Simulation of Regional Product and Income With Emphasis on Iowa, 1954-1974

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CONTENTS

SUMMARY

To simulate the growth of a region's product and income is to create the data that describe the evolution of a regional economic system. In this study the data pertain to the Iowa economy for the 20-year period – 1954 to 1974. They are presented for two primary purposes – to illustrate (a) the effects of major market and technological trends on a state or regional economy and (b) the uses of social accounting data in state or regional development and planing. Estimates of the gross Iowa product are presented to show its changing composition over the 1954-74 period. In addition, a system of economic relationships is used to generate year-to-year changes in specific components of Iowa's gross product.

The Iowa data show the principal structural features of the state's economy. In 1954, for example, the gross Iowa product (i.e., the "value added" by economic activity in Iowa) was 5.6 billion dollars, of which 4.5 billion dollars was in the form of personal income payments. Thus, the 1954 gross state product of $2,090 per capita was sufficient to allow for an average personal income of $1,690, given a total Iowa population of 2,665,000.

By 1974, the Iowa gross product will reach 9.5 billion dollars (in constant 1954 dollars) – an increase over the 20-year period of 2.7 percent per year, compounded annually – according to the benchmark projections. Total population in 1974 is estimated at 2,852,400, an increase of only ⅓ percent per year. Per-capita personal income would reach 2,560 dollars per person, while projected gross investment would reach 2.2 billion dollars.

Thus, for the first time, estimates of the Iowa gross product are available to show the contribution of the Iowa economy to the Gross National Product. Although this contribution is declining on a percentage basis, it is increasing on a per-worker basis. Thus, the Iowa economy is benefiting from national economic growth because resources, particularly labor and capital, are adjusting to the changing patterns of remunerative employment opportunities in the nation as a whole.

The results of the study show that, because 20 percent or more of the gross Iowa product is invested in new plant and facilities, relatively high rates of increase in productivity are maintained among Iowa industries. These high growth rates require correspondingly high demand growth to maintain employment levels. In the agricultural sector, however, productivity increases greatly exceed the growth in demand; this contributes to a substantial reduction of employment in this industry. In transportation, also, similar trends characterize the industry.

Another contribution of this study is the projections of state product and income obtained under alternative assumptions regarding the diffusion of technological progress and the growth in aggregate market demand. Under one alternative, rapid growth in labor productivity in the commodity-producing industries is associated with a decline in total employment. We recognize, however, that these increases in productivity are essential for competitive reasons. These increases are associated implicitly with private and public policies to reduce production and transfer costs, increase new product development, and effectively promote these products in out-of-state markets. However, further research is needed to explicitly show the effects of these policies and their related activities on the competitive position of Iowa businesses in out-of-state markets.

Another pattern of regional economic growth emphasizes the production of those goods and services for which the demand elasticities are high. In these industries, as consumer incomes increase, or as prices decrease because of an increase in output, the total value of output increases. Generally, the service industries, which belong in this group, are marked also by relatively small increases in labor productivity. Consequently, the service industries provide some of the new job opportunities for displaced workers from the commodity-producing industries.

The four alternative patterns of regional economic growth are represented by four simulation runs for the 20-year period. These simulation runs include the benchmark projection, based on historical trends in labor productivity and out-of-state shipments, and three experimental runs that correspond to the alternative growth patterns. Two series of projections were prepared by using lower rates of increase in output per worker than in the benchmark series; a third series assumes lower levels of out-of-state shipments.

In the first productivity experiment, growth in output per worker in livestock and crop agriculture was reduced from 3.9 percent and 7.8 percent, respectively, to 3 percent. As a result of this modification in the growth patterns, total employment increased, and, hence, the gross product increased by 46 million dollars, population increased by 140,000, personal income dropped slightly, and gross investment increased by 73 million dollars.

In the second productivity experiment, growth in output per worker in wholesale and retail trade, finance, real estate, insurance and other services was reduced to 0.5 percent – a reduction of 50 to 60 percent from the benchmark levels. As a result of these changes, the gross product increased by 34 million dollars, population increased by 93,000, personal income increased by 27 million dollars (but per-capita income declined 72 dollars), and gross investment increased by 67 million dollars.

In the export experiment, the growth rates in out-of-state shipments of livestock, crops and other agricultural products, meat products, and other food and kindred products were reduced by ½ percent. This experiment resulted in substantial reductions in all the major economic indicators. Gross product, personal income and gross investment each declined by more than 500 million dollars. Population also declined, thus resulting in a smaller reduction in per-capita income than in the other two experiments.

Each of the three experiments can be related to public programs, or the lack of them, that affect the competitive position of Iowa industries in out-of-state markets in two ways: One, by increasing output per worker or, two, by increasing the aggregate demand for the products of Iowa industries. By tracing the effects of these programs on Iowa's product and income accounts, their social benefits can be assessed. These benefits can be compared with the program costs. Thus, the simulation model makes possible quantitative estimates of the merits of alternative public programs as a basis for improving the quality of public decisions at the regional or state level.

Simulation of Regional Product and Income With Emphasis on Iowa, 1954-1974[1]

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The use of mathematical models for analytical purposes is not new. Such models are used widely in both engineering and economic studies to represent a simplification or idealization of reality, to predict performance or to achieve control of a system(3). As pointed out by Forrester, "A model, compared to the real system it represents, can yield information at lower cost. Knowledge can be obtained more quickly and for conditions not observable in real life" (5).

A model of state economic growth is a representation of the variables, factors and conditions affecting the levels and rates of change in particular components of a state's economy. The major economic components are the labor and capital, the outputs of goods and services, and the technical structure that relates the quantities of different outputs to specified resource inputs.

Finally, the concept of economic development denotes the conscious use of public and private means to achieve certain goals (1). A computable model, therefore, represents a system of relationships and variables for ascertaining the effects of particular components of a state's economy on its total employment, production and income.[2]

Characteristics of Computable Models

A model that correctly and adequately depicts the "anatomy" and "physiology" of an economic system and that also has certain powers of prescription possesses the elements of success in economic prognosis (19). By the anatomy of a model, we mean the framework of production, consumption and accumulation of a particular region.

Production occurs for several reasons: first, to meet current demands (including capital accumulation) of other regional industries; second, to provide the regional population with various goods and services; and third, to engage in profitable out-of-region sales that result in business growth and expansion.

Consumption and accumulation compete in the disposition of output. When the ratio of consumption to production increases, less product is left to accumulate as investment in new plant and facilities and other capital outlays (including the rest-of-world account). However, outside financial resources can make possible an increase in consumption, or a decrease in exports, without adversely affecting the balance of payments with the rest of the world.

The physiology of the economic system is represented by behavioral and technological relationships that describe the patterns of consumer and business expenditures and of resource utilization. Behavioral patterns are influenced by changes in product prices and quality, business and personal incomes, and customer preferences. Techniques of production also are constantly changing because of new technology and changing expenditure patterns.

Finally, the diagnostic capabilities of the model are enhanced by use of a computer that makes possible the inclusion of a large number of separate equations to describe the regional economy. Moreover, different assumptions regarding prospective levels of exports, taxes and productivity can be made, and their implications can be traced without excessive strain on computing costs.

A comprehensive model of Iowa's economy would include the sequence of events contributing to expansion of both export markets and employment. Such a model would also include the means for accomplishing economic development, particularly the government inducements and constraints on private decisions that affect the levels of output and investment.

Economic Analysis for Regional Development

Factors affecting regional development

Regional economic development involves a continual choosing among alternative means to reach a multiplicity of ends. Not the least of these choices concerns the allocation of income between consumption and investment. When regional development is viewed in a context of investment decision making, the gross regional product becomes a relevant measure of economic vitality and well-being. What the national or regional economy produces in the way of goods and services determines the income levels of its people and institutions. From the retained profits and capital consumption allowances of businesses, the savings of households and the tax receipts of governmental agencies come the financial resources to cover investments in buildings, equipment, education, roads and other means of increasing resource productivity.

[1] Project No. 1615 of the Iowa Agricultural and Home Economics Experiment Station, Center for Agricultural and Economic Development cooperating.

[2] Because this study focuses on computable models for use in development planning, it is confined to the deterministic rather than stochastic forms of simulation models.

The productivity per worker is an important element in a regional economic model. Productivity per worker is directly related to the rate of increase in total output and the rate of decrease in total man-hours. Using Iowa as an illustration, we can observe that total farm employment is declining at a rate of 2.8 percent per year, while total farm output is increasing at a rate of slightly more than 2 percent per year (12). Productivity per worker in Iowa agriculture, therefore, is increasing at an annual rate of approximately 5 percent, which is substantially in excess of the average annual increase in population in the United States.

To have a growth rate in agricultural output in excess of the rate of national population growth requires investment in new facilities and in management skills that would help maintain and, indeed, improve the competitive position of a region's agriculture. In this way, a region can maintain or even increase its share of the total domestic trade in farm products. At the same time, a decline in farm employment requires changes in both jobs and residences. New jobs would mean remunerative opportunities for displaced farmers, while the lack of new jobs would force migration out of the region to nearby states, and, generally, to those areas where adequately remunerative jobs can be found.

Information needs in regional decision making

Information for decision making is not necessarily relevant knowledge for understanding the factors affecting regional development. Understanding is not the same as foresight, nor is prediction a substitute for explanation. A description of economic process or a model of economic development should include, therefore, the determinants of change and the sequence of events that have led to the present state or condition of the regional economy.

Although the primary objective of this report is to provide information for decision making, the procedures for generating the information are examined critically with reference to those theories of economic growth and development that provide an understanding of the ways in which an area economy grows and develops. For decision making at the state level of development planning, the information requirements include estimates of:

(a) Local and export (out-of-state) market projections, made under different assumptions regarding total national market shares for present and prospective industries;

(b) Job opportunities and labor requirements associated with the expected future outputs of goods and services;

(c) Capital requirement of the projected industries and institutions, including government;

(d) Productivity of the labor force in the different industries;

(e) Labor mobility and population migration associated with the projected levels of employment and income.

A system of employment, production and income accounts provides a scheme for organizing the economic data pertaining to regional economic growth by providing a basis for formulating economic models consisting of behavioral, technical and definitional relationships. The definitional relationships can be derived directly from the accounting framework, while the behavioral and technical relationships would be based upon economic theory and the results of empirical analysis of time series, survey and engineering data.

Accordingly, the purpose of this bulletin is to describe a comprehensive system of social accounts for a regional economy and to present a simulation model for analyzing regional economic growth. The accounting system is described and estimated for the Iowa economy in 1954. This is followed by a presentation of the simulation model. The model is applied to the Iowa economy, and several simulation runs for the 1954-74 period are discussed. Finally, the policy implications of the simulation model and social accounting system for regional development are described.

REGIONAL PRODUCT AND INCOME

The first contribution of this study is a presentation of the methodology for estimating the gross regional (or state) product; i.e., the regional contribution to the Gross National Product. Subsequently, the structural features or the anatomy of the regional economy are represented in terms of the product and income flows among major groups of transactors. At least five different groups of transactions are identified with reference to a system of product and income accounts.

1. The production transactions that deal with the disposition of goods and services produced and with reimbursement of the owners of the primary inputs for the value of the services rendered;
2. The consumption transactions that involve the income payments to households as well as expenditures on goods and services;
3. The government transactions that also involve both income payments and expenditures for goods and services;
4. The capital transactions that represent the accumulation and disposition of savings;
5. The rest-of-world transactions that contribute to the balance-of-payments position of a region.

These transactions can be represented by a flow chart as shown in fig. 1. In this chart, the directions of the income flows are shown by the connecting lines between the five different groups of transactors. In addition, the estimated 1954 volume of transactions — both product and income flows — are specified in the parentheses (in millions of dollars) for the Iowa economy.

Social Accounting Systems

The estimates of the Iowa product and income accounts presented in fig. 1 are based on an application of national income theory to a regional economy (18, 19). To illustrate this application in numerical terms, the 1953 national product and income accounts are presented, followed by a corresponding set representing the Iowa social accounts.

1953 U. S. social accounts

Pertinent data depicting the U.S. product and income flows for 1953 are summarized according to the five major groups of transactors (table 1). In this

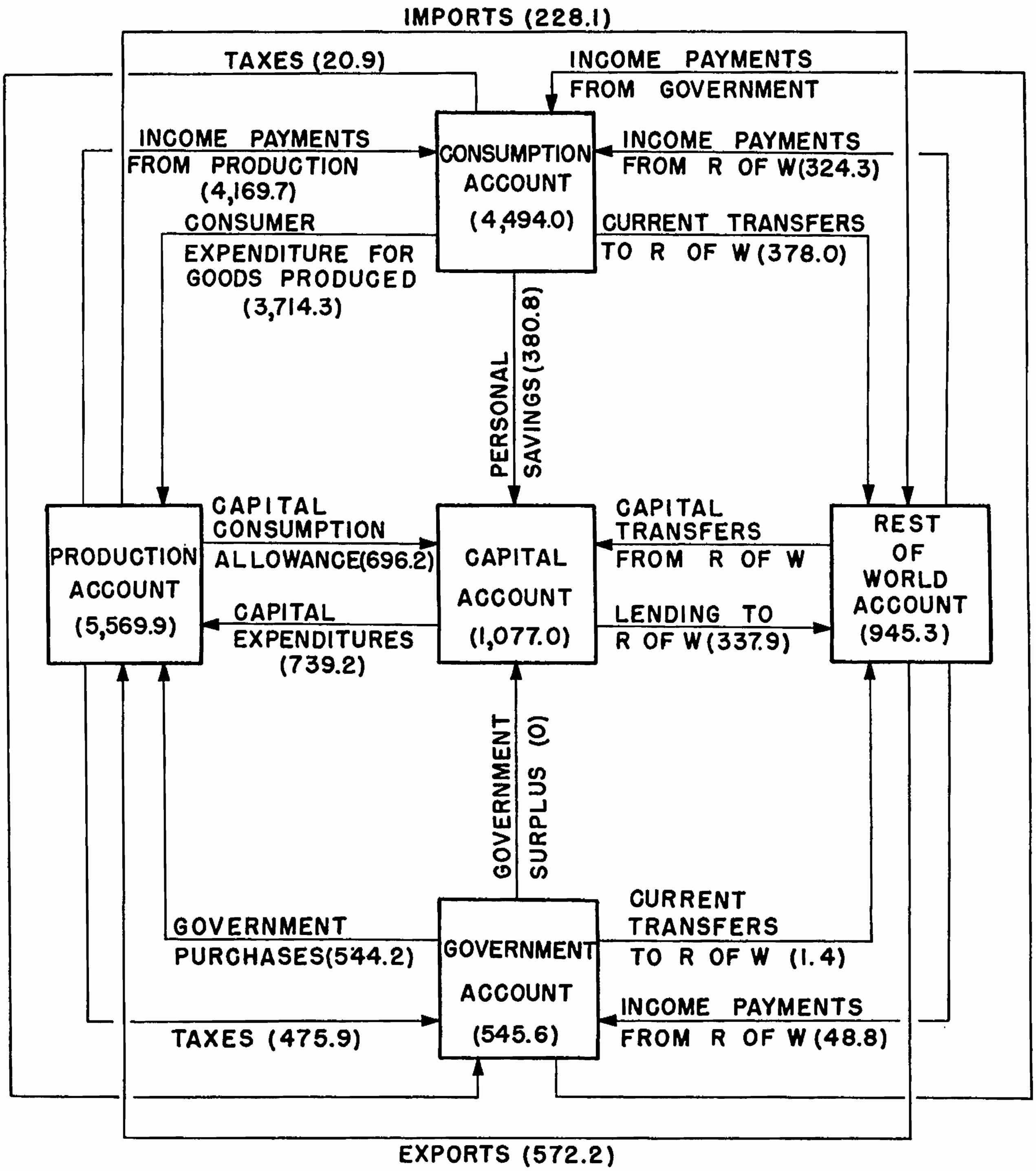

Fig. 1. Flow chart for an area economy.

system of accounts, consumption expenditures on goods and services are differentiated with reference to households and government. The consumption account shows the expenditures, tax payments, transfer payments, earnings and savings of all household and nonprofit institutions. Intersectoral transactions are excluded, except for the 7.6-billion-dollar entry representing subsidies and government interest that has been deducted from tax and income payments of producing units to government. A 16.4-billion-dollar entry representing imports has been deducted from the production accounts.

The individual entries in the social accounting matrix can be represented, also, as a series of transactors and of flows among these transactors (table 2). Each of the 25 flows represented in the social accounting matrix in table 1 are identified in table 2 in terms of the origin and destination of these flows.

1954 Iowa accounts

A system of state income and product accounts is substantially more difficult to prepare than a corresponding system of national accounts, since some of the information necessary to establish the location of the transactor is lacking on an area basis. For example, only partial series of state-to-state commodity shipments and money flows are available. Although the national censuses of business and manufacturers show the total sales of establishments, no comparable data are collected that show the geographical destination of out-shipments, the geographical location of the purchasers of the goods and services sold or the residence of the recipients of income payments originating in the state.

Despite the lack of adequate statistical data to construct a comprehensive system of regional or state accounts, it was possible to use the interindustry transactions table of the Iowa economy in preparing a system of social accounts for Iowa. At this point, only the social accounting matrix (table 3) and the supporting table of product and income flows (table 4) are presented, simply to illustrate a regional, or subnational, system of social accounts.

Table 1. Social accounting matrix for the United States, 1953.[a]

Incomings	Outgoings: Production account	Consumption account	Government account	Capital account	Rest-of-world account	Totals
	(billion dollars)					
Production account	0	229.6	77.2	53.1[b]	4.9[c]	364.8
Consumption account	277.5	0	12.8	0	0	290.3
Government account	46.8[d]	44.6	7.6	0	0.1	99.1
Capital account	40.5[e]	15.6	-4.8	0	1.9	53.1
Rest-of-world account	0	0.5	6.3	0	16.4	23.2
Totals	364.8	290.3	99.1	53.1	23.2	...

[a] National Bureau of Economic Research. The national economic accounts of the United States. U.S. Govt. Print. Off. 1958. pp. 44-45.
[b] Gross expenditures on producers durable goods plus net change in producing units inventories.
[c] Net exports.
[d] Tax and income payments by producing units to government, exclusive of subsidies and government interest, which are included under government account.
[e] Including statistical discrepancy.

Table 2. The income and product accounts of the United States, 1953.[a]

Flow	Production account: Allocation	Production account: Source	Consumption account: Allocation	Consumption account: Source	Government account: Allocation	Government account: Source	Foreign account: Allocation	Foreign account: Source	Capital account: Allocation	Capital account: Source
					(billion dollars)					
1. Payments by producing units to individuals	277.5	....	...	277.5	....	....	....	....	....	....
2. Income retained by producing units	39.5	....	....	....	....	....	....	....	....	39.5
3. Tax and income payments by producers to government	54.4	....	...	....	....	54.4	....	....	....	....
4. Subsidies and government interest	-7.6	....	...	....	7.6	....	....	....	....	....
5. Statistical discrepancy	1.0	....	....	...	....	....	....	....	....	1.0
6. Consumers' expenditures on goods and services		229.6	229.6	....	....	....	....	....	....	....
7. Government expenditures on goods and services		77.2	....	....	77.2	....	....	....	....	....
8. Gross expenditures on producers' durable goods		51.6	....	....	....	....	....	....	51.6	....
9. Net change in enterprise inventories		1.5	....	....	....	....	....	....	1.5	....
10. Exports		21.3	....	....	....	....	21.3	....	....	....
11. Imports		-16.4	....	....	....	....	....	16.4	....	....
12. Tax payments by individuals to government		....	44.6	....	....	44.6	....	....	....	....
13. Transfer payments by individuals to abroad		....	0.5	....	....	....	....	0.5	....	....
14. Personal saving		....	15.6	....	....	....	....	....	....	15.6
15. Transfer payments by government to individuals		...	....	12.8	12.8	....	....	....	....	....
16. Transfer payments from abroad to individuals		....	....	0	....	....	0	....	....	....
17. Transfer payments to abroad by government		....	...	....	6.3	....	....	6.3	....	....
18. Government surplus		...	....	....	-4.8	....	....	....	....	-4.8
19. Transfer payments from abroad to government		....	....	....	....	0.1	0.1	....	....	
20. Net borrowing from abroad		....	....	....	....	....	1.9	....	....	1.9
Total	364.8	364.8	290.3	290.3	99.1	99.1	23.2	23.2	53.1	53.1

[a] National Bureau of Economic Research. The national economic accounts of the United States. U.S. Govt. Print. Off., Washington, D.C. 1958. p. 46.

Table 3. Social accounting matrix for Iowa, 1954.[a]

Incomings	Outgoings: Production account	Consumption account	State and local government account	Capital account	Rest-of-world account[b]	All accounts
	(million dollars)					
Production account	0	3,714.3	544.2	739.2	572.2	5,569.9
Consumption account	4,169.7	0	0	0	324.3	4,494.0
State and local government account	475.9	20.9	0	0	48.8	545.6
Capital account	696.2	380.8	0	0	0	1,077.0
Rest-of-world account[b]	228.1	378.0	1.4	337.8	0	945.3
All accounts	5,569.9	4,494.0	545.6	1,077.0	945.3	....

[a] Outgoings and incomings are with reference to the directional flows depicted in fig. 1.
[b] Including federal government.

Production flows

Two concepts of product value are used in production estimates: one is an estimate of total output value, including the cost of raw materials; the other is an estimate of gross margins, which excludes the cost of raw materials and supplies but not depreciation, wages and salaries, and other operating expenses. The estimated value of production, therefore, involves double counting to the extent that the total output value concept is applied to sectors other than primary sectors.

In this study, the total output value concept applies only to the agricultural, mining and manufacturing sectors and to the establishments in these sectors that are located in Iowa. The control totals for these sectors have been obtained from the *Farm Income Situation* published by the U.S. Department of Agriculture (21), the 1954 U.S. *Census of Manufacturers* (23) and the U.S. *Census of Mineral Industries,* 1954 (24). Contrary to the procedures used in the corresponding national studies, however, estimates of inventory accumulation or depletion were not prepared as a basis for adjusting the reported (producer) value of the specified primary outputs.

The disposition of Iowa production is less readily ascertained than its total value. First, household consumption in Iowa is based on national per-capita estimates of the commodities produced in Iowa, adjusted for income (i.e., the per-capita consumption of an industry's output is a function of per-capita disposable income). In this study we assumed identical levels of per-capita consumption for Iowa and the United States, given income, and expenditure-income relationships. The total estimated personal income, when adjusted for direct taxes, savings and competitive imports, is a control total for the household expenditure estimates.

The reported payment of taxes and fees to state, local and federal governmental agencies is adjusted

Table 4. The income and product accounts of Iowa, 1954.[a]

Flow	Production account: Allocation	Production account: Source	Consumption account: Allocation	Consumption account: Source	State and local govt. account: Allocation	State and local govt. account: Source	Federal govt. and foreign account: Allocation	Federal govt. and foreign account: Source	Capital account: Allocation	Capital account: Source
	(million dollars)									
1. Payments by producing units to individuals	4,169.7	....	....	4,169.7	....	....	....	....	....	....
2. Income retained by producing units	696.2	....	....	....	....	....	....	....	....	696.2
3. Tax and income payments by producers to state government	475.9	....	....	....	....	475.9	....	....	....	....
4. Tax and income payments by producers to federal government	228.1	....	....	....	....	....	....	228.1	....	....
5. Consumers' expenditures on goods and services	....	3,714.3	3,714.3	....	....	....	....	....	....	....
6. State government expenditures on goods and services	....	544.2	....	....	544.2	....	....	....	....	....
7. Gross expenditures on producers' durable goods	....	739.2	....	....	....	....	....	....	739.2	....
8. Exports	....	2,417.0	....	....	....	....	2,417.0	....	....	....
9. Imports	....	-1,844.8	....	....	....	....	....	1,844.8	....	....
10. Tax payments by individuals to state government	....	....	20.9	....	....	20.9	....	....	....	....
11. Tax payments by individuals to federal government	....	....	378.0	....	....	....	....	378.0	....	....
12. Federal government payments to state and local government	....	....	....	....	....	48.8	48.8	....	....	....
13. Federal government transfer payments to individuals	....	....	....	226.0	....	....	226.0	....	....	....
14. Federal government wages and salaries to individuals	....	....	....	98.3	....	....	98.3	....	....	....
15. State government payments to federal	....	....	....	....	1.4	....	....	1.4	....	....
16. Personal saving	....	....	380.8	....	....	....	....	....	....	380.8
17. Foreign balance of payments	....	....	....	....	....	....	-337.9	....	337.9	....
Total	5,569.9	5,569.9	4,494.0	4,494.0	545.6	545.6	2,452.3	2,452.3	1,077.1	1,077.1

[a] Individual column entries may not add to the total because of rounding.

to another control total, namely, government purchases. However, competitive imports must be deducted from government purchases to obtain the purchases of Iowa-produced goods and services by governmental agencies.

Finally, independent estimates of private capital formation in Iowa were prepared from data on construction employment and capital expenditures of selected industries. For example, an increase in total farm output, despite a decline in farm employment, points to increasing productivity in agriculture. The latter can occur only because of an increasing rate of investment in agriculture. Thus, in agriculture, and in other sectors with rising levels of labor productivity, private capital formation probably exceeds the level of capital consumption. In any case, the data show that the 1954 capital outlays in Iowa exceeded the level of capital consumption.

The value of out-of-state shipments of Iowa-produced goods and services, which includes purchases in Iowa by the federal government, is a residual estimate of the production sector. However, the total level of imports into the state cannot differ greatly from the total level of exports without repercussions on the entire Iowa economy. If exports of Iowa-produced goods and services greatly exceed imports, for example, the multiplier effects of the inflow of money or income would lead to increased expenditures and, eventually, to an expansion of existing levels of local market-oriented activities. On the other hand, a money outflow would accompany a deficit balance-of-trade position.

Outflows from the consumption account occur primarily in the form of labor services rendered (which, in turn, involve an inflow of income, as in the case of the product accounts). In addition, the government sector must fulfill certain commitments that involve transfer payments from government to households. Similarly, the state and local government sector renders a service that, in an aggregate sense, is reimbursed in the form of tax payments by businesses and households and out-of-state transfers to the government sector.

The capital account is derived from each of the remaining four sectors, but primarily from the production sector. In the consumption and government sectors, the capital account represents personal savings and governmental surplus, respectively. An outflow of capital from the state is represented by the negative entry in the out-of-state account.

The flow of goods into Iowa would be shown as a positive entry in the out-of-state account. The out-of-state transfers of funds from the consumption and product accounts also are shown as positive entries. Each of the three entries is an approximation based primarily on information from surveys conducted in other states.

Income flows

The income flows are represented by the column entries in table 3 and the "allocation" entries in table 4. For the production account, the income flows are readily ascertained, since they are the estimated payments to households and government agencies and the estimated depreciation reserves and earnings retained in the business. Corresponding entries are shown in the consumption and government accounts. Payments to the production sector, however, are differentiated in terms of consumer expenditures on goods and services and government expenditures on producers' durable goods. For the capital goods sector, only two entries are shown; namely, the gross expenditures on producers' durable goods and the net change in inventories. Finally, the out-of-state account shows income (or inflow, as in the case of the import entry) received from out-of-state sources. Thus, the aggregate income flows equal the aggregate product flows through the use of the export-import mechanism.

Elaboration of Production and Income Accounts

Social accounts are extended further by a series of classification converters. These classification converters provide a means of dealing with the sectors of the economy in the various roles they play in production, consumption and capital accumulation.

The expanded social accounting system closely resembles the typical interindustry transactions table. The dollar flows of goods and services among sectors move in the same direction as in the input-output table. Transactions representing the real, as opposed to the financial side of the economy, are emphasized in the table. The financial side is fully represented in the system, but in less detail.

The schematic layout of the expanded product and income accounts, which now comprise 22 individual accounts, is presented in table 5. Each additional transactions table shows the "origin" and the "destination" of the product or income flows. The intersectoral flows are additive so that marginal totals can be obtained to check the accuracy and logical consistency of the individual entries. A general discussion of the individual accounts is presented first; this is followed by the presentation of data for the Iowa social accounts. The individual accounts in table 5 are described as follows:

1. Industries intermediate purchases, T1.1: The entries are the intermediate product flows of industry on current account.
2. Household purchases (classification converter for private consumers, T1.2): These entries show consumers' purchases by budget group according to the industries from which the purchases originate.
3. Government purchases (classification converter for government, T1.3): This account shows

government purchases by function according to the industries from which they originate.

4. Industry purchases of capital goods, T1.5: This account shows industries' purchases of new plant and equipment by sector of origin. Legal fees and other business services used in construction are spread over the columns in the account in proportion to construction. Investment in inventories appears diagonally in this account.
5. Exports to rest-of-world, T1.7: This account shows net out-of-state shipments of the products of Iowa industries (exports less competitive imports).
6. Household purchases, T2.4: This account shows households' personal consumption expenditures by budget group.
7. Government purchases, T3.4: This account shows government expenditures according to function.
8. Factor payments to institutions, T4.1: Factor payments earned in Iowa and indirect taxes are treated as costs of production by industry in this account. Wages and salary payments, income from self-employment, profits and interest, rental income, and taxes and fees paid to government are shown by industry of origin.
9. Direct household expenditures, T4.2: Direct household expenditures for labor and indirect taxes. (Taxes not charged directly on consumers' expenditures are routed through one of the industries.)
10. Direct labor payments of government, T4.3: Wages and salaries paid by each function of government are shown in this account.
11. Institutional transfers, T4.4: Self-employment income, profits, interest, rental income, direct taxes on business and personal incomes, government transfer payments to individuals, and intergovernment payments are shown in this account.
12. Capital consumption, T5.1: Depreciation of capital in the producing sectors valued on a replacement-cost basis is entered in the main diagonal of this account (off-diagonal entries are zero).
13. Net investment by sector, T5.6: The entries in this account relate to the finance for net investment in fixed assets and stocks in the different industries. (Stocks have already appeared in the main diagonal of a preceding account.) The estimates for net investment in fixed assets are the excess of gross investment over depreciation.
14. Institutional saving, T6.4: This account shows the savings of business, households and government.
15. Institutional capital expenditures, T6.6: The entries in this account show expenditures on net additions to fixed assets, stocks and financial claims by the institutional sectors.
16. Capital transfers to rest-of-world, T6.7: This account contains only one entry, which represents capital transfers between rest-of-world and federal government in Iowa. A negative entry indicates federal government transfers of capital out of Iowa, net of expenditures within the state. A positive entry would indicate capital transfers into federal government in Iowa.
17. Complementary (noncompetitive) imports of production, T7.1: The entries in this account show imports of goods and services used in production but not produced in Iowa.
18. Noncompetitive imports of consumers, T7.2: This account shows consumer outlays for goods and services not produced in Iowa.
19. Noncompetitive imports of government, T7.3: This account shows government outlays for goods and services not produced in Iowa.
20. Out-of-state transfers, T7.4: This account represents net income from property paid out-of-state and other remittances out-of-state by persons.
21. Net lending to rest-of-world, T7.5: Net lending by institutional sectors to the rest-of-world is reported in this account. When all resident sectors of the state on balance save, this corresponds to a net increase in their assets and net acquisition of claims upon the rest-of-world.
22. Rest-of-world trade balance, T7.6: This account shows Iowa's balance of trade with the rest of the world.

Estimates of Individual Account Entries

To facilitate development of the additional accounts involved in the expanded social accounting system, the 25 interacting sectors of the basic Iowa interin-

Table 5. Location of transaction accounts in expanded input-output system for Iowa.

Originating Sectors	Destination sectors						
		Current accounts			Capital accounts		
	Production	Consumption	Government	Institutional	Production	Institutional	Rest-of-world
Current accounts:							
Production	T1.1	T1.2	T1.3		T1.5	...	T1.7
Consumption	...	...	...	T2.4	...	..	...
Government	...	...	...	T3.4	...	...	...
Institutional	T4.1	T4.2	T4.3	T4.4	...	...	...
Capital accounts:							
Production	T5.1	...	...	...	...	T5.6	...
Institutional	...	...	...	T6.4	...	T6.6	T6.7
Rest-of-world	T7.1	T7.2	T7.3	T7.4	...	T7.6	T7.7

dustry transactions table (see ref. 12) are aggregated into seven sectors for the expanded social accounting system. However, the first seven rows and columns in table 6 represent only one account in the expanded system of accounts for Iowa (see table 7). Briefly, the estimation procedures for obtaining each of the 22 Iowa accounts are:

1. Industries intermediate purchases: The current interindustry transactions of the seven producing sectors are shown in this account. The gross output and gross outlay of these sectors are shown as margin totals.

2. Household purchases: No distinction could be made between the households' current and capital account expenditures without redefining and recomputing the underlying income-consumption functions. Hence, this account shows total household purchases of goods and services by major commodity groups from each of the seven producing sectors. The expenditures of households for food involved 75.4 million dollars from agriculture—the value of food consumed on farms—524.7 million dollars from the food manufacturing sector and 441.6 million dollars' worth of transportation and trade margins connected with the marketing of the food. Also, household spent 205 million dollars for food items imported into the state. This was made up of noncompetitive food items and competitive food items for which local production was insufficient to supply the state's entire requirements.

3. Government purchases: The current account of government is comparable to the current account for households. However, all government expenditures are classified in the current account because data were not readily available on capital expenditures.[3]

4. Industry purchases of capital goods: This account shows the purchases of building materials, construction and equipment of the producing sectors from those sectors producing capital goods. The construction industry, which is included in sector 7, is defined on a margin basis; hence, the building materials required for capital replacement and expansion are purchased directly from the producing sectors. The construction services—labor, construction and equipment services—are purchased from sector 7. Changes in stocks (inventories) are not considered in the Iowa model; hence, no entries of stocks are made on the main diagonal of this submatrix. The producing sector's purchases of

[3] The value of the expanded input-output system is evident at this point. We can now look at the household and government accounts and determine the sectors of the economy involved and the degree to which they will be stimulated or inhibited by government spending or household expenditures. With the inverse matrix of the production account, the impact of a change in spending by government function can be computed.

Table 6. Iowa interindustry transactions, 1954.

Originating Sector	Intermediate purchases: Agriculture: Livestock	Crops and other	Manufacturing: Food	Farm machinery	Other mfg.	Services: Regulated Industries	Trade, construction and other services	Final demands: Household expenditures	Government purchases	Private capital formation	Exports	Gross output
	1	2	3	4	5	6	7	8	9	10	11	12
						(million dollars)						
Agriculture:												
1. Livestock	211.8	....	1,094.6	....	0.2	0.1	5.2	50.4	2.5	....	736.0	2,100.8
2. Crops and other	824.8	144.1	123.1	....	59.2	0.4	2.8	25.0	0.8	1.0	171.5	1,352.7
Manufacturing:												
3. Food	129.7	9.3	177.0	....	15.2	2.4	20.9	524.8	6.5	....	1,043.3	1,929.1
4. Farm machinery	1.4	3.8	....	16.1	4.5	0.1	0.7	....	2.4	103.4	103.1	235.5
5. Other manufacturing	10.5	47.5	50.1	48.3	293.2	29.7	174.4	290.4	86.1	210.1	3.9	1,244.2
Services:												
6. Regulated industries	69.9	27.2	46.9	5.9	42.8	48.9	153.2	254.8	30.9	16.3	81.9	778.7
7. Trade, construction and other services	98.0	238.3	46.7	8.1	49.9	75.3	490.6	1,921.7	299.5	177.8	200.0	3,605.9
Distribution of business income:												
8. Households	434.6	701.7	225.0	76.5	425.0	276.1	1,926.9	....	428.2	....	....	4,494.0
9. Government	41.0	56.6	26.5	9.6	54.2	99.6	416.4	398.9	156.6	....	....	1,259.4
10. Capital consumption	23.5	78.6	58.4	7.9	94.4	184.6	248.9	380.8[a]	....		....	1,077.1
11. Imports	255.6	45.6	80.8	63.1	205.6	61.5	165.9	647.2	89.1	230.6		1,845.0
12. Gross outlay	2,100.8	1,352.7	1,929.1	235.5	1,244.2	778.7	3,605.9	4,494.0	1,102.6	739.2	2,339.7	19,922.4

[a] Personal saving of households.

Table 7. Disposition of specified goods and services to production current accounts, T1.1, T4.1, T5.1 and T6.1, Iowa, 1954.

Originating sector	Agriculture: Livestock 1	Agriculture: Crops and other 2	Manufacturing: Food 3	Manufacturing: Farm machinery 4	Manufacturing: Other[a] 5	Services: Regulated industries 6	Services: Other 7
			(million dollars)				
1. Livestock agriculture	211.8	...	1,094.6	....	0.2	0.1	5.2
2. Crops & other agriculture	824.8	144.1	123.1	....	59.2	0.4	2.8
3. Food manufacturing	129.7	9.4	177.0	....	15.2	2.4	20.9
4. Farm machinery mfg.	1.4	3.8	....	16.1	4.4	0.1	0.7
5. Other mfg. & mining	10.5	47.5	50.1	48.3	293.2	29.7	174.4
6. Regulated industries	70.0	27.2	46.9	5.9	42.8	48.9	153.2
7. Trade, services & const.	98.0	238.3	46.8	8.1	49.9	75.3	490.6
16. Households	434.6	701.7	225.0	76.5	425.0	276.0	1,926.9
17. Business	....	....	12.0	0.9	20.0	4.0	9.2
18. Federal government	6.1	10.3	19.2	7.9	43.2	35.9	105.5
19. State government	14.4	19.2	3.0	0.7	4.6	26.4	120.5
20. Local government	20.4	27.1	4.3	1.0	6.5	37.4	190.4
21. Livestock agriculture	23.5	....	....	....	....	....	....
22. Crops & other agriculture	....	78.6	....	....	....	....	....
23. Food manufacturing	....	....	46.3	....	....	....	....
24. Farm machinery mfg.	....	....	....	7.0	....	....	....
25. Other mfg. & mining	....	....	....	....	74.4	....	....
26. Regulated industries	....	....	....	....	....	180.6	....
27. Trade, services & const.	....	....	....	....	....	....	239.6
35. Imports — production	255.6	45.5	80.8	63.1	205.6	61.5	166.0
Total	2,100.8	1,352.7	1,929.1	235.5	1,244.2	778.7	3,605.9

[a] Including mining.

capital equipment by sector was the most difficult matrix of transactions to estimate.[4]

5. Exports to rest-of-world: Net exports by producing sector are given in this account. Competive imports are not subtracted from exports but are included with complementary (noncompetitive) imports in row 35.

6. Household purchases: Consumer expenditures by major budget category appear in this account. In column 16 of table 10, we see how households allocated their personal income among personal consumption expenditures by budget category, personal income taxes and savings.

7. Government purchases: Government expenditure by level of government and function are shown in this account. Columns 18, 19 and 20 in table 10 show how governments disbursed their revenues.

8. Factor payments to institutions: In this account are the factor incomes earned by the five institutional sectors of the Iowa model. For households, row 16 in table 10 shows the sources of personal income. Row 17 shows the retained earnings of the business sector. Rows 18, 19 and 20 show the sources of tax revenues of the three levels of government from the producing industries.

9. Direct household expenditure: No entries are shown in this account since domestic services are included in the service sector; thus, they are purchased from sector 7. Sales and excise taxes are included with trade margins.

10. Direct labor payments of government: This account shows the wages and salaries of government employers by governmental function. The salaries of personnel in the educational system are included with those of the service sector.

11. Institutional transfers: The interest paid by the federal government to households is shown in row 16, column 18, table 10. Also shown in this account are the income taxes paid by households to federal and state governments as well as intergovernmental payments (e.g., federal

[4] If a matrix of capital coefficients had been available, the task would have been one of simple multiplication of gross investment times the capital coefficient (which would yield capital flows from sector i to sector j). The lack of capital coefficients required that the flows be estimated directly. This was done by using data on expenditures on new plant and equipment and private purchases of durable equipment by type as contained in *U. S. Income and Output* (22). The use of only seven sectors made the task of allocating the estimated purchases of capital equipment by purchasing sector among the producing sectors feasible. A problem arose in the allocations of capital purchases among the two agricultural sectors, because they are defined on a commodity basis. To have allocated the building materials, equipment and construction services in the proportion that they contributed in the production of livestock or crop agriculture would have been difficult indeed. Thus, the simplifying assumption was adopted of allocating half to each sector, except in the case of farm machinery where two-thirds of the machinery purchases were allocated to crop agriculture. A set of capital coefficients was computed from this matrix and used in the recursive programming model of the Iowa economy (11).

government payments to state and local governments for education, highways and other services).

12. Capital consumption: Depreciation charges by producing sector are shown as a diagonal matrix in this account. These charges are assessed for the purchase of new plant and equipment. The splitting of retained earnings and capital consumption allowances, which are shown together in table 6, was done by taking the same proportions of retained earnings and depreciation by sector as was reported for the United States in *Statistics of Income* (26).
13. Net investment by sector: This account shows the net private (positive or negative) investment by producing sector. Negative investment is shown when capital consumption exceeds investment in new plant and equipment.
14. Institutional saving: This account shows the net savings of the institutional sectors. The federal government shows net savings in Iowa because part of the federal government expenditures in Iowa could not be determined. The remaining part of federal government expenditures is assumed to have been included in the export sector.
15. Institutional capital expenditures: The financial transactions in this account show the source of funds from the savings of the institutional sectors for the purchase of net private investment. Net private investment was estimated to be 89.1 million dollars, with 46.1 million dollars financed from the retained earnings of the business sector and with borrowings of 43 million dollars (i.e., negative acquisition of claims). Actual financial transactions occurring in this account were not readily available. The model presents, however, the idea of how financial transactions are brought into the system in a meaningful way.
16. Capital transfers to rest-of-world: This account shows net federal government capital transfers out-of-state. The negative entry indicates that federal government transferred 156.8 million dollars out of Iowa, net of expenditures within the state. However, not all federal government purchases and subsidies within the state are shown explicitly. This account provides a

Table 8. Disposition of specified goods and services to household current accounts, T1.2, T4.2 and T7.2, Iowa, 1954.

Originating sector	Food 8	Durables and nondurables 9	Transportation and utilities 10	Trade and services 11
1. Livestock agriculture	50.4	...	...	....
2. Crops & other agriculture	25.0	....	...	....
3. Food manufacturing	524.7		...	....
5. Other mfg. & mining	..	290.4	...	....
6. Regulated industries	46.9	44.5	163.5	....
7. Trade, services & const.	394.7	405.2		1,121.8
36. Imports—consumption	205.0	426.1	16.1	....
Total	1,246.7	1,166.2	179.6	1,121.8

Table 9. Disposition of specified goods and services to government current accounts, T1.3, T4.3 and T7.3, Iowa, 1954.

Originating sector	Education 12	Highways 13	Social services 14	Other government services 15
1. Livestock agriculture	....	....	2.5	....
2. Crops & other agriculture	....	....	0.8	....
3. Food manufacturing	....	..	6.5	....
4. Farm machinery mfg.	....	1.4	.	1.0
5. Other mfg. & mining	....	33.9	13.7	38.6
6. Regulated industries	....	1.1	2.3	27.4
7. Trade, services & const.	220.4	27.5	17.1	34.5
17. Business	....	27.8	22.5	328.1
35. Imports—production	...	42.4	19.5	29.9
Total	220.4	134.1	84.9	459.5

Table 10. Disposition of specified goods and services to institutional current accounts, T2.4, T3.4, T4.4, T6.4 and T7.4, Iowa, 1954.

Originating sector	Households 16	Business 17	Government: Federal 18	Government: State 19	Government: Local 20
8. Food	1,246.7	....	...	....	....
9. Durables & nondurables	1,166.2	....	....	....	....
10. Transportation & utilities	179.6	....	....	....	....
11. Trade and services	1,121.8	....	....	....	....
12. Education	....	....	....	38.2	182.2
13. Highways	....	....	....	57.6	76.5
14. Social services	....	....		61.3	23.6
15. Other government services	....	....	353.3	19.9	86.3
16. Households	...	....	49.9	....	...
18. Federal government	378.0	....	....	....	...
19. State government	20.9	....	46.5	....	12.9
20. Local government	...	....	2.3	92.1	....
32. Federal government	380.8	....	....	....	....
33. State government	....	46.1	....	....	....
34. Local government	....	....	156.8	....	....
Total	4,494.0	46.1	608.8	269.1	381.5

Table 11. Disposition of specified goods and services to production capital account, T1.5, Iowa, 1954.

Originating sector	Agriculture		Manufacturing			Services	
	Livestock 21	Crops and other 22	Food 23	Farm machinery 24	Other 25	Regulated industries 26	Other 27
2. Crops & other agriculture	0.5	0.5		...	...	....	..
4. Farm machinery mfg.	34.4	68.8		.			0.2
5. Other mfg. & mining	17.8	17.8	8.7	4.9	22.5	35.5	102.8
6. Regulated industries		..			.	16.3	
7. Trade, services & const.	3.2	3.2	2.5	1.4	6.3	41.4	119.9
35. Imports—production	14.7	14.7	7.6	4.3	19.5	46.3	123.5
Total	70.6	105.0	18.8	10.6	48.3	139.5	346.4

Table 12. Disposition of specified goods and services to institutional capital accounts, T5.6, T6.6 and T7.6, Iowa, 1954.

Originating sector	Net private investment 28	Net acquisition of claims 29	Households 30	Business 31
21. Livestock agriculture	47.1		....	....
22. Crops & other agriculture	26.5	...	....	....
23. Food manufacturing	-27.6	...	....	...
24. Farm machinery mfg.	3.6	...	....	.
25. Other mfg. & mining	26.1	....	....	...
26. Regulated industries	41.1	...	...	....
27. Trade, services & const.	106.7	....	....	.
28. Net private investment	....	....	.	89.1
29. Net acquisition of claims	...	.	380.8	-43.0
37. Imports—accumulation		337.8		...
Total	223.5	337.8	380.8	46.1

Table 13. Disposition of specified goods and services to rest-of-world accounts, T1.7, T6.7 and T7.7, Iowa, 1954.

Originating sector	Production 35	Consumption 36	Accumulation 37	All accounts total
1. Livestock agriculture	736.0	....	....	2,100.8
2. Crops & other agriculture	171.5	.	....	1,352.7
3. Food manufacturing	1,043.3	....	...	1,929.1
4. Farm machinery mfg.	103.1	....	....	235.4
5. Other mfg. & mining	3.9	..	..	1,244.2
6. Regulated industries	81.8	....	....	778.7
7. Trade, services & const.	199.9	...	....	3,605.9
32. Federal government		-156.8	....	0
36. Imports—consumption	-491.9	..	....	-491.9
Total	1,847.7	-156.8	..	....

means whereby a surplus in the federal government capital account in Iowa can be transferred out-of-state. It also provides a means of bringing in capital to support federal government spending in Iowa if spending is greater than revenues in Iowa.

17, 18 and 19. Imports from the rest-of-world: Row 35 shows the total imports for each sector. Imports are defined in this model as consisting of both competitive and noncompetitive goods.

20. Out-of-state transfers: No information was available on net transfers between the institutional sectors and the rest-of-world, hence this account contains no entries.

21. Net lending to rest-of-world: This account shows net lending by Iowa to rest-of-world of 337.8 million dollars. Because resident sectors of the state on balance had net savings, this corresponded to a net increase in their assets and net acquisition of claims (net lending to rest-of-world).

22. Rest-of-world trade balance: This account shows the rest-of-world balance of trade with Iowa. Iowa's favorable balance of trade of 491.9 million dollars is indicated by a negative import from the rest-of-world in row 35, column 34, table 13. The column and row totals for the rest-of-world account do not balance because of the nature of the entries required to close the system of accounts.

REGIONAL DEVELOPMENT MODEL

The second contribution of this study is the formulation and presentation of a regional development model. This model is based on the Iowa social accounts. It is used to generate a series of population, income and output variables in the context of state economic growth and development. Because of the complexity of the development process, however, the computer programming procedures that make the model operational are confined to simulation techniques (13).

Economic Growth and Development Processes

In preparing the economic model and the programming procedures, we have had the benefit of some empirical data and a variety of economic considerations pertaining to economic growth and development which include, first, the investment process itself and the interactions between demand, technology and output; second, the production and income flows of an economy; and third, the interdependence of rural and urban activities. This classification of relevant theories and techniques, of course, is important in formulating the basic economic problem (17).

First, the recent formulations of production theory in which output growth is represented as a function of both capital accumulation and technical progress and of labor are highly useful for this analysis (4, 16). Technical progress is embodied in the concept of increasing labor productivity while the incremental capital-output ratio is maintained at a given level. Thus, an increase in total physical capital is viewed as making possible an increase in output, but the impact of this increase on the required labor force depends on the changing levels of labor productivity. For a given market demand, however, an imbalance in the levels of the two primary inputs results in excess capacity or unemployment. When both labor and capital are in excess supply, an increase in area output is limited by the levels of market demand.

Local demand is viewed, also, as a function of local population and income; the latter is a function of the gross local output. Export demand, however, depends on an additional factor; namely, the share of the total national market accounted for by the given local industry. Whether or not the market share is increasing depends on relative production costs and accessibility to national markets (15).

Reducing production costs and finding new market outlets involves both private and public investment, the latter providing the social overhead capital in such forms as education, highways and research. Private investment involves two kinds of capital expenditures–replacement investment and induced investment. Replacement investment is financed by capital consumption allowances. However, for some industries with large incremental capital-output ratios and substantial growth in market demand, the supply of internal financing (i.e., income from capital consumption allowances and retained business earnings) may be inadequate to cover needed capital expenditures. For these industries, financing may be obtained from outside the area, provided the rate of return is adequate to attract the risk capital. In our model, the marginal productivity concept is "embodied" in the projected levels of market demand. The rate of return on capital in a growth industry presumably is adequate to induce capital movements into the industry.

The economic model thus involves elements of several theories of business growth in a local context. To show the social significance of private investment decisions, or the private business impacts of governmental decisions, a system of income and product accounts has been incorporated into the model.

The Simulation Model

The computable model of state development relationships and processes is formulated around the basic Leontief input-output equation,

$$X = AX + Z, \qquad (1.1)$$

where

X = vector of sector outputs;
Z = vector of sector final demands;
A = matrix of interindustry flow coefficients.

Output is expressed as a function of final demand; i.e.,

$$X = BZ, \qquad (1.2)$$

where

$B = (I\text{-}A)^{-1}$, or the inverse of the Leontief matrix.

A more complete model can be developed by adding matrix equations. For example, if part of final demand is explained by output in the preceding year, then the dependence on the exogenous factors is decreased, and the model is more self-contained. Introducing additional relationships thus increases the explanatory value of the model.

The basic equations in the formal model will be presented first. The components of these equations (namely, the coefficients and variables) are identified in tables 14, 15 and 16. In table 14 are the coefficient matrices, which are represented by the capital letter A. Vectors of variables are listed in table 15. Finally, in table 16 are the scalar numbers, denoted by the small letter a, and other variables, also denoted by small letters, plus other constants not included in table 14 or table 15. The subscript t is time in years.

Basic equations

The first equation in the model relates the capacity of plant and equipment to the capacity of the previous year:

$$X_t^K = X^K_{t\text{-}1} + (A_1)^{-1}(I_{t\text{-}1} - A_2K_t). \qquad (2.1)$$

Thus, capacity in year t is made up of two components, the capacity in year t-1, and the additions to capacity during year t-1. A certain amount of capital is needed to replace old plant and equipment, which is accounted for by the term A_2K_t. The remainder of gross investment, $(I_{t\text{-}1} - A_2K_t)$, is new plant and equipment; i.e., additions to capacity.

Investment decisions are influenced by the available capacity, capital stock and demand, as shown by the equation,

$$I_t = A_2K_t + A_1(A_3)^2X^D_{t\text{-}1} - A_4X^K_t. \qquad (2.2)$$

It is assumed that there is some ratio less than or equal to one which the businessman wishes to maintain between the output of a firm and its capacity. It is assumed, also, that businessmen have some expectation concerning the rate of growth in the demand for their firms' output. Thus, investment in any sector is made up of two components, the replacement of old plant and equipment, and new plant and equipment. The term A_2K_t is replacement investment, whereas investment in new plant and equipment is viewed as a function of the imbalance between present capacity and the capacity anticipated for the following year. Accordingly, the term $A_1(A_3)^2X^D_{t\text{-}1}$ is an estimate of the capacity needed to fulfill demand in year $t + 1$,

Table 14. Coefficient matrices in area development model.

Matrix symbol	Description
A_1	Diagonal matrix of incremental capital-output ratios; or, when given as the inverse of A, a diagonal matrix of output capital ratios.
A_2	Diagonal matrix of depreciation ratios.
A_3	Diagonal matrix with elements being one plus the anticipated rate of growth in demand for the specified sector's output.
A_4	Diagonal matrix of output-capacity ratios that businessmen try to maintain.
A_5	Diagonal matrix with elements being the maximum amount of investment per unit of capital stock.
A_6	Column vector of parameters where the coefficients are the proportion of total household expenditures spent for specified outputs.
A_7	Matrix of capital input-output ratios where the element in the i-th row and j-th column is the proportion of sector j's capital purchases from sector i.
A_8	Diagonal matrix with elements being one plus the sector's export demand growth rate.
A_9	Column vector of parameters where the coefficients express the relationship between state and local tax collections in year t-1 and state and local government expenditures in year t.
A_{10}	Column vector of parameters where the i-th coefficient is the proportion of federal expenditures for the output of sector i.
A_{11}	Inverse matrix $(I-A)^{-1}$ where A is the matrix of interindustry flow coefficients.
A_{12}	Diagonal matrix with elements being the equilibrium labor force-employment ratios.
A_{13}	Diagonal matrix with elements being one plus the growth rates in employment.
A_{14}	Diagonal matrix representing lower bonds on percentage change in labor force.
A_{15}	Diagonal matrix representing upper bounds on percentage change in labor force.
A_{16}	Diagonal matrix of output labor ratios in year 0.
A_{17}	Diagonal matrix with elements being one plus the annual rate of growth in the corresponding output labor ratios.
A_{18}	Diagonal matrix with the i-th diagonal element being the ratio of value added to output in sector i.
A_{19}	Diagonal matrix of state and local tax receipts per unit of output.
A_{20}	Diagonal matrix of state and local tax receipts per unit of capital stock at beginning of period.
A_{21}	Diagonal matrix of federal tax receipts per unit of output.
A_{22}	Diagonal matrix of federal tax receipts per unit of capital stock at beginning of period.
A_{23}	Diagonal matrix with L-th element being the wage rate in the i-th industry in year 0.
A_{24}	Diagonal matrix of growth rates in wages by sector.
A_{25}	Diagonal matrix with c-th element being the ratio of autonomous retained earnings to value added in i-th sector.
A_{26}	Diagonal matrix with i-th element being the proportion of unallocated value added which is allocated to business saving in sector i.
A_{27}	Diagonal matrix with i-th element being the ratio of imports to output for sector i.
A_{28}	Diagonal matrix in which the i-th element is the population-labor ratio for sector i in the first year of the simulation.
A_{29}	Diagonal matrix with i-th element being one plus the rate of growth in the corresponding element in A_{29}.

while $A_4X^K{}_t$ is the capacity that businessmen consider adequate for year t. The difference between these two terms will be the investment in new plant and equipment.

In the first 4 years of the simulation, the matrix A_3 is given. However, beginning with the fifth year, the coefficients are recomputed for each year. Each diagonal element is computed as an average of 1 plus the rate of growth in output demanded in the previous 4 years.

The value of I_t is bounded, as shown by the form,

$$A_2K_t \leq I_t \leq A_5K_t. \tag{2.3}$$

The upper boundary coefficients in the A_5 matrix represent certain financial and technical constraints that limit the rate of growth of capital stock. The lower bound, A_2K_t, indicates that a sector's capacity is not allowed to decrease. Gross investment must be enough to at least replace depreciated plant and equipment.

The third major equation relates household, or consumption, expenditure to lagged disposable income by the form,

Table 15. Vectors of variables in area development model.

Symbol	Description
$X_t{}^K$	Capacity of plant and equipment, t-th year.
$X_t{}^D$	Output demanded, t-th year.
$X_t{}^L$	Maximum outputs with a given labor force L_t, t-th year.
$X_t{}^R$	Realized output, t-th year.
V_t	Value added, t-th year.
I_t	Gross investment, t-th year.
K_t	Capital stock, beginning of t-th year.
Z_t	Final demands, t-th year.
L_t	Labor force, t-th year.
$L_t{}^E$	Employment, t-th year.
$G_t{}^S$	State and local tax collections, t-th year.
$G_t{}^F$	Federal tax collections, t-th year.
C_t	Unallocated value added, t-th year.
$S_t{}^B$	Business savings, t-th year.
$Y_t{}^B$	Personal income received from business, t-th year.

Table 16. Scalar numbers and variables in area development model.

Symbol	Description
a_1	Desired ratio of expenditure to current disposable income.
a_2	One plus the expected rate of growth in disposable income.
a_3	Lag coefficient.
a_4	One plus the annual rate of growth in federal expenditures.
a_5	Coefficient relating state and local payments to households to lagged state and local taxes.
a_6	Proportion of federal expenditures paid to households.
a_7	Ratio of state and local personal taxes to personal income.
a_8	Federal personal income tax rate.
a_9	One plus the rate of growth of $P_o{}^g$.
a_{10}	Labor-population ratio for governmental employment.
a_{11}	Coefficient relating state and local government wage and salary payments to lagged state and local taxes.
a_{12}	Proportion of federal expenditures paid as wages and salaries.
h_t	Total household expenditures, t-th year.
t_t	State and local tax collections, t-th year.
$t_t{}^F$	Total federal tax collections, t-th year.
$s_t{}^P$	Total personal savings, t-th year.
s_t	Total savings, t-th year.
$x_t{}^G$	Gross area product, t-th year.
$x_t{}^N$	Net area product, t-th year.
$y_t{}^P$	Total personal income, t-th year.
$y_t{}^D$	Disposable income (i.e., personal income minus state, local and federal personal taxes), t-th year.
e_t	Total exports, t-th year.
m_t	Total imports, t-th year.
P_t	Total population, t-th year.
$P_o{}^g$	Total population associated with government employment, base year.
E_o	Vector of export demands in year 0.
f_o	Federal government expenditures in year 0.
z_t	Fourteenth element of the vector Z_t.
l_t	Total labor force.
$l_t{}^E$	Total employment.

$$h_t = a_1a_2(y_{t-1})^D. \tag{2.4}$$

Consumers expect to receive current disposable income of $a_2(y_{t-1})^D$. A portion, a_1, of this will be spent. The remaining portion, $1 - a_1$, will be saved. In the application of the model, the scalar quantity, a_2, is computed, beginning with the fifth year, as the average of 1 plus the growth rate of disposable income in the previous 4 years.

If the computed expenditures are less than expenditures in the previous year (i.e., $h_t < h_{t-1}$), the value of h_t is increased by a portion of the difference. The new value of h_t then becomes,

$$h_t + a_3(h_{t-1} - h_t), 0 < a_3 < 1. \tag{2.5}$$

This restriction has the effect of dampening excessive fluctuations in h_t.

Total final demand is computed next by using the form,

$$Z_t = A_6h_t + A_7I_t + (A_8)^tE_o + A_9t_{t-1} + A_{10}(a_4)^tf_o. \quad (2.6)$$

In equation 2.6, the column vector of parameters A_6 is updated each year by assigning certain growth rates to the coefficients. The coefficients are normalized so that the sum of the elements equals one.

Final demand consists of five parts: household demand, capital goods demand, export demand, state and local government demand and federal government demand. Export demand and federal government demand are simply functions of time. Household demand is a function of total household expenditures, determined by equation 2.4. The demand for capital goods is determined by the amount of investment in the economy, which in turn is determined by equation 2.2. State and local expenditures are a function of lagged tax collections.

The final demand vector is made up of 14 elements —the 13 domestic sectors and one import sector.[5] Part of household purchases, part of capital goods purchases and part of state, local and federal government purchases are made from the import sector. The fourteenth element of Z_t, the final demand for imports, is denoted by z_t. Given the final demand vector, the input-output equation is used to calculate the demand for sector outputs in the equation,

$$X_t^D = A_{11}Z_t. \quad (2.7)$$

The vector Z_t in this case is only a 13-element vector; it does not include the import sector.

The available labor resources by sector are calculated by using the form,

$$L_t = A_{12}A_{13}(L_{t-1})^E. \quad (2.8)$$

Beginning with the fifth year of the simulation, the growth rates are computed each year as the average of the 4 previous years' rates. Thus, the labor force in a sector is determined by the projected employment, $A_{13}(L_{t-1})^E$; it is adjusted to allow for normal levels of unemployment by the matrix A_{12}.

Upper and lower bounds,

$$A_{14}L_{t-1} \leqq L_t \leqq A_{15}L_{t-1}, \quad (2.9)$$

are placed on the labor force. These bounds reflect institutional restrictions on the percentage change in the labor force from year to year. Thus, with a limited labor force, there is a corresponding upper bound to output, as given by the expression,

$$X_t^L = A_{16}(A_{17})^tL_t. \quad (2.10)$$

Labor force productivity increases at a constant rate. This is a principal source of economic change in this model; as annual output per worker increases, income per capita tends to increase. Realized output is the minimum of output demanded, maximum output of the labor force, and maximum output allowed by plant and equipment capacity. Hence,

$$X_t^R = \text{minimum of } (X_t^K, X_t^L, X_t^D). \quad (2.11)$$

Thus, the actual, or realized, output of a sector will be the output demanded, unless the labor force and the capacity of plant and equipment are too small to produce the output demanded. That is, for each sector, the minimum is selected of the sector's elements in the three vectors, X_t^K, X_t^L and X_t^D.

Employment is a function of realized output in the equation,

$$L_t^E = [A_{16}(A_{17})^t]^{-1}X_t^R. \quad (2.12)$$

Employment, therefore, equals output times the labor output ratio, which follows directly from equation 2.10.

Capital stock at the beginning of year t+1 (or end of year t) is,

$$K_{t+1} = K_t + I_t - A_2K_t. \quad (2.13)$$

Capital stock equals capital stock in the previous year plus net investment.

Value added in each sector is a constant proportion of output; i.e.,

$$V_t = A_{18}X_t^R. \quad (2.14)$$

State and local tax collections from business are a function of output and capital stock; i.e.,

$$G_t^S = A_{19}X_t^R + A_{20}K_t. \quad (2.15)$$

Federal tax collections from business are determined by the function,

$$G_t^F = A_{21}X_t^R + A_{22}K_t. \quad (2.16)$$

Finally, total value added is divided into several components. Remember that part of total value added has already been allocated to specific uses (e.g., wages and taxes). The remaining, unallocated portion of value added is, therefore,

$$C_t = V_t - A_2K_t - A_{23}(A_{24})^tL_t^E - G_t^S - G_t^F - A_{25}X_t^R. \quad (2.17)$$

Unallocated value added is found by subtracting, from total value added: (a) depreciation allowances, A_2K_t; (b) wage and salary payments, $A_{23}(A_{24})^tL_t^E$; (c) state and local taxes, G_t^S; (d) federal taxes, G_t^F; and (e) autonomous retained earnings, $A_{25}X_t^R$. Autonomous retained earnings are a minimum amount of earnings retained. Finally, the unallocated portion of value added is divided between two uses; namely, dividends and proprietorial income and additional business savings (i.e., savings in addition to depreciation allowances and autonomous retained earnings).

A matrix, A_{26}, is computed to divide the unallocated value added between the two alternative uses. The diagonal matrix is computed by the equation,

$$A_{26} = [(I_t - A_2K_t)I]\,[(I_t)I]^{-1}. \quad (2.18)$$

In this equation, I is the identity matrix and $(I_t - A_2K_t)$ is the vector of net investment. Thus, the i-th diagonal element of A_{26} is the ratio of net investment to gross investment in the i-th sector. If gross investment is made up entirely of the replacement of old plant and equipment, then net investment is zero, and the corresponding element of A_{26} is zero. If new additions to a sector's capacity are large, then net investment is a large proportion of gross investment,

[5]In the computer model, the 7 sectors presented in table 2 are expanded into 13 sectors by a breakdown of the food manufacturing sector into 2 subsectors, the other manufacturing sector into 2 subsectors, and the residual service sector into 4 subsectors.

and the corresponding element of A_{26} will be close to one.[6]

After the matrix, A_{26}, has been computed, total business savings are calculated by using the equation,

$$S_t^B = A_2K_t + A_{25}X_t^R + A_{26}C_t, \qquad (2.19)$$

which shows a sector's total savings as composed of depreciation allowances, A_2K_t; autonomous retained earnings, $A_{25}X_t^R$; and induced retained earnings, $A_{26}C_t$.

Personal income derived from the business sectors is computed with the form,

$$Y_t^B = A_{23}(A_{24})^tL_t^E + (I - A_{26})C_t, \qquad (2.20)$$

which shows personal income payments from any sector as composed of wage and salary payments, $A_{23}(A_{24})^tL_t^E$; and dividends and proprietorial income, $(I - A_{26})C_t$.

Total personal income can be computed by using the equation,

$$y_t^P = iY_t^B + a_5t_{t\text{-}1} + (a_6)\ (a_4)^tf_o. \qquad (2.21)$$

In equation 2.21, i is a unit row vector. Premultiplying a column vector by the row vector i has the effect of adding the elements of the column vector. Thus, total personal income is the sum of total personal income received from business, iY_t^B; personal income received from state and local governments, $a_5{}^tt_{t\text{-}1}$; and personal income received from the federal government, $(a_6)(a_4)^tf_o$.

State and local taxes are given by the form

$$t_t = iG_t^s + a_7y_t^P. \qquad (2.22)$$

State and local taxes are made up of business taxes, iG_t^s, and taxes on households, $a_7y_t^P$.

The last of the major equations,

$$y_t^D = (1 - a_7 - a_8)y_t^P, \qquad (2.23)$$

yields an estimate of disposable income. Disposable income is equivalent to personal income minus state and local personal taxes and federal personal taxes.

The 23 basic equations form a complete recursive system. Given the initial values of the exogenous variables, the values of the endogenous variables are derived as functions of time, lagged endogenous variables and current endogenous variables calculated earlier in the sequence of equations.

Auxiliary equations

The 23 basic equations constitute a complete set of equations; however, the auxiliary equations provide useful information about the functioning of the model (and, consequently, the economy represented by the model).

First among the auxiliary equations are the exports and imports of the given economy. Exports are estimated by the equation,

$$e_t = i(A_8)^tE_o - i(X_t^D - X_t^R). \qquad (3.1)$$

Total export demand is given by $i(A_8)^tE_o$. However, realized exports are reduced by the difference between realized output and output demanded; i.e., $i(X_t^D - X_t^R)$. If realized output equals output demanded, then realized exports equal exports demanded. Thus, the implicit assumption is that all other components of final demand will be satisfied first. Exports will be reduced by the difference, if any, between realized output and output demanded.

Total imports are the total of imports by the business sectors for further processing and resale, $iA_{27}X_t^R$, and imports for final demand, z_t. Thus,

$$m_t = iA_{27}X_t^R + z_t. \qquad (3.2)$$

Total federal tax collections t_t^F are given by,

$$t_t^F = iG_t^F + a_8y_t^P. \qquad (3.3)$$

Federal tax collections are composed, therefore, of tax collections from the business sectors, iG_t^F, and from households, $a_8y_t^P$.

Personal savings, s_t^P, equals personal income minus household expenditures for goods and services, state and local taxes, and federal taxes, as shown by the equation,

$$s_t^P = y_t^P - h_t - a_7y_t^P - a_8y_t^P. \qquad (3.4)$$

Gross social product, x_t^G, and net social product, x_t^N, measure the output of the state's economy; i.e.,

$$x_t^G = iV_t + a_{11}t_{t\text{-}1} + a_{12}\ (a_4)\ {}^tf_o \qquad (3.5)$$

and

$$x_t^N = x_t^G - iA_2K_t. \qquad (3.6)$$

Gross product is the summation of value added over all private business sectors, iV_t, plus state and local government wage and salary payments, $a_{11}t_{t\text{-}1}$, and federal government wage and salary payments, $a_{12}(a_4)^tf_o$. Net product is gross product minus the sum of depreciation allowances over all sectors.

Total population is represented by the form,

$$P_t = iA_{28}(A_{29})^tL_t + p_o^g(a_9)^t. \qquad (3.7)$$

Total population thus equals population associated with nongovernmental employment, $iA_{28}(A_{29})^tL^t$, and population associated with governmental employment, $p_o^g(a_9)^t$.

The total labor force, l_t, is,

$$l_t = iL_t + a_{10}p_o^g(a_9)^t. \qquad (3.8)$$

The labor force associated with business is iL_t, and the government labor force is $a_{10}p_o^g(a_9)^t$.

Similarly, total employment, l_t^E, is given by the equation,

$$l_t^E = iL_t^E + a_{10}p_o^g(a_9)^t. \qquad (3.9)$$

It is assumed that the labor force associated with government is equal to employment in government.

Total savings in the economy, s, is the sum of business savings, iS_t^B, and personal savings, s_t^P. Thus,

$$s = iS_t^B + s_t^P. \qquad (3.10)$$

Ordering of variables

The system of equations representing the area economic model is arranged as a recursive sequence (20). Altogether, 23 basic equations and 10 auxiliary

[6] In the simulation runs, A_{26} was computed with equation 2.18 except for the elements corresponding to sectors 1, 2 and 11; the latter elements were set equal to zero.

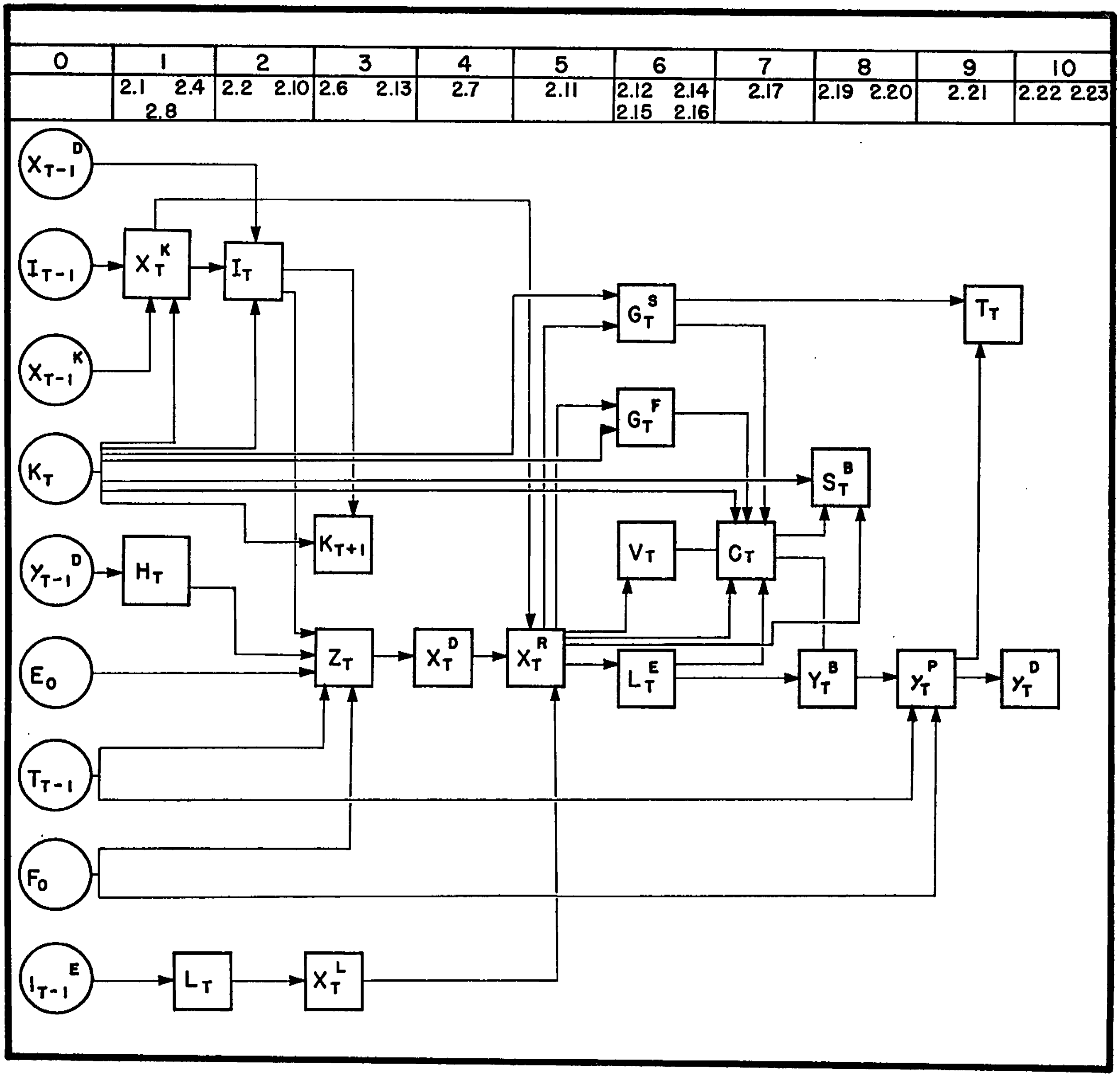

Fig. 2. Causal ordering of variables in the economic model.

equations make up a chain of events from capital consumption and labor utilization to the disposition of the business income among its claimants—households, government and business. Of the 33 major and auxiliary equations, 17 are disaggregated into 13 subequations—one for each of the 13 (rather than 7, as in table 6) interacting sectors of the Iowa economy. Also, one equation, 2.6, is disaggregated into 14 subequations. Thus, 250 different equations are represented in the computer model.

A flow diagram of the structure of the economic model is presented in fig. 2. The exogenous and lagged endogenous variables are of order zero and appear in the first column. The current endogenous variables are enclosed in rectangular boxes, and the exogenous and lagged endogenous variables are enclosed in circles. Variables of order one are dependent upon variables of order zero. Variables of order two depend upon variables of order zero or one, or both. In general, variables of any order greater than one may be dependent upon only those variables of a lower order. Thus, according to fig. 2, the values of nine series of variables are needed, first, to obtain the values of all subsequent series of variables for the given year. In the simulation process, the outputs of year (t) become the inputs of year (t+1).

The model can be divided into two parts linked together by the fifth-order equation 2.11. The equations of orders one through four are mainly concerned with determining the level of production, while equations of orders six through 10 are mainly concerned with the distribution of income created in the production process.

The level of production depends upon the demand and the productive capacity of the economy. Demand is made up of five components, two of which (exports and federal government demand) are exogenously determined. Two components, household and state and local government demands, are determined by lagged endogenous variables. The final component of demand, investment, is a function of two lagged endogenous variables and one current endogenous variable.

The productive capacity of the economy is limited by the amount of labor available, which is functionally related to employment in the previous year. Productive capacity is also limited by the capacity of plant and equipment, which is equal to the capacity in the previous year plus net additions to capacity (gross investment minus depreciation).

Final demand is translated into output demanded by means of the input-output matrix A_{11}. The actual level of production is equal to output demanded if the two capacity restraints are not binding.

Value added is defined as production minus interindustry purchases and imports by the business sectors. Thus, the second part of the model serves to divide value added into four categories: payments to the federal government, payments to state and local governments, payments to households, and business savings. The first two categories, payments to governmental units, are determined directly as functions of the level of production and the amount of capital stock. Part of payments to households, wages and salaries, is determined by employment, which is a function of the level of production.

After payments to government and labor are deducted, the remaining portion of value added is payment for the services of capital. Part of the returns to capital are retained in the business sector as depreciation allowances and autonomous retained earnings. The remainder, unallocated value added, is divided between payments to households and additional business savings. The matrix A_{26} (not shown in fig. 2) is used to make this allocation. If a large amount of investment is made, more money is retained within the business sector; but if a small amount of investment is made, a larger share of unallocated value added is paid to the household sector.

Finally, household income is augmented by payments from governmental units. Federal government payments are a fixed share of total federal expenditures, which is determined exogenously. Similarly, state and local government payments to households are a fixed share of total state and local government expenditures, which is determined by lagged tax collections.

Empirical Results

The multiple-sector recursive system of equations was constructed as a simulation model. A solution of the model is a set of time series of the endogenous variables. By formulating the model in the FORTRAN computer language, it is possible to conduct experiments or simulations on the model at a relatively low cost.[7]

Several simulation runs were performed over the 1954-74 period. One of these runs, referred to as the "benchmark run," generated a set of time series which closely resembles the actual time series for 1954-62. The time series for the years 1963-74 were generated under the assumption that all parameters (including various growth rates) remained the same throughout the simulation.

Benchmark data

We turn, first, to the 1954 Iowa interindustry transactions table (see tables 7 through 13). In these tables, several of the sectors in the 7-sector model in table 2 have been expanded as mentioned earlier. It should be noted, also, that government receipts, capital consumption and imports are not balanced with the corresponding final demands (i.e., government purchases, capital formation and exports, respectively).

The technical coefficients matrix, which shows the value of goods and services purchased per $1 of gross output, can be derived from the data in table 17 and 18. However, the inverse matrix, rather than the technical coefficients matrix, presented in table 19. This matrix shows the direct and indirect output effects of a $1 change in final demand. For example, a $1 increase in the final demand for livestock requires a $1.13 increase in livestock gross output—which is the direct effect—and a $0.91 increase in the gross output of all other sectors—which is the indirect effect. The total effect is given, also, which, in the case of the meat animal sector, is $2.04 per $1 change in final demand for livestock.

An examination of the coefficients in table 19 shows the meat products sector as having the largest multiplier coefficient. An increase in meat products output, however, is contingent on (a) an increase in livestock output and (b) an increase in the proportion of total national livestock production slaughtered in Iowa. The production implications of the multiplier coefficients will vary, therefore, depending upon the location orientation of the specified economic activity.

The coefficients

The capital input-output coefficients used in this study are summarized in table 20. For the most part, U.S. Department of Commerce data reported in *U.S. Income and Output* (22) and the *Census of Manufacturers* (23) were used in preparing the capital-output coefficients for the Iowa sectors. According to these estimates, the livestock sector, for example, purchases $0.0078 per $1 of total capital purchases from sector 2, which is made up of crops and other agricultural outputs.

[7] One simulation run takes about 2 minutes on an IBM 7074 at a cost of $2.50 per minute. Thus, several simulation runs can be made on a relatively small budget.

Table 17. Total purchases of intermediate demand sectors, in thousand dollars, Iowa, 1954.

Originating sectors	Livestock	Crops and other	Meat products	Other food and kindred products	Other non-durables	Farm machinery	Other machinery	Other durable goods	Regulated industries	Wholesale and retail trade	Finance, real estate and insurance	Other services	con-struction
	1	2	3	4	5	6	7	8	9	10	11	12	13
Agriculture:													
1. Livestock	211,804		976,244	118,394	221	....	....	....	80	3,468	...	1,682	..
2. Crops and others	824,842	144,114	....	123,054	58,668	....	44	443	446	1,659	..	606	495
Manufacturing:													
3. Meat products	...	.	64,121	4,749	3,432	....	109	557	257	5,221	....	2,383	....
4. Other food and kindred prod.	129,658	9,337	7,695	100,413	10,688	...	13	357	2,158	10,921		2,385	6
5. Other nondurables	8,022	39,954	13,706	18,525	118,432	3,603	6,967	20,266	15,584	11,938	20,771	49,727	4,737
6. Farm machinery	1,409	3,830	22	4	39	16,041	3,961	450	124	142		438	94
7. Other machinery	12	153	3,981	1,428	2,345	22,790	44,934	10,369	3,572	1,862	1,918	6,325	4,913
8. Other durables	2,448	7,368	7,826	4,595	4,347	21,936	26,005	59,538	10,530	9,051	9,559	23,295	28,432
Services:													
9. Regulated industries	69,950	27,153	22,632	24,270	14,945	5,949	5,943	21,901	48,934	30,112	84,171	31,019	7,870
10. Wholesale and retail trade	34,712	41,729	12,551	8,051	8,522	4,017	5,248	7,565	11,386	11,839	24,395	25,278	13,704
11. Finance, real estate, Ins.	47,111	173,880	3,151	3,835	4,063	1,222	2,091	5,119	20,858	72,406	92,460	42,980	2,888
12. Other services	12,822	19,789	6,431	10,693	7,687	2,241	3,245	4,864	17,214	81,168	15,730	24,011	5,721
13. Construction	3,348	2,877	1,260	757	518	604	355	661	25,832	2,586	67,190	10,244	27
Distribution of business income:													
14. Households	434,601	701,719	128,510	96,525	132,307	76,492	115,432	177,292	276,014	609,871	568,912	546,611	201,495
Government:													
15. State and local	34,848	46,331	3,101	4,172	5,091	1,750	2,408	3,576	50,154	99,953	135,646	35,600	3,205
16. Federal	6,111	10,317	8,468	10,722	17,927	7,882	10,387	14,942	45,855	35,969	19,850	25,717	6,419
17. Capital consumption	23,510	78,567	13,897	44,469	38,755	7,879	26,989	28,679	188,201	20,640	197,369	72,937	11,923
18. Imports	255,550	45,571	16,197	64,607	66,515	63,093	50,799	88,282	61,476	45,537	52,525	38,471	29,441
Gross outlay	2,100,758	1,352,689	1,289,793	639,263	494,502	235,499	304,930	444,861	778,675	1,054,343	1,290,496	939,709	321,370

Table 18. Total purchases of final demand sectors, and total gross outputs, in thousand dollars, Iowa, 1954.

Originating sectors	Household expenditures	State and local government	Federal government	Capital formation	Exports	Gross output
	14	15	16	17	18	19
Agriculture:						
1. Livestock	50,363	2,467	....	....	736,035	2,100,758
2. Crops and others	25,021	592	203	1,024	171,478	1,352,689
Manufacturing:						
3. Meat products	194,030	4,502	....	....	1,010,432	1,289,793
4. Other food and kindred prod.	330,716	2,034	2	12	32,868	639,263
5. Other nondurables	126,672	22,604	1,939	9,790	1,265	494,502
6. Farm machinery		2,347	39	103,427	103,132	235,499
7. Other machinery	30,885	21,263	2,012	143,505	2,663	304,930
8. Other durables	132,862	26,658	11,643	58,768	.	444,861
Services:						
9. Regulated industries	254,794	23,422	7,457	16,267	81,886	778,675
10. Wholesale and retail trade	799,941	11,277	5,802	28,326		1,054,343
11. Finance, real estate, ins.	569,269	40,817	2,458	5,969	199,919	1,290,496
12. Other services	552,510	155,717	8,042	11,824		939,709
13. Construction	....	49,700	25,698	129,713	...	321,370
Distribution of business income:						
14. Households	....	103,879	324,318	....	....	4,493,978
Government:						
15. State and local	70,987	104,958	48,815	....	...	650,595
16. Federal	385,485	1,413	1,368	....	...	608,832
17. Capital consumption	355,024	....	.	....	....	1,108,839
18. Imports	615,419	76,945	12,181	230,573		1,813,182
Gross outlay	4,493,978	650,595	451,977	739,198	2,339,678	19,922,314

Table 19. Direct and indirect effects of a $1 change in specified final demands, Iowa, 1954.

Producing sectors	Agriculture: Livestock 1	Agriculture: Crops and other 2	Manufacturing: Meat products 3	Manufacturing: Other food and kindred products 4	Manufacturing: Other non-durables 5	Manufacturing: Farm machinery 6	Manufacturing: Other machinery 7	Manufacturing: Other durables 8	Services: Regulated industries 9	Services: Trade 10	Services: Finance, real estate and insurance 11	Services: Other services 12	Construction 13
							(Dollars)						
1	1.1317	0.0033	0.9035	0.2584	0.0173	0.0011	0.0015	0.0029	0.0020	0.0119	0.0009	0.0066	0.0012
2	0.5215	1.1303	0.4204	0.3841	0.1926	0.0060	0.0077	0.0136	0.0073	0.0138	0.0049	0.0156	0.0070
3	0.0013	0.0008	1.0536	0.0103	0.0103	0.0007	0.0012	0.0023	0.0009	0.0059	0.0005	0.0036	0.0007
4	0.0889	0.0116	0.0791	1.2111	0.0377	0.0017	0.0020	0.0040	0.0050	0.0146	0.0015	0.0064	0.0019
5	0.0366	0.0524	0.0465	0.0707	1.3306	0.0367	0.0464	0.0754	0.0342	0.0264	0.0294	0.0785	0.0307
6	0.0025	0.0035	0.0021	0.0015	0.0009	1.0750	0.0166	0.0018	0.0004	0.0003	0.0001	0.0008	0.0008
7	0.0021	0.0022	0.0061	0.0054	0.0090	0.1263	1.1788	0.0331	0.0077	0.0040	0.0043	0.0104	0.0217
8	0.0106	0.0128	0.0175	0.0185	0.0192	0.1306	0.1203	1.1615	0.0232	0.0158	0.0182	0.0348	0.1070
9	0.0667	0.0411	0.0756	0.0779	0.0560	0.0424	0.0357	0.0679	1.0751	0.0432	0.0807	0.0474	0.0372
10	0.0414	0.0417	0.0449	0.0375	0.0334	0.0255	0.0255	0.0246	0.0205	1.0180	0.0261	0.0335	0.0479
11	0.1069	0.1629	0.0909	0.0750	0.0451	0.0138	0.0157	0.0221	0.0360	0.0835	1.0842	0.0585	0.0183
12	0.0235	0.0247	0.0264	0.0355	0.0298	0.0173	0.0184	0.0188	0.0283	0.0838	0.0194	1.0331	0.0253
13	0.0112	0.0127	0.0112	0.0098	0.0065	0.0055	0.0039	0.0056	0.0380	0.0093	0.0595	0.0162	1.0029
Totals	2.0449	1.5000	2.7778	2.1957	1.7884	1.4826	1.4737	1.4336	1.2786	1.3305	1.3297	1.3454	1.3026

Table 20. Capital input-output coefficients, Iowa, 1954.[e]

Producing sectors	Agriculture: Livestock 1	Agriculture: Crops and other 2	Manufacturing: Meat products 3	Manufacturing: Other food and kindred products 4	Manufacturing: Other non-durables 5	Manufacturing: Farm machinery 6	Manufacturing: Other machinery 7	Manufacturing: Other durables 8	Services: Regulated industries 9	Services: Trade 10	Services: Finance, real estate and insurance 11	Services: Other services 12	construction 13
							(dollars)						
2	0.0078	0.0051	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0.0004	0	0	0	0	0	0	0	0	0
5	0.0167	0.0110	0.0132	0.0064	0.0085	0.0133	0.0070	0.0100	0.0132	0.0132	0.0160	0.0133	0.0037
6	0.5263	0.6896	0	0	0	0	0	0	0	0	0	0	0.0317
7	0	0	0.2500	0.6367	0.5206	0.2500	0.6026	0.4311	0.1780	0.2783	0.1270	0.2783	0.7305
8	0.1689	0.1107	0.0639	0.0309	0.0408	0.0639	0.0338	0.0485	0.0639	0.0639	0.0774	0.0639	0.0182
9	0	0	0	0	0	0	0	0	0.1166	0	0	0	0
10	0.0484	0.0317	0.0383	0.0186	0.0245	0.0383	0.0203	0.0291	0.0383	0.0383	0.0464	0.0383	0.0109
11	0.0102	0.0067	0.0080	0.0039	0.0052	0.0081	0.0043	0.0061	0.0081	0.0081	0.0088	0.0081	0.0348
12	0.0202	0.0132	0.0160	0.0077	0.0102	0.0160	0.0085	0.0122	0.0160	0.0160	0.0194	0.0160	0.0046
13	0.0724	0.0474	0.2096	0.1014	0.1339	0.2095	0.1110	0.1589	0.2095	0.2096	0.2538	0.2096	0.0596
14	0.1291	0.0846	0.4010	0.1940	0.2563	0.4009	0.2125	0.3041	0.3564	0.3726	0.4512	0.3725	0.1060
Totals	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

[e] Sectors 1 and 3 have no capital production.

The remaining series of coefficients used in the Iowa model are summarized in table 21. First, the estimate of capital per dollar of output (row 1) is based primarily on two sources: *Capital in the American Economy* by Kuznets (8) and Leontief's article on "Factor Proportions and the Structure of American Trade: Further Theoretical and Empirical Analysis" (9). Depreciation per dollar of capital (row 2) is based on the value of capital stocks and capital consumption per unit of output. The anticipated rates of growth in demand (row 4) are based on derived trends in output (12).

The output-capacity ratios that businesses try to maintain (row 4) were estimated on the basis of the fluctuations in the industry's output. The ratio would tend to be low for an industry with highly cyclical output. Ceiling investment rates (row 5) were set on the basis of previous investment cycles. Ceilings are effective only for sectors 7, 8 and 11, which show unreasonably high levels of investment in some years if ceilings are not applied. Values of 10 for other sectors mean that, in effect, no ceiling rates are operative for those sectors.

The coefficients in row 6 are the proportions of total household expenditures spent for specified outputs in 1954. These coefficients can be derived directly from the data in table 18. The export demand trends are based on derived data (12).

The coefficients in diagonal matrix number 9 are the ratios of state and local government expenditures for the output of a particular sector to tax collections in the previous year. The coefficients were estimated by dividing total 1954 tax receipts of state and local governments into 1954 state and local government expenditures per sector and by adjusting these data to allow for the annual rate of growth in tax receipts. Finally, the ratios of federal expenditures for individual sectors to total federal expenditures (row 10) were assumed to remain the same as in 1954. Again, the data in table 1 can be used to derive these ratios.

The equilibrium labor force-employment ratios (diagonal matrix number 12) were based upon what appeared to be reasonable unemployment rates during periods of high employment. However, the growth rates in employment (matrix 13) were based upon *U.S. Census of Population* data (25).

The upper and lower bounds on percentage change in the labor force (matrices 14 and 15) were initially based upon the trends in employment shown in matrix 13. These estimates were later modified on the basis of preliminary simulation runs.

The output-labor ratios are based on data derived from a related study (12) as are the trends in the output-labor ratios (matrix 17).

The ratios of value added to output (matrix 18) are assumed to be the same as in 1954 and are computed from the data in table 17.

The coefficients relating state and local tax receipts

Table 21. Coefficients of diagonal matrices in computer model of Iowa economy, 1954.[a]

	Agriculture		Manufacturing						Service				
Matrix Number[b]	Livestock	Crops and other	Meat products	Other food and kindred products	Other non-durables	Farm machin-ery	Other machin-ery	Other durables	Regulated indus-tries	Wholesale and retail trade	Finance, real estate and insurance	Other services	Construc-tion
1	0.4275	0.7439	0.1423	0.3497	0.5389	0.4150	0.4945	0.5015	1.1467	0.6523	5.2199	1.9767	0.0608
2	0.0249	0.0742	0.0519	0.1275	0.0999	0.0575	0.1150	0.0768	0.1546	0.0209	0.0149	0.0333	0.1417
3	1.0173	1.0204	1.0288	1.0288	1.0331	1.0482	1.0482	1.0482	1.0363	1.0204	1.0438	1.0299	1.0204
4	0.9500	0.9500	0.9500	0.9500	0.9000	0.8000	0.8000	0.8500	0.9000	0.9000	0.9500	0.9000	0.8000
5	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	0.2300	0.1600	10.0000	10.0000	0.0575	10.0000	10.0000
6	0.0137	0.0068	0.0527	0.0898	0.0344	0.0000	0.0084	0.0361	0.0692	0.2172	0.1546	0.1500	0
8	1.0170	1.0200	1.0290	1.0290	1.0330	1.0480	1.0480	1.0000	1.0360	1.0000	1.0440	1.0000	1.0000
9	0.0051	0.0012	0.0092	0.0042	0.0464	0.0048	0.0436	0.0547	0.0481	0.0232	0.0838	0.3197	0.1020
10	0	0.0004	0	0	0.0043	0.0001	0.0044	0.0258	0.0165	0.0128	0.0054	0.0178	0.0569
12	1.0200	1.0200	1.0200	1.0200	1.0300	1.0400	1.0400	1.0400	1.0300	1.0300	1.0200	1.0300	1.0400
13	0.9695	0.9695	1.0231	1.0231	1.0166	0.9766	1.0270	1.0703	0.9924	1.0030	1.0278	1.0215	0.9963
14	0.9500	0.9500	0.9900	0.9900	1.0000	0.9700	1.0000	1.0000	0.9900	0.9900	1.0000	1.0000	0.9900
15	1.0200	1.0000	1.0300	1.0300	1.0300	1.0200	1.0400	1.0800	1.0200	1.0200	1.0400	1.0400	1.0200
16	14.3619	11.2981	45.9721	26.6612	15.3687	14.5847	11.4678	10.7469	11.2654	5.3954	41.2009	5.5489	6.3283
17	1.0390	1.0780	1.0310	1.0310	1.0320	1.0330	1.0330	1.0330	1.0420	1.0100	1.0130	1.0100	1.0120
18	0.2376	0.6187	0.1194	0.2439	0.3925	0.3992	0.5090	0.5037	0.7195	0.7269	0.7140	0.7247	0.6940
19	0	0	0	0	0	0	0	0	0.0200	0.0888	0.0040	0.0064	0
20	0.0369	0.0437	0.0160	0.0177	0.0172	0.0143	0.0128	0.0136	0.0272	0.0083	0.0184	0.0143	0.0656
21	0.0029	0.0076	0.0066	0.0168	0.0363	0.0335	0.0341	0.0334	0.0589	0.0341	0.0154	0.0275	0.0200
23	0.2594	0.2594	4.2057	3.5181	3.5913	4.3630	3.9251	3.9169	3.3130	2.3801	2.8734	1.8347	2.3630
24	1.0210	1.0420	1.0270	1.0270	1.0270	1.0270	1.0270	1.0270	1.0220	1.0160	1.0230	1.0200	1.0270
25	0	0	0.0015	0.0011	0.0093	0.0018	0.0087	0.0096	0.0025	0.0022	0.0619	0.0022	0.0059
27	0.1216	0.0337	0.0126	0.1011	0.1345	0.2679	0.1666	0.1985	0.0789	0.0432	0.0407	0.0409	0.0916
28	2.7556	2.7556	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545	2.5545
29	1.0042	1.0042	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026	1.0026

[a]For matrices 6, 9 and 10, the coefficients with reference to sector 14 are 0.1671, 0.2133 and 0.7176, respectively; for matrices 9 and 10, the coefficients with reference to sector 15 are 0.1580 and 0.0270, respectively.
[b]See table 1 for description of matrices.

to output (matrix 19) are derived by dividing 1954 sales tax payments by 1954 output. Similarly, the coefficients in matrix 20 were derived by dividing 1954 state and local tax payments, other than sales tax payments, by the capital stock in 1954.

The ratios of federal tax payments to output are assumed to be the same as in 1954. Thus, the coefficients in matrix 21 can be derived from data in table 17.

The elements of matrix 23 are derived by dividing 1954 wages and salaries by 1954 employment.

The growth rates in wages and salaries by sector are based on data in the *U.S. Census of Population* (25).

The ratios of autonomous retained earnings to value added (matrix 25) are determined on the basis of preliminary simulation runs.

The ratios of imports to output are assumed to be the same as in 1954. The data used in deriving the ratios are in table 17.

The population-labor ratios are based on derived data (12) while the elements of matrix 29 are based on data in the *U.S. Census of Population* (25).

Labor productivity experiments

The benchmark run provides a starting point for the computer "experiments." Two types of experiments could be performed by changing the parameters: (a) some of the parameters for the 1954-62 period could be changed to observe what "would have been" if different conditions had prevailed during the historical period, and (b) some of the parameters for the 1963-74 period could be changed to generate alternative predictions of the area's economic variables. For example, different growth rates in labor productivity could be hypothesized and their impact on the economy measured by the results of the simulation run.

The model, as formulated in the FORTRAN language, is a good experimental tool. Changes in the parameters of the model are made by simply replacing the appropriate data inputs to the computer. It is also quite easy to make selected changes in the structure of the model. For example, the investment function (equation 2.2) could be changed by replacing a few cards in the program deck.

Table 22. Specified annual rates of growth in output per worker, Iowa, 1954-74.

Producing sector	Benchmark	Experiment 1	Experiment 2
Agriculture:			
1. Livestock	0.039	0.030	0.039
2. Crops	0.078	0.030	0.078
Manufacturing:			
3. Meat products	0.031	0.031	0.031
4. Other food products	0.031	0.031	0.031
5. Other nondurables	0.032	0.032	0.032
6. Farm machinery	0.033	0.033	0.033
7. Other machinery	0.033	0.033	0.033
8. Other durables	0.033	0.033	0.033
Services:			
9. Regulated industries	0.042	0.042	0.042
10. Wholesale and retail	0.010	0.010	0.005
11. Finance, real estate and insurance	0.013	0.013	0.005
12. Services	0.010	0.010	0.005
13. Construction	0.012	0.012	0.012

As noted earlier, a "benchmark run" was defined as a basis of comparison for future "experiments" on the simulation model. Two experiments were conducted to investigate the effects of different growth rates in labor productivity on the endogenous variables in the model. The labor productivity growth rates for the 1954-62 period in the two experimental runs were the same as those for the benchmark run, but for the 1963-74 period, some of the growth rates were changed (see table 22). Results of these two experiments are illustrated in tables 23 and 24.

The labor productivity growth rates for the two agricultural sectors were decreased for experiment No. 1. In comparing the results of the experiment with the results of the benchmark run, we see that:

(a) Net product is smaller from 1964 through 1968, but larger in later years, reaching a maximum difference of 85 million dollars in 1974.

(b) Personal income is the same or smaller in all years except 1970 through 1972.

(c) Gross investment is the same or smaller in all years before 1969, but larger in all subsequent years.

(d) Population is larger in all years after 1963, with a maximum difference of 140,000 in 1974.

(e) Employment is larger in all years, with a difference of 49,000 in 1974.

(f) Per-capita income is lower in all years after 1963, the greatest difference being $125 in 1974.

The effects of the lower productivity growth rates can be evaluated by the trends in the difference between the benchmark series and the experimental series. The net product, personal income and gross investment series in experiment No. 1 exhibit no clear

Table 23. Time series of net product, personal income and gross investment.

	Net product			Personal income			Gross investment		
	Benchmark	Difference		Benchmark	Difference		Benchmark	Difference	
Year		No. 1[a]	No. 2[b]		No. 1[a]	No. 2[b]		No. 1[a]	No. 2[b]
	(million dollars)			(million dollars)			(million dollars)		
1963	6,001	0	0	5,418	0	0	1,442	0	0
1964	6,066	-15	0	5,553	-15	0	1,017	0	0
1965	6,302	-28	0	5,792	-27	0	1,292	0	0
1966	6,563	-48	-2	6,012	-41	-1	1,247	-37	0
1967	6,947	-52	-20	6,153	-4	-8	1,665	-31	0
1968	7,218	-17	-21	6,150	0	11	2,127	-54	-2
1969	7,261	20	-2	6,238	-3	28	1,997	31	-8
1970	7,223	13	24	6,519	5	20	1,723	15	4
1971	7,319	54	51	6,650	40	41	1,246	81	68
1972	7,614	59	45	6,923	48	37	1,583	66	10
1973	7,956	85	61	7,197	0	16	1,653	87	80
1974	8,421	46	34	7,315	-15	27	2,173	73	67

[a]Experiment No. 1 minus benchmark series.
[b]Experiment No. 2 minus benchmark series.

Table 24. Time series of population, employment and per capita income.

Year	Population Benchmark	Population Difference No. 1[a]	Population Difference No. 2[b]	Employment Benchmark	Employment Difference No. 1[a]	Employment Difference No. 2[b]	Per-capita income Benchmark	Per-capita income Difference No. 1[a]	Per-capita income Difference No. 2[b]
	(thousands)			(thousands)			(dollars)		
1963	2,786	0	0	978	4	2	1,945	0	0
1964	2,769	4	0	963	8	5	2,006	-9	0
1965	2,753	17	2	972	10	7	2,104	-22	-1
1966	2,753	29	11	982	11	9	2,184	-38	-9
1967	2,770	38	25	1,005	15	9	2,221	-31	-22
1968	2,808	50	25	1,017	22	11	2,190	-38	-15
1969	2,836	65	31	1,005	29	17	2,200	-51	-14
1970	2,841	82	39	983	31	22	2,294	-62	-24
1971	2,829	92	43	971	40	28	2,350	-60	-21
1972	2,819	107	60	981	44	31	2,456	-74	-38
1973	2,824	123	76	996	48	35	2,549	-107	-62
1974	2,853	140	93	1,021	49	35	2,564	-125	-72

[a]Experiment No. 1 minus benchmark series.
[b]Experiment No. 2 minus benchmark series.

trends in comparison with the benchmark runs. However, both the population and employment series in experiment No. 1 tend to become larger in comparison with the corresponding benchmark series, while the per-capita income series tends to become smaller (although it increases in absolute terms).

In the second experiment, the labor productivity growth rates for three sectors (wholesale and retail trade; finance, real estate and insurance; and services) were decreased to 0.005. The results of this experiment, when compared with the benchmark run, are similar to the results of experiment No. 1.

Additional insights into the functioning of the model can be obtained by examining the disaggregated series for individual sectors. Employment and gross output time series for the 13 business sectors are presented in tables 25 and 26.

The employment data for the benchmark run in table 25 show the importance of the two agricultural sectors in the total employment picture; the rapid downward trends in these two sectors are also important factors in the dynamic employment changes in the whole economy. The largest increases in employment were found in the wholesale and retail, and other services sectors. The finance, real estate and insurance, and construction sectors also showed sizable increases.

Figures 3 through 8 show the employment time series for six sectors for the benchmark run, experiment 1 and experiment 2. As illustrated in figs. 3 and 4, employment in the two agricultural sectors in experiment 1 is much larger than in the benchmark run, while the results of experiment 2 are close to those of the benchmark run. However, the results of

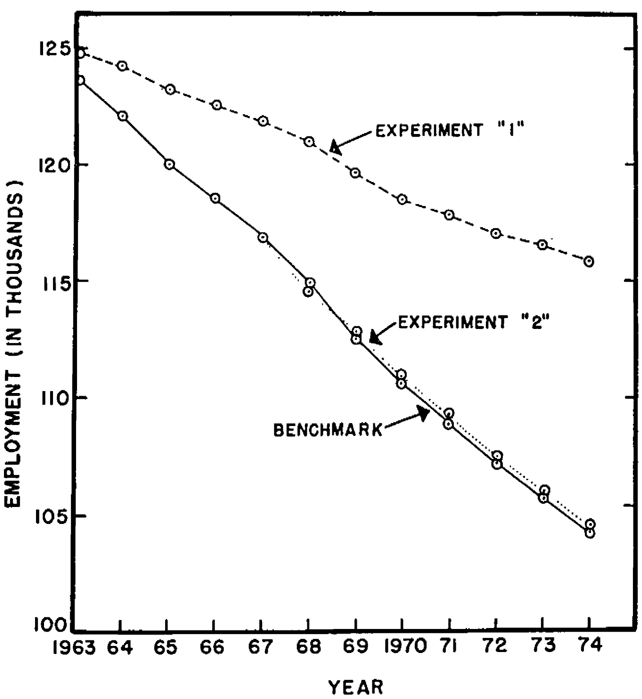

Fig. 3. Employment trends in livestock production under alternative assumptions, Iowa, 1963-74.

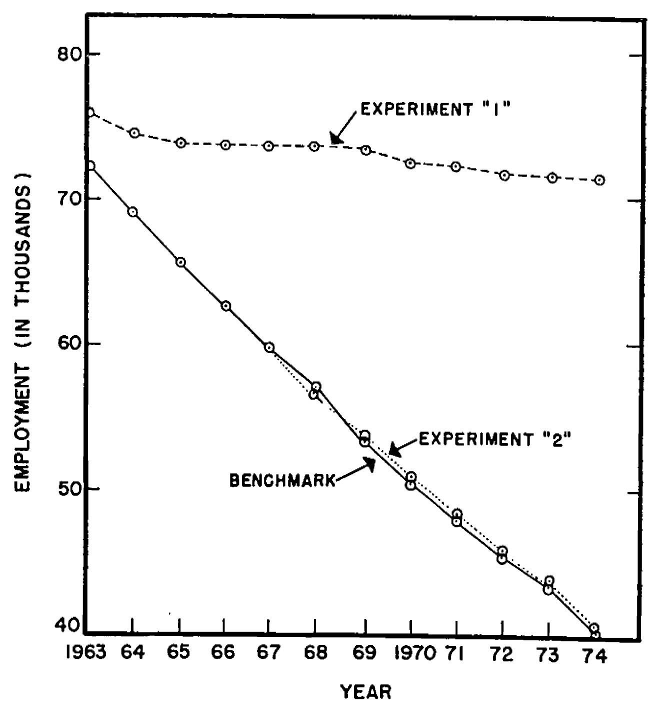

Fig. 4. Employment trends in crop production under alternative assumptions, Iowa, 1963-74.

Table 25. Estimated employment and differences in employment under alternative assumptions, by sector, Iowa, 1963-74.

	Series	Livestock	Crops	Meat prod.	Other food	Other nondurab.	Farm machinery	Other machinery	Other durables	Regulated	Wholesale and retail	Fin., real estate, ins.	Services	Construction
							(thousands)							
1963	Benchmark	123.8	72.7	26.8	21.4	34.6	15.2	36.1	45.8	60.7	202.5	36.2	177.4	61.7
	Exp. 1	1.1	3.4	0	0	0	0	0	0	0	0	0	0	0
	Exp. 2	0	0	0	0	0	0	0	0	0	1.0	0.3	0.9	0
1964	Benchmark	122.1	69.1	26.7	21.5	34.6	14.9	30.1	42.4	59.5	202.8	37.2	179.6	59.2
	Exp. 1	2.1	5.5	0	0	0	0	0	0	0	0	0	0	0
	Exp. 2	0	0	0	0	0	0	0	0	0	2.0	0.6	1.8	0
1965	Benchmark	120.0	65.6	26.6	21.3	35.4	15.6	30.5	45.0	58.9	206.7	38.0	182.3	62.3
	Exp. 1	3.1	8.3	-1.0	a	-0.1	0	a	-0.1	-0.1	-0.5	-0.1	-0.4	0
	Exp. 2	0	0	0	0	0	0	0	0	0	3.1	0.9	2.7	0
1966	Benchmark	118.5	62.6	26.6	21.5	36.4	15.8	30.2	45.1	58.9	212.1	39.4	186.9	63.5
	Exp. 1	4.1	11.4	a	-0.1	-0.2	-0.1	-0.5	-0.5	-0.3	-1.4	-0.2	-1.0	0
	Exp. 2	0	0	0	0	0	0	0	0	0	4.1	1.2	3.7	0
1967	Benchmark	116.9	59.7	26.6	21.6	38.0	16.3	35.8	49.2	59.7	217.5	40.8	193.5	64.8
	Exp. 1	5.1	14.2	a	-0.1	-0.2	0	-0.8	-0.6	-0.4	-0.8	-0.2	-1.4	0
	Exp. 2	a	a	a	0	0	0	a	a	a	2.9	1.4	4.8	0
1968	Benchmark	114.9	56.7	26.4	21.4	39.2	16.6	40.4	50.8	59.8	221.9	41.7	196.1	66.1
	Exp. 1	6.1	17.2	a	a	-0.2	0	0	0	-0.2	-0.8	-0.1	-0.5	0
	Exp. 2	a	a	a	a	0	0	0	0	0.1	3.0	2.0	5.6	0
1969	Benchmark	112.6	53.4	26.2	20.8	38.6	16.5	41.3	50.4	57.7	219.7	41.7	193.1	67.4
	Exp. 1	7.1	20.1	0	a	0.1	0.1	0.5	0.3	0.1	0.3	a	0.1	0
	Exp. 2	a	a	a	a	a	a	-0.2	-0.1	a	7.8	2.4	6.8	0
1970	Benchmark	110.5	50.4	26.1	20.3	38.1	15.9	35.5	47.8	55.3	215.0	41.9	191.1	68.7
	Exp. 1	8.0	22.2	a	a	a	0.1	0.2	2.1	0.1	0.2	a	a	0
	Exp. 2	0.1	a	a	0.1	0.2	a	0.1	0.2	0.2	9.7	2.9	8.5	0
1971	Benchmark	109.0	8.0	26.0	20.4	38.3	15.8	29.1	44.9	54.4	214.9	43.0	193.0	67.1
	Exp. 1	8.9	24.4	a	a	0.2	a	1.1	0.6	0.2	1.2	0.1	0.7	2.4
	Exp. 2	0.1	0.1	a	0.1	0.2	0.1	0.7	0.6	0.2	11.3	3.3	9.8	2.2
1972	Benchmark	107.2	45.5	25.9	20.1	39.2	16.2	31.2	47.3	53.8	218.4	43.9	195.3	69.9
	Exp. 1	9.9	26.4	a	0.1	0.3	0	0.7	0.7	0.3	2.0	0.2	1.4	1.6
	Exp. 2	0.1	0.1	a	0.1	0.2	0.1	0.2	0.3	0.2	12.7	3.9	11.2	1.6
1973	Benchmark	105.8	43.4	25.9	20.3	40.5	16.6	32.0	48.4	53.9	224.4	45.4	200.1	71.3
	Exp. 1	10.8	28.4	a	0.1	0.4	0	1.1	0.8	0.4	2.4	0.3	1.7	1.7
	Exp. 2	0.1	0.1	a	0.1	0.3	0.1	0.9	0.7	0.3	14.1	4.4	12.7	1.7
1974	Benchmark	104.4	41.5	25.8	20.4	41.8	16.9	38.3	52.4	54.6	229.7	47.1	206.8	72.7
	Exp. 1	11.4	30.2	a	a	0.5	0	1.2	0.5	0.1	2.8	a	0.5	1.7
	Exp. 2	c	a	a	a	0.3	0.1	1.1	0.5	0.2	13.5	4.8	13.4	1.7

[a] Less than 50.

Table 26. Estimated gross output and differences in output under alternative assumptions, by sector, Iowa, 1963-74.

Year	Series	Livestock	Crops	Meat prod.	Other food	Other nondurables	Farm machinery	Other machinery	Other durables	Regulated	Wholesale and retail	Fin., real estate, ins.	Services	Construction
							(million	dollars)						
1963	Benchmark	2,508	1,615	1,619	748	706	297	554	659	990	1,195	1,674	1,077	434
	Exp. 1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Exp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	Benchmark	2,570	1,655	1,667	776	728	301	478	630	1,012	1,209	1,743	1,101	422
	Exp. 1	0	-23	0	0	0	0	0	0	0	0	0	0	0
	Exp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	Benchmark	2,625	1,693	1,711	792	770	326	500	691	1,043	1,244	1,803	1,129	449
	Exp. 1	-1	-28	0	-2	-1	0	0	-1	-1	-3	-3	-3	0
	Exp. 2	0	0	0	0	0	0	0	0	0	0	0	0	0
1966	Benchmark	2,693	1,741	1,764	825	816	341	511	716	1,086	1,289	1,893	1,169	464
	Exp. 1	-2	-26	-1	-2	-5	-2	-8	-7	-5	-8	-7	-7	0
	Exp. 2	0	0	0	0	0	0	0	0	0	-1	-1	0	0
1967	Benchmark	2,761	1,792	1,817	855	880	361	627	807	1,149	1,336	1,989	1,222	479
	Exp. 1	-4	-26	-2	-3	-4	0	-14	-9	-8	-5	-9	-9	0
	Exp. 2	-1	0	0	0	0	0	0	0	0	-16	-12	0	0
1968	Benchmark	2,819	1,833	1,864	873	935	381	731	860	1,198	1,376	2,058	1,251	494
	Exp. 1	0	-14	0	-1	-4	0	0	0	-3	-5	-3	-3	0
	Exp. 2	0	-1	0	-1	0	0	0	0	-1	-22	-2	-2	0
1969	Benchmark	2,871	1,862	1,906	874	952	391	771	882	1,205	1,376	2,085	1,244	510
	Exp. 1	-1	0	0	0	1	3	9	4	0	2	1	1	0
	Exp. 2	0	0	1	0	0	-1	-4	-2	0	1	1	0	0
1970	Benchmark	2,927	1,894	1,952	881	968	389	684	863	1,204	1,360	2,122	1,243	526
	Exp. 1	0	0	0	0	1	2	3	3	2	2	1	0	0
	Exp. 2	2	2	1	3	4	1	1	4	3	7	7	5	0
1971	Benchmark	2,999	1,942	2,009	911	1,005	399	579	838	1,235	1,373	2,208	1,268	520
	Exp. 1	1	2	1	2	5	1	23	12	3	8	5	5	18
	Exp. 2	1	3	1	3	6	3	14	11	4	9	7	6	16
1972	Benchmark	3,064	1,988	2,062	928	1,061	425	642	912	1,271	1,409	2,280	1,297	548
	Exp. 1	3	3	2	5	9	0	15	13	7	13	12	9	13
	Exp. 2	3	3	2	5	7	2	5	5	6	10	11	7	13
1973	Benchmark	3,142	2,045	2,124	965	1,131	447	680	964	1,326	1,462	2,391	1,341	566
	Exp. 1	4	4	3	6	12	0	23	17	11	16	14	12	13
	Exp. 2	3	3	2	4	9	3	19	15	8	10	11	10	13
1974	Benchmark	3,222	2,106	2,187	1,000	1,207	471	841	1,079	1,401	1,512	2,511	1,400	584
	Exp. 1	0	1	0	0	14	0	25	10	4	18	2	4	14
	Exp. 2	1	1	1	1	9	3	23	10	5	-3	4	5	14

experiment 2 diverge more from the benchmark results than do those of experiment 1 in the other four sectors (figs. 5, 6, 7 and 8).

The gross output time series exhibits a substantially different pattern from that of employment. All 13 sectors show sizable growth rates over the 1963-74 period (table 26). The rapid increase in labor pro-

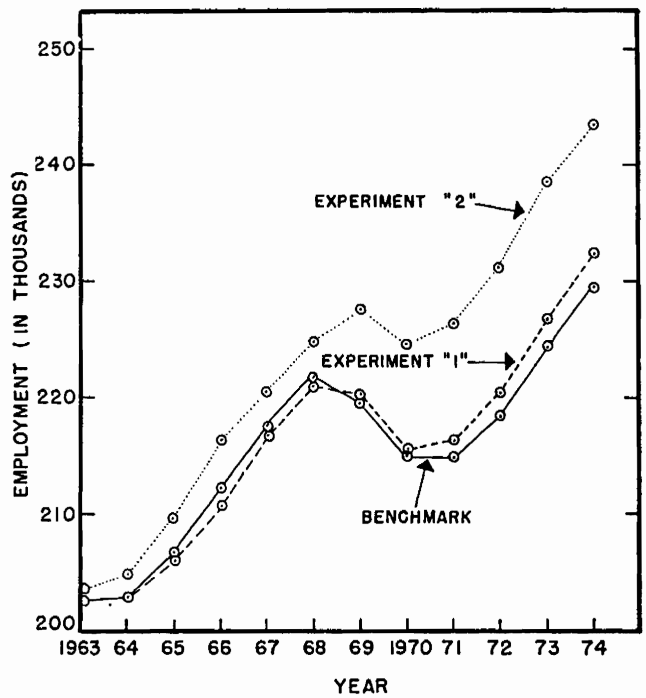

Fig. 5. Employment trends in wholesale and retail trade under alternative assumptions, Iowa, 1963-74.

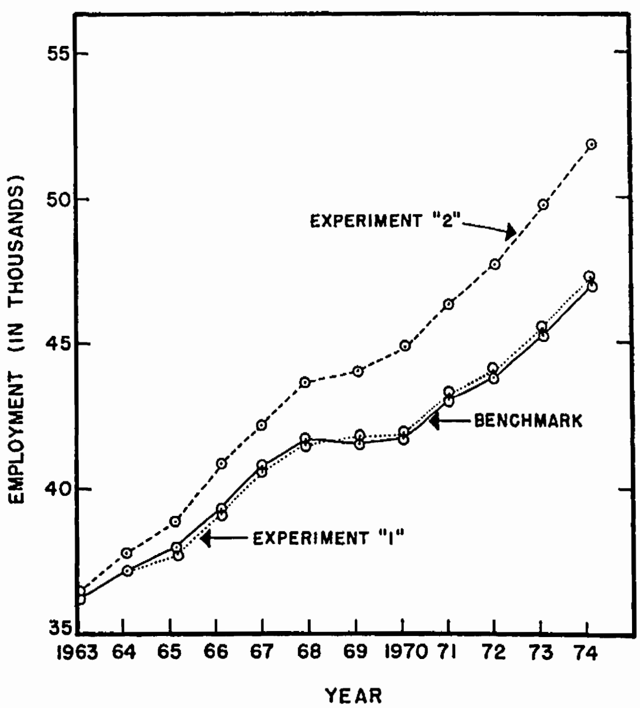

Fig. 6. Employment trends in finance, real estate and insurance under alternative assumptions, Iowa, 1963-74.

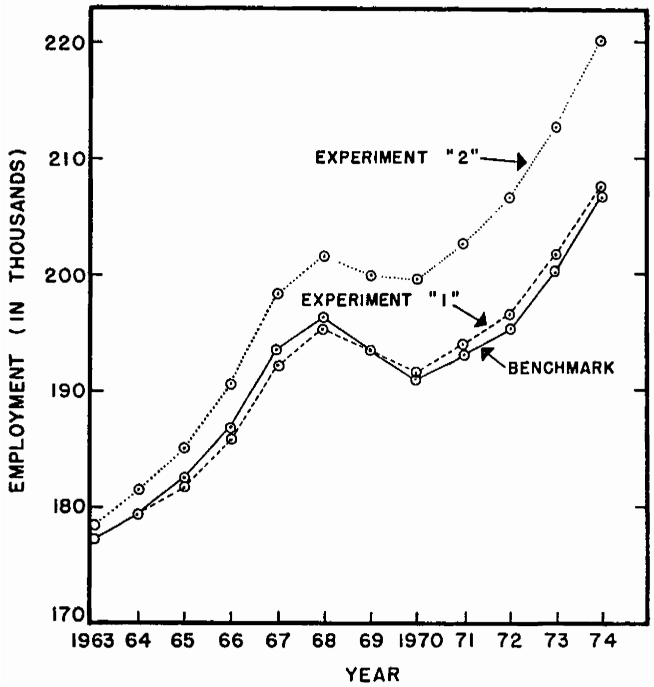

Fig. 7. Employment trends in other services under alternative assumptions, Iowa, 1963-74.

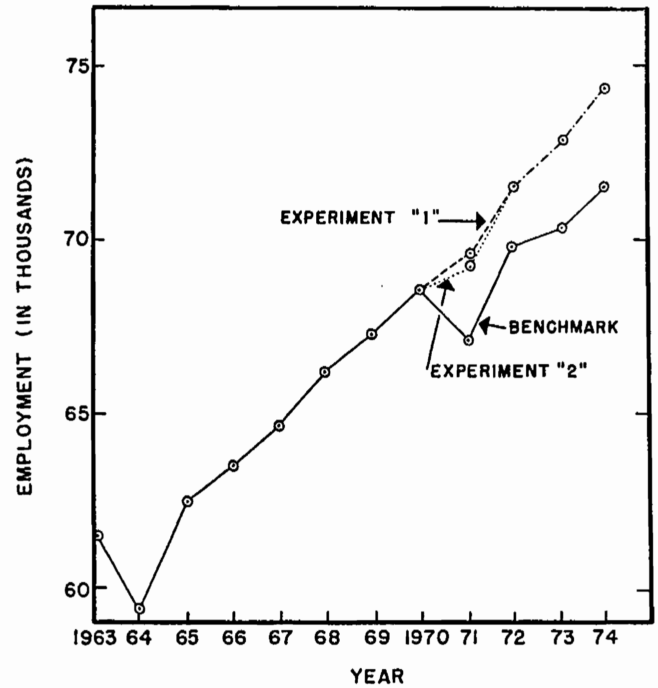

Fig. 8. Employment trends in construction under alternative assumptions, Iowa, 1963-74.

ductivity in the agricultural sectors allowed large increases in output, while the number of agricultural workers dropped sharply. On the other hand, the increased output in wholesale and retail trade and other services required fairly large increases in employment.

Experiment No. 1 (in comparison with the benchmark run) first lowered output in all sectors until 1969, and then increased output in subsequent years. The level of employment in the two agricultural sectors increased sharply, until 41,700 more workers were employed in these two sectors by 1974. The other sectors showed employment declines, followed by slight increases.

In experiment No. 2, gross output did not differ greatly from that of the benchmark run in any sector. Employment increased substantially in the three sectors (10, 11 and 12) with lower labor productivity growth rates. Employment increased slightly in all sectors in the later years.

Export demand experiment

Experiment No. 3 was conducted to study the effects of export demand on the endogenous variables. The growth rates in export demand for the first four sectors—livestock, crops and other agriculture, meat products, and other food and kindred products—were reduced by ½ percent. These four sectors accounted for 87 percent of Iowa's total exports in 1954. The largest export sector was the meat products sector, with exports of slightly more than 1 billion dollars.

The reduction in export demand growth is accomplished by changing the first four coefficients (the first four diagonal elements) of the matrix A_{21}. These coefficients for experiment No. 3 are 1.012, 1.015, 1.024 and 1.025.

The results of the experiment, when compared with the benchmark run, are shown in table 27. Net product, personal income, population and employment

Table 27. Differences in selected time series for experiment No. 3, Iowa, 1963-74.

Year	Difference from benchmark run[a]					
	Net product	Personal income	Gross investment	Population	Employment	Per-capita income
	(mil. dol.)	(mil. dol.)	(mil. dol.)	(thou.)	(thou.)	(dol.)
1963	-86	-81	0	0	-11	-29
1964	-208	-186	-90	-10	-27	-61
1965	-364	-323	-301	-22	-48	-101
1966	-533	-458	-366	-42	-71	-136
1967	-658	-363	-442	-75	-82	-72
1968	-617	-116	-667	-123	-78	57
1969	-315	-112	-264	-140	-47	72
1970	-41	-385	333	-121	-16	-39
1971	-132	-433	695	-90	-20	-80
1972	-442	-450	131	-86	-49	-88
1973	-749	-631	-470	-100	-82	-138
1974	-953	-517	-692	-141	-100	-57

[a] Benchmark series: Experiment No. 3

were lower than the corresponding series of the benchmark run.

EVALUATION OF SIMULATION MODELS AND SOCIAL ACCOUNTING SYSTEMS FOR REGIONAL ANALYSIS

The two major models presented in this report represent two approaches to data analysis. The product and income accounts are a means of *describing* a highly complex set of economic relations that characterize an economic system. The computer model and simulation procedures are techniques for *creating* a dynamic representation of a less complex counterpart of the static economic system described by the product and income accounts. Without the social accounts, the computer model presented in this report could not be constructed. Without the computer model, however, the system-wide effects of changes in particular segments of a regional economy could not be readily presented over a period of years. Thus, the two analytical approaches reinforce each other and also indicate the data and computer programming procedures needed to adequately analyze the complex system of interdependent technical and behaviorial relations that describe a regional economy.

In this section, three areas of consideration in describing and creating a regional economic system are reviewed. This review is approached in terms of (a) the design of regional social accounts; (b) the preparation and reconciliation of regional economic projections; and (c) the evaluation of regional trends and programs.

Design of Regional Accounts

The design of the regional product and income accounts corresponds to the design of the national product and income accounts so that a regional breakdown can be obtained of the critical variables affecting the rate of aggregate economic growth. Thus, the regional accounts can serve a useful purpose in the devolution of national economic policies and programs.

A system of regional accounts can be designed also from a regional rather than a national viewpoint. The region can be viewed as a separate level of governmental policy-making that is distinct from the national and the local levels. The region, moreover, can be described in terms of a series of interdependent functional relations in a manner comparable to the description of the national and local economic systems.

In the case of the nation, different commodity and financial markets can be identified that are national in scope. Except for trade with the rest of the world (which is of relatively small magnitude when compared with a region or a local area), most industries in the national market obtain their material and service inputs from other industries or sectors in the nation, and they dispose of their outputs among other industries or sectors within the nation. Thus, a system of intersectoral transactions describes both the technical and the behaviorial relations among sectors.

At the local level, the unifying concept is one of trade and transportation—the movement of people from their homes to work, shop and play, and of interplant and interarea transfers of raw materials and semifinished or finished products. Thus, a local system of intersectoral transactions is primarily a behaviorial system rather than one based on engineering or technical relations (which are involved, again, at the micro-local, or individual firm, level, but not at the local area level).

The region as an economic entity stands apart from the nation and the local area. From the viewpoint of this study, the well-being of a region is determined by two important factors—its resource productivity and its terms of trade and balance of payments with the rest of the world. Thus, from a regional standpoint, the production account and the rest-of-world account are of unique importance in describing the internal mechanism of growth in a regional economy. Moreover, the relationship between the rest-of-world account and the production account, given the total employment and population of the region, provides a specific measure of potential growth in its residentiary or nonexport activities.

The social accounting matrix for Iowa describes an economic system that is neither regional nor local in its functional organization. The Iowa economy is made up of several local economies (each of which is centered on one of a dozen or so of Iowa's largest cities); Iowa, along with nine other states, makes up one of 16 resource regions—the Missouri Basin. Because water, land and other natural resources are

Table 28. Social accounting matrix for Iowa, 1974.[a]

Incomings	Outgoings: Production account	Consumption account	State and local govt. account	Capital account	Rest-of-world account	Total all accounts
	(million dollars)					
Production account	0	4,953.1	945.3	2,201.7	780.2	8,880.2
Consumption account	6,720.4	0	0	0	522.7	7,243.1
State and local government account	826.7	36.2	0	0	84.8	947.8
Capital account	1,040.7	1,661.5	0	0	0	2,702.2
Rest-of-world account[b]	292.4	592.3	2.5	500.5	0	1,387.7
All accounts	8,880.2	7,243.1	947.8	2,702.2	1,387.7	0

[a] Sums of individual entries are not necessarily equal to column totals because of rounding.
[b] Including federal government.

Table 29. Income and product accounts of Iowa, 1974.[a]

Flow	Production account Allocation	Production account Source	Consumption account Allocation	Consumption account Source	State and local govt. account Allocation	State and local govt. account Source	Federal govt. and foreign account Allocation	Federal govt. and foreign account Source	Capital account Allocation	Capital account Source
	(million dollars)									
1. Payments by producing units to individuals	6,720.4			6,720.4						
2. Income retained by producing units	1,040.7									1,040.7
3. Tax and income payments by producers to state govt.	826.7					826.7				
4. Tax and income payments by producers to fed. govt.	292.4							292.4		
5. Consumer's expenditures on goods and services		4,953.1	4,953.1							
6. State govt. expenditures on goods and services		945.3			945.3					
7. Gross expenditures on producers durable goods		2,201.7							2,201.7	
8. Exports		4,046.5					4,046.5			
9. Imports		-3,266.3						3,266.3		
10. Tax payments by individuals to state govt.			36.3			36.3				
11. Tax payments by individuals to federal govt.			592.3					592.3		
12. Federal govt. payments to state and local govt.						84.8	84.8			
13. Federal govt. transfer payments to individuals				364.3			364.3			
14. Federal govt. wages and salaries to individuals				158.5			158.5			
15. State govt. payments to federal govt.					2.5			2.5		
16. Personal saving			1,661.5							1,661.5
17. Foreign balance of payments							-500.5		500.5	
Totals	8,880.2	8,880.2	7,243.1	7,243.1	947.8	947.8	4,153.4	4,153.4	2,702.2	2,702.2

[a] Sums of individual entries are not necessarily equal to column totals because of rounding.

Table 30. Estimates of out-of-state shipments to total final demand in Iowa, 1954 and 1974.

Item	Units	1954	1974
Final demand:			
Out-of-state sales[a]	millions dollars	2,417.0	4,046.5
In-state sales	millions dollars	4,997.7	8,100.0
Total		7,414.7	12,146.5
Ratio of out-of-state to in-state sales	percent	48	50

[a] Including federal government.

relatively important in Iowa's economic development, and because the federal government historically has assumed leadership in the development of these resources, the cooperative federal-state river basin development programs also are of critical importance to the Iowa economy. The effects of these programs can be studied advantageously within the context of a regional system of social accounts that are disaggregated on an individual state basis. Thus, the regional social accounts, although best developed on a multi-state basis as an accounting system depicting the functional organization of spatially differentiated economic activities, can be used on a state basis for evaluating the state-level effects of regional development programs.

Two major categories of economic activities can be described with reference to the social accounting matrix illustrated earlier in tables 3 and 4 and, again, in tables 28 and 29. These categories are included in the product and the rest-of-world accounts in terms of total exports and imports, and total production.

A comparison of total exports with total production for final demand shows essentially the same ratio of exports to in-state purchases in 1954 and 1974, according to the summary data in table 30.[8] To the extent that the dollar value of final demand corresponds with relative employment levels among the individual sectors, the export-nonexport sales ratio is comparable to a basic-service or an export-residentiary dichotomy in total Iowa employment. Therefore, assuming a one-to-one correspondence between value of sales and employment, the data in table 30 suggest that the estimated long-run area multiplier is essentially a constant. This conclusion is contrary to area multiplier trends in the nation as a whole. Increasing consumer incomes are encouraging rapid expansion of the local service sectors which are contributing to a declining basic-service or export-residentiary employment ratio.

The 13-sector disaggregated version of the 7-sector computer model, the greater sectoral detail regarding exports, imports and employment, has made possible a refinement in the estimation procedures that yields lower estimates of exports and, thus, a lower export-nonexport ratio. Thus, the additional sectoral detail is important in obtaining more realistic

[8] Because of disaggregation and adjustment of the data in the 7-sector model, the computer runs using the 13-sector model show a somewhat smaller ratio of exports to nonexport sales for 1974; these differences are discussed later.

Table 31. Derived trends in income of major economic sectors, Iowa.[a]

Year (from 1954 base)	Gross production	Personal income	State and local taxes	Gross saving	Federal taxes	Trade		
						Exports	Imports	Net
				(million dollars)				
0	5,570	4,494	497	1,077	606	2,417	1,845	572
1	5,692	4,423	500	1,308	612	2,191	2,077	114
2	5,748	4,443	513	1,392	616	2,301	2,080	222
3	5,774	4,670	528	1,389	636	2,490	1,998	492
4	5,937	4,841	542	1,337	656	2,602	1,982	620
5	6,110	4,990	552	1,349	677	2,670	2,022	648
6	6,411	5,180	565	1,442	707	2,674	2,242	432
7	6,729	5,165	581	1,542	722	2,603	2,453	150
8	6,869	5,170	600	1,711	729	2,630	2,547	83
9	6,838	5,418	621	1,686	747	2,900	2,414	486
10	6,931	5,553	638	1,551	760	3,063	2,268	795
11	7,176	5,792	649	1,663	792	3,092	2,452	640
12	7,446	6,012	667	1,639	823	3,206	2,507	699
13	7,840	6,153	683	1,765	855	3,170	2,771	399
14	8,145	6,150	704	1,952	870	3,093	3,000	93
15	8,253	6,238	730	2,055	882	3,360	2,976	384
16	8,269	6,519	753	2,009	905	3,521	2,884	637
17	8,390	6,650	770	1,866	919	3,718	2,725	993
18	8,689	6,923	783	2,018	957	3,758	2,938	820
19	9,043	7,197	805	2,035	996	3,867	3,058	809
20	9,527	7,315	826	2,205	1,031	3,823	3,377	446

[a] Benchmark series of 13-sector computer model.

and valid estimates of future regional economic conditions.

Regional Economic Projections

The regional economic projections prepared by use of the computer models are a means of describing trends and changing relationships among the major entries in the regional system of product and income accounts. The regional trends presented pertain primarily to a region's (e.g., Iowa's) economic base and its trade relations with other regions. From the viewpoint of regional analysis (as contrasted to local area analysis), these trends focus on the determinants of regional economic growth—resource productivity and aggregate demand for the products produced in the region. These growth determinants are described with reference to the Iowa social accounts presented earlier for 1954 and 1974.

Gross regional product

The gross regional product is equivalent to net production plus a depreciation allowance; it is the gross social product of the region—the reimbursement to primary resources engaged in productive activity (see equations 3.5 and 3.6). It is the regional counterpart of the gross national product. It also corresponds with the marginal production account entries in tables 3 and 28.

According to the data in table 31, gross production in Iowa (according to the benchmark series of the 13-sector computer model) is increasing steadily at an annual rate of 2.68 percent; in 20 years it is expected to reach a level 71 percent above its base year level of 5.57 billion dollars (in constant 1954 dollars). Thus, the growth in gross social product exceeds the growth in population (inasmuch as the population growth rates are only 0.34 percent per annum, from a 1954 base of 2,665,000 to 2,852,400 in 1974). On a per-capita basis, gross Iowa product is expected to increase from $2,090 to $3,340.

The substantial increase in the imputed market value of primary resource inputs makes possible corresponding increases in wages and salaries and other earnings, and also, in taxes. These income flows become the expenditures flows of the next year in the computer programming procedures (see fig. 2).

Personal income

Personal income is derived from three major sources—businesses, state and local governments, and the federal government (see equation 2.21). It is equivalent to the marginal total for the consumption account (see tables 3 and 28). It represents the source of household expenditures, personal savings and personal taxes of the next year in the computer program.

Personal income in Iowa, according to the derived series in table 31, is expected to increase from 4.494 billion dollars to 7.315 billion dollars in constant 1954 dollars—an increase of 2.44 percent per annum over the 20-year period. With reference to gross production, personal income is expected to decline from 80 percent to 77 percent of the gross social product over the 20-year period. This declining proportion is the result of a corresponding increase in tax payments and business savings.

As personal income payments increase, personal or household expenditures also increase, but not proportionately. The yearly fluctuations in personal expenditures are revealed by the corresponding, but inverse, fluctuations in personal savings. Table 32 shows the changing ratio of personal savings to total personal income over the 20-year projection period.

State and local taxes

State and local taxes are paid by businesses and households (see equation 2.22). These taxes are expected to increase by 66 percent above the 1954 base of 497 million dollars. This increase amounts to a per-annum increase of 2.54 percent annually. Thus, state and local taxes are expected to increase at about the same rate as the gross product and total personal income.

With reference to the system of social accounts, the state and local tax series in table 32 excludes federal government transfer payments to state and local governments. In 1954, for example, these payments totaled 49 million dollars.

Gross saving

Total gross saving is the sum of business saving and personal saving (see equation 3.10); it corresponds with the marginal total for the capital account in tables 3 or 28.

Because of yearly fluctuations in both personal and business savings, the gross saving estimates for Iowa show considerable variability over the projected 20-year period. The series, nonetheless, shows substantial growth from its base year level of 1.077 billion dollars to its projected 1974 level of 2.205 billion dollars—a 3.61 percent per-annum increase compounded annually.

On a per-capita basis, the projected gross savings are expected to increase from $404 to $773, or 3.24 percent per annum over the 20-year period. This pattern of savings, based on estimated historical trends in Iowa, contributes to relatively high rates of growth in labor productivity and to relatively favorable demand prospects facing specific Iowa industries. Changes in rates of capital accumulation would result, of course, in productivity and market-share changes, but not necessarily on the proportional basis (see table 32). Accordingly, private capital formation and labor productivity rates and market share estimates would need to be adjusted to account for the lower rates of capital accumulation.

Federal taxes

Federal taxes, which are collected from businesses and households (see equation 3.3), are expected to increase by 2.66 percent per annum. This increase in federal tax receipts is closely related to the increase in gross production, capital stock and personal income (see equations 2.16 and 2.21).

Table 32. Derived trends in ratios of personal saving to personal income, gross saving and gross investment to net product, Iowa.[a]

Year (from 1954 base)	Personal saving	Gross saving	Gross investment
	(percent)		
1	6.0	25.8	25.4
2	7.3	27.3	25.3
3	11.4	27.3	20.9
4	10.3	25.6	17.4
5	9.9	25.0	16.7
6	9.6	25.3	21.5
7	5.6	25.8	26.4
8	6.6	28.1	29.6
9	11.1	28.1	24.0
10	9.3	25.6	16.8
11	11.0	26.4	20.5
12	9.7	25.0	19.0
13	7.8	25.4	24.0
14	6.3	27.0	29.5
15	7.9	28.3	27.5
16	11.0	27.8	23.9
17	9.0	25.5	17.0
18	10.6	26.5	20.8
19	9.7	25.6	20.8
20	7.4	26.2	25.8

[a] Benchmark series of 13-sector computer model.

Exports

Exports, or out-of-state shipments, are a residual element in the disposition of gross production among the final demands (see equation 3.1). Other components of final demand (namely, household demand, capital goods demand, state and local government demand and federal government demand) may fluctuate from year to year, thus, by definition, contributing to a highly variable export demand. For example, the peculiarities of the model resulted in a 226-million-dollar, or 9-percent, drop in exports from 1954 to 1955 (table 31).

From 1954 to 1974, the derived level of out-of-state shipments is expected to increase by 1.406 million dollars, or 2.29 percent per annum.

Imports

Imports include both goods for further processing and resale, and goods for final use (see equation 3.2). Thus, import demand can fluctuate because of yearly changes in gross product or final demand. Over the 20-year period illustrated in table 31, imports grew from 1.845 billion dollars to 3.337 billion dollars—an increase of 3.02 percent per annum.

If import substitution in Iowa were to increase at a faster rate than postulated in the computer model, the projected 1974 level of imports would be reduced, provided output remained the same. This model cannot establish the effects of import substitution on production, however, inasmuch as the functional relations connecting import substitution to output changes, other than in terms of imports utilized directly in production or consumption, are not included in the system of equations that make up the model. Further work is needed, therefore, to establish the effects of accelerated growth in the industries that now fail to supply Iowa's total requirements from these industries but that might supply a larger share of these requirements in the future.

Evaluation of Regional Trends and Programs

Economic projections based on historical trends inherently suffer from an obvious shortcoming—the assumption that the future is like the past, if not in exact levels of major economic activity, at least in their interrelationships and structural characteristics. If out-of-state shipments and industrial technology, for example, change in specified amounts, then presumably, the pattern of relationships between these exogenous variables and particular regional variables, such as production, employment and capital stock, is expected to remain stable. However, not all determinants of regional growth are exogenous, nor are they entirely a matter of prediction. A few of the regional growth determinants are subject to influence by state and federal policies that focus upon regional affairs.

A further step in the simulation of regional product and income is suggested by the possibility that a series of cause-and-effect relations can be established between particular regional programs and indicators of regional well-being. For example, water resource development programs in the Missouri Basin will improve the productivity and competitive position of the Basin's industries, thus, making possible potential growth in the Basin's share of the total national markets of the selected industries. Moreover, expansion of municipal and industrial water supplies could encourage some industries, such as chemicals and food processing, to locate in the Basin. Similarly, improvements in water transportation on the Missouri could improve the competitive position of those industries seeking low-cost bulk transportation facilities. Finally, workers in these industries might view the favorable consequences of the water quality control and recreational area development programs as important factors in their decisions to move or to stay. Indeed, because of the high value per ton of manufactured goods and the increasing importance of personal expenditures for services, the household relocation decision is becoming a major factor in plant location decisions. Except for chemicals, food processing and a small number of related industries, most industries seek premium rather than bulk transportation; they are more interested in obtaining a particular quality of transportation service than the least-cost mode of transportation or the least-cost location with respect only to transportation services.

A "program of action" for regional government can be formulated in terms of the derived consequences of each program on the product and income accounts of the region. Much additional description of regional economic structure and processes is needed, however, before the relevant cause-and-effect relations that connect specified programs with particular economic goals can be identified and estimated for use in a more refined computer model of regional development. Given the additional description, the framework presented in this report offers a convenient and meaningful starting point for deriving, on an experimental basis, the economic outcomes from the specified programs. This, then, remains as a future challenge rather than a present accomplishment of simulation models and social accounting systems.

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