, that management decisions in education have not been optimal. This is not to say that educational administrators have necessarily been lax, but rather that the nature of educational production is so complex that even the best administrators would be unable to arrive at an optimal decision.

The study therefore explores some techniques that could assist educational managers in their attempt to arrive at more optimal input and output mixes. No panacea is offered here; only suggestions which would require thoughtful and searching analysis along with serious data collection are proposed.

The report begins in chapter 2 with an overview of input-output analysis as it applies to education, including a brief survey of some of the major input-output studies in education.

Chapter 3 provides a brief introduction to the Pennsylvania Plan, which forms the basis for the analysis developed in succeeding chapters.

The next chapter contains single- and simultaneous-equation systems describing input-output relationships for the fifty-three Pennsylvania secondary schools (as of fall 1971) for which extensive data are available. Some applications of the results are also discussed.

Chapter 5 presents a discussion of the development of an educational output index using the technique of canonical correlations. Several output indexes are developed and compared, and applications of the output index analysis are explored.

The major conclusions of the study are reiterated in chapter 6.

CHAPTER 2

INPUT-OUTPUT ANALYSES: A NEW PERSPECTIVE FOR EDUCATION

The Wide Domain of Input-Output: An Introduction

Having just passed thro· h a period of very great growth at all levels, American education has most recently shifted its focus from issues of quantity to those of quality. A decline in the school-age population, combined with the emergence of other competing societal priorities, have made educators aware that they will be increasingly called upon to demonstrate that the output of formal education is commensurate with the magnitude of inputs being committed to educational processes.

Educational inputs and outputs have been notably difficult to specify--not to mention the problems of quantifying them once some degree of consensus has been reached about their mere identification. As Katzman (1971) points out, the determination of whether particular schools have performed satisfactorily in the past has been made in two basic ways. One could either look subjectively at the school setting and try to "feel" whether it appears to be working well, or one could attempt to make objective judgments about the resources being consumed and the product being put out. The former is clearly the most commonly used approach and has a long history of evolution; however, the latter method is the emerging approach and the one with which educators will need to deal if they are to justify enrichment of educational programs in the years ahead.

It must be understood that problems remain in operationalizing educational inputs and outputs and in developing a true educational production function. For example, in studying the effects of schooling on equality of opportunity, Jencks and his associates (1972) explain why they were forced to use standardized test scores as a measure of educational attainment.

> We have looked at cognitive skills, as measured on standardized tests....We have not looked in any detail at habits, values, or attitudes. The reader should not infer that we think test scores more important than values or character. We take a dim view of test scores, both as measures of schools' effectiveness and as measures of individual talent. But while cognitive tests have many obvious defects, most measures of attitudes, values, and character structure are even worse. In the absence of evidence, theorists must rely on intuition and personal experience. These have proven a poor guide to the one thing we *can* measure, namely, cognitive skills...(Jencks *et al.*, 1972, p. 12).

Jencks' example is important to the comprehension of what follows because it argues that we must use indices, even though they are less than perfect, on the assumption that what information they do provide is better than having no objective information upon which to base important decisions. While we may still be far from the ultimate goal, each tentative step brings us closer to our objective.

The organization of this chapter is as follows. A discussion of the general area of open systems theory is presented first and forms a theoretical base for the specific input-output analyses which have been done in the field of education. This discussion is followed by a review of some of the studies which have been undertaken in elementary and secondary schools.

The Emergence of Input-Output Studies: A Systems Perspective

Until the very recent past, educational institutions had not regularly undergone the type of critical scrutiny familiar to other "complex organizations"--notably the for-profit corporate structure. Education, it was said, was so different from the production processes in other segments of the economy that principles of a general nature about the structure, functions, and operations of other organizations would not apply to educational institutions. In reviewing the available research on the organizational characteristics of American education, Anderson (1963) concluded that:

> ...the literature in this field was largely reminiscent, anecdotal, or hortatory, and what passed for research was largely of the normative-survey variety....The procedures of the research or its findings did not tie in, in any systematic way, with what is being called a theory of organization or a science of management (p. 1).

Ikenberry (1972) points out that the traditional inability to consider education, particularly higher education, within the context of general organizational theory has been due purportedly to the following factors: (1) lack of clarity in the specification of specific, stable missions, goals, or objectives; (2) extreme decentralization of academic authority within institutions; and (3) the disproportionately high number of professional employees--that is, faculty and other supervisory staff.

However, as the number of other service industries in our society has increased, it has become apparent that institutions other than schools share many of these characteristics and are still amenable to objective analysis. Some changes in terminology are needed to conform to different purposes and rationale, but much can be gained from application of the methodology developed for judging the effectiveness of functioning organizations in general.

Willingness to examine the effectiveness of educational institutions in terms of use of resources vis-à-vis outcomes has come about, in large part, due to acceptance of a systems perspective of education in line with general systems theory. A brief discussion of the development of systems theory would therefore be useful.

Systems Theory

Churchman (1968) defines a system as "a set of parts coordinated to accomplish a set of goals" (p. 29). In a more detailed fashion, Hall and Fagen (1968) describe a system as "a set of objects together with relationships between the objects and their attributes" (p. 81). They further define objects as the components of the system, attributes as the properties of the objects, and relationships as those things that "tie the system together" (p. 82).

The value of a systems orientation is that it allows and encourages one to see the dynamic relationships which exist between the components and the environment outside the system. In analogue, one could allude to the difference between a movie and a snapshot. In the motion picture one can see not only the components and their attributes, but also their paths of movement from one state to another. Rather than a static picture, the systems approach attempts to show and account for "flow of energy."

Increasingly, the attempt is to view organizations as "open systems," that is, systems which interact with their environments. While the concept of open systems originated in the study of thermodynamics (Bertalanffy, 1950), it appears to promise wide acceptance in many areas, not the least of which is management science.

Gouldner (1959) introduced the terms rational and natural systems into the management literature to correspond roughly with the physical concepts of closed and open systems, respectively. More recent theorists refer to closed and open systems directly. The closed system sees the organization as an instrument which can organize itself internally more or less independently of the conditions outside of the system. The open system, on the other hand, is viewed as an organization which is in "dynamic equilibrium," maintaining itself "in exchange of materials with the environment and in continuous building up and breaking down of components" (Bertalanffy, 1950, p. 23).

Authors generally associated with the closed system approach include Henri Fayol, Frederick Taylor, Max Weber, and Elton Mayo (Hall, 1972). Irrespective of their substantive differences, each of these writers strove to find the "one best way" of organizing internal structures and conditions. Two of the most well-known dicta deriving from this perspective are those dealing with "span of control" and "unity of command." The approaches identified by the terms scientific management, human relations management, and the study of bureaucracy have wide currency outside of the field of management. Relatively fewer people are familiar with the newer open systems model.

Lawrence and Lorsch (1967) put the matter this way:

> Until very recently, organization researchers and theorists have tended to view the internal functioning of effective organizations as if there was one best way to organize. No attention was devoted to the problem in which we are interested--that different external conditions might require different organizational characteristics and behavior patterns within the effective organization (p. 14).

Katz and Kahn (1966) have written what many consider the definitive work on open systems. They state:

> The theoretical concepts should begin with the input, output, and functioning of the organization as a system and not with the rational purposes of its leaders....Our theoretical model for the understanding of organizations is that of an energic input-output system....Living systems, whether biological organisms or social organizations, are acutely dependent upon their external environment and so must be conceived of as open systems (pp. 16, 18).

Katz and Kahn go on to discuss the key elements of all open systems, whether biological or social. They detail the following nine separate characteristics, the headings of which are repeated in their terminology.

1. Importation of energy: Some form of energy is input into all living systems in terms of money, people, material, and/or information from the environment.

2. The through-put: Some transformation of the inputs takes place within the system.

3. The output: Some product of the transformation process is exported back to the environment.

4. Systems as cycles of events: There is a pattern within systems that is reinforced by the export of outputs to the environment. Internally, there are also patterns which recur as new elements are input.

5. Negative entropy: Entropy is the process whereby systems, over time, tend to run down, decompose, etc. Building negative entropy entails the development of means through which the system is replenished.

6. Information inputs, negative feedback, and the coding process: Information can be as much of an input as physical commodities. Negative feedback is information which deflects the organization back to a planned course. Positive feedback merely maintains present course. (A thermostat is an ideal analogue; temperature change is information to thermostat to bring back to pre-set temperature level [negative feedback]. Positive feedback to thermostat merely "says" temperature setting on thermostat needs to be changed.) Coding determines what information inputs will be monitored.

7. The steady state and dynamic homeostasis: Though elements are constantly being imported and exported, open systems characteristically maintain a steady state. This is homeostasis rather than true equilibrium since there is movement, but the relation of energy in and out is constant. A safety margin of energy is input and stored to arrest entropic process.

8. Differentiation: Open systems tend to move toward a more complex form and a more specialized division of activities.

9. Equafinality: In open systems there are multiple paths to the same goal. There is no "one best way."

Principles such as these quite obviously give us a new set of parameters within which to evaluate the functioning of organizations. Since they were conceived to be of universal applicability, they do not have the closed system disadvantage of being idiosyncratic to particular settings--such as the profit sector of the economy.

The Many Uses of an Input-Output Approach: An Overview

The basic concepts of input-output analysis have been used in different ways in the various levels and settings of our educational system. In higher education, the unit of analysis has been the academic department (and other cost centers) and stress has been on dollar inputs. In contrast, input-output studies of elementary and secondary education are concerned with the individual student as a unit of analysis with individual characteristics and sociocultural factors as inputs into the process through which competencies--the output of the system--are developed. Use of the flexible input-output approach in such diverse ways lends to the overall heuristic value of the concepts.

Since the emphasis of the present study is on the explanation of student performance in the elementary and secondary school setting, use of input-output techniques as a financial management strategy in higher education will be discussed here only briefly before delving directly into the topic at hand. While input-output studies of higher education, conceived of as management tools, are a more limited view of the total utility of the approach, they do demonstrate the variations of the theme in education as a whole.

Rourke and Brooks (1966) believe that there has been a "managerial revolution in higher education" under way since the early 1960s. In their view, the new approach to higher education administration has come about due to: (1) expanded use of computer-assisted records systems; (2) extensions of institutional research capabilities; and (3) the adoption of new management tools originally used in other "complex organizations."

Most characteristic of the new management tools applied to higher education is the Planning, Programming, Budgeting System (PPBS). First implemented in the Department of Defense (Hitch, 1971), the system was being operationalized in all federal agencies by 1965.

PPBS can be considered one specific technique of the general approach known as cost-benefit analysis. Hu, Lee, Stromsdorfer, and Kaufman (1969) define cost-benefit analysis as "a procedure by which relevant economic and noneconomic criteria are applied to cost and benefit data to compare the relative merits of alternatives" (p. 20). Succinctly stated, the intent is to compare not only the costs of different alternative courses of action but also the benefits that each would produce.

This approach differs markedly from what institutions of higher education attempted to do in the past through budgetary and planning functions. As Clark and Huff (1972) point out:

> Traditionally, institutions have planned and budgeted on the basis of inputs to departments in the form of dollars, faculty, staff, physical facilities, etc. Relatively little reference was made to the outcomes of the programs those departments support. Thus, resource requests in traditional budgets have failed to link costs to program outcomes (p. 5).

Since program budgeting is the most frequently adopted vehicle of cost-benefit analysis, the present description will focus primarily on this specific technique. Parden (1971) notes that a planning, programming, budgeting cycle can be conceptualized in terms of the following ten sequential steps:

1. Establish objectives and goals.
2. Develop alternative programs which will accomplish the same goal.
3. Estimate resource requirements for each alternative.
4. Estimate benefits to be gained from each program alternative.
5. Develop an operating plan by selecting from among alternatives.
6. Test the long-range fiscal implication of the plan.
7. Compile the annual budget.
8. Evaluate the success with which program benefits are achieved.
9. Revise planning standards.
10. Repeat the cycle to accommodate changes in objectives, goals, available resources, and the institution's environment (from pp. 203-208).

The way in which these ten steps are input into the planning, programming, and budgeting process is described by Farmer (1970):

> Planning--the selection or identification of overall, long-range objectives of the organization and the systematic analysis of various courses of action in terms of relative costs and benefits.

Programming--deciding on the specific course of action to be followed in carrying out planning decisions.

Budgeting--translating planning and programming decisions into specific financial plans (p. 7).

Weathersby and Balderston (1971) view the matter similarly and add a time frame for the entire process. Their schema is presented below:

FUNCTION	LEAD TIME	ACTIVITY
Planning	5 to 15 years	Articulate global objectives, costs, and benefits.
Programming	1 to 5 years	Translate global objectives into a specific short-range course of action.
Budgeting	0 to 1 year	Determine specific financial, manpower, and policy plans toward goals (adapted from p. 4).

According to Dilley (1968) the implementation of such a programmed budget format ameliorates many of the problems of traditional "line-item" budgets by providing: (1) a record of accomplishments as a function of costs, (2) detailed planning for the whole institution as well as its parts, (3) planning in specific written form so that it can be discussed and reviewed by all involved, and (4) planning in time perspective so that alternative courses of action can be evaluated in terms of long-term capabilities.[1]

Before delving directly into a description of the types of input-output analyses which have been performed with regard to individual

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[1]Additional information on PPBS implementation and implications can be found in Newton (1972) and Huff and Manning (1972).

performance in the elementary and secondary schools, it is appropriate to mention briefly another spin-off of the basic approach which is generating much interest in educational circles.

Increasingly, attention is being centered on the development of criterion-based school curricula. Also known as competency- or performance-based education, the new emphasis is placed on determining what specific skills are requisite to particular educational attainments (as a measure of school output), in conjunction with a specification of the inputs necessary to reach these attainments.[2] With regard to teacher education, the requirements for certification in many states have been radically altered to provide for competency-based programs as a substitute for presentation of selected course work. In New York and Texas, ability to demonstrate specific competencies has now been mandated as the sole route to teacher certification (Rosner and Kay, 1973). Clearly, the attention of many has now been directed toward the actual cognitive and noncognitive abilities of students leaving educational institutions. This approach is in stark contrast to traditional reliance on the degree or diploma as a credential in itself.

While the approaches discussed in this section indicate the diversity of present and potential uses of input-output methodology, the most common use of input-output analyses (and the one pioneered by economists) has concerned the development of a tentative production function for elementary and secondary education. It is this topic which forms the basis for the next major section of this chapter.

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[2] Much of the work on criterion-based education has taken place in the context of teacher-preparation programs. While a discussion of these efforts is not within the scope of this study, additional information can be found in Schmieder (1973), Elam (1972), and Broudy (1972).

Input-Output Studies: The Development of an Educational Production Function for Elementary and Secondary Education

A production function, quite simply, is a technical statement of relation between inputs and outputs. As Burkhead and his associates (1967) indicate, "The function may be conceptualized as a set of relations among possible factor inputs and a corresponding set of outputs for a firm or industry. For a given set of inputs, the production function permits the choice of the locus of maximum output" (p. 18).

In developing a true production function for education, one is hampered by a number of problems. The absence of any generally agreed upon theory of learning is perhaps most troublesome. In place of a unitary theory, one finds that educational psychologists have posited a plethora of theoretical orientations which seem equally plausible at present.

Additionally, it must be pointed out that if the process is amenable to various modes of analysis, so also is the output of education less clear than one might hope. Most commonly, the educational process is assumed to have multiple outputs, including cognitive development, improved citizenship, and the potential for economic independence.

A prominent Canadian educator, W. R. Wees (1967), considers the formal thrusts of education to include at least the following: (1) to teach what is called a body of knowledge; (2) to develop character and train for citizenship; (3) to foster intellectual development for the society; and (4) to transmit such skills as to qualify students for gainful and productive life. Bloom (1956) likewise sees a multiplicity of educational objectives in the cognitive and noncognitive domains.

An analysis by Helm (1972) shows the complexity of problems affecting the development of an educational production function. He indicates:

> It is no easy matter to specify a theory of production as it applies to education. One reason is the tradition of defining the responsibility of schools to be that of offering opportunities for education rather than insuring that individuals receive an education....A second factor which has discouraged attempts to develop a theory of production of educational output is the difficulty of isolating unambiguously the school and nonschool influences which together result in the educational product. A third reason for the primitive state of production theory in education has been the lack of agreement as to what the proper output of educational institutions should be.... As a result of these and other forces, proportionally less effort has been extended to the question of input-output relationships in the education industry than is typical of industries producing more tangible products (p. 10).

Most input-output analyses in education have attempted to relate student, school, and/or societal factors to the more limited outcome of student achievement as measured by various standardized testing instruments. This approach has not stemmed from any effort to denigrate other aspects of school output, but rather, as indicated by Jencks (cited earlier in this chapter), intellectual achievement as demonstrated on standardized tests is the best measure that we have of any of the outcomes at this moment.

Guthrie (1970) suggests that the first significant attempt at input-output analysis was undertaken in 1956 for the Educational Testing Service by Mollenkopf and Melville (1956). These researchers attempted to control for the socioeconomic status of over 17,000 ninth- and twelfth-grade students in 206 schools and found a number of factors to be significantly related to tested ability. These factors include the number of guidance counseling and support staff in the schools, student-teacher ratio, class size, and instructional expenditures per student. (This study and those which follow are summarized in table 2-1.)

Also of great importance in establishing the value of input-output studies was the New York State education department's large-scale Quality Measurement Project (Goodman, 1959). Utilizing a sample of 70,000 seventh- and eleventh-grade students in over 100 districts in

TABLE 2-1

Summary Chart of Effectiveness Studies on School Service Components

Study Author(s)	Description of Sample	Measure of Pupil Performance (School Output)	Measure(s) of Effective School Service Component(s) (School Input)
1. Mollenkopf and Melville (1956)	U.S., 17,000 9th (in 100 schools) and 12th (in 106 schools) grade, male and female	Aptitude and achievement tests	1. Number of special staff 2. Class size 3. Pupil-teacher ratio 4. Instructional expenditures
2. Goodman (1959)	New York, 70,000 7th and 11th grade, male and female in 102 school districts	Achievement test	1. Number of special staff 2. Instructional expenditures 3. Teachers' experience 4. "Classroom atmosphere"
3. Thomas (1962)	Project TALENT sample (national) 10th and 12th grade, male and female	Achievement test	1. Teachers' salaries 2. Teachers' experience 3. Number of library books
4. Green et al. (1964)	Virginia (Primarily Negro) Secondary students	Stanford Achievement Test	1. Aggregate measure of entire instructional program
5. Benson et al. (1965)	California 5th grade, 249 school districts	Reading achievement test	1. Teachers' salaries 2. Administrators' salaries 3. Instructional expenditures
6. Kiesling (1967)	New York, 70,000 7th and 11th grade male and female in 102 school districts	Achievement test	1. Expenditure per pupil (in large school districts)
7. Coleman Report (1966)	U.S. Sample	Verbal ability test	1. Teachers' verbal ability
8. Shaycoft (1967)	U.S. 108 schools 6,500 9th and 12th grade, male and female	Battery of 42 aptitude and achievement tests	1. Curriculum variables
9. Burkhead et al. (1967)	90,000 Chicago high school students in 39 schools. 19,000 Atlanta high school students in 22 schools and 180 small community high schools	Aptitude and achievement tests and school holding power	1. Age of building 2. Teachers' experience 3. Teacher turnover 4. Teachers' salary

TABLE 2-1 (Continued)

Summary Chart of Effectiveness Studies on School Service Components

Study Author(s)	Description of Sample	Measure of Pupil Performance (School Output)	Measure(s) of Effective School Service Component(s) (School Input)
10. Plowden Report (1967)	English elementary school students		1. Age of building 2. Teachers' experience 3. Teachers' academic preparation 4. Teachers' "ability"
11. Cohn (1968)	Iowa high school students in 377 school districts	Achievement test	1. Teachers' salary 2. Number of instructional assignments per teacher 3. School size
12. Raymond (1968)	W. Virginia, 5,000 high school students	Freshman year (college) GPA and achievement test scores	1. Teachers' salary
13. Katzman (1968)	Boston elementary school students	School attendance, school holding power, reading achievement, special school entrance examination	1. Pupils per classroom 2. Student-staff ratio 3. Attendance district enrollment 4. Teachers' employment status 5. Teachers' degree level 6. Teachers' experience 7. Teacher turnover ratio
14. Bowles (1970)	U.S. 12th grade Negro males	Verbal ability test	1. Teachers' verbal ability 2. Science laboratory facilities 3. Length of school year
15. Bowles (1969)	U.S. 12th grade Negro males	Mathematics and reading achievement test and a test of general academic ability	1. Class size 2. Ability grouping 3. Level of teacher training 4. Age of school building 5. Expenditures per pupil
16. Bowles and Levin (1968b)	12th grade Negro students and 12th grade white students	Verbal ability test scores	1. Teachers' verbal ability 2. Teachers' salary
17. Hanushek (1968)	6th grade white students in 471 schools and 6th grade Negro students in 242 schools	Verbal ability test	1. Teachers' verbal ability 2. Teachers' experience

TABLE 2-1 (Continued)

Summary Chart of Effectiveness Studies on School Service Components

Study Author(s)	Description of Sample	Measure of Pupil Performance (School Output)	Measure(s) of Effective School Service Component(s) (School Input)
18. Ribich (1968)	Project TALENT sample	Achievement test	1. Expenditures per pupil
19. Guthrie *et al.* (1969)	5,284 6th grade students in Michigan	Reading ability, mathematics understanding, verbal facility	1. School site size 2. Building age 3. % classrooms makeshift 4. Library volumes 5. Textbook supply 6. Teachers' verbal ability 7. Teachers' experience 8. Teachers' job satisfaction 9. School size (enrollment) 10. Classrooms per 1,000 students 11. % of students transferring

Source: Reproduced from Guthrie (1970), pp. 47-48.

the state, the results were meant to be generalizable to all schools in New York. Input factors found to be significantly correlated with measured student achievement include per student expenditures, number of special staff personnel, amount of teacher experience, and "classroom atmosphere." The latter factor evolved from an in-class observation of the teacher's effort to relate the formal course content to the needs and abilities of the particular students.

The next major study was undertaken by Thomas (1962) employing the data generated by the "Project TALENT" study. This sample consisted of tenth- and twelfth-grade students in over 200 high schools across the country. In one of the first major studies to use regression (in contrast to correlational) techniques, Thomas found the following factors to be of importance: beginning teacher salaries, amount of teacher experience, and number of books in the school library.

Perhaps the largest, most comprehensive, and most hotly-debated study was published in 1966. Directed by James S. Coleman and his associates (1966), a study entitled Equality of Educational Opportunity attempted to determine the school and nonschool factors related to the achievement of over 600,000 students from coast to coast. Popularly known as the "Coleman Report," the study found very little association between school factors (taken singly or collectively) in comparison to nonschool factors. Of the school factors, the teacher's verbal ability seemed to be of most importance.

The Coleman report has been criticized along three basic axes. First, there is uncertainty as to whether the measurements used are sufficient for the task involved. Secondly, the handling of the data is thought by some to have been less than precise. Perhaps most damning, however, is the fact that many contend the manner by which the regression technique was used "stacked the cards" against any strong showing by school factors.

Basically, this latter argument is that step-wise multiple regression requires the statistical assumption of independence of variables. Where such independence is not present (i.e., multi-collinearity is present), the first variables to be entered (in this case nonschool factors) will appear most potent. In point of fact, the nonschool and school factors may be so nested within each other that their effects cannot be so arbitrarily separated. This criticism has been expounded most persuasively by Bowles and Levin (1968a, 1968b).

Following the release of the Coleman Report findings, a number of other, less extensive studies were undertaken. The results of these studies are presented in table 2-1.

After a span of some years, another work has caught the public eye and galvanized public opinion. Perhaps destined to be as controversial as the Coleman Report, the work by Jencks and his associates (1972) sees the appropriate outcome of schooling not as demonstrated student achievement, but as equality of opportunity. In this regard, they find the school deficient.

> [It is our contention] that differences between schools have rather trivial long-term effects, and that eliminating differences between schools would do almost nothing to make adults more equal. Even eliminating differences in the amount of schooling people get would do relatively little to make adults more equal. If this is true, schools ought to be judged largely by their short-term effects. This does not, in our view, weaken the case for distributing school resources and opportunities equally. But it means that this case is no different from the case for making the distribution of public parks, trash collection, or other public services equal (pp. 16-17).

Jencks contends that the main value of the school is its immediate effects as a milieu. He finds this to be no small task in itself, although others continue to suggest the need for a more long-term educational output to society.

Concluding Comments

This chapter has presented an overview of the many ways in which educators have found value in the concept of input-output analysis. The new perspective includes: a general systems approach to education; the implementation of program budgeting, unit-cost, and other analytical cost-effectiveness studies; the development of criterion-based educational programs; and the identification of school and nonschool inputs to level of student achievement.

This chapter has focused mainly on the study of inputs to student achievement. In movement toward the development of a meaningful production function for education, a number of important studies have provided pieces of the total picture. The preponderance of studies suggests that the characteristics of teachers and other professional support staff are of considerable importance in fostering student achievement. In addition to the caliber of the faculty and staff, their absolute number and average salaries, as well as the mechanics of their development, appear to add significantly to their effectiveness.

It is important to remember that most studies have dealt with a singular aspect of educational output--tested cognitive achievement. Since few would argue that the educational process benefits the individual and society only in this one way, increased efforts must be directed toward the task of identifying and measuring educational outputs and the factors which contribute to them.

CHAPTER 3

THE PENNSYLVANIA PLAN

Since most of the data used in this study were accumulated by the Division of Educational Quality Assessment, Pennsylvania Department of Education, it is desirable to provide some information about the genesis, character, and development of the Pennsylvania Educational Quality Assessment (EQA) Program, also known as the Pennsylvania Plan.[1]

Purposes of the Plan

On August 8, 1963, the Pennsylvania legislature passed the School Reorganization Act (Act 299). Section 290.1 of the act directed the State Board of Education to

> develop or cause to be developed an evaluation procedure designed to measure objectively the adequacy and efficiency of the educational programs offered by the public schools of the Commonwealth. The evaluation procedure to be developed shall include tests measuring the achievements and performance of students pursuing all of the various subjects and courses comprising the curricula. The evaluation procedure shall be so constructed and developed as to provide each school district with relevant comparative data to enable directors and administrators to more readily appraise the educational performance and to effectuate without delay the strengthening of the district's educational program. Tests developed under the authority of this section to be administered to pupils shall be used for the purpose of providing a uniform evaluation of each school district and the other purposes set forth in this subdivision. The State Board of Education shall devise performance standards upon completion of the evaluation procedure required by this section (p. 6).

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[1] This chapter is based on _Educational Quality Assessment in Pennsylvania_ (1973). All page numbers refer to that publication.

The need for such an evaluation was apparent when, in the hearings preceding the enactment of the Reorganization Act, both proponents and opponents of the measure relied on the elusive term "quality education" for defense of their respective positions. The obvious question then arose: "Just what is quality education?"

The legislation emphasizes the use of the data by school administrators in such a manner that the educational decision-making process may be improved.

The Ten Goals of Quality Education

In an effort to develop a comprehensive instrument which would be capable of satisfying the desire to measure educational quality, the Pennsylvania Department of Education has established the Ten Goals of Quality Education. The choice of the ten goals was made after consultation with "civic and professional leaders from throughout the state" (p. 7). These ten goals are summarized in table 3-1.

It is clear that the Pennsylvania Plan provides for a measurement of quality far different from the widespread use of expenditure data, quality of inputs, or merely achievement tests. The plan recognizes the importance of such goals as attitude modification regarding such areas as citizenship, race relations, drug usage, and the learning process; vocational development; and creative output and potential.

Data Collection

The process of data collection has undergone some changes since the inception of the plan. In the first phase (fall 1968), the fifth and eleventh grades in 100 schools were selected throughout the state of Pennsylvania for the purpose of testing the reliability and content validity of the measures developed to assess the attainment of the ten goals.

TABLE 3-1

Pennsylvania's Ten Goals of Quality Education

Quality education should:

I. Help every child acquire the greatest possible understanding of himself or herself and appreciation of his or her worthiness as a member of society.

II. Help every child acquire understanding and appreciation of persons belonging to other social, cultural and ethnic groups.

III. Help every child acquire, to the fullest possible extent, mastery of the basic skills in the use of words and numbers.

IV. Help every child acquire a positive attitude toward the learning process.

V. Help every child acquire the habits and attitudes associated with responsible citizenship.

VI. Help every child acquire good health habits and an understanding of the conditions necessary for maintaining of physical and emotional well-being.

VII. Give every child opportunity and encouragement to be creative in one or more fields of endeavor.

VIII. Help every child understand the opportunities open to him or her to prepare for a productive life and help each child to take full advantage of these opportunities.

IX. Help every child to understand and appreciate as much as possible of human achievement in the natural sciences, the social sciences and the humanities and the arts.

X. Help every child to prepare for a world of rapid change and unforseeable demands in which continuing education throughout adult life should be a normal expectation.

Source: Educational Quality Assessment in Pennsylvania (1973), p. 5.

In Phase II of the plan (fall 1969), "a stratified random sample of some 37,000 students in grades five and eleven in 428 different schools" was employed (p. 7). The data were gathered mainly for the purpose of studying the meaning of the numerical scores obtained for the various goals so that an interpretation of results could be provided to schools in subsequent testing.

Phase III marked the beginning of actual assessment. Beginning with the fall of 1970, a number of schools have been assessed each year on the basis of voluntary participation. On the basis of the legislative authorization, the new regulations make participation mandatory, and one-third of all schools will be assessed each year, so that each school will be evaluated once every three years. The samples for the period 1970 to 1973 are summarized in table 3-2. In addition to testing fifth and eleventh grades, assessment will also be available for seventh, eighth, and ninth grades to satisfy the needs of middle and junior high schools.

TABLE 3-2

EQA Samples, 1970 to 1973

Year	Number of Districts	Number of Schools	Grade Level	Number of Students
Fall 1970 to 1971	110	444	5	26,000
		89	11	24,000
Fall 1971 to 1972	49	172	5	11,000
		53	11	12,000
Fall 1972 to 1973	84	382	5	28,000
		90	11	29,000
Spring 1972 to 1973	55	63	7	15,650
	96	148	9	34,850

Source: *Educational Quality Assessment in Pennsylvania* (1973), p. 8.

Administration

To avoid what would amount to "a monumental--and expensive--undertaking," local school districts must themselves administer the assessment. Data are gathered from pupils, teachers, and administrators. These data are sent to Harrisburg, where, together with additional data on file, analysis of each school is carried out.

Use of the Data

Each school receives a School Report containing the following information:

(i) The school's standing in the state on each of the Ten Goals of Quality Education.

(ii) The school's standing relative to schools operating with a similar set of resources. For example, the Appalachia school with limited resources is not expected to match the achievement of an affluent suburban school with a vastly different student body, faculty and financial support.

(iii) The school's standing on each of the different resources (as many as forty-four) which are employed in setting the "level of expectation" cited in (ii) that "similar" schools are meeting.

(iv) How many high and how many low student scores there were which contributed to the average score--school score--cited in (i). Student replies to selected items.

or

Student replies to selected groups of items (subscales on each goal) (pp. 10-11).

It should be noted that the unit of analysis is the school. Data concerning individual students are not released, and, in any event, students provide anonymous replies so that identification of individual replies is impossible. The relative standing on each of the ten goals is provided through the use of multiple regression analysis, in which each school's score is predicted on the basis of its standing on a number of explanatory variables. Each school, then, can compare its actual standing with the predictive (relative) standing. The School Report also provides confidence intervals for the predicted scores.

The EQA division claims that the results of the assessment program have induced a number of changes in the schools, including the following:

1. Faculty and students human relations meetings conducted;
2. improved the "humanness" of the secondary faculty;
3. Changed emphasis in guidance, particularly in areas of self-esteem;
4. Revision of social studies curriculum;
5. Increased cultural program with ESEA Title I funds;
6. Concentration on knowledge of differing occupations;
7. Basic changes in reading and math program;
8. Health education program changed; and
9. Teacher awareness of ten goals (p. 15).

Concluding Comments

The nature of the Pennsylvania Plan and the data collected provide a fertile ground for further input-output analysis of secondary schools. For the purposes at hand, data from the 1971 to 1972 survey for fifty-three secondary schools have been combined with additional data collected by Kuhns (1972). The analysis here, moreover, will go beyond the School Report, providing additional management information to affected schools.

CHAPTER 4

INPUT-OUTPUT ANALYSIS:

SINGLE- AND SIMULTANEOUS-EQUATION SYSTEMS

Although the School Report (prepared by the EQA staff in the Pennsylvania Department of Education) is based on multiple regression analysis, the main purpose of the analysis is to estimate equations which provide the best predictors of each of the ten goals. To that end, all of the available inputs are used as the basis for the predictive model, although each equation in the model contains only a small subset of all inputs. The important distinction between the EQA analysis and the present analyses is the intended use of the regression analysis. If the purpose is merely to predict the goals, then it makes no difference which inputs are entered in the equation. A step-wise program which selects the "best" equation without any _a priori_ analysis is perfectly satisfactory. However, if the regression _coefficients_ are to be used for management decisions, a great deal of care must be exercised in the selection of variables for each of the equations.

Moreover, the entire EQA analysis is cast in terms of a single-equation estimation procedure. Since this approach ignores possible interactions among the outputs, the possibility exists that the estimates are neither unbiased nor consistent.[1] This chapter therefore explores both the choice of explanatory variables and the utilization of simultaneous-equation systems.

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[1] Actually, two issues must be settled: (1) identification and (2) estimation. For thorough discussions of these issues consult, e.g., Hu (1973), chapter 7, and Johnston (1972), chapters 12 and 13.

Educational Production Functions

Although the educational process cannot be equated to an ordinary production process in other enterprises, there are certain general similarities which permit broad generalizations about the educational production process. As is the case in any production process, the essential ingredients--the inputs--must somehow be transformed into outputs. Hence, we must be able to identify the following: (1) the set of inputs which is involved in the educational process; (2) the outputs arising out of that process; and (3) the characteristics of the process itself, i.e., the nature or shape of the production function.

The identification of each of these aspects of the educational production process requires a great deal of information and involves problems which must be surmounted before an acceptable production function can be established. Beginning with the inputs, one must first distinguish among several classes of inputs. For example, one may divide inputs into "environmental" factors (such as socio-demographic characteristics of the students and the community) and schooling factors (teachers' attributes, facilities, etc.). Moreover, one could provide further classifications of inputs, such as manipulative vs. nonmanipulative variables. Again, what is manipulative depends on who is to use the results of the analysis. The variable "state subsidy per weighted pupil," for example, can hardly be manipulated by a <u>school</u>; however, changes in the subsidy level could easily be achieved at the state level and, to a lesser extent, at the school district level in Pennsylvania, where the subsidy level is, in part, a function of local expenditures per pupil.[2]

Perhaps the most troublesome aspect of the input set is the obvious practical requirement to make use of input <u>proxies</u>. For

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[2]The so-called percentage equalization plan, operating in Pennsylvania, disburses funds to districts in direct proportion to their local expenditures per weighted pupil and in inverse proportion to their wealth, measured by valuation of real property. See Cohn (1974), pp. 52-53, and Johns (1972), pp. 277-289.

example, the contribution of teachers to the educational production process may be measured by such proxies as the quantity and quality of teacher education, teacher attitudes and classroom practices, teacher experience, and so forth. But each of these proxies provides at best an approximate measure for the actual inputs; moreover, a proxy might represent two or more, sometimes conflicting, input factors.[3] It is therefore crucial that the input set be chosen critically, and that any interpretation of the results take this fact into account.

On the output side, there are again substantial difficulties that must be resolved. First, educational output is both abstract and multidimensional in character. Its abstract nature requires that approximate indices be constructed to evaluate longitudinal or cross-sectional output differences. Such indices must be reasonably accurate and consistent. In addition, it is highly unlikely that any single dimension of education could describe the entire complex of educational output. The heavy reliance on achievement scores in studies of educational production reflects the experience educational psychologists have had with achievement scores, but the neglect of other outputs could greatly bias the overall observed performance of schools.

Even if ideal input and output measures were available, one would still need to know something about the process by which inputs are transformed into outputs. Unfortunately, one is faced with a total lack of an acceptable and coherent learning theory which could be used to specify an educational production function (Bowles, 1970). Rather than attempt a formulation of such a theory (which would require extensive study), it will be assumed here--as most researchers have

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[3]For an excellent discussion of this point consult Mood (1970).

assumed so far--that a linear relationship between inputs and outputs would provide a reasonably satisfactory function.[4]

In general, then, if one specifies n outputs, $Q_1, Q_2, \ldots, Q_n$; k schooling inputs, $X_1, X_2, \ldots, X_k$; and m environment inputs, $Z_1, Z_2, \ldots, Z_m$; then the generalized production function for the ith output is given by:

$$(4.1) \qquad Q_i = f(X_1, X_2, \ldots, X_k / Z_1, Z_2, \ldots, Z_m; u), \qquad (i=1, n)$$

That is, given the levels of the environmental input set, one would determine Q_i according to the levels of the X-vector and the random error, u. If the production function has a linear form, equation (4.1) becomes:

$$(4.2) \qquad Q_i = \sum_{j=1}^{k} a_{ji}X_j + \sum_{h=1}^{m} b_{hi}Z_h + \text{intercept} + u_i, \qquad (i=1, n)$$

where the a_{ji}'s and the b_{hi}'s are the coefficients which we seek to estimate.

In the present context, twelve equations of type (4.2) may be estimated (one for each of the twelve output measures described in table 4-1). Two major problems arise in providing such estimates: (1) the large number of inputs and (2) multicollinearity. An inspection of table 4-2 indicates that altogether we have data for fifty-five inputs. With fifty-three observations, there would be insufficient degrees of freedom. Also, many of the inputs are correlated with other inputs to a greater or lesser extent, and, as is well known, such intercorrelation would obscure the true impact of each variable on the output measures. The full correlation matrix is given in the appendix.

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[4]Michelson argues that a linear-additive relation could not be described as a production function in the economic sense of the term. Rather, he argues, such a relation provides "coefficients which describe in some average way the effect of the independent variables on the dependent variables" (Michelson, 1970, p. 133). The distinction is between a relation providing marginal as opposed to average effects. To the extent that the production process is characterized either by significant interactions or other nonlinear characteristics, the linear function will obviously not provide the desired estimates of the production function coefficients. However, to the extent that nonlinearities are either insignificant or otherwise unimportant, the linear function will be satisfactory.

TABLE 4-1

Output Variables: Definitions, Means, and Standard Deviations

Output	Acronym	Description[a]	Mean	Standard Deviation
1	GOAL I	Self Concept	89.41	1.38
2	GOAL II	Understanding Others	90.74	1.45
3	GOAL III-v	Verbal Basic Skills	16.08	1.35
4	GOAL III-m	Mathematical Basic Skills	18.24	1.30
5	GOAL IV	Interest in School	90.97	3.02
6	GOAL V	Citizenship	163.43	4.88
7	GOAL VI	Health Habits	119.58	2.75
8	GOAL VII-p	Creativity Potential	60.74	1.14
9	GOAL VII-o	Creativity Output	137.72	3.30
10	GOAL VIII	Vocational Development	83.12	0.83
11	GOAL IX	Appreciation of Human Accomplishments	153.93	3.25
12	GOAL X	Preparation for Change	106.15	2.23

Source: Kuhns (1972), p. 143.

[a]For a more detailed description consult Beers (1970).

TABLE 4-2

Input Variables: Definitions, Means, and Standard Deviations

Acronym	Description[a]	Mean	Standard Deviation
SEX	Student's sex	1.51	0.04
INTERRAC	Exposure to different races	1.38	0.37
LOCATION	Type of community (urban, rural, suburban)	3.60	2.01
RACE	Ethnic or racial origin	4.92	0.09
LIBRARY	Accessibility of library	4.37	0.31
COUNSEL	Accessibility of counselors	4.59	0.26
MORESB	Boy's mores	3.11	0.18
MORESG	Girl's mores	3.22	0.13
VALUES	Personal values	3.91	0.15
ATTEND	Student attendance	3.32	0.22
FOCC	Father's occupation	34.87	10.16
MOCC	Mother's occupation	39.11	7.14
OCDESIRE	Occupational desires	53.50	4.98
OCEXPECT	Occupational expectations	45.58	6.71
PCTMW	Percentage of mothers working	0.35	0.10
FAMSES	Family socioeconomic status	48.60	12.65
TAGE	Teacher's age	3.69	0.57
TPPOS	Teacher's number of years in present position	4.78	0.50
TCOLLEGE	Type of college from which teacher graduated	2.39	0.13
TLOCALE	Locale where teachers graduated from high school	4.31	0.16
TSTABLE	Locale in which teachers spent most of their lives	4.40	0.19
TMEDUC	Educational level of teacher's mother	3.74	0.38
TFOCC	Occupational level of teacher's father	4.12	0.61
REACTL	Perception of actual characteristics influencing professional recognition	3.67	0.74
RECIDEA	Perception of ideal characteristics influencing professional recognition	1.70	0.26
TCAREER	Teacher career aspirations	7.24	0.69
TSATISF	Teacher satisfaction	19.85	1.09
DISCREP	Difference between real and ideal influences on education processes	4.74	0.52
CLPRACT	Teacher classroom practices	38.09	1.38
TSALARY	Teacher's salary	8205.66	562.50
TEXPER	Teacher's teaching experience	11.04	2.68
TEDUC	Teacher's education	4.75	0.29
TSEX	Teacher's sex	1.37	0.07
POSTGRAD	Graduates continuing their education	53.41	13.51
SUBSIDY	State subsidy/weighted pupil	249.34	68.01

TABLE 4-2 (Continued)

Acronym	Description[a]	Mean	Standard Deviation
INSEXADM	Instructional expenses/pupil	423.40	40.86
EFFORT	Actual tax/market values	23.79	3.41
ENROLL	School enrollment	926.15	400.42
HOUSING	Types of residence in community	3.40	0.67
HOLDING	Holding power	91.45	6.08
STAFFP	Instructional personnel/pupil	0.05	0.006
BOOKSP	Library books/pupil	10.87	3.68
GUIDANCE	Counselors/pupil	0.002	0.0005
INNOVATE	School usage of innovations	33.55	6.83
ADA	Average daily attendance	932.32	346.19
CUG	Curriculum units/grade	23.92	7.45
PRCO	Preparation coefficient (teacher specialization)	0.50	0.09
TLOD	Teacher load	20.05	1.85
CSIZ	Class size	24.29	5.61
AEE	Average extracurricular expenditure/pupil	66.47	21.67
BRAT	Building ratio-enrollment capacity	1.08	0.23
AMAN	Administrative man-hours/pupil	3.95	1.93
AXMAN	Auxiliary man-hours/pupil	8.02	2.65
FSRAT	Student/academic faculty ratio	30.40	6.48
PSUP	Paraprofessional support	56.08	70.41

[a]For a more detailed description consult Kuhns (1972) and Russell (1971).

Several approaches may be followed to overcome these problems. One would be to select variables for each equation on the basis of their contribution to explaining the output variance. In this method, one would continue adding explanatory variables to the equation until the addition to R^2 (the coefficient of determination) is less than a prespecified amount. (This amount might be set arbitrarily, or, alternatively, one could terminate the addition of variables when the difference between the R^2 derived when the new variable is added and that derived before the variable was added is not statistically significant.)

Another alternative would be to employ principal components or factor analysis to derive a set of new variables from the original input set. The new set of variables would contain fewer factors representing most of the variation in the original data set, hence increasing the number of degrees of freedom and the reliability of the coefficient estimates. However, the new factors so produced are usually difficult to interpret, so that the use of factor or principal components analysis is obviously limited.

A third possibility would be to combine _a priori_ specification with factor analysis. For example, if one wishes to examine the effect of various manipulative variables on educational output, it would be necessary to express these factors in their original units. However, there is no need to specify in the equation all (or some subset) of the vectors of environmental and nonmanipulative school inputs. Instead, principal components of the latter two groups may be computed and entered in the equation along with those manipulative variables that are thought to belong in the equation _a priori_.[5]

In the foregoing discussion it has been assumed that it is appropriate to estimate separate input-output relationships for each of the outputs. However, it is reasonable to assume that the educational process is characterized by strong interdependencies among the

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[5]Such a suggestion is made by Kendall (1957), pp. 70-74, cited in Johnston (1972), p. 329.

outputs. To the extent that the degree of simultaneity in the equation system is statistically significant, biased and inconsistent coefficients will be produced when ordinary least squares analysis is employed. Consequently, a simultaneous-equation system should be specified.[6]

For the purpose of describing the simultaneous-equation system, we distinguish between endogenous and exogenous variables. Endogenous variables are to be determined by the model. In our case, the twelve outputs of the educational system comprise the set of endogenous variables, whereas the inputs comprise the set of exogenous variables.

Since estimation of the regression coefficients in the system requires that the system be identified, it is necessary to exclude in each equation a number of exogenous variables equal to or exceeding the number of endogenous variables which are included in the equation less one (Johnston, 1972, p. 359).[7] One must, therefore, select different sets of endogenous and exogenous variables for each of the equations in the set.

In general, the simultaneous-equation system will have the following form:

$$Q_1 = f_1\ (Q_2,\ Q_3,\ \ldots,\ Q_n;\ \ X_1,\ X_2,\ \ldots,\ X_k/Z_1,\ Z_2,\ \ldots,\ Z_m;\ u_1)$$

$$Q_2 = f_2\ (Q_1,\ Q_3,\ \ldots,\ Q_n;\ \ X_1,\ X_2,\ \ldots,\ X_k/Z_1,\ Z_2,\ \ldots,\ Z_m;\ u_2)$$

$$\cdot$$

(4.3) $$\cdot$$

$$\cdot$$

$$Q_n = f_n\ (Q_1,\ Q_2,\ \ldots,\ Q_{n-1};\ X_1,\ X_2,\ \ldots,\ X_k/Z_1,\ Z_2,\ \ldots,\ Z_m;\ u_n)$$

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[6] Studies employing a simultaneous-equation system include Fox (1971), Levin (1970), and Michelson (1970).

[7] For example, if five outputs (endogenous variables) are included in the first equation, the maximum number of exogenous variables that may be included in the equation is k-5-1, where k is the number of exogenous variables in the entire equation set.

where the Q's are the outputs, the X's are the school-related inputs, the Z's are the environmental factors, the u's are random errors, and the f's are the functional operators describing the manner by which the sets of explanatory variables within the parentheses combine to explain variations in each of the outputs.

Since some of the endogenous and exogenous variables will be omitted from each equation, the empirical counterpart of equation system (4.3) would be far more truncated. Moreover, for the purposes of this study, only linear-additive functional forms will be employed.

The Data

The data employed in this study were collected in part by the Pennsylvania Department of Education, Division of Educational Quality Assessment (DEQA), and in part by Rodney J. Kuhns (1972) in cooperation with DEQA. Definitions of the variables, along with their means and standard deviations, are reported in table 4-1 for the outputs and in table 4-2 for the inputs. More detailed discussions of the output and input data are provided in Kuhns (1972) and in Beers (1970) and Russell (1971).

Data Analysis

Analysis of the data takes the form of multiple regression analysis, including both single and simultaneous-equation estimation.

As noted earlier, a major problem in the analysis is the choice of variables to be included in each equation. Much effort has already been exerted in this regard, and it would be presumptive to claim any superior expertise regarding the proper specification of the model. Consequently, what is presented here does not constitute a complete overhaul of previous work in the area, but rather a shift in emphasis and marginal changes in the choice of independent variables.

Since the objective of the study is to formulate a model which is useful for management decisions, the focus is on variables that schools can manipulate. Examples of such variables are INNOVATE, CUG, PRCO, and TLOD. At the same time, it is recognized that the equations must include variables that describe environmental influences as well as schooling factors which are not easily manipulated.

The following approach was utilized to specify the sets of explanatory variables for each equation. Kuhns's model, which was based on the same data and also placed an emphasis on manipulative inputs, serves as the initial basis for the specification. However, instead of choosing in each equation a subset of the environmental variables (based upon the step-wise regression program), all of the environmental variables were subjected to factor analysis, and four factors, taken together, "explain" more than 70 percent of the variance in that set. The acronym for the ith factor is given by SEFAC 2.

Use of such factors restricts the interpretation of the results regarding student characteristics and other environmental variables. While it might be interesting to find out about output differences among the races and sexes, it is assumed here that the schools cannot do anything about sex or racial composition. Similarly, it might be interesting to find the extent of output variations due to locational differences, but, again, the school managers are powerless to affect such variables.

The regression results are reported in tables 4-3 through 4-14. The first column in each table provides regression results reported by the Division of Educational Quality Assessment (DEQA) of the Pennsylvania Department of Education. The results are based on a study of seventy-three secondary schools in the fall of 1969. The variables chosen in each equation were selected on the basis of a step-wise regression program (UPREG). The second column in each of those tables reports the regression results obtained by Kuhns (1972). In that study, Kuhns examined data pertaining to fifty-three secondary schools in the fall of 1971. In addition to the data generated by the DEQA, Kuhns gathered information about additional manipulative variables, including CUG, PRLO, TLOD, CSIZ, AEE, ERAT, AXMAN, FSRAT, and FSTP. Specification of the model was also determined by the step-wise regression technique.

TABLE 4-3

Production Functions for Goal I: Self Concept

	Single-Equation System				Simultaneous System
Explanatory Variable	DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	
Endogenous					
Goal III-v				0.064 (0.26)	0.310 (1.00)
Goal III-m				0.026 (0.13)	0.080 (0.34)
Goal IV				0.077 (1.22)	0.013 (0.20)
Goal VI				-0.059 (0.74)	-0.054 (0.56)
Goal VII-p				-0.087 (0.48)	-0.055 (0.22)
Goal VIII				0.959 (4.37)	0.643 (2.40)
Goal IX				0.014 (0.17)	0.085 (0.84)
Exogenous					
LOCATION	0.273 (2.68)				
RACE	-1.342 (3.52)				
COUNSEL	0.868 (2.09)				
VALUES	2.479 (3.12)	3.8916 (3.57)			
FAMSES		-0.0271 (1.55)			
TSTABL	1.579 (2.97)				
TMEDUC	0.401 (1.49)				
FFACIL	-0.577 (4.15)				
TSALARY	-0.0008 (3.06)				
TEDUC	1.939 (3.59)	0.5191 (0.86)	0.723 (1.18)	0.600 (1.16)	0.508 (1.07)
POSTGRAD	-0.027 (2.35)	0.0321 (2.06)			
EFFORT	0.095 (2.65)	-0.0383 (0.84)	-0.054 (1.11)	-0.027 (0.59)	-0.014 (0.32)
ENROLL	0.0505 (1.92)				
HOUSING	0.491 (1.63)				
GUIDANCE	205.135 (1.35)	828.5301 (2.56)	438.632 (1.33)	-169.606 (0.55)	57.389 (0.19)
ADA		-0.066 (1.08)			

TABLE 4-3 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
TLOD		-0.1806 (2.00)	-0.223 (2.54)	-0.080 (0.95)	-0.046 (0.56)
CSIZ		0.1141 (1.91)	-0.033 (1.02)	-0.008 (0.28)	-0.008 (0.31)
AEE		-0.0095 (1.10)	-0.001 (0.12)	-0.007 (0.95)	-0.011 (1.48)
AMAN		0.1913 (1.94)	0.116 (1.17)	0.102 (1.09)	0.042 (0.45)
AXMAN		-0.2416 (3.42)	-0.204 (2.94)	-0.150 (2.46)	-0.121 (2.10)
FSPAT		-0.0967 (1.72)			
SEFAC 1			0.281 (1.37)	0.209 (0.92)	-0.039 (0.15)
SEFAC 2			-0.602 (4.04)	-0.366 (2.42)	-0.378 (2.55)
SEFAC 3			-0.097 (0.58)	-0.099 (0.66)	-0.146 (1.04)
SEFAC 4			0.065 (0.39)	-0.111 (0.71)	-0.133 (0.88)
Intercept	63.39 (12.82)	76.52	92.80 (23.40)	93.10 (17.35)	25.46 (1.36)
R_c^2	0.61	0.51	0.47	0.66	0.66
F	9.03	5.20	4.87	6.21	6.21
SEE	0.975	0.967	1.006	0.812	0.812
N	73	53	53	53	53

Sources: For DEQA, computer print-out furnished by the Division of Educational Quality Assessment, Pennsylvania Department of Education. For Kuhns, Kuhns (1972), table 5, p. 71.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-4

Production Functions for Goal II: Understanding Others

Explanatory Variable	Single-Equation System: DEQA	Single-Equation System: Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
Endogenous					
Goal III-v				0.261 (0.93)	0.052 (0.17)
Goal III-m				-0.039 (0.16)	0.020 (0.07)
Exogenous					
VALUES	4.647 (4.99)	-1.9937 (1.84)			
LOCATION	0.454 (4.60)				
BOOKSP	-0.045 (1.54)				
STAFFP	39.277 (2.32)				
MORESB	1.777 (3.12)				
PCTMW	5.326 (3.29)				
TCOLLEGE	-2.318 (3.22)	-1.3025 (1.02)	-1.274 (0.87)	-1.331 (0.89)	-1.324 (1.04)
TFOCC	0.525 (3.10)				
TCAREER	-0.279 (2.13)				
THEDUC	0.772 (2.44)				
DISCREP	-0.360 (1.94)	-0.3211 (0.91)	-0.337 (0.93)	-0.317 (0.86)	-0.324 (1.04)
FAMSES		0.0832 (5.34)			
TSALARY		0.0004 (1.33)	0.0002 (0.45)	0.0002 (0.45)	0.0002 (0.55)
EFFORT	0.063 (2.15)	0.0015 (1.92)	-0.073 (1.37)	-0.068 (1.25)	-0.072 (1.59)
ADA		0.0012 (2.18)	0.0015 (2.30)	0.0013 (1.99)	0.0014 (2.55)
TIOS		0.1108 (1.10)	0.145 (1.36)	0.188 (1.66)	0.157 (1.58)
TEXPER	0.116 (2.46)				
CSIZE		-0.0021 (1.62)	-0.041 (1.16)	-0.037 (1.65)	-0.040 (1.33)
ATE		0.0123 (1.47)	0.011 (0.95)	0.008 (0.64)	0.010 (1.60)
BRAT		-0.8970 (1.24)	-1.202 (1.56)	-1.091 (1.39)	-1.161 (1.74)

TABLE 4-4 (Continued)

	Single-Equation System				Simultaneous System
Explanatory Variable	DEQA	Kuhns	Alternative Models (1)	(2)	
FSRAT		0.0660 (1.15)			
PSUP		-0.0025 (1.12)	-0.0009 (0.36)	-0.0003 (0.11)	-0.0006 (0.29)
SEFAC 1			0.858 (4.00)	0.653 (2.37)	0.806 (3.02)
SEFAC 2			0.230 (1.33)	0.254 (1.45)	0.237 (1.61)
SEFAC 3			0.056 (0.28)	0.030 (0.14)	0.042 (0.23)
SEFAC 4			0.058 (0.31)	0.032 (0.16)	0.047 (0.29)
Intercept	63.17 (14.90)	95.29	93.10 (17.35)	88.87 (13.53)	91.76 (14.04)
R_c^2	0.66	0.52	0.41	0.40	0.40
F	11.56	5.26	3.59	3.18	3.18
SEE	1.11	1.01	1.11	1.12	1.12
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 7, p. 73.

Notes: $\bar{R}^2$ = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-5

Production Functions for Goal III-v: Verbal Skills

Explanatory Variable	Single-Equation System: DEQA	Single-Equation System: Kuhns	Single-Equation System: Alternative Models (1)	Single-Equation System: Alternative Models (2)	Simultaneous System
Endogenous					
Goal I				0.006 (0.05)	0.119 (0.85)
Goal II				0.033 (1.02)	0.032 (0.34)
Goal III-m				0.548 (5.95)	0.427 (3.68)
Goal VI				-0.006 (0.10)	0.024 (0.41)
Goal VIII				0.069 (0.33)	-0.043 (0.20)
Exogenous					
TEXPER	0.087 (3.05)	0.0494 (1.02)	-0.007 (0.13)	-0.006 (0.15)	-0.008 (0.23)
STAFFP	29.635 (2.81)	[illegible]4.1747 (1.12)	31.341 (1.26)	14.799 (0.81)	15.146 (0.94)
ADA		0.0010 (2.13)	0.0010 (1.81)	0.0005 (1.21)	0.0006 (1.67)
CUG		-0.3750 (1.93)	-0.029 (1.24)	-0.005 (0.30)	-0.003 (0.53)
TLOD		-0.1603 (2.22)	-0.227 (2.76)	-0.140 (2.00)	-0.131 (1.94)
ASE		0.0100 (1.53)	0.017 (2.13)	0.009 (1.61)	0.012 (2.20)
AMAN		0.1803 (2.60)	0.198 (2.41)	0.144 (2.39)	0.144 (2.76)
AXMAN		-0.0967 (1.84)	-0.0[illegible]2 (1.45)	-0.064 (1.30)	-0.049 (1.13)
LOCATION	-0.277 (2.58)	-0.1859 (2.11)			
VALUES	1.479 (2.39)	1.5545 (1.93)			
EXTC	0.129 (6.73)	0.0765 (4.60)			
OCEXPECT	-0.166 (3.8[illegible])	0.0593 (2.23)			
BUILDING	0.0[illegible] (1.98)	0.0091 (3.45)			
OCDESIRE	0.125 (2.51)				

TABLE 4-5 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Single-Equation System: Kuhns	Single-Equation System: Alternative Models (1)	Single-Equation System: Alternative Models (2)	Simultaneous System
POSTGRAD	0.029 (3.16)				
HOUSING	0.497 (2.70)				
SEFAC 1			0.755 (4.13)	0.347 (2.28)	0.422 (3.02)
SEFAC 2			-0.122 (0.93)	-0.114 (0.97)	-0.031 (0.29)
SEFAC 3			0.217 (1.50)	0.028 (0.26)	0.066 (0.67)
SEFAC 4			0.233 (1.80)	0.075 (0.67)	0.078 (0.74)
Intercept	-0.095 (0.03)	0.009	17.726 (6.99)	-6.403 (0.42)	-3.935 (0.26)
R_c^2	0.77	0.72	0.58	0.80	0.80
F	25.33	11.04	7.10	12.88	12.88
SEE	0.792	0.719	0.869	0.610	0.610
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 9, p. 76.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-6

Production Functions for Goal III-m: Math Skills

Explanatory Variable	Single Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
Endogenous					
Goal I				-0.043 (0.26)	0.142 (0.72)
Goal II				-0.020 (0.18)	0.039 (0.32)
Goal III-V				0.810 (5.47)	0.556 (2.72)
Goal VI				0.039 (0.54)	-0.053 (0.60)
Goal VIII				0.136 (0.47)	-0.025 (0.08)
Exogenous					
CUG		-0.0387 (1.72)	-0.038 (1.45)	-0.014 (0.64)	-0.030 (1.47)
PRCO		-1.8326 (1.23)	-1.485 (0.81)	-0.387 (0.23)	-0.115 (0.07)
TLOD		-0.1917 (2.38)	-0.155 (1.72)	0.045 (0.56)	-0.046 (0.55)
AEE		0.0238 (3.10)	0.011 (1.16)	-0.002 (0.24)	0.004 (0.60)
AXMAN		-0.0703 (1.22)	-0.041 (0.62)	-0.009 (0.18)	-0.005 (0.10)
PSUP		-0.0044 (2.27)	-0.005 (2.54)	-0.002 (1.10)	-0.004 (1.98)
LOCATION	-0.228 (2.35)	-0.2701 (2.44)			
FOCC	0.097 (5.59)	-0.0871 (0.98)			
PCTMW	2.129 (1.56)	-4.8529 (1.81)			
FAMSES		0.1601 (2.05)			
POSTGRAD	0.042 (4.59)	0.0392 (2.38)			
RACE	1.499 (5.29)				
NDRESB	0.836 (2.49)				
TSATISF	0.135 (2.79)				
SEFAC 1			0.807 (4.12)	[illegible] [illegible]	0.174 (0.72)
SEFAC 2			0.008 (0.05)	[illegible] (0.57)	0.030 (0.32)
SEFAC 3			0.283 (1.62)	0.130 [illegible]	0.219 (1.66)
SEFAC 4			0.166 [illegible]	-0.026 (0.19)	0.109 (0.75)

TABLE 4-6 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	(2)	Simultaneous System
Intercept	-0.390 (0.19)	19.00	22.91 (11.28)	-5.09 (0.26)	3.15 (0.15)
R_c^2	0.76	0.51	0.36	0.64	0.64
F	33.24	5.85	3.91	7.25	7.25
SEE	0.819	0.913	1.041	0.78	0.78
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 11, p. 78.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-7

Production Functions for Goal IV: Interest in School

	Single-Equation System				Simultaneous System
Explanatory Variable	DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	
Endogenous					
Goal I				0.186 (0.58)	0.134 (0.33)
Goal V				0.245 (2.17)	0.174 (1.18)
Goal VI				-0.203 (1.17)	0.121 (0.56)
Goal IX				0.325 (2.34)	0.308 (1.74)
Exogenous					
GUIDANCE	1372.092 (3.17)				
LIBRARY	1.390 (2.87)	2.6638 (2.56)	2.802 (2.50)	1.505 (1.56)	1.489 (1.68)
TPPOS	-1.865 (2.48)	0.6434 (0.68)	0.608 (0.62)	1.002 (1.16)	-3.892 (2.35)
TSATISF	0.460 (2.06)	0.3819 (1.24)	0.358 (1.05)	-0.302 (1.07)	0.396 (1.59)
MORESB	2.876 (2.00)	5.8656 (2.86)			
HOLDING	0.107 (1.86)				
POSTGRAD	-0.056 (1.83)				
MOCC	0.095 (1.75)	-0.1131 (1.76)			
PCTMW	7.267 (1.70)	-7.3361 (1.86)			
ATTEND	2.482 (1.65)				
TAGE	0.659 (1.59)				
VALUES	3.195 (1.31)	8.1218 (3.22)			
INSEXAM	-0.038 (1.22)				
TSTABL	1.633 (1.04)	-3.9559 (1.72)	-3.456 (1.49)	-3.547 ([illegible])	-3.892 (2.35)
TSALARY		[illegible] (1.68)	[illegible] ([illegible])	[illegible] ([illegible])	0.0006 (0.78)
AEE		[illegible] (1.13)	[illegible] (1.16)	[illegible] (0.26)	-0.013 (0.78)
ENAT		[illegible] (1.69)	-2.179 (1.35)	-0.946 ([illegible])	[illegible] (1.49)

TABLE 4-7 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
AXMAN		-0.1957 (1.41)	-0.171 (1.13)	-0.106 (0.82)	-0.086 (0.75)
FSRAT		-0.1314 (2.14)	-0.120 (1.78)	-0.048 (0.33)	0.0004 (0.007)
SEFAC 1			-0.849 (1.77)	-0.082 (0.16)	-0.406 (0.79)
SEFAC 2			-1.521 (4.15)	-0.595 (1.47)	-0.381 (0.98)
SEFAC 3			0.341 (0.89)	0.149 (0.45)	0.123 (0.42)
SEFAC 4			0.783 (2.17)	0.305 (0.87)	0.037 (0.11)
Intercept	23.72 (1.66)	45.45	85.34 (6.18)	10.38 (0.33)	-12.45 (0.37)
R_c^2	0.416	0.61	0.36	0.61	0.61
F	4.66	4.69	3.91	5.88	5.88
SEE	2.81	2.18	1.04	1.87	1.87
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 13, p. 81.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-8

Production Functions for Goal V: Citizenship

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	(2)	Simultaneous System
Endogenous					
Goal IV				0.700 (3.69)	0.597 (3.04)
Goal VI				0.145 (0.66)	-0.032 (0.13)
Goal VII				-0.277 (2.21)	-0.269 (2.03)
Goal VIII				1.401 (2.15)	1.422 (1.92)
Goal IX				0.272 (1.51)	0.332 (1.75)
Exogenous					
VALUES	9.203 (3.46)	16.6300 (4.96)			
TAGE	1.755 (3.60)				
OCEXPECT	-0.686 (3.59)				
LIBRARY	4.745 (3.34)	1.8996 (1.01)	2.623 (1.35)	2.438 (1.78)	2.522 (2.16)
RACE	2.811 (2.28)	10.2521 (1.71)			
ATTEND	4.730 (2.50)				
OCDESIRE	0.516 (2.43)				
TNEDUC	2.468 (2.41)				
TSALARY	-0.0014 (1.99)	0.0999 (1.00)			
STAFFP	103.367 (1.59)				
ENROLL	0.001 (1.48)	-0.0004 (1.92)			
TCOLLEGE	-3.070 (1.41)	-6.1[illegible] (1.4[illegible])	-5.851 (1.3[illegible])	-0.738 (0.24)	-0.592 (0.22)
GUIDANCE	669.189 (1.36)	15[illegible] (1.36)	731.[illegible] ([illegible])	-925.4[illegible] (0.9[illegible])	-698.117 (0.83)
[illegible]	0.745 (0.9[illegible])				
[illegible]	2.[illegible] (1.67)	-[illegible] (1.[illegible])	-2.[illegible] (0.76)	-3.01[illegible] (1.26)	-2.691 (1.37)
[illegible]		-5.1938 (3.41)			
ADA		0.0[illegible] (1.65)	0.[illegible] ([illegible])	0.[illegible] (1.97)	0.003 (2.21)
[illegible]		-0.1520 (1.63)	-0.1[illegible] (1.[illegible])	-0.073 (1.04)	-0.081 (1.31)

TABLE 4-8 (Continued)

Explanatory Variable	Single Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
TLOD		-0.2732	-0.486	0.070	0.012
		(0.90)	(1.54)	(0.28)	(0.05)
CSIZ		0.1587	-0.174	-0.027	-0.052
		(0.79)	(1.50)	(0.32)	(0.75)
BRAT		-3.5068			
		(1.55)			
AMAN		0.7223	0.586	0.595	0.564
		(2.21)	(1.72)	(2.57)	(2.99)
AXMAN		-0.2824	-0.236	0.014	-0.008
		(1.14)	(0.91)	(0.08)	(0.05)
FSRAT		-0.3242			
		(1.84)			
SEFAC 1			-1.914	-2.191	-2.185
			(2.66)	(4.17)	(4.83)
SEFAC 2			-1.918	-0.205	-0.408
			(3.59)	(0.47)	(1.05)
SEFAC 3			0.783	0.334	0.452
			(1.43)	(0.87)	(1.43)
SEFAC 4			1.390	-0.123	0.110
			(2.63)	(0.28)	(0.28)
Intercept	67.97	95.16	192.18	-35.94	-17.66
	(3.81)		(7.30)	(0.56)	(0.27)
R_c^2	0.584	0.56	0.40	0.78	0.78
F	7.75	5.12	3.72	10.73	10.73
SEE	3.35	3.24	2.33	2.29	2.29
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 15, p. 83.

Note: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-9

Production Functions for Goal VI: Health Habits

Explanatory Variable	Single-Equation System				Simultaneous System
	DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	
Endogenous					
Goal I				-0.133 (0.38)	0.287 (0.59)
Goal III-v				0.139 (0.33)	0.195 (0.35)
Goal III-m				0.191 (0.53)	-0.359 (0.81)
Goal IV				-0.038 (0.25)	0.105 (0.65)
Goal V				0.086 (0.73)	0.081 (0.46)
Goal VII-o				-0.099 (0.97)	-0.031 (0.60)
Goal VIII				0.637 (1.19)	0.385 (0.61)
Goal IX				0.098 (0.73)	-0.064 (0.33)
Exogenous					
RACE	1.545 (2.41)				
MORESB	8.494 (5.10)	2.6473 (1.13)			
TEDUC	3.309 (4.14)				
LOCATION	-0.848 (4.10)				
TMEDUC	1.669 (3.13)				
MORESG	-5.246 (2.53)	4.0577 (1.15)			
SEX	7.359 (2.07)	21.4221 (3.31)			
ATTEND	1.666 (1.65)				
LIBRARY	-1.339 (1.81)				
VALUES	1.675 (2.41)	3.7456 (1.67)			
ENROLL	-0.0096 (1.45)				
TLOCALE	2.071 (2.29)				
FAMSES	0.119 (4.21)	0.0670 (2.40)			

TABLE 4-9 (Continued)

Explanatory Variable	Single-Equation System				Simultaneous System
	DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	
TSALARY		-0.0010 (1.91)	-0.0010 (1.82)	-0.0009 (1.72)	-0.0009 (1.68)
CUG		-0.1083 (2.50)	-0.099 (2.27)	-0.041 (0.87)	-0.075 (1.59)
TLOD		-0.5568 (3.51)	-0.455 (2.95)	-0.273 (1.62)	-0.330 (1.96)
AEE		0.0214 (1.50)	0.017 (1.08)	0.016 (0.97)	0.021 (1.33)
BRAT		2.2765 (2.03)	2.175 (1.88)	1.633 (1.22)	1.824 (1.32)
AXMAN		-0.1656 (1.46)	-0.160 (1.44)	-0.162 (1.31)	-0.123 (1.07)
FSRAT		-0.1442 (3.05)	-0.151 (3.17)	-0.090 (1.76)	-0.093 (1.84)
PSUP		-0.0103 (2.64)	-0.011 (3.00)	0.008 (2.01)	-0.011 (2.30)
SEFAC 1			0.704 (1.96)	0.505 (0.99)	0.803 (1.08)
SEFAC 2			-0.993 (3.74)	-0.662 (1.76)	-0.446 (1.16)
SEFAC 3			0.416 (1.46)	0.158 (0.51)	0.301 (0.98)
SEFAC 4			1.104 (4.22)	0.635 (2.28)	0.817 (2.54)
Intercept	44.849 (4.00)	72.38	142.22 (22.40)	76.76 (2.00)	80.70 (1.94)
R_c^2	0.70	0.62	0.50	0.64	0.64
F	13.84	7.44	4.67	5.60	5.60
SEE	1.80	1.70	3.46	1.65	1.65
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 17, p. 86.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-10

Production Functions for Goal VII-P: Creativity Potential

Explanatory Variable	Single-Equation System: DEQA	Single-Equation System: Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
Endogenous					
Goal I				0.030 (0.21)	0.159 (0.89)
Goal VII-O				0.099 (2.91)	-0.003 (0.07)
Goal VIII				0.112 (0.50)	-0.031 (0.12)
Goal IX				0.172 (3.75)	0.190 (3.09)
Goal X				0.080 (1.50)	0.062 (0.94)
Exogenous					
OCDESIRE	0.115 (3.67)	0.1184 (4.16)			
INSEXADM	0.006 (2.76)				
ENROLL	-0.0005 (2.70)				
FAMSES	0.038 (2.61)				
ATTEND	-1.265 (2.29)				
T SALARY		0.0004 (1.47)	0.0005 (1.58)	0.0002 (0.85)	0.0002 (0.95)
FRCO		4.3489 (3.14)	3.444 (2.12)	3.383 (2.26)	3.680 (2.28)
FSRAT		0.0473 (2.39)	0.035 (1.44)	0.042 (2.11)	0.056 (2.76)
SEFAC 1			0.445 (2.85)	0.346 (2.66)	0.379 (2.75)
SEFAC 2			-0.174 (1.19)	0.131 (0.94)	0.265 (1.77)
SEFAC 3			-0.153 (1.11)	-0.031 (0.74)	-0.117 (1.07)
SEFAC 4			-0.016 (0.12)	-0.193 (1.66)	-0.250 (2.09)
Intercept	54.37 (22.63)	47.60	54.19 (18.11)	-4.44 (-0.33)	-4.44 (-0.33)
R_c^2	0.577	0.49	0.30	0.63	0.63
F	20.64	9.54	4.19	8.28	8.28
SEE	1.107	0.883	0.951	0.695	0.695
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 19, p.88.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-11

Production Functions for Goal VII-o: Creativity Output

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
Endogenous					
Goal V				-0.278 (2.15)	-0.273 (1.72)
Goal VI				-0.095 (0.40)	0.162 (0.57)
Goal VII-p				1.330 (3.23)	0.811 (1.58)
Exogenous					
TSTABL	-4.294 (5.22)	-4.9351 (1.76)	-2.408 (0.85)	-2.718 (1.08)	-2.741 (1.25)
RACE	-2.813 (4.80)				
OCEXPECT	0.194 (4.10)	0.2142 (2.66)			
EFFORT	-0.186 (3.06)				
SEX	-10.373 (3.16)				
LIBRARY	1.876 (2.53)				
LOCATION	-0.426 (1.84)				
PCTMW	-5.941 (2.29)	10.3527 (2.06)			
TAGE	0.358 (1.71)				
SUBSIDY	0.007 (1.42)				
MORESG	-2.001 (2.04)	-9.2067 (2.43)			
TSALARY		0.0021 (2.13)	0.0018 (1.71)	0.0016 (1.64)	0.0019 (2.21)
TEDUC	-1.243 (1.53)	-2.9251 (1.46)	-2.88 (1.35)	-1.969 (1.03)	-2.427 (1.45)
HOUSING	-0.337 (0.78)	0.9064 (1.09)			
TLOD		0.2905 (1.13)	0.153 (0.57)	0.006 (0.02)	0.103 (0.45)
CSIZ		0.1852 (2.22)	0.121 (1.32)	0.019 (0.22)	0.063 (0.78)
BRAT		-4.2561 (2.22)	-4.509 (2.21)	-5.650 (2.88)	-5.959 (3.23)
AXMAN		-0.1627 (0.90)	-0.251 (1.31)	-0.290 (1.68)	-0.265 (1.75)

TABLE 4-11 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
FSUP		0.0103	0.005	0.005	0.007
		(1.69)	(0.70)	(0.76)	(1.17)
SEFAC 1			0.937	-0.288	-0.083
			(1.65)	(0.45)	(0.12)
SEFAC 2			0.317	0.061	0.163
			(0.72)	(0.13)	(0.36)
SEFAC 3			-0.814	-0.238	-0.507
			(1.82)	(0.55)	(1.25)
SEFAC 4			-0.595	-0.175	-0.456
			(1.30)	(0.37)	(1.00)
Intercept	184.59	177.44	147.72	129.62	126.11
	(21.79)		(8.50)	(3.21)	(2.92)
R_c^2	0.62	0.599	0.17	0.36	0.36
F	9.93	2.68	1.92	2.95	2.95
SEE	1.65	2.80	3.00	2.64	2.64
N	73	53	53	53	53

Sources: For DEQA see table 4-3. For Kuhns, Kuhns (1972), table 21, p. 91.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-12

Production Functions for Goal VIII: Vocational Development

Explanatory Variable	Single-Equation System DFQA	Kalars	Alternative Models (1)	(2)	Simultaneous System
Endogenous					
Goal I				0.401 (5.63)	0.399 (4.43)
Goal III-v				0.052 (0.46)	0.079 (0.54)
Goal III-a				0.018 (0.19)	-0.133 (1.15)
Goal V				0.024 (1.00)	0.031 (0.93)
Goal VI				0.066 (1.67)	0.072 (1.52)
Goal VII-p				0.022 (0.21)	-0.127 (0.78)
Goal IX				-0.029 (0.067)	0.003 (0.04)
Exogenous					
STAFFP	10.312 (1.13)				
OCEXPECT	-0.065 (3.69)				
FOCC	0.052 (3.55)				
VALUES	1.936 (3.37)	0.9296 (1.52)			
SEX	3.779 (2.66)	3.1811 (1.44)			
DISCREP	-0.292 (2.11)				
TSATISF	0.116 (1.71)				
TMEDUC	0.318 (1.71)	-0.2978 (1.09)	-0.179 (0.57)	-0.295 (1.38)	-0.247 (1.31)
REACTL	0.297 (3.01)	-0.2112 (1.77)	-0.195 (1.40)	-0.211 (2.03)	-0.186 (1.82)
TSALARY		0.0003 (1.54)	0.0004 (1.69)	0.0002 (1.25)	0.0003 (2.09)
TEXPER	0.033 (3.06)	-0.0799 (1.83)	-0.076 (1.49)	-0.043 (1.16)	-0.064 (1.63)
POSTGRAD	0.023 (2.69)	0.0033 (1.09)			
TFOCC	0.375 (3.42)				
CUG		-0.0451 (3.17)	-0.042 (2.61)	-0.022 (1.95)	-0.025 (2.44)
PRCO		3.8205 (3.50)	3.146 (2.52)	3.561 (3.93)	3.805 (4.27)

TABLE 4-12 (Continued)

Explanatory Variable	Single-Equation System				Simultaneous System
	DEQA	Kuhns	Alternative Models (1)	(2)	
TLOD		-0.1889 (3.57)	-0.197 (3.46)	-0.064 (1.50)	-0.072 (1.81)
CSIZ		0.0472 (1.45)	-0.026 (1.34)	-0.00009 (0.006)	0.007 (0.51)
AXMAN		-0.0427 (1.13)	-0.030 (0.73)	0.031 (1.08)	0.023 (0.91)
FSRAT		-0.0733 (2.39)			
SEFAC 1			0.168 (1.22)	-0.057 (0.45)	0.50 (0.36)
SEFAC 2			-0.101 (0.92)	-.259 (2.95)	0.268 (3.21)
SEFAC 3			0.045 (0.44)	0.022 (0.30)	0.045 (0.67)
SEFAC 4			0.135 (1.39)	0.022 (0.27)	-0.011 (0.12)
Intercept	63.96 (18.57)	78.74	86.20 (27.86)	37.80 (4.87)	41.55 (4.56)
R_c^2	0.64	0.52	0.42	0.75	0.75
F	11.67	5.28	3.88	8.80	8.80
SEE	0.708	0.574	0.632	0.414	0.414
N	73	53	53	53	53

Sources: For DEQA, see table 4-3. For Kuhns, Kuhns (1972), table 23, p. 93.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SÊE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-13

Production Functions for Goal IX: Appreciation of Human Accomplishments

Explanatory Variable	Single-Equation System: DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
Endogenous					
Goal I				0.387 (1.20)	0.616 (1.97)
Goal IV				0.059 (0.37)	-0.083 (0.52)
Goal V				0.269 (2.58)	0.292 (2.70)
Goal VI				0.193 (1.27)	0.137 (0.79)
Goal VII-p				1.113 (3.54)	1.212 (3.08)
Goal VIII				-1.166 (2.02)	-1.479 (2.61)
Goal X				0.170 (1.21)	0.270 (1.88)
Exogenous					
RACE	1.102 (1.63)				
TPPOS	-0.862 (2.55)				
MORESB	3.810 (3.71)	7.2781 (3.44)			
VALUES	5.582 (3.22)	4.1945 (1.75)			
OCEXPECT	-0.192 (1.71)				
ATTEND	3.667 (3.49)				
TCOLLEGE	-2.574 (2.03)	-8.2897 (2.95)	-6.335 (2.14)	-3.375 (1.48)	-4.113 (2.09)
PCTMW	6.836 (2.08)				
STAFFP	86.958 (3.26)				
RECIDEA	1.935 (3.03)	1.7509 (1.38)	2.573 (1.87)	1.920 (1.77)	2.406 (2.58)
FAMSES	0.093 (2.97)				
TSTABL	2.921 (2.78)				
OCDESIRE	0.335 (2.55)	0.1806 (2.11)			
TSALARY		0.0015 (2.20)	0.0015 (2.14)	0.001 (1.90)	0.001 (2.42)

TABLE 4-13 (Continued)

Explanatory Variable	Single-Equation System: DEQA	Single-Equation System: Kuhns	Alternative Models (1)	Alternative Models (2)	Simultaneous System
ENROLL		-0.0017 (1.34)			
CUG		-0.0678 (1.26)	-0.102 (1.64)	-0.030 (0.63)	-0.024 (0.55)
TIOD		-0.1974 (1.01)	-0.343 (1.62)	-0.155 (0.91)	-0.204 (1.35)
FSRAT		-0.1225 (2.05)	-0.099 (1.45)	-0.071 (1.28)	-0.091 (1.68)
ADA			-0.001 (1.06)	-0.001 (1.16)	-0.002 (1.81)
SEFAC 1			0.462 (0.98)	0.164 (0.37)	0.047 (0.11)
SEFAC 2			-1.494 (3.91)	-0.320 (0.89)	-0.375 (1.10)
SEFAC 3			-0.119 (0.34)	-0.126 (0.46)	0.017 (0.07)
SEFAC 4			0.995 (2.72)	0.435 (1.34)	0.587 (1.99)
Intercept	80.38 (6.33)	120.93	165.85 (16.06)	61.73 (1.58)	68.49 (1.72)
R_c^2	0.65	0.53	0.46	0.74	0.74
F	11.12	6.76	4.96	9.16	9.16
SEE	1.99	2.24	2.40	1.66	1.66
N	73	53	53	53	53

Sources: For DEQA see table 4-3. For Kuhns, Kuhns (1972), table 25, p. 96.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

TABLE 4-14

Production Functions for Goal X: Preparation for a Changing World

	Single-Equation System				Simultaneous System
Explanatory Variable	DEQA	Kuhns	Alternative Models (1)	(2)	
Endogenous					
Goal VII-p				0.717	1.090
				(2.16)	(2.60)
Goal IX				0.045	-0.097
				(0.35)	(0.65)
Exogenous					
VALUES	10.734				
	(6.09)				
GUIDANCE	-849.114	1097.3669	1473.935	1441.021	1453.408
	(3.08)	(2.02)	(2.36)	(2.50)	(3.08)
BOOKSP	0.130	-0.1363	-0.141	-0.100	-0.090
	(2.63)	(1.70)	(1.48)	(1.12)	(1.22)
CLPRACT	-0.255	-0.3361	-0.371	-0.461	-0.460
	(2.36)	(1.70)	(1.67)	(2.22)	(2.68)
TCOLLEGE	-2.733				
	(2.27)				
TSATISF	-0.413	0.5232	0.162	0.572	0.592
	(2.13)	(1.82)	(1.80)	(1.82)	(2.29)
TSALARY	-0.0010				
	(2.16)				
MORESB	-2.384				
	(1.38)				
RACE	1.293	-6.6997			
	(1.78)	(2.19)			
DISCREP	-0.708				
	(1.75)				
MOCC	0.073	-0.0756			
	(1.73)	(1.59)			
FAMSES	0.050	0.0962			
	(1.53)	(2.84)			
TEXPER	0.154				
	(1.58)				
TCAREER	-0.364	0.6174	0.919	0.904	0.868
	(1.48)	(1.62)	(2.14)	(2.28)	(2.66)
INNOVATE	0.049	0.0947	0.087	0.086	0.088
	(1.30)	(2.26)	(1.85)	(1.93)	(2.46)
MORESB		0.9597			
		(0.56)			
ADA		0.0002	0.0002	0.0003	0.001
		(0.20)	(0.13)	(0.68)	(1.08)
CUG		-0.1671	-0.171	-0.157	-0.169
		(3.87)	(3.39)	(3.24)	(4.14)
TLOD		-0.3929	-0.299	-0.201	-0.231
		(2.07)	(1.41)	(1.00)	(1.37)
CSIZ		-0.1951	0.081	0.062	0.037
		(1.83)	(1.23)	(0.97)	(0.66)

TABLE 4-14 (Continued)

	Single-Equation System				Simultaneous System
Explanatory Variable	DEQA	Kuhns	Alternative Models (1)	Alternative Models (2)	
AMAN		0.2702 (1.76)	0.302 (1.72)	0.346 (2.12)	0.377 (2.77)
FSRAT		0.2756 (2.85)			
PSUP		-0.0074 (2.03)	-0.006 (1.33)	-0.004 (0.96)	-0.004 (1.28)
SEFAC 1			0.196 (0.47)	-0.280 (0.66)	-0.452 (1.17)
SEFAC 2			-0.031 (0.09)	0.186 (0.55)	0.081 (0.27)
SEFAC 3			-0.246 (0.79)	-0.118 (0.41)	-0.058 (0.24)
SEFAC 4			0.155 (0.50)	0.115 (0.36)	0.266 (0.94)
Intercept	95.99 (9.38)	135.60	103.89 (11.00)	54.72 (2.74)	54.76 (2.67)
R_c^2	0.53	0.47	0.30	0.41	0.41
F	6.46	3.66	2.40	3.00	3.00
SEE	2.04	1.63	1.87	1.71	1.71
N	73	53	53	53	53

Sources: For DEQA see table 4-3. For Kuhns, Kuhns (1972), table 27, p. 98.

Notes: R_c^2 = coefficient of determination adjusted for degrees of freedom.
SEE = standard error of estimate.
Numbers in parentheses are t-ratios.

The third column in tables 4-3 through 4-14 reports results for an alternative single-equation model, utilizing Kuhns's data. It is similar to the DEQA and Kuhns models insofar as only input variables are included as explanatory variables in each equation. It differs from Kuhns's model in two respects: first, all of the environmental variables are omitted, and the four environmental factors SEFAC 1 to SEFAC 4 are included instead in each equation. Second, an attempt has been made to remove from the equations variables which appear to represent outputs more than inputs (such as OCDESIRE, OCEXPECT, HOLDING, and POSTGRAD) as well as variables which are highly correlated with other variables in the equation. (For example, it does not seem reasonable to include both CSIZ and FSRAT in the same equation, since the correlation between these two variables is 0.86; similarly, ENROLL and ADA are highly correlated [r = 0.88] so that only one of these two variables would be retained in any equation.) The consequence of the specification approach would be to reduce the explanatory power of the model--since Kuhns's specification was based on maximization of R^2--but it was hoped that the reliability of the regression coefficients would be enhanced.

The fourth column (Alternative Model 2) differs from the third column (Alternative Model 1) in that a number of outputs are included in the set of explanatory variables in each of the equations. The outputs chosen for each equation represent the *a priori* judgment of the author, which was influenced by discussions with persons familiar with the data and the educational process. The inclusion of output variables in the equations takes into account interactions among the outputs and affords comparisons between the coefficients of Alternative Models 1 and 2.

The final column in the tables reports the structural coefficients for the simultaneous-equation model. The specification of that model is identical to that of Alternative Model 2, except that the output variables in the explanatory sets are treated as endogenous variables, and the Two-Stage Least Squares technique is utilized to provide efficient estimates. Note that the values of R^2, F, and SEE for the simultaneous-equation model are taken from the respective values obtained for Alternative Model 2. This probably underestimates the explanatory power of the simultaneous-equation model, but no theoretically valid alternatives are available as yet. In any event the effort here was not to maximize R^2, nor should it be implied that the maximization of R^2 is necessarily a primary objective.

The simultaneous-equation technique also permits the computation of the reduced-form coefficients. That is, by solving algebraically the system of twelve equations in terms of the twelve outputs, it is possible to derive coefficient estimates for each output, including inputs only in each equation. The advantage of the reduced-form coefficients over the DEQA or Kuhns models is that the interactions among the outputs are taken into account. The reduced-form coefficients are presented in table 4-15.

Applications

It would be fruitless to describe the regression results for each of the outputs without some applications in mind. Therefore, it seems that the best way to highlight the results would be in the form of applications to which the results may be put.

A word of caution may be appropriate at the outset. It should be recognized that the results reported in this study cannot be accepted uncritically. There are problems in the collection of the data, in the reliability of both output and input measures, in the considerable intercorrelation that remains in the various equations despite efforts to reduce it, and, finally, in the specification of the models. What follows is a description of what could be done with such results once one is [illegible] satisfied that the data and the underlying models are both sound.

Internal Reallocation of Resources

School principals could, in principle, be given sufficient flexibility to reallocate resources within their schools, subject to some constraints, so long as total expenditures remain fixed.

TABLE 4-15

Reduced-Form Coefficients for Simultaneous-Equation System

Outputs / Inputs	Goal I	Goal II	Goal III-v	Goal III-m	Goal IV	Goal V	Goal VI	Goal VII-p	Goal VII-o	Goal VIII	Goal IX	Goal X
SPEND 1	0.155	0.857	0.745	0.027	-0.954	-3.176	0.317	0.366	1.132	-0.035	-0.176	-0.036
SPEND 2	-0.502	0.232	-0.097	0.010	-1.159	-1.626	-0.857	-0.004	0.465	-0.056	-1.052	0.172
SPEND 3	-0.011	0.058	0.265	0.306	0.534	0.351	0.447	-0.140	-0.826	0.037	-0.033	-0.227
SPEND 4	0.018	0.259	0.166	0.291	0.570	0.955	0.993	-0.112	-0.648	0.106	0.654	0.077
[illegible]	0.376	0.004	0.066	0.027	3.266	5.857	1.032	0.426	-1.065	0.359	1.872	0.281
[illegible]	0.956	5.000	0.006	0.000	0.650	0.506	0.135	0.029	-0.003	0.037	0.110	0.025
[illegible]	-0.983	-1.345	-0.280	-0.301	-3.801	-6.161	-0.777	-1.759	0.127	-0.426	-8.122	-1.129
[illegible]	-0.232	-0.003	-0.051	-0.027	-1.439	-4.085	-0.683	-0.366	0.870	-0.269	-1.650	-0.240
[illegible]	-0.168	-0.002	-0.033	-0.079	-4.552	-2.406	-0.598	-0.101	-2.263	-0.165	-0.418	-0.070
[illegible]	-0.210	-0.002	-0.024	-0.020	-0.060	-0.448	-0.273	0.031	0.114	-0.308	0.280	0.067
[illegible]	-0.158	-0.001	-0.018	-0.015	-0.045	-0.307	-0.205	0.024	0.086	-0.277	0.211	0.065
[illegible]	0.508	0.008	0.107	0.107	2.010	2.960	0.365	0.971	0.037	0.204	4.511	0.621
[illegible]	0.055	0.001	0.012	0.015	0.256	0.352	0.051	0.184	0.059	0.012	0.557	1.011
[illegible]	0.065	0.001	0.013	0.000	0.685	0.650	0.125	0.148	-0.032	0.037	0.455	0.765
[illegible]	-0.012	-0.326	-0.023	-0.027	-0.008	-0.013	-0.001	-0.005	-0.030	-0.003	-0.013	-0.004
CLPRACT	-0.023	-0.000	-0.006	-0.007	-0.136	-0.187	-0.016	-0.098	-0.051	-0.007	-0.317	-0.555
TSALARY	0.001	0.000	0.000	0.000	0.002	0.002	-0.001	0.001	0.002	0.000	0.002	0.001
TEXPER	-0.051	-0.001	-0.019	-0.013	-0.020	-0.135	-0.074	0.006	0.030	-0.019	0.068	0.060
TEDUC	0.984	0.013	0.185	0.277	0.955	2.236	0.820	0.770	-2.604	0.436	1.124	0.294
EFFORT	-0.025	-0.073	-0.010	-0.011	-0.018	-0.035	-0.013	-0.000	-0.030	-0.011	-0.025	-0.007
STAFFP	11.674	1.426	22.350	13.605	7.842	14.876	0.163	3.713	-0.046	5.070	9.563	3.118
BOOKSP	-0.000	-0.000	-0.001	-0.001	-0.027	-0.037	-0.003	-0.019	-0.006	-0.001	-0.062	-0.105
GUIDANCE	110.232	2.063	26.595	34.764	119.682	-506.577	-75.972	244.242	323.936	-0.039	655.913	1655.083
INNOVATE	0.006	0.000	0.001	0.001	0.026	0.036	0.003	0.019	0.006	0.001	0.061	0.102
ADA	0.001	0.001	0.001	0.001	0.001	0.004	0.001	0.000	-0.001	0.000	-0.000	0.001
[illegible]	-0.063	-0.003	-0.039	-0.053	-0.144	-0.319	-0.133	-0.061	0.016	-0.059	-0.207	-0.216
[illegible]	3.572	0.018	0.421	0.292	5.000	11.010	3.803	5.056	1.938	5.103	6.472	5.557
[illegible]	-0.307	0.141	-0.245	-0.184	-0.452	-0.800	-0.566	-0.130	0.078	-0.233	-0.656	-0.374
CSIZE	-0.014	-0.049	-0.006	-0.006	-0.055	-0.113	-0.021	-0.008	0.085	-0.002	-0.033	0.032
AGE	-0.007	0.011	0.017	0.012	-0.017	-0.017	0.014	-0.002	0.065	-0.002	-0.006	-0.002
[illegible]	-0.001	-1.173	-0.085	-0.222	-1.295	1.256	2.301	0.142	-5.738	0.215	0.669	0.020
AMAN	0.265	0.016	0.243	0.157	0.534	1.363	0.251	0.214	-0.157	0.139	0.749	0.538
ANMAN	-0.216	-0.008	-0.113	-0.086	-0.240	-0.246	-0.213	-0.075	-0.293	-0.075	-0.211	-0.062
FSRAT	-0.014	-0.000	-0.002	0.004	-0.031	-0.064	-0.119	0.056	0.044	-0.024	-0.012	0.063
PSUP	-0.002	-0.001	-0.002	-0.005	-0.005	-0.008	-0.012	-0.002	0.006	-0.001	-0.007	-0.006

For example, a secondary school principal might be given an option to choose between the following: (1) hire ten teachers at the average salary of $10,000 and (2) hire fifteen teachers at an average salary of $6,667. In the first instance, the typical teacher might possess greater previous experience and/or educational training than would be the case in the second option. However, with fifteen teachers, the principal could expand the curriculum, and/or reduce the teaching load, and/or reduce the average class size (provided enough classroom space is available).

Suppose, for example, that a school has an enrollment of 100 pupils and offers 200 academic hours per week of instruction. If ten teachers are hired, the teacher/pupil ratio would be 0.1, and the average teaching load would be twenty hours per week. If fifteen teachers are hired, the teacher/pupil ratio would be 0.15, and the teaching load would be only 13.3 hours per week. Suppose, further, that the school principal wishes to increase the students' verbal skills, and that the average experience of the two sets of teachers would be identical (the only difference between the two sets being the average educational level). From table 4-5 it is seen that the coefficients for the teacher/pupil ratio and teaching load, respectively, are 15.146 and -0.131. The difference between the two options is given by a reduction in teaching load of 6.67 and an increase in the teacher/pupil ratio of 0.05. The total effect is given by:

$$\begin{aligned}\text{Change in Verbal Score} &= 15.146\ (0.05) - 0.131\ (-6.67)\\ &= 0.757 + .874\\ &= 1.63\end{aligned}$$

That is, the replacement of the ten expensive teachers by the fifteen less expensive ones would result in an increase in the verbal-skills score of 1.63--more than a 10 percent increase over the mean score for the fifty-three Pennsylvania schools.

It should be noted that no offsetting reductions in the verbal scores are calculated for the alleged effect of the reduction in teacher "quality" (resulting from hiring less expensive teachers) on verbal skills. However, except for TEXPER, none of the variables supposedly related to teacher quality have entered the equation.

Moreover, there is a negative (though not statistically significant) coefficient associated with teacher experience. If the more expensive teachers are more experienced, as is usually the case, then it is _possible_ that the anticipated change in the verbal score reported above would be even _greater_.

The results indicate the potential improvements in verbal skills that may be reaped by changing the mix of teachers. This is not quite so easy to implement as it may seem at first sight, because teacher hiring and firing is subject to collective bargaining agreements. Furthermore, school principals all too often have no decision-making latitude in this respect. Nevertheless, the results do indicate an area where internal reallocation of resources might enhance the productivity of the school system.

One problem that must be considered in this regard is the effect of the proposed change on _other_ outputs. For example, how does the change affect students' attitudes, health habits, and vocational development? Consider Goal I: Self Concept. Table 4-3 indicates that the reduction in teacher load might, again, lead to improvement in self concept. However, a reduction in the average educational level of the teachers is likely to result in an opposite effect. Since neither coefficient is statistically significant, one might conclude that the overall effect of the proposed change on self concept is probably nil, but the need to assess the impact of the reduction in the average educational level of the teachers remains. Moreover, an inspection of table 4-4, for example, reveals that a reduction in the teaching load is likely to _reduce_ the score on Goal II: Understanding Others. A similar effect is shown for the reduction in salary. The implication of all this is that the school decision maker must weigh the benefits from a change in one output (such as verbal skills) against losses in other outputs (such as understanding others). The decision may not be simple or easy to make, but consistent results of the type presented here would go a long way in enabling school management personnel to make _better_ decisions.

Other Management Implications

The results suggest several implications for management which do not require either new or realigned resources. For example, the use of innovative practices by teachers could enhance output, as could changes in teacher satisfaction and values. In table 4-14 it is observed that greater use of innovative practices (INNOVATE) and greater teacher job satisfaction (TSATISF) are likely to increase the score on Goal X: Preparation for a Changing World. Another example is the coefficient of REACTL (-0.186) in table 4-12, indicating a lower score on Goal VIII: Vocational Development as more teachers perceive professional recognition to be achieved through personal relationships (such as rapport with central office or immediate supervisor) rather than quality and quantity of work completed.

In addition, the results suggest district-wide implications regarding such matters as desirable teacher characteristics, use of guidance personnel, auxiliary manpower, extracurricular expenditures, paraprofessional support, or library resources. A complete discussion of these possibilities is beyond the scope of the present research, and the reader is urged to examine the results in detail regarding possibilities for both reallocation of present resources or the allocation of new resources.

Prediction

The main purpose of the data collection activities of the Division of Educational Quality Assessment in the Pennsylvania Department of Education is to enable schools to determine the extent to which they achieve an output level consistent with their input levels. If there are n schools in the system, then we compute for each school

$$\hat{Y}_i = a_0 + a_1 X_{1i} + a_2 X_{2i} + \dots + a_k X_{ki}, \qquad (i=1, n) \tag{4.4}$$

where $\hat{Y}_i$ is the predicted level of the output, Y, for the ith school; $a_0, a_1, \dots, a_k$ are the k regression coefficients for the production function of Y taken from tables 4-3 through 4-14 for the single-equation models and table 4-15 for the simultaneous-equation model; and X_{ji} is the level of the jth input observed in the ith school. When the results obtained by DEQA, Kuhns, or Alternative Model 1 are employed, the production-function coefficients may be used. In the case of a simultaneous-equation model, the structural (production-function) coefficients are not appropriate because their use would require *a priori* prediction of some of the outputs in order to predict other outputs. The reduced-form coefficients in table 4-15 overcome this problem, providing coefficients useful for predictive purposes without the need of prior prediction of the outputs.

The main thrust of the DEQA analysis is that schools with different input levels ought to expect different output levels. Hence $\hat{Y}$ would depend on the levels of student, community, school, and instructional-staff inputs. The School Report, sent to participating schools by the DEQA, contains predictions for each school for each of the outputs, along with a prediction interval (given by $\hat{Y} \pm$ SEE).[a] The position of the actual school score (Y) is also noted. To the extent that Y is within the prediction interval, the implication is that the school is doing approximately as it should. Similarly, if Y is less than $\hat{Y}$ - SEE, the school is apparently less productive than it should be, and some remedial action is recommended (Burson, 1972).

Concluding Comments

The Pennsylvania data provide a number of insights for school management personnel. Properly interpreted, the results should be quite useful. At the same time, it must be recognized that both the data and the analysis are less than ideal, so that management decisions should not rely exclusively on the data presented here. Moreover, the

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[a]SEE = standard error of estimate.

equation systems reported in this chapter provide only partial information to decision makers. The analysis does not permit an examination of the effect of various inputs on the _overall_ level of output. The next chapter presents a model which attempts to overcome this difficulty.

CHAPTER 5

THE OUTPUT INDEX: CANONICAL CORRELATIONS

The analysis of the preceding chapter provides a limited use of input-output analysis for educational management because the regression coefficients--whether in the single- or the simultaneous-equation models--indicate the expected change in any one output due to changes in one or more inputs, but not in the overall level of educational output. An index of output which takes into account all of the outputs could be used to overcome this problem. In addition, an overall output index is necessary for a number of applications, including an analysis of economies of scale in secondary schools, and for the development of a teacher salary plan based upon the production-function concept. The output indexes presented in this chapter are based upon the canonical correlation technique.[1]

Canonical Correlations

The technique of canonical correlation is designed to assess the degree of association between two sets of variables. Let one of these sets be denoted by $Y_1, Y_2, \ldots, Y_n$ and the second set by $X_1, X_2, \ldots, X_m$. In the canonical correlation analysis, a canonical correlation coefficient is computed such that the correlation between the weighted sum of the Y's, given by $\sum_{i=1}^{n} w_i Y_i$, and the weighted sum of the X's, given by $\sum_{j=1}^{m} v_j X_j$, is maximized. Of interest in the present analysis are not so much the canonical correlation coefficients, but rather the weights, w_i, which are associated with the maximum canonical correlation.

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[1] One study which utilized canonical correlations for educational input-output analysis is [illegible] ([illegible]). That study, however, did not consider the utilization of the technique for developing an educational output index. For a discussion of the methodologies of and studies on canonical correlations [illegible] (19[illegible]); [illegible] ([illegible]); [illegible] ([illegible]); Johnston ([illegible]), pp. [illegible]; [illegible] ([illegible]); and [illegible] ([illegible]).

In the present context, the set of the Y's would represent the outputs and the set of the X's, the inputs. Thus, the w's are the canonical output weights, and the v's are the respective input weights. To the extent that one could assume that outputs are the outcomes of the inputs, the output weights indicate the relative importance of each of the outputs as exhibited by the input-output data. This may be a product of some conscious management decisions on the part of school administrators, or it could result from the interplay of forces beyond the control of school administrators (when nonmanipulative inputs are also included in the input set). Consequently, it would not be surprising if the weights produced by the canonical correlation technique conflict with the weights that some administrators believe should be assigned to the outputs.

Once output weights are obtained, an output index could be computed according to:

$$Q^* = \sum_{i=1}^{n} w_i^2 Q_i \qquad (5.1)$$

where Q^* is the output index, and w_i^2 is the squared canonical weight associated with the ith output, Q_i. Q^* could then be computed for each school, and analyses utilizing such an index may take place.

Output Indexes

The Pennsylvania data have been utilized to derive a number of output indexes. The indexes differ from one another according to the sets of input and output variables that are included in the canonical correlation analysis. Table 5-1 provides a list of outputs and inputs included in each of the canonical analyses.

The first and second canonical analyses differ only in that the variable HOLDING was included in the second, but not in the first, analysis. That variable has been included in the input set by DEQA and by Kuhns. However, it appears that HOLDING represents an output of the educational system, indicating the degree to which the system has been successful in retaining students.[2] The two canonical analyses

[2] For a similar argument, see Burkhead, Fox, and Holland (1967), where a similar variable was regarded as an output variable in the analysis.

are intended to provide a comparison between the resulting output indexes and to indicate the effect of changing the output mix from twelve to thirteen variables.

The third and fourth canonical analyses likewise provide a descriptive test of the sensitivity of the canonical output weights and resulting output indexes to changes in the sets of inputs included in the respective canonical analyses. Thus, while both the third and fourth analyses contain the same output sets as the first analysis, the number of input variables increases from thirteen to forty-two for the third run and to forty-seven input variables for the final run. We note that the inputs in the first canonical analysis are based on Kuhns's "proposed model" which includes mainly manipulative variables. The input set included in the third run was chosen on the basis of a somewhat revised list of variables entering into the single-equation model developed by Kuhns, whereas the input set included in the final canonical analysis contains all of the input variables in the data set, with the exception of inputs which appear to be proxies for outputs (OCDESIRE, OCEXPECT, POSTGRAD, and HOLDING) and inputs which are highly correlated with other inputs in the same set.

The normalized canonical weights for the outputs in each of the analyses are reported in table 5-2. One is immediately struck by the considerable variation among the sets of weights, although the variation between the first and second sets is relatively small. It should be noted, however, that the output indexes are based on the squares of the canonical coefficients (w_i^2); hence, a shift in sign but not in absolute value of a weight between successive canonical analyses would have no effect on the output index. Moreover, even if the various sets of weights are substantially different from one another, it is still possible that the output indexes would be highly correlated, so that *in practice* it would not make much difference which of the sets was chosen for the development of the output index.

Table 5-3 provides an illustration of the manner by which the output index is computed from the canonical weights for a particular school (School A). The levels of the twelve outputs in that school

TABLE 5-1

Input and Output Variables Included in the Canonical Correlation Analyses

Output Index	Output Variables Number	Output Variables Acronyms	Input Variables Number	Input Variables Acronyms
1	12	Goal I through Goal X	13	FAMSES, TSALARY, ADA, CUG, PRCO, TLOD, CSIZ, AEE, BRAT, AMAN, AXMAN, FSRAT, PSUP
2	13	Goal I through Goal X, HOLDING	13	FAMSES, TSALARY, ADA, CUG, PRCO, TLOD, CXIZ, AEE, BRAT, AMAN, AXMAN, FSRAT, PSUP
3	12	Goal I through Goal X	42	SEX, LOCATION, RACE, LIBRARY, MORESB, MORESG, VALUES, FOCC, MOCC, PCTMW, FAMSES, TPPOS, TLOCALE, TCOLLEGE,TSTABL, TMEDUC, REACTL, RECIDEA, TCAREER, TSATISF, DISCREP, CLPRACT, TSALARY, TEXPER, TEDUC, EFFORT, ENROLL, HOUSING, STAFFP, BOOKSP, GUIDANCE, INNOVATE, CUG, PRCO, TLOD, CSIZ, AEE, BRAT, AMAN, AXMAN, FSRAT, PSUP

TABLE 5-1 (Continued)

Output Index	Output Variables		Input Variables	
	Number	Acronyms	Number	Acronyms
4	12	Goal I through Goal X	47	SEX, INTERRAC, LOCATION, RACE, LIBRARY, COUNSEL, MORESB, MORESG, VALUES, ATTEND, PCTMW, FAMSES, TAGE, TPPOS, TCOLLEGE, TLOCALE, TSTABL, TMEDUC, TFOCC, REACTL, RECIDEA, TCAREER, TSATISF, DISCRIT, CLPRACT, TSALARY, TEXPER, TEDUC, TSEX, SUBSIDY, INSEXADM, EFFORT, ENROLL, HOUSING, BOOKSP, GUIDANCE, INNOVATE, CUC, PRCO, TLOD, CSIZ, AEE, BRAT, AMAN, AXMAN, FSRAT, FSUP

TABLE 5-2

Normalized Canonical Weights for Various Input-Output Sets

Outputs	Set 1	Set 2	Set 3	Set 4
Goal I	0.108	0.130	-0.158	0.030
Goal II	0.446	0.382	0.097	0.309
Goal III-v	0.497	0.470	-0.026	0.355
Goal III-m	0.099	0.145	-0.468	-0.003
Goal IV	0.241	0.237	0.141	-0.126
Goal V	-0.525	-0.502	-0.444	0.368
Goal VI	-0.156	-0.139	0.090	-0.351
Goal VII-p	0.068	0.133	0.181	0.108
Goal VII-o	-0.140	-0.091	-0.589	-0.257
Goal VIII	0.303	0.328	0.212	0.227
Goal IX	0.068	0.051	0.022	-0.038
Goal X	-0.233	-0.317	0.310	-0.113
HOLDING	a	-0.175	a	a

[a] This output was not included in the output set.

TABLE 5-3

Calculation of an Output Index: An Illustration for "School A"

Goal	Value of Goal in School A (Q_i)	Canonical Weight (w_i^2)	Contribution of Goal to Output Factor in School A ($Q_i * w_i^2$)
I	89.45	.006400	.5725
II	91.05	.095481	8.6935
III-v	15.52	.126025	1.9559
III-m	18.71	.363609	6.8031
IV	94.62	.015876	1.5022
V	170.81	.135424	23.1318
VI	122.74	.123201	15.1217
VII-p	60.72	.011664	.7082
VII-o	137.21	.056169	7.7069
VIII	84.02	.051529	4.3295
IX	156.47	.001444	.2259
X	109.33	.012769	1.3960
		Output Factor ($\Sigma w_i^2 * Q_i$)	= 72.1472

are given in the first column (Q_i). In the second column, the squared canonical weights for the fourth canonical analysis are provided (w_i^2). The third (rightmost) column represents the contribution of each of the outputs to the total output index, measured by the product of the squared canonical weight and the respective output level ($Q_i \cdot w_i^2$). The overall output level is given by the sum of the contributions of the output factors (72.1472 for School A).

The same procedure was employed to derive output levels for each of the fifty-three Pennsylvania schools on the basis of the four sets of canonical weights. To test the consistency of the four output indexes, the correlations among the four indexes were computed and are reproduced in table 5-4. The output indexes were also correlated with an alternative measure of output--the sum of the verbal and mathematical scores (Goal III-v + Goal III-m)--to see whether an output index which is based on a number of educational output dimensions differs from the traditional measure of basic skills as the sole index of educational output.

The results of the correlational analysis in table 5-4 are inconclusive. On the one hand, a high correlation is found among the first, second, and fourth indexes. For reasons not yet clearly understood, the third output index is not as highly correlated with the others as one would desire if it can be argued that the canonical correlation technique provides output indexes that are relatively insensitive to changes in the set of inputs. Apparently, the addition of 29 input variables does change the output index to a considerable extent. However, the fourth index, based on 47 input variables, is highly correlated with the first and second indexes. Also, the addition of the output HOLDING does not appear to affect the output index much (compare indexes 1 and 2).

In addition, the correlations between the basic skills score and the output indexes are relatively low. Even the highest correlation (between the basic skills index and the fourth canonical index [r=0.729]) is not very high; a regression analysis, with the basic skills score as the independent variable and the fourth output index as the dependent variable, indicates that in many cases the predicted output is much different from the actual score, so that the rank ordering of many schools differs considerably in the two cases. This

TABLE 5-4

Zero-Order Correlation Coefficients for
Output Indexes

	Index 1	Index 2	Index 3	Index 4	Sum of Verbal and Math Scores
Index 1	1.0000				
Index 2	0.9924	1.0000			
Index 3	0.6492	0.6449	1.0000		
Index 4	0.9086	0.9180	0.6372	1.0000	
Sum of Verbal and Math Scores	0.4257	0.4576	0.3093	0.7290	1.0000

is exactly why it is considered necessary to include other outputs in the analysis, and the results reported herein support that position. (A similar regression analysis for the canonical indexes indicates that the first, second, and fourth indexes are very good predictors of one another; this is not true for the third index.)

Applications Involving the Output Index

Although there would be numerous opportunities to utilize the output index, the present analysis will be confined to two applications with reference to a third.

Economies of Scale

One area in which considerable research has been undertaken in recent years is economies of scale in school operations.[3] The research has been hampered, however, by the lack of a comprehensive output measure that must be used in the analysis to take account of varying educational qualities. Since the methodology used to determine scale effects has been developed and fully discussed elsewhere, there is no need to repeat it here.

Suppose that the school is the proper unit for analyzing scale effects. If a parabolic relationship is assumed (between the cost and size variables), then the equation which one seeks to estimate would resemble the following:

$$C = a + bS + cS^2 + dQ + eP + u \qquad (5.2)$$

where C is per pupil cost, S is school size, Q is the overall output measure, P is an index of the prices that the schools must pay for various services, and u is a stochastic error term. It is not necessary to include variables measuring differences in socioeconomic conditions because they should not affect the cost of education unless educational quality is affected, and educational quality is included as a variable in the equation. P is included to adjust for cost variations among

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[3]See, for example, Cohn (1968), Cohn and Hu (1973), Hettich (1968), Hirsch (1959, 1960), Riew (1966), and Sabulao and Hickrod (1971).

schools which are due strictly to differences in cost-of-living conditions across the state.

It has also been argued that a hyperbolic cost function might be more appropriate (Cohn, 1968, and Cohn and Hu, 1973), in which case the equation to be estimated is given by:

$$(5.3) \qquad C = a + b(1/S) + cQ + dP + u$$

Empirical Results. The fourth canonical output index was utilized as a proxy for Q (because it is based on the largest number of input variables). Although a comprehensive measure of cost is lacking, information is available on the variable INSEXADM (instructional expenditures per pupil in average daily membership) for the Pennsylvania data. Use of this variable will certainly limit the extent of scale economies shown by the data, but the main purpose of the analysis is to illustrate the uses of the output index. Also, average teacher salary (TSALARY) has been used to represent P because most instructional costs are a direct result of teacher compensation.

Table 5-5 provides the regression results for equations (5.2) and (5.3). The empirical results are clearly disappointing. First, none of the regression coefficients are statistically significant, and it appears also that all of the variables taken together do not contribute significantly toward the reduction in the variance of INSEXADM.[4] Despite this, the signs of the coefficients are consistent with *a priori* expectations. Further analysis, utilizing both different data and different cost measures, might prove more rewarding.

Evaluation of the Contribution of Teacher Characteristics

It is well known that teacher salaries are typically based on the so-called single salary schedule, where individual teacher salaries are only a function of teaching experience and educational attainment (Cohn, 1972, chapter 9; Benson, 1968, chapter 10). This author has

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[4] It should be noted, however, that, except for ENROLL, all of the variables included in the model have very low coefficients of variation (0.096 for INSEXADM, 0.068 for TSALARY, and 0.018 for the output index).

TABLE 5-5

Regression Results for Economies of Scale Model
(Dependent Variable = INSEXADM)

Explanatory Variables	Parabolic Function b	Parabolic Function t	Hyperbolic Function b	Hyperbolic Function t
Output (Q)	0.9048	0.195	0.952	0.207
TSALARY (P)	0.0178	1.547	0.0179	1.538
ENROLL (S)	-0.0168	0.0341		
$ENROLL^2$ (S^2)	0.00000115	0.062		
1/ENROLL (1/S)			9550.7617	0.777
R^2	0.06		0.056	
R_c^2	0.00		0.00	
F	0.77		0.96	
SEE	41.23		40.91	

Notes: b = partial regression coefficient
t = t-ratio

R_c^2 = coefficient of determination corrected for degrees of freedom.

SEE = standard error of estimate

argued elsewhere (Cohn, 1972, pp. 293-297, and Cohn, 1973) in favor of a salary program which would take into account those factors which appear to influence educational output, so that teachers possessing those attributes which, on the average, are shown to enhance educational output would be rewarded in proportion to the production-function coefficients. For example, if a unit of teaching experience is shown to increase output by an average amount of 1 percent, a teacher possessing one unit of experience greater than the average for the sample under study would be paid an increment in salary proportional to the 1 percent improvement in output. Such a salary policy would encourage teachers to acquire the attributes for which a monetary reward is offered and would serve to reduce the gap between salary payments and relative productivity levels of teachers.

Again, the model proposed here is not intended as the ideal framework for measuring the contribution of teacher characteristics but rather serves only as an example. The equation to be estimated is given by:

$$Q = a + b_1 TCOLLEGE + b_2 TEXPER + b_3 TEDUC + \sum_{i=1}^{k} FAC\ i + u \qquad (5.4)$$

where Q is the overall output measure; FAC i is the ith factor accounting for student, community, school, and teacher inputs not explicitly included in the equation; and u is a stochastic error term. The model would assess the contribution to total output (Q) of educational preparation, teaching experience, and type of college from which the teacher graduated.

Empirical Results. Estimates for the three teacher characteristics were obtained on the basis of the inclusion of eleven factors and five factors (other than those explicitly included in the equation), respectively. Since the addition of six factors did not contribute significantly to the explanatory power of the model, only the equation with the five factors (k=5) is reported in table 5-6. The results indicate that none of the teacher characteristics has a statistically significant coefficient. This is particularly revealing with regard to TEXPER and TEDUC, because the results conflict with accepted opinion that experience and educational preparation should be rewarded.

TABLE 5-6

Regression Results for Teacher Characteristics Model
(Dependent Variable = Fourth Output Index [Q])

Explanatory Variable	Partial Regression Coefficient	t-Ratio
TCOLLEGE	-0.0582	0.042
TEXPER	0.0067	0.083
TEDUC	0.1520	0.229
FAC 1	0.2348	1.234
FAC 2	0.1149	0.555
FAC 3	-0.6956	4.154
FAC 4	-0.2617	1.731
FAC 5	0.1829	1.180
R^2	0.405	
R_c^2	0.297	
F	3.743	
SEE	1.085	

Notes: R_c^2 = coefficient of determination corrected for degrees of freedom

SEE = standard error of estimate

Note, however, that the output variable has an extremely low coefficient of variation (0.018), indicating that the fifty-three Pennsylvania schools utilized in this analysis are quite similar in their educational output. The same is also true of TCOLLEGE and TEDUC (with coefficients of variation of 0.053 and 0.067, respectively), but not of TEXPER (with a coefficient of variation of 0.243). One would have to examine additional evidence before the present assumption regarding the contribution to output of educational preparation and experience could be dismissed.

Output Incentives in State Aid to Education

It has been proposed by this author (Cohn, 1974, chapter 7) that the state aid formula should include incentives for schools to increase their productivity. A prerequisite for such a framework would be the development of an output index that can be shown to be consistent over time. The present analysis provides the nucleus for further development and testing of the output index over time and space. (Readers who are interested in the state aid incentive plan may turn to the earlier publication [Cohn, 1974].)

Concluding Comments

The development of the output indexes was shown to provide several possibilities for future application. Although it does not appear that the present empirical results offer much in terms of major conclusions, they do offer a new framework that should be helpful in future research.

It has been noted that the output indexes are not very sensitive to changes in the output set utilized in the canonical correlation analysis. They are, however, sensitive to changes in the input set. Also, the output indexes may not be consistent over time and space, and one would need to study them with great care before sweeping conclusions are drawn.

Finally, one should not be satisfied with the canonical correlation method as the single framework for obtaining output indexes. Alternative approaches should be devised and comparisons among the resulting indexes should be made to ascertain that the output index used for management purposes is as sound as can be.

CHAPTER 6

CONCLUSIONS

The models presented herein support the contention that, on the average, some reallocation of resources--without the need to purchase new inputs--could enhance the outputs of the educational system. One is not quite certain, however, how far such a reallocation could go and what precise effects such changes in inputs would generate.

Considering the equation systems, a strong argument was made in favor of the development of a simultaneous-equation system. It is quite apparent from a close examination of the results that the levels and signs of the regression coefficients vary between the single-equation and the simultaneous-equation models. Moreover, the simultaneous-equation approach enables one to calculate the reduced-form coefficients which permits prediction of each of the outputs on the basis of the input set alone.

It has been noted that the main limitation of the equation systems is that decisions must often be made with reference to the overall output level. For such an analysis, some form of an output index is needed. The canonical correlation technique appears to be one useful method for developing such an output index. It has been shown that the resulting output index is sensitive to changes in the input mix but relatively insensitive to changes in the output mix utilized in the canonical correlation analysis.

Although the output index should clearly be helpful in a number of applications, its use in the context of the present data and the two applications discussed in chapter 5 was less than encouraging. This may be due, at least in part, to the very low observed variation in the output index among the fifty-three Pennsylvania schools. The results of the teacher-characteristics analysis do suggest, however, the need to reevaluate the prevailing assumption regarding the contribution to educational output of teaching experience and educational preparation.

The results of the study suggest that schooling factors are important in the production of education and that some manipulative inputs could be changed to some extent by school administrators to increase educational output. Because the sample used in this study is relatively small, and because the nature of the educational production function still eludes us, one should view the results with proper caution.

Additional data collection and analysis, involving both the present and alternative approaches, is necessary in order that a body of empirical knowledge will become available. Successive experimentation with the models and affirmation of the results across time and space are necessary before such results could be used with any degree of confidence.

APPENDIX

GOAL II	2	[illegible]	[illegible]				
GOAL III-V	3	0.41124409	0.51842581	1.00000000			
GOAL III-M	4	0.37512222	0.61078650	0.82772450	1.00000000		
GOAL IV	5	0.37392206	0.04097175	0.05966571	0.09880371	1.00000000	
GOAL V	6	0.24607258	-0.10621160	0.07153900	0.15725192	0.73997911	1.0000000
GOAL VI	7	0.41423794	0.29102843	0.46002773	0.59699314	0.47180857	0.5657711
GOAL VII-V	8	0.47259432	0.17756423	0.30927938	0.05956799	0.29417637	0.0752434
GOAL VII-M	9	0.35743722	0.17140226	0.01163962	-0.17297155	-0.35437137	-0.3156
GOAL VIII	10	0.09251701	0.02964817	0.45402114	0.44605790	0.36973606	0.4432328
GOAL IX	11	0.51471577	0.13521195	0.26573736	0.26601930	0.73131424	0.4456432
GOAL X	12	0.22653443	0.22886551	0.25909881	0.27373739	0.16477059	0.2559529
SEX	13	0.23949900	0.21152194	0.14259963	0.16002491	0.24665335	0.1377491
INTERSTAT	14	0.16017903	0.16663930	-0.07906427	-0.18933310	-0.13222543	-0.2773
LOCATION	15	0.36439821	0.37562707	0.44312150	0.27015305	-0.12530457	-0.41341
RACE	16	-0.12702766	0.17206184	0.17699364	0.14432125	0.24206452	0.2595060
ETHNICITY	17	0.21670622	-0.07589567	0.15203642	0.24795764	0.35954956	0.3651254
COUNSEL	18	[illegible]	0.11621260	0.17075152	0.19853132	0.29523457	0.2154665
MORES	19	0.15941778	-0.25114704	-0.05321080	-0.03523063	0.47684172	0.4161534
MORENT	20	0.37453933	-0.20660707	-0.14048926	-0.11527165	0.31581498	0.3538913
VALUES	21	0.11341943	-0.06712655	0.17009556	0.19840911	0.44655932	0.5056570
ATTEND	22	0.32267318	0.17594565	0.22295493	0.34717033	0.15307505	0.1351454
RCCE	23	0.16522128	0.65674316	0.62649832	0.50916075	-0.05307124	-0.2541173
MODE	24	0.22810211	0.12371528	0.50702292	0.32153073	-0.00456675	-0.2144295
CCCPSTAT	25	0.55443134	0.44667157	0.62168424	0.44365581	0.09825618	-0.2120
CCCPACT	26	0.54257470	0.37769577	0.69146670	0.42234583	0.07494537	-0.2237
PCTMA	27	-0.24445394	0.30639555	0.12427341	0.13922777	-0.09256278	-0.0256
FAMSES	28	0.20246225	0.63133668	0.67199868	0.50555538	-0.05971032	-0.2657
TAFF	29	0.10251600	-0.05084658	-0.03763724	0.07599695	0.08709117	-0.0217
TPPCS	30	0.53030103	-0.06532736	-0.05355606	-0.30381273	0.53863284	-0.0072
TCHELGE	31	0.13877485	-0.04936035	0.20150299	0.21270501	-0.15437342	-0.2329
TCCCALE	32	0.27516743	-0.15657769	-0.05502288	-0.16403025	-0.03828442	-0.1145
INTAKE	33	0.24367750	-0.23324479	0.00341373	-0.00350734	-0.07142325	-0.0217
INFO	34	-0.04312621	0.16172565	0.24913008	0.27256731	0.16571265	0.0652
IICCC	35	-0.04351882	0.22715854	0.02160230	0.24764270	-0.03602278	-0.1289
REACTI	36	0.14155410	-0.14593593	-0.05771518	-0.15320155	-0.31915589	-0.2635
RECEPT-A	37	0.00141544	-0.11370265	-0.16501467	-0.14263759	0.08677108	-0.0073
TEAMSI	38	-0.21542133	0.12632374	-0.04339300	0.12312164	0.05416190	0.0523
TSATISF	39	-0.24415447	0.11809259	-0.04347600	0.01035163	0.15570675	0.0111
DISCREP	40	0.11104762	-0.26530176	-0.07927665	-0.13259171	-0.09712564	-0.1125
CEPHACT	41	-0.03723843	0.02625503	0.04939109	0.03252795	0.05225525	-0.0485
TSALARY	42	0.34622593	0.25172130	0.42927014	0.35452754	0.14955415	-0.0411
TEXPER	43	0.12340224	-0.10660728	0.03729214	0.04427546	0.14526634	0.1370
TECUC	44	0.11111766	0.19265078	0.25089900	0.27565049	0.08272855	-0.0066
TSEX	45	0.23303072	-0.09622688	-0.08093113	0.02597519	-0.06726157	-0.0827
PUNSTAND	46	0.43322773	0.41805455	0.60745579	0.49447119	0.05312622	-0.1515
SUSSEXT	47	-0.28134208	-0.59380123	-0.53351349	-0.33769970	0.06643213	0.2820
TASPIRE	48	0.22371620	0.14084169	0.18853042	0.15547393	0.10556776	-0.0915
EFFORT	49	-0.34127210	0.07786059	0.15993382	0.17927313	-0.24765430	-0.2555
ENROLL	50	0.19005444	0.35504225	0.30053433	0.22660690	-0.30170332	-0.3487
HOUSING	51	0.28626010	0.37453160	0.51719318	0.33733341	-0.05553280	-0.2155
MEETINGS	52	0.14173471	0.15036822	0.32229567	0.33332152	0.13554817	0.0404
STAFF	53	0.11210469	0.05832539	0.13369464	0.08803727	0.14325234	0.0208
HOUSEP	54	-0.07330331	0.05838256	0.07451223	0.06159329	0.22239111	0.1937
GUIDANCE	55	0.25443026	0.27672552	0.22129627	0.24566425	0.13909253	0.1122
INNOVATE	56	0.27159774	0.42188875	0.40512755	0.26756211	0.06613854	-0.0714
ADA	57	0.13414361	0.30576251	0.31266874	0.18615325	-0.30854775	-0.3305
COG	58	0.15407940	0.30877504	0.32414659	0.11818762	-0.15500981	-0.4341
PREC	59	-0.22274111	-0.16001527	-0.10823646	-0.09459596	0.20450255	0.1462
TEMP	60	-0.41356250	-0.02761576	-0.41819471	-0.27765958	-0.03329753	0.0307
CSIZ	61	-0.41432367	-0.22126302	-0.18523407	-0.24322597	-0.21515240	-0.2605
AGE	62	-0.27794516	-0.03961283	-0.09677351	0.07752087	0.21282635	0.3309
BRAT	63	0.11421240	-0.04708604	0.04555976	-0.07015460	-0.21370213	-0.2752
AMEN	64	0.35461809	0.24474567	0.29113224	0.12164195	-0.11031595	-0.0411
AXMAN	65	-0.16620010	0.10685529	0.04951463	0.03777991	0.01907738	0.0076
ESRAT	66	-0.01724768	-0.26513213	-0.37623560	-0.37629352	-0.15873221	-0.1374
PSUP	67	-0.32503906	-0.02037424	-0.02933010	-0.20203052	-0.20456158	-0.1720
SEPACT-1	68	[illegible]	0.55411926	0.47697210	0.45342557	-0.05845659	-0.3927
SEPACT-2	69	-0.04410291	0.27253082	-0.01198772	-0.02907580	-0.42245163	-0.3053
SEPACT-3	70	-0.03319642	0.14542109	0.20122895	0.29079352	0.14543216	0.2521
SEPACT-4	71	0.33767519	0.21841256	0.21258561	0.17051332	0.37137551	0.2306

VARIABLE		8	9	10	11	12	13	14
GOAL VII-P	8	1.00000000						
GOAL VII-D	9	0.36241151	1.00000000					
GOAL VIII	10	0.38906372	-0.19957008	1.00000000				
GOAL IX	11	0.53679471	-0.07541787	0.50956295	1.00000000			
GOAL X	12	0.37376456	-0.05129638	0.23310408	0.41703739	1.00000000		
SEX	13	0.00496230	-0.07242228	0.16306179	0.31769187	0.02446090	1.00000000	
INTERRAC	14	0.27647261	0.37772563	-0.11251671	0.01522801	0.14987938	-0.04718781	1.00000000
LOCATION	15	0.34521553	0.02641564	0.23146495	0.03326737	-0.09176844	0.08716452	0.27059157
RACE	16	-0.13429350	-0.11057970	0.11373661	0.10814362	-0.00661248	0.10787211	-0.04481942
LIBRARY	17	0.05514831	0.04053823	0.27570063	0.21659144	0.09926109	0.09884974	-0.02710435
COUNSEL	18	0.01997778	-0.05666582	0.25580919	0.17993187	0.03665291	0.23441195	-0.14096682
MCHESH	19	0.21645711	-0.15967121	0.19014951	0.49504687	0.30804783	-0.05107564	-0.06159966
MCRESH	20	0.07432036	-0.22165166	0.12599900	0.30107021	0.17339086	-0.08601476	-0.17111909
VALUES	21	0.17441257	-0.27615853	0.38323568	0.46257130	0.25996786	0.21630617	-0.03808304
ATTEND	22	-0.07223236	-0.04114777	0.03096684	0.34531853	0.13394471	0.08857114	-0.33663338
FOCC	23	0.39678165	0.18107798	0.27930932	0.07257213	0.13364951	0.11291754	0.02932414
MOCC	24	0.33476866	0.17644661	0.25773508	0.08200793	0.19789754	-0.00612260	0.27511358
OCDESIRE	25	0.51194012	0.25203215	0.33391349	0.32211204	0.20946753	0.17578529	0.28673508
OCEXPECT	26	0.43234925	0.21655821	0.28124995	0.20855779	0.13393621	0.06437622	0.20957868
PCTMA	27	-0.21537230	-0.19872341	0.00174597	-0.07972180	0.06896153	0.00687351	-0.02699574
FAMSES	28	0.27294961	0.11050528	0.22650640	0.05495895	0.13742252	0.12577202	0.08219555
TAGE	29	-0.09146217	0.15531563	-0.10961772	0.10279698	-0.08942465	-0.02563230	-0.02281119
TPPOS	30	-0.17339550	0.15348904	-0.10930957	0.08667416	-0.18670660	0.20722215	0.20551063
TCOLLEGE	31	-0.02964070	0.15219520	-0.05710096	-0.14308039	-0.12751955	-0.11541651	0.04995215
TDEGREE	32	0.22142956	0.08386608	-0.08296664	0.07309909	0.05312931	0.15409963	0.19116335
TSTART	33	0.14409505	0.10609013	-0.06057022	0.08432247	0.07009616	0.05659751	0.37762265
TMEDUC	34	0.30114376	-0.12150158	0.27024762	-0.02139335	-0.06271902	0.00974217	-0.05948124
TFOCC	35	0.07149675	0.07982093	0.17324040	-0.07164334	-0.17954714	0.03027227	0.05748137
REACTC	36	0.35624188	0.11404405	-0.21236279	-0.06759419	-0.23763435	-0.14127805	0.20909393
RECTEFA	37	-0.03260168	0.21911771	-0.01937276	0.01777735	-0.20020672	-0.00544755	-0.01755252
TCAREER	38	-0.05825663	0.01505727	-0.11400495	-0.01816605	0.25306062	0.19601350	-0.13425808
TSATISF	39	0.08275067	-0.19800278	0.03795446	0.13957749	0.31370525	0.21550264	0.15778631
DISCREP	40	0.33409154	0.25641874	-0.07801574	-0.01776069	-0.25467916	-0.01594551	0.01097565
CLPRACT	41	0.14024346	0.11094411	-0.05596639	0.04675591	-0.06304505	-0.01024155	-0.09595900
TSALARY	42	0.24377401	0.15904457	0.20190921	0.26302305	-0.08103180	0.07759269	0.16459627
TEXPER	43	-0.05083213	0.17701282	-0.12434308	0.20252259	-0.18326305	0.02264011	-0.02459437
TEDUC	44	0.30422546	-0.05308544	0.23192212	0.24963637	-0.00560172	0.24678753	0.14109732
TSEX	45	0.12253220	0.10698002	-0.10878272	0.01693864	-0.01921546	-0.07607478	0.23799693
POSTGRAD	46	0.35950031	0.10618878	0.30516679	0.27963176	0.12345504	0.11276160	0.04789019
SUBSIDY	47	-0.25433453	-0.06819261	-0.23064990	-0.18079993	-0.15596123	-0.11674624	-0.04453597
INSTEXADM	48	0.16699958	-0.07797215	0.31125090	0.10699769	-0.19121646	-0.02416788	-0.15041090
EFFORT	49	-0.17207744	-0.01033275	-0.06234461	-0.32537695	-0.23087557	-0.19500003	0.04958237
ENROLL	50	0.03950892	0.23660071	-0.12662113	-0.16459715	-0.05693530	0.04022896	0.02183275
HOUSING	51	0.27127252	-0.00265632	0.27429595	0.03229430	-0.09809746	0.11614038	-0.07377174
BUILDING	52	0.15227072	0.02295459	0.28616877	0.09517409	-0.07126326	0.19300711	-0.11241136
STAFFP	53	0.05806051	-0.02260370	0.24210507	0.03694128	0.01871122	-0.04176855	0.10952909
BOOKSP	54	-0.07703118	-0.09100554	0.18695266	0.03155140	-0.09468253	0.03866154	-0.29314050
GUIDANCE	55	0.11952178	-0.08322964	0.49564799	0.17871265	0.19301773	0.25742354	-0.15792976
INNOVATE	56	0.11179374	0.12177000	0.13106415	0.07521173	0.27177267	-0.11501303	0.11398144
ALA	57	0.34003734	0.17589946	-0.12239549	-0.18600330	0.02512293	-0.02494433	0.17211429
CUG	58	0.14043570	0.10741827	-0.07003249	-0.16621581	-0.24313541	0.11951441	0.17533516
PRCO	59	0.27789438	-0.15099344	0.33527481	0.14749320	0.03995237	-0.05835289	0.05694447
TLGD	60	-0.22756116	-0.02871725	-0.31931122	-0.12854917	0.09378152	0.13846248	-0.00290835
CSIZ	61	0.16204850	0.27108136	-0.20830844	-0.20876552	0.01759840	-0.29092101	0.02399926
ALE	62	-0.22444364	-0.17382271	0.04136835	0.05795749	0.07262344	0.10016974	-0.13487332
SPAT	63	0.15096514	-0.10465571	0.15640835	-0.09705754	0.15697421	-0.07904975	0.24817292
AMER	64	0.01311715	-0.05964254	0.07621252	0.05276910	-0.03462122	0.06501120	0.00796469
AXHAN	65	-0.06626935	-0.21248456	0.10447781	0.01969825	0.09208291	0.13235717	-0.21703570
ESRAT	66	0.10056419	0.17233919	-0.32526299	-0.17937303	0.15703337	-0.29591695	0.16674913
PSUP	67	-0.01141746	0.16407914	-0.07987523	-0.20077243	-0.08053377	-0.22837472	0.00039199
SEFACTOR1	68	0.42262630	0.15947967	0.30403962	0.11391613	0.07682711	0.07871446	0.15996252
SEFACTOR2	69	-0.26598821	0.12001301	-0.24432271	-0.43910427	-0.29741822	0.05181066	0.02635322
SEFACTOR3	70	-0.21751360	-0.25274924	0.08961772	0.03187983	-0.02682677	0.00136921	-0.06355675
SEFACTOR4	71	0.00631928	-0.24056041	0.26673605	0.39172681	0.22713679	0.67125122	0.03123956

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VARIABLE		15	16	17	18	19	20	21
LOCATION	15	1.00000000						
RACE	16	0.04224216	1.00000000					
LIBRARY	17	0.16555276	0.20116451	1.00000000				
COUNSEL	18	0.10593167	0.31731551	0.41661065	1.00000000			
[illegible]	19	-0.23327564	-0.11419260	0.13705586	-0.05214282	1.00000000		
[illegible]	20	-0.30395513	-0.00553100	-0.03072844	0.03362094	0.77630576	1.00000000	
VALUES	21	-0.07434036	0.11521664	0.15266506	0.13055797	0.38853285	0.25553284	1.00000000
ATTEND	22	-0.08561447	0.22551110	0.10190282	0.31229469	0.03830206	0.16661902	0.14258456
FOCC	23	0.72292691	0.16583716	0.00252069	0.12491617	-0.25929782	-0.30354331	-0.03715515
MOCC	24	0.53260968	-0.09105658	0.14597827	0.10030659	0.12707304	-0.03323332	0.12000198
CODESIRE	25	0.75144485	-0.06095227	0.08144560	0.01666624	0.05279595	-0.12714418	0.15225843
COEXPECT	26	0.71462122	-0.10281430	0.04698529	0.08863972	0.02108723	-0.11237680	0.00873548
PCTMA	27	0.59559706	0.24880097	-0.00245911	0.10102269	-0.27341216	-0.33136263	0.10451893
FAMSES	28	0.71194959	0.19709745	0.09297289	0.15934560	-0.26551246	-0.34525450	0.02537040
TAGE	29	-0.08269836	-0.09022464	0.00544702	0.15980541	0.06193521	-0.02683455	-0.14547844
TPPUS	30	0.04335855	0.01550054	0.02690073	0.11534740	-0.04687202	-0.13531865	-0.13166717
TCOLLEGE	31	0.27096082	-0.10839970	-0.05661777	-0.25552165	-0.01789438	-0.02490402	-0.07544852
TEDSCALE	32	0.35312745	-0.15803127	-0.09321020	-0.00399585	-0.01577531	-0.10023372	0.04276200
TSTABL	33	0.04098627	-0.18773968	0.08836607	0.04795208	0.26019528	-0.06075418	-0.00836440
TMEDUC	34	0.11463022	0.23512328	0.17019868	0.09401607	-0.28118657	-0.27691317	0.04410203
TFOCC	35	0.34344085	0.20759556	-0.01892591	0.23440337	-0.34717545	-0.21220475	-0.02648723
REACTL	36	0.03644427	-0.01518826	-0.22608832	-0.14545735	-0.14096545	-0.22135566	-0.05954799
RECTOLA	37	-0.01941452	-0.05600563	-0.16663957	-0.35171607	-0.05970873	-0.11567455	-0.21748345
TCAREER	38	-0.20687920	0.21396405	-0.09166344	0.21114764	-0.02121794	0.05105761	0.05577450
TSATISF	39	0.02734446	-0.09185598	-0.03860108	-0.19159276	0.14488271	0.23152675	0.17587913
DISCREP	40	0.05185229	0.14269401	0.08896760	0.00327703	0.05565567	-0.03539450	0.00360210
CONTACT	41	0.21341456	-0.07326356	0.15696449	0.02831047	-0.22613651	-0.11327865	-0.23039225
TSALARY	42	0.44946112	0.03667452	0.05181303	0.11262407	-0.05431344	-0.13579800	0.06297601
TEXPER	43	-0.11405862	-0.03057654	0.00716732	0.16446735	0.17465735	0.16377076	-0.01157022
TEDUC	44	0.47103577	0.05716456	-0.11756733	0.10273310	0.02628554	-0.05567310	0.11446621
TSEX	45	-0.05600361	-0.14547533	-0.26594563	-0.00504587	0.06274567	-0.03274084	-0.03430355
POSTGRAD	46	0.47331711	0.04483980	0.20213197	0.01203327	-0.13923733	-0.28256133	0.00591926
SUBSTIT	47	-0.72865711	-0.10440967	-0.08653578	-0.09143350	0.13106533	0.11646849	0.05099149
INSERVICE	48	0.11264275	0.05496035	0.21366787	0.09537107	0.02263806	-0.01327556	0.03722695
EFFORT	49	0.20535748	-0.06522024	0.02556134	-0.15397257	-0.24651971	-0.21534322	-0.23233750
ENROLL	50	0.26123147	0.06533694	-0.11055740	0.06337287	-0.31334831	-0.34075158	-0.16574156
HOUSING	51	0.61770792	0.15577027	0.10833000	0.11939423	-0.23932472	-0.40201927	-0.10622991
HOLDING	52	0.20589872	0.21878687	0.33402632	0.03077014	-0.13351899	-0.15281566	0.05199109
STAFFP	53	0.05250924	-0.18087621	0.09931230	0.01384427	0.02333214	0.00075365	0.00234397
ROOMSP	54	-0.03579034	0.10756650	0.25120710	0.25744845	-0.01592751	0.14549808	-0.13533101
GUIDANCE	55	0.25910590	0.10698175	0.34892921	0.33958998	-0.02862036	0.02356315	-0.00049607
INNOVATE	56	0.24216888	0.10175315	-0.19527283	0.05051293	0.05176321	0.15556322	-0.00255988
ADA	57	0.42736464	0.00001423	-0.00809106	0.05596781	-0.28264329	-0.35205514	-0.21559512
LOG	58	0.54533422	-0.00580286	-0.19222393	-0.13758374	-0.25920552	-0.28162734	-0.18443171
PRED	59	-0.07583940	-0.09280466	0.06354983	-0.07901693	0.20849219	0.21403464	0.27632692
TECH	60	-0.40998583	-0.03342170	-0.24149755	-0.19612376	0.05692440	0.21364104	0.00256162
CSIZ	61	-0.05317026	-0.35498579	-0.07757931	-0.20223793	0.17256341	0.07126077	-0.08769258
AGE	62	-0.37378951	0.15686060	0.11503858	0.09675335	0.07890483	0.21237157	0.30033343
BEAT	63	0.29830449	-0.15267402	-0.10285758	-0.12531002	0.02184012	-0.06048751	-0.07628256
AMEN	64	0.22210405	0.04925221	-0.15239500	-0.15436773	-0.06142372	0.02177629	-0.15107890
AXMAN	65	-0.03156527	0.10267983	-0.06815162	0.01275766	0.00658164	0.20192067	0.12493784
ESRAT	66	-0.26419266	-0.20049980	-0.02151010	-0.13223786	0.31356815	0.18665411	-0.01676299
PSUP	67	0.15841576	0.12086576	0.07874886	-0.01353750	-0.33977492	0.01671313	-0.20556230
SEFACTOR1	68	0.87162901	0.12006441	0.13560565	0.13840925	-0.12710403	-0.21858005	-0.09033754
SEFACTOR2	69	0.09566310	0.15727585	-0.10377086	-0.02579111	-0.86769675	-0.25810484	-0.50499095
SEFACTOR3	70	-0.15927368	0.70566008	0.19547104	0.30380619	0.00492431	0.17127077	0.05163774
SEFACTOR4	71	-0.02807558	0.21525180	0.09147360	0.16250803	0.06002874	-0.00212261	0.72082256

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VARIABLE		22	23	24	25	26	27	28
ATTEND	22	1.00000000						
FOCC	23	0.06745384	1.00000000					
MOCC	24	-0.05170382	0.54675454	1.00000100				
OCCDESIRE	25	0.07138583	0.72413913	0.66279005	1.00000000			
OCCEXPECT	26	0.11393572	0.69302005	0.63176175	0.87379489	1.00000000		
PCTMA	27	-0.00210421	0.26564611	-0.26113040	-0.08203283	-0.06173680	1.00000000	
FAMSES	28	0.03346107	0.46944059	0.54471281	0.66723063	0.64152022	0.44426227	1.00000000
TAGE	29	0.11776250	-0.20762976	-0.10880968	-0.06606257	-0.06526661	-0.16364724	-0.22611039
TPROS	30	0.05599391	-0.17525518	-0.11599562	0.02583686	-0.00226127	-0.00695817	-0.18439669
TCOLLEGE	31	0.04563520	0.25467776	0.28012513	0.32071560	0.31463040	-0.05240565	0.21195033
TLOCALL	32	-0.06529955	-0.16295592	0.15421676	0.12974273	0.06415126	-0.06522712	-0.23162435
TSTABL	33	0.13560065	-0.21465060	0.17976107	0.14834449	0.11249480	-0.37974102	-0.24042545
TMEDUC	34	-0.17363952	0.24426960	0.14832387	0.12249922	0.13154120	0.17534106	0.35625052
TFOCC	35	-0.11265744	0.53910435	0.26101110	0.21829517	0.26273604	0.22711536	0.53264431
AFACTL	36	-0.19144703	-0.20834660	0.04601020	-0.06378159	-0.01212008	-0.02212919	-0.16803554
RECIDEA	37	-0.24663475	-0.06362475	-0.16108569	0.00719324	-0.01567105	-0.11616703	-0.13632782
TCAREER	38	0.11219470	-0.00477014	-0.19274677	-0.13665567	-0.25127517	0.10595483	0.02052161
TSATISF	39	0.05960747	0.15150737	-0.00519412	0.04951808	0.05902123	0.13149412	0.15746633
DISCREP	40	-0.06413037	-0.14719501	0.25981119	0.00659179	-0.02560316	-0.16483387	-0.12385776
CEPRACT	41	-0.04263966	0.11095520	0.00647087	-0.02753054	0.04315040	0.16759545	0.22025321
TSALARY	42	0.13999837	0.23173632	0.29714871	0.46312013	0.41485378	0.10499151	0.37609948
TEXPER	43	0.26103005	-0.24800840	-0.07597711	0.00467609	0.07153644	-0.11920602	-0.24799938
TLOGC	44	0.05612959	0.45544447	0.34200775	0.43922993	0.45666733	0.05440502	0.44148690
TSEX	45	-0.03821007	-0.04006912	0.19367629	0.14687355	0.16364087	-0.27760414	-0.08512556
POSTGRAD	46	0.05939902	0.74640031	0.53649772	0.76759431	0.73017628	-0.03718119	0.67100782
SUBSIDY	47	-0.10392685	-0.75041593	-0.40433242	-0.66119362	-0.64329716	-0.15076173	-0.74198123
INSTRADM	48	-0.14587163	0.18006080	0.20597377	0.25776477	0.21208035	0.05200467	0.36319740
EFFORT	49	-0.04711509	0.31427089	0.24870373	0.01676593	0.12969370	0.14791216	0.22769045
ENROLL	50	0.15479311	0.36157660	0.27709075	0.33900465	0.30707387	0.08572714	0.34825221
HOUSING	51	-0.59675263	0.70055154	0.45203563	0.54543528	0.55641766	0.16357272	0.68511140
HOLDING	52	-0.06370554	0.23793775	0.17604065	0.21394354	0.06530512	-0.17764235	0.16264201
STAFFP	53	-0.05543935	0.26628936	0.14490081	0.08299769	0.18576682	-0.00055145	0.23935178
BOOKSP	54	0.11631549	0.11207605	-0.09110200	-0.07295194	-0.00352880	-0.05568164	0.05669561
GUIDANCE	55	0.12862662	0.41914263	0.17008330	0.25302173	0.18131152	0.04236616	0.37729528
INNOVATE	56	0.34267066	0.43332054	0.25139919	0.28813120	0.37941524	0.00129963	0.40127355
ADA	57	0.05378266	0.33353677	0.31403287	0.35409482	0.33756679	0.16780242	0.35459796
CUG	58	-0.11576355	0.56359981	0.41628777	0.41281297	0.41652169	0.05258301	0.55243460
PRCO	59	-0.17916602	0.01505984	0.00337620	-0.05779503	-0.09232573	-0.07205841	-0.01603044
TLCD	60	0.01502346	-0.25939320	-0.36601143	-0.36446154	-0.39977096	-0.01469507	-0.29418376
CSIZ	61	-0.03439320	-0.20564489	0.05336840	-0.04726236	-0.13335720	-0.22603538	-0.21059238
SEE	62	0.34386555	-0.22899096	-0.53432436	-0.36379891	-0.36115924	0.20340435	-0.23091987
BRAT	63	-0.06799325	0.07325275	0.13179068	0.22712577	0.24910540	0.10695522	-0.10236708
AMEN	64	-0.16054112	0.37820646	0.21757494	0.19427818	0.27193771	0.05720552	0.35652532
AXMAN	65	-0.03034733	0.21966756	-0.05768280	0.00394905	-0.30189319	0.05922524	0.16226256
ESRAT	66	-0.05675068	-0.44322560	-0.01488043	-0.27181462	-0.33652263	-0.26683530	-0.43154540
PSUP	67	-0.05908754	0.12800635	0.05586831	-0.02756517	-0.03852411	0.20583707	0.18132782
SEFACTOR1	68	0.04381472	0.52035097	0.74267393	0.81092296	0.78824499	0.09000622	0.89003392
SEFACTOR2	69	-0.19640077	0.17646736	-0.33530205	-0.18032181	-0.16993365	0.52116953	0.23117659
SEFACTOR3	70	0.45846675	0.10127621	-0.27123877	-0.15326692	-0.14272226	0.16602246	0.06521935
SEFACTOR4	71	-0.03157565	0.10012227	-0.05549626	0.09069076	0.00397843	0.54161440	0.22897242

VARIABLE		29	30	31	32	33	34	35
TAGS	29	1.00000000						
TPROS	30	0.24465085	1.00000000					
TCOLLEGE	31	0.04712615	-0.19597704	1.00000000				
TCOCALL	32	0.23576446	0.24042319	-0.25221362	1.00000000			
TSTATE	33	0.37178312	0.27065264	-0.21506759	0.83154545	1.00000000		
TPROJC	34	-0.21258963	-0.37717545	0.16625510	-0.37655078	-0.47843846	1.00000000	
TDOCC	35	-0.07647135	-0.30094045	0.27716952	-0.45285757	-0.51765470	0.02325675	1.00000000
TEACH	36	0.35025762	0.07605466	0.05624777	0.16078305	0.70658292	-0.22344403	-0.01106579
SECTION	37	0.15592770	0.09274531	0.05852055	-0.13356757	-0.13806996	0.02144223	0.04556509
TCAREER	38	0.05542069	0.15170158	-0.26560909	0.10572385	0.18798477	-0.03550488	-0.03678914
TSATISF	39	-0.16931598	-0.12752922	-0.10649362	-0.04079959	-0.13254020	0.04063574	-0.13184674
DISCRIP	40	0.04405153	0.05962852	0.05109073	0.07619902	0.14765484	-0.18487717	0.04168543
CONTACT	41	-0.07766425	0.01503610	0.06457329	-0.04427883	-0.10464728	0.04555572	0.12217847
TSALARY	42	0.27143613	0.51119041	0.21263808	0.13933725	0.26106240	-0.11003664	0.07611485
TEXPER	43	0.62073956	0.26952226	0.07356035	0.29633153	0.43630695	-0.42101115	-0.36022587
TAGE	44	[illegible]	0.26038441	0.25185617	-0.04317473	-0.06523634	0.09840364	0.38207998
TSEX	45	0.01652493	-0.16213625	0.35513031	0.03769317	0.00955113	0.04355553	0.22300003
POSTGRAD	46	-0.16981148	-0.08667874	0.21587069	0.03374692	0.05444408	0.15555363	0.22055535
SUBSIDY	47	0.21521623	0.00272684	-0.11530068	0.08652916	0.07236433	-0.16712179	-0.27569212
INSTAPP	48	-0.15816728	-0.06922728	0.25565256	-0.29315633	-0.36074717	0.19913653	0.33575846
EFFORT	49	-0.22859655	-0.10169451	0.29710357	-0.21781235	-0.18191734	0.22114471	0.23659177
ENROLL	50	-0.33074227	0.13053695	-0.00876387	0.14644003	0.24903440	-0.06622142	0.13158650
HOUSING	51	-0.13090946	0.06252666	0.17535239	0.05315096	-0.02389073	0.39786221	0.25144882
MEETING	52	-0.02698947	-0.02051360	0.16437216	0.03355691	-0.05219323	0.48836267	0.22615774
STAFFP	53	-0.02960739	-0.27679787	0.10285216	-0.22535307	-0.39425405	0.24437064	0.24130529
SERVSP	54	0.27841088	-0.01721074	0.01335299	-0.03415746	-0.06411474	0.17060538	0.07596446
GUIDANCE	55	-0.28243793	-0.32329581	0.05330955	-0.30315332	-0.31457479	0.24076550	0.25285773
INNOVATE	56	-0.12570812	-0.24982409	0.08211348	-0.07015063	-0.15856848	0.01564448	0.06579888
ADA	57	0.01761005	0.15873130	-0.07746603	0.11042962	0.25552271	-0.12442623	0.06766333
COG	58	-0.11757084	-0.03332476	0.28654804	-0.02274837	-0.05908354	0.07610805	0.25485420
PROD	59	-0.34190050	-0.40612060	0.04713253	-0.23962951	-0.42467644	0.30490373	0.16349861
ALCO	60	-0.13970249	-0.15932171	-0.00659310	-0.11073127	-0.26577496	-0.02737716	-0.18407563
CSIZ	61	0.31033022	0.21986304	-0.09866282	0.27953225	0.34067169	-0.40587251	-0.24357634
ACE	62	0.01293157	-0.02196205	0.15142788	-0.23521559	-0.23278531	0.13762271	-0.11671640
PRAT	63	-0.16509554	-0.02645444	0.05377303	0.01203115	0.00721040	0.12755222	0.01383391
AMEN	64	-0.14606473	-0.27318145	0.27718338	-0.09654497	-0.14276032	0.04354290	0.17703595
AXMAN	65	-0.20596435	-0.21350625	0.19211774	-0.29916835	-0.38843774	0.21026136	0.36485906
PSRAT	66	0.23269497	0.18020273	-0.25445725	0.26606731	0.32162640	-0.42244011	-0.40083449
PSUP	67	-0.06862026	-0.24285941	0.01813172	-0.19568602	-0.16297105	0.01858151	0.17538250
SEFACTOR1	68	-0.16180686	-0.07742313	0.24308892	-0.02730407	-0.04052871	0.26749411	0.41127717
SEFACTOR2	69	-0.02152563	0.09171043	-0.05003266	-0.09925082	-0.14481245	0.23607145	0.29545227
SEFACTOR3	70	0.00383343	0.01072087	-0.06820142	-0.25922161	-0.13923467	0.02524788	0.02474482
SEFACTOR4	71	-0.17132071	-0.02605539	-0.12113232	-0.07623777	-0.15982020	0.15115554	0.08532334

VARIABLE		36	37	38	39	40	41	42
RFACIL	36	1.00000000						
RECIDFA	37	-0.02945025	1.00000000					
TCAREER	38	-0.11084812	-0.22878871	1.00000000				
TSATISF	39	-0.45945643	-0.03922300	0.23677318	1.00000000			
DISCREP	40	0.57388525	-0.02727286	-0.14262858	-0.51730585	1.00000000		
CLPRACT	41	-0.02047482	0.03314765	0.04683922	0.19132821	-0.20152537	1.00000000	
TSALARY	42	-0.05592363	-0.13888076	0.08849824	0.05436950	-0.06393706	0.12238978	1.00000000
TEXPER	43	0.14475536	-0.01967499	0.06772348	-0.24299817	0.19930412	-0.03755353	0.30911073
TEDUC	44	-0.01991713	0.06712974	-0.21543200	0.05165565	-0.10017500	0.00602782	0.59592042
TSEX	45	0.12399017	0.03505698	0.02767999	-0.29270582	0.23516302	-0.31148510	-0.29675527
POSTGRAD	46	-0.04137888	0.15053680	-0.19714580	0.09356337	-0.04494712	0.18601025	0.29995078
SUBSIDY	47	0.20896151	0.07050789	0.01954135	-0.29972052	0.19301398	-0.21255566	-0.41791480
INSERADM	48	-0.09461029	-0.03270647	-0.22181757	-0.02246677	-0.03429749	0.18754685	0.20463915
EFFCAT	49	-0.21737432	-0.01435801	-0.02706512	0.11531118	-0.16381935	0.13241926	0.21986534
ENROLL	50	0.06774706	-0.05991640	0.10122095	-0.14927228	-0.02761997	0.07677122	0.39293511
HOUSING	51	-0.12125097	-0.11322355	-0.13162669	0.08509953	-0.15228167	0.07627751	0.39245374
HOLDING	52	-0.26024403	-0.02292160	-0.08646623	0.07625744	0.02580068	0.02141130	0.15720296
STAFFP	53	-0.17111839	0.08387567	-0.34649039	0.10998603	-0.16691359	0.07567933	-0.17726795
BOOKSP	54	-0.29126256	0.00445517	-0.00859136	0.00725427	-0.08055716	0.11732050	-0.06255972
GUIDANCE	55	-0.33352790	0.00485272	-0.00666968	0.07205597	-0.24436518	0.21017271	0.05277678
INNOVATE	56	-0.26048695	-0.12988595	0.00445640	0.27337389	-0.24179741	0.10767827	-0.01176953
ADA	57	0.06790617	-0.01526520	0.03078677	-0.09511313	-0.12098457	0.00285207	0.31269053
CUG	58	0.35382941	-0.01053250	-0.01985868	0.07555105	0.01688550	0.00546050	0.35192656
PROG	59	-0.01269145	-0.07743757	-0.12626695	0.09375722	0.08630019	-0.02664022	-0.33553244
TCCO	60	-0.21583337	0.14862351	0.09275811	0.41346508	-0.29403246	-0.10325105	-0.13573563
CSIZ	61	0.10346725	-0.00642063	-0.01810948	-0.09353797	0.02592311	-0.02730027	-0.02258838
ACE	62	-0.30363561	-0.10455070	0.15825505	0.21649115	-0.27120770	0.00782154	-0.02956113
RPAT	63	-0.08467753	0.00348173	-0.09953105	0.22161510	-0.15078840	-0.00314052	0.14995638
AMER	64	-0.05296580	0.03647246	-0.11729640	0.15769250	-0.09713888	0.15251774	0.12752032
AXMAN	65	-0.12168542	0.00418784	0.07021567	0.14785708	-0.21772901	0.02737823	-0.10523345
FSRAT	66	0.15220955	-0.00522339	0.01592233	-0.04995715	0.15561662	-0.10570761	-0.22376167
PSUP	67	0.01200040	-0.03675226	0.00399778	0.14698205	0.13279659	0.18809133	-0.07852892
SEFACTOR1	68	-0.13345738	-0.11380075	-0.12290868	0.15098802	-0.05220734	0.16074802	0.04829965
SEFACTOR2	69	0.13722745	0.12325263	0.08920046	-0.16241825	-0.08328456	0.20574598	0.01754223
SEFACTOR3	70	-0.25156911	-0.10745206	0.21098425	-0.04686876	-0.05095824	0.04014054	-0.01733975
SEFACTOR4	71	-0.05302564	-0.16174270	0.22637126	0.24666450	-0.07169582	-0.05199452	0.14966582

VARIABLE		43	44	45	46	47	48	49
TENPER	43	1.00000000						
TEDUC	44	0.12579555	1.00000000					
PSCN	45	0.01677742	0.03924736	1.00000000				
POSTGRAD	46	-0.11395820	0.33511259	0.16563295	1.00000000			
SUBSIDY	47	0.05927676	-0.43392555	0.08648353	-0.70367718	1.00000000		
INSEXADM	48	-0.15253303	0.44143518	-0.12549647	0.22590111	-0.33273453	1.00000000	
EFFORT	49	-0.14285259	-0.28391622	-0.09726619	0.16713531	-0.18480855	0.40078492	1.00000000
ENROLL	50	0.05786116	0.17410652	-0.01313314	0.19824846	-0.25098347	-0.05461009	0.21176301
HOUSING	51	-0.18303121	0.50201254	-0.04208125	0.61450515	-0.61550336	0.35479604	0.35146435
HOLDING	52	-0.22069564	-0.05401987	-0.00263133	0.25900454	-0.17709415	0.18716188	0.17359287
STAFFP	53	-0.16923951	0.22167719	-0.14399907	0.14060751	-0.07457523	0.30732505	0.05093830
BOOKSP	54	0.17567998	-0.05815464	-0.06452104	0.16377390	-0.12441325	0.03778826	-0.12529873
GUIDANCE	55	-0.32198561	0.25762742	-0.10462966	0.30156236	-0.40233856	0.47077128	0.18055322
INNOVATE	56	-0.04301525	0.24356154	-0.00975531	0.21184471	-0.26942519	0.07111448	0.05555775
ADA	57	0.01915682	0.12150457	-0.00255536	0.21695932	-0.27399980	-0.04307877	0.13591480
CUG	58	-0.05342695	0.20759583	0.23558461	0.47763678	-0.54271467	0.23566101	0.35934718
PROD	59	-0.15672007	-0.12218362	-0.09888098	-0.03579089	-0.01497124	0.27646083	-0.15221454
TLOD	60	-0.23773008	-0.03868867	-0.07579923	-0.39963515	0.25314691	-0.13897277	-0.03513198
CSIZ	61	0.16727623	-0.08997523	-0.00165834	-0.25137082	0.17475478	-0.14375628	-0.14889887
AGE	62	0.10339499	-0.05590507	-0.28357274	-0.39714142	0.18008774	0.07252477	-0.01949775
RRAT	63	-0.07672391	0.21054056	0.06060553	0.07732994	-0.20869756	0.12370176	0.10573079
AREA	64	-0.08127875	0.21882283	-0.01723763	0.37809504	-0.35530252	0.07257143	0.27594037
ARMAN	65	-0.25948423	0.02321745	0.03636332	0.13333698	-0.29135299	0.13746540	0.04932869
FSRAT	66	0.06273882	-0.25545797	0.06043917	-0.42977236	0.35344063	-0.28673258	-0.27209828
PSUP	67	-0.00760412	-0.10576629	-0.07304677	-0.07802433	-0.18699439	0.02075133	0.04999482
SEFACTOR1	68	-0.16357756	0.52007559	-0.00176942	0.78312949	-0.84709947	0.25443058	0.30849341
SEFACTOR2	69	-0.11100755	-0.06785666	-0.13329301	0.07775309	-0.04781050	-0.01450438	0.21347489
SEFACTOR3	70	0.11276741	-0.01611879	-0.27361866	-0.00895395	-0.15553918	0.00706585	-0.04121371
SEFACTOR4	71	-0.02194910	0.15489492	-0.13619808	-0.01294091	-0.01554801	0.02019580	-0.16762257

VARIABLE		50	51	52	53	54	55	56
ENROLL	50	1.00000000						
HOUSING	51	0.16874262	1.00000000					
HOLDING	52	0.02528428	0.21423049	1.00000000				
STAFFP	53	-0.44940244	0.22314049	-0.10092981	1.00000000			
BUDGSP	54	-0.41574444	0.14081863	-0.05550168	0.41672290	1.00000000		
GUIDANCE	55	0.02341755	0.30596757	0.21054803	0.28950136	0.25930587	1.00000000	
INNOVATE	56	0.14031065	0.21756519	-0.11473163	0.29346464	0.06989271	0.11819086	1.00000000
ADA	57	0.16161768	0.17921240	-0.02924379	-0.37051456	-0.39634001	0.04380611	0.12173025
CUG	58	0.37676122	0.45790158	0.23957489	0.03250243	-0.03353758	0.15995160	0.11367211
PRCO	59	-0.65180375	0.04231818	0.18930953	0.39973602	0.24125257	0.25202744	-0.14219114
ILCO	60	-0.34110402	-0.17417807	-0.15143939	0.13659919	-0.05555551	-0.05626061	0.09238711
CSIZ	61	0.14263068	-0.18732936	-0.22457450	-0.19303163	-0.21160160	-0.21722387	-0.12516782
AFE	62	-0.32763356	-0.21359325	0.19009925	0.04757255	0.15563636	0.01235915	0.07419169
PRAT	63	0.16029770	0.14057062	-0.09801132	-0.11320737	-0.15319535	0.13107532	0.07819180
AMCN	64	-0.08777471	0.27603500	0.07063521	0.27732464	0.28316227	0.13763061	0.17361558
AZMAN	65	-0.27000483	0.08620713	0.14619648	0.27204108	0.33846505	0.33842881	-0.13367533
ESRAT	66	-0.03091178	-0.37909442	-0.22809516	-0.30511226	-0.24257169	-0.22142205	-0.23153858
PSUP	67	0.11285854	-0.01541028	-0.21095815	-0.02293824	-0.18651081	-0.02031755	0.15615330
SEFACTOR1	68	0.34245050	0.70892322	0.24655600	0.20433139	0.06795744	0.38456650	0.38518444
SEFACTOR2	69	0.23451049	0.25791332	0.05426732	-0.05203874	-0.02016572	-0.07325368	-0.13657565
SEFACTOR3	70	0.02767300	-0.00257405	0.10553130	-0.13624971	0.25875474	0.15846560	0.17699995
SEFACTOR4	71	-0.07509405	0.04731137	0.05447476	-0.00733552	-0.12731526	0.10049459	-0.06952741

VARIABLE		57	58	59	60	61	62	63
ADA	57	1.00000000						
CUG	58	0.42395810	1.00000000					
PRCO	59	-0.37217974	-0.06217558	1.00000000				
TUGO	60	-0.35277304	-0.33082915	0.11127025	1.00000000			
CSIZ	61	0.28744047	-0.08677770	-0.05863869	-0.05105254	1.00000000		
AEL	62	-0.42352787	-0.34102191	0.20479408	0.39033511	-0.16395316	1.00000000	
BRAT	63	0.30726303	0.12839525	-0.01648864	-0.15710551	0.18636289	-0.14124121	1.00000000
AMEN	64	-0.14925822	0.34230784	-0.06188538	0.01833784	-0.38202860	-0.11669737	-0.12628411
ARMAN	65	-0.37862945	0.14598730	0.35663500	0.10090604	-0.38255614	0.20501487	-0.20051530
ESRAT	66	0.11710824	-0.24929810	0.04156079	0.11686844	0.86111778	-0.10580549	-0.11642418
PSUP	67	0.15792259	0.03036035	-0.09530278	-0.09778691	0.12900906	-0.14272821	0.21463761
SEFACTOR1	68	0.50225580	0.59872333	-0.00677518	-0.39834580	-0.11746326	-0.25384316	0.20359409
SEFACTOR2	69	0.24373075	0.17563585	-0.29321937	-0.01584646	-0.17581830	-0.07394279	0.00965569
SEFACTOR3	70	-0.32416775	-0.13039627	-0.10579968	0.02600744	-0.27545511	0.40887609	-0.20271364
SEFACTOR4	71	-0.12170611	-0.03547356	0.10967067	0.10631860	-0.29254635	0.27129920	-0.04888169

VARIABLE		64	65	66	67	68	69	70	71
AMFN	64	1.00000000							
AXMAN	65	0.48891840	1.00000000						
FSFAT	66	-0.41399869	-0.36556725	1.00000000					
PSUP	67	-0.02453465	-0.13422178	-0.11365851	1.00000000				
SEFACTOR1	68	0.35006761	0.13001322	-0.33687260	0.14339887	1.00000000			
SEFACTOR2	69	0.03891994	-0.07214756	-0.26378791	0.08576640	0.00000488	1.00000000		
SEFACTOR3	70	-0.02199422	0.19341272	-0.22134049	0.06182378	-0.00000165	0.00000076	1.00000000	
SEFACTOR4	71	-0.01896793	0.14632171	-0.21964701	-0.13919188	0.00001281	0.00000185	0.00000365	1.00000000

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