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A View of Food and Agriculture in 1980

By David W. Culver and J. C. Chai [1]

Projected growth in population and the general economy suggest larger domestic food requirements in 1980. The major consumption trends of recent years are projected to continue, with per capita consumption rising for beef and poultry but declining for milk. Food use of most crop products may expand about in line with population, but processed fruits and vegetables will continue to displace fresh use. Production is projected to rise substantially for livestock products and for total crops. Crop yields may rise about as rapidly as demand, with acreage needed for crop production in 1980 likely to be near recent levels.

Key words: Projections, population, economic growth, farm production, crop acreage, food consumption.

The past two decades have seen dramatic changes in U.S. farm production capacity, and in the organization of resources and the production mix. Both technological developments in production and changes in consumer demand have spurred the rate of adjustment.

Farm production has become more closely linked with the nonfarm economy through increased use of nonfarm inputs. Consumption patterns have been upgraded as incomes have risen. In addition, differential rates of technological change have influenced food consumption through their impact on production costs and product prices. Nonfood farm products such as the fibers and the industrial oils have faced strong competition from nonfarm substitutes.

While export markets have increased in total, the importance of foreign markets varies by commodity. Agricultural export levels have fluctuated widely both in total and for individual commodities. Both commercial and Government-assisted export levels have varied considerably.

This article summarizes some of the major results of recent projection analyses. The information presented emphasizes markets provided by domestic food consumption. The prospective total demand picture is then completed by the addition of projections for nonfood use and exports. Projected production, prices, crop yields, and harvested acres for major crops round out a projected profile for agriculture in 1980. Some important and interesting facets of agriculture, such as farm income and the location and organization of production, are treated summarily in this paper.

An attempt has been made to analyze each commodity or commodity group in an equilibrium framework. Formal models were used for some major commodity groups. Methods of estimation varied from large multiequation systems to single-equation estimates and less formal techniques. Considerable reliance was placed on the judgment of commodity specialists for all commodity estimates.

Recent trends toward larger and fewer farms and increasing use of nonfarm inputs are assumed to continue. Domestic farm policy goals are expected to continue to emphasize market expansion and the orderly adjustment of production to meet market needs. The major demand shifters, including population and income, are expected to continue to expand markets for farm products.

Factors Affecting Demand[2]

Population and income are the primary forces influencing domestic demand for farm products. Total U.S. population is assumed to rise to 235 million by

[1] Many ERS staff members participated in various phases of the analysis, including J. D. Ahalt, R. Daly, D. Durost, R. Rizek, R. Hoffman, J. Mathews, A. Rojko, and W. Simmons. Others of the ERS staff who provided basic data and assisted in developing and appraising the projections include W. Askew, M. Clough, J. Donald, S. Gazelle, A. Mathis, D. Seaborg, R. Miller, B. Huang, W. Cathcart, C. Brader, and M. Harron.

[2] A statistical supplement, containing data on which the following charts are based and also commodity supply and distribution detail, is available on request from the Outlook and Projections Branch, Economic and Statistical Analysis Division, Economic Research Service.

1980 as shown in the Series "C" projections of the Bureau of the Census. This would be an annual growth rate of about 1.3 percent compared with a rate of nearly 1.6 percent between 1950 and 1969 (fig. 1).[3]

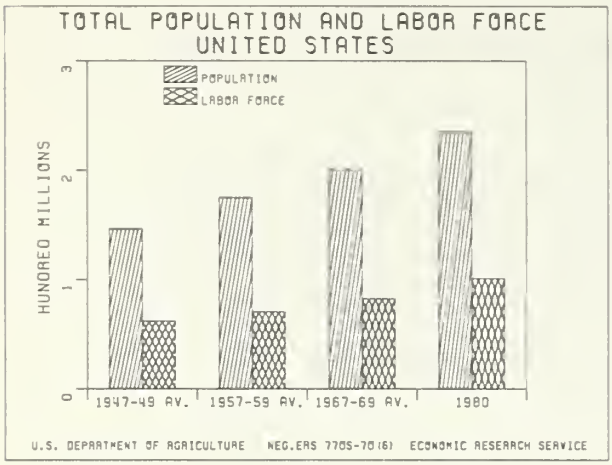

Figure 1

Population growth rates over the next decade are expected to be most rapid among persons 20-44 years old and under 5 years old. This is in contrast with the more rapid growth during the last two decades in the 5-19 and over 65 age groups.

Growth of the labor force in the next 10 years is expected to be at a rate of about 1.7 percent in comparison with 1.4 percent during 1950-69. This higher projected rate is due to a higher rate of growth projected for the age group 20-44 and to expected slightly higher participation rates. The migration of workers from rural to urban areas is expected to continue, although at a slower pace since much of this transfer has already taken place.

Gross national product (GNP) in real terms is projected to rise about 4-4½ percent per year following an expected slower rate in the near term (fig. 2). Real growth during 1950-69 averaged about 3.9 percent per year although the rate from 1962 to 1968 averaged 5 percent. General price increases are assumed to slow gradually in the next few years to around 2 percent per year, then remain at about 2 percent per year for the rest of the decade. The current dollar value (including inflation) of GNP in 1980 is projected to be almost double the 1969 level of $932 billion. This rate of economic growth can be expected to result in increased

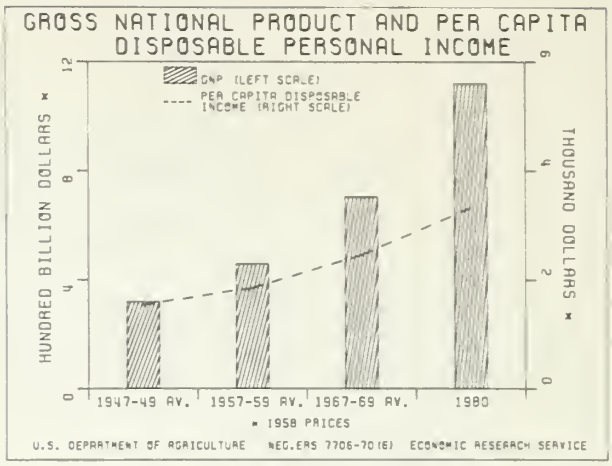

Figure 2

after-tax incomes and a continued expansion of consumer buying power.

The increasing world trade in agricultural commodities is expected to provide important markets for U.S. farm products. The rate of growth in export markets will depend to a considerable extent on factors outside direct U.S. control, such as growth rates of industrialized countries, relative growth of population and food production in less developed countries, and restrictions on trade by individual nations or trading groups. The export projections in this paper assume that the less developed countries will continue to increase production through the use of improved crop varieties and cultural practices. The further assumption is made that the major U.S. agricultural export commodities will continue to be competitive in "free" world trade.

Not all factors favor growth of agricultural markets. Farm product markets face competition from a number of synthetic and other substitute products. Cotton and wool have both suffered from inroads by synthetic fibers in both domestic and foreign markets. Similarly, the natural oils have lost a large part of industrial outlets for products such as paints and detergents; and urea appears to have captured a significant part of the market for high-protein feeds.

Trends in Consumption

Per capita food consumption on a price-weighted index basis increased slightly over the last two decades even though per capita consumption in terms of total pounds declined over the same period (fig. 3). This reflects changes in the mix of food consumed in response to a variety of forces: Rising incomes, trends in relative prices, changes in living and working conditions, and the increasing importance of convenience foods. The

[3]Recent demographic reports suggest a slower rate of growth than is assumed here. Subsequent projection efforts probably will incorporate a slower assumed rate of population increase such as Series "D" of the Bureau of the Census.

price-weighted index of per capita food consumption may show some further increase with a continued shift toward more meats, poultry, and convenience foods.

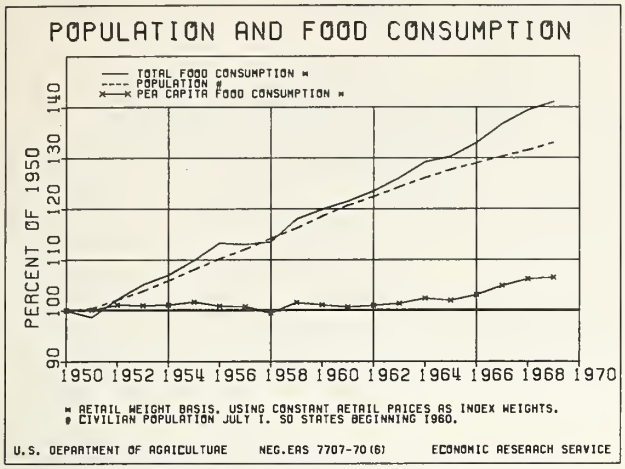

Figure 3

Per capita food consumption trends of the last two decades are highlighted by a rapid rise in consumption of poultry meat. At least part of this increase was in response to lower prices resulting from important technological changes in production and recent developments in marketing methods. Beef consumption also has increased markedly as consumer buying power rose. At the same time, per capita use of all dairy products has declined, mainly because of the sharp decline for butter and other high-fat products. On the other hand, per capita use of cheese has increased somewhat. The downtrend in per capita consumption of wheat products has moderated in recent years, while consumption rates for most other cereals have been steady or rising. There has been relatively little change in per capita use of all fruits and vegetables. However, processed uses of both fruits and vegetables have increased markedly while fresh uses have trended downward.

Rising income levels and the strong consumer preference for beef which encouraged substantial increases in beef consumption over the last two decades seem likely to continue. Accordingly, per capita beef and veal consumption may rise by 15 to 20 pounds above the 1969 level of 113 pounds. Pork consumption per person has not shown a clear trend over the last two decades and may change relatively little by 1980. However, efforts to improve the desirability of pork by reducing the amount of fat could bring some increase in per capita use (fig. 4).

The very rapid increase in per capita consumption of poultry meat over the last two decades resulted in part from the major technological advances in production

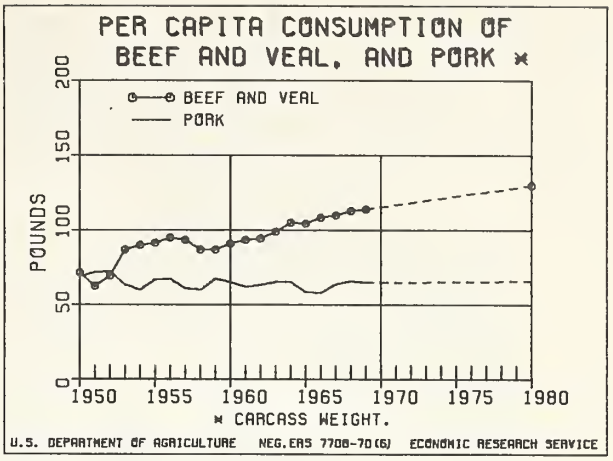

Figure 4

and marketing which brought lower relative prices for poultry. Future technological developments are not likely to be as favorable toward increased production and consumption of poultry as were developments of the last two decades. Nevertheless, poultry prices should continue to encourage expanded consumption of both chicken and turkey. Per capita use of chicken is projected for 1980 at around 50 pounds with per capita use of turkey rising to about 10 pounds (fig. 5).

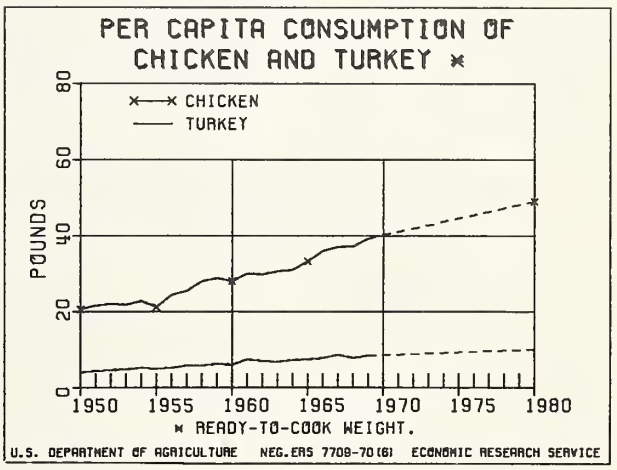

Figure 5

Milk consumption per person has declined sharply over the last two decades as butter and other high-fat dairy products have faced strong price competition from competing products. In addition, these same products have been adversely affected by diet and health questions. Per capita milk consumption (milk equivalent of all uses) may decline by 15-20 percent in 1980 from the 1969 level of 566 pounds. A decline of this magnitude

would more than offset the effect of population growth and would imply some decline in total use from the 1969 level. Per capita consumption of eggs is projected to decline slightly as the continued decline in fresh egg use may not be fully offset by processed uses. However, total use may rise perhaps by around 10 percent in 1980 (fig. 6).

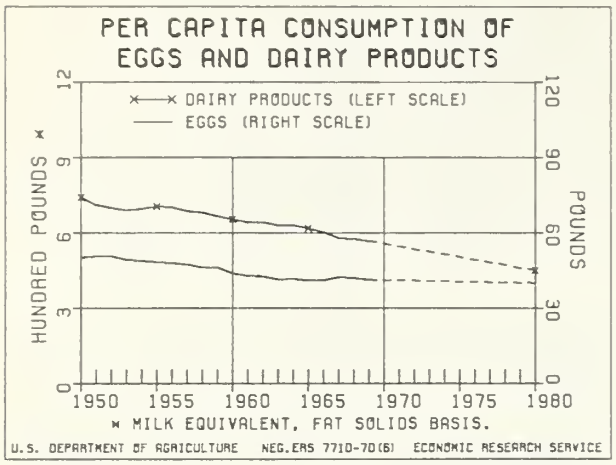

Figure 6

Use of food fats and oils has increased perceptibly in the last few years, perhaps partly because of the increase in quick service retail food outlets. Per capita disappearance is projected to increase slightly in the next decade, possibly by 2 to 5 pounds (fat content) from 52 pounds in 1969. The shift from animal to vegetable oils is expected to continue (fig. 7).

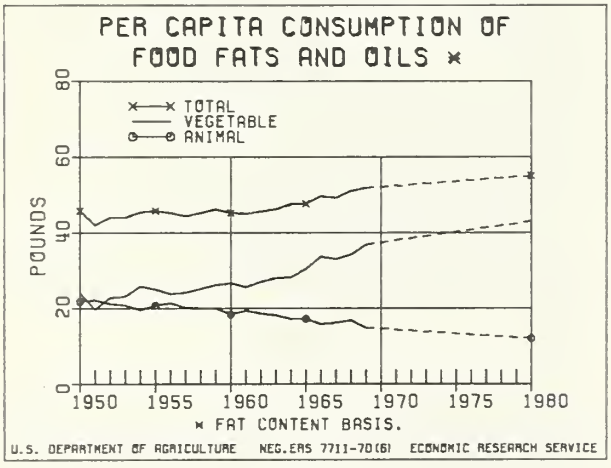

Figure 7

An expected increase in citrus production and consumption suggests that per capita consumption of all fruit may rise in the next few years. Large citrus tree plantings in recent years in frost-free production areas point to continued growth in citrus production. For this reason, citrus consumption, which was 89 pounds per capita in 1969, is projected to be 20 to 25 percent higher by 1980 (fig. 8).

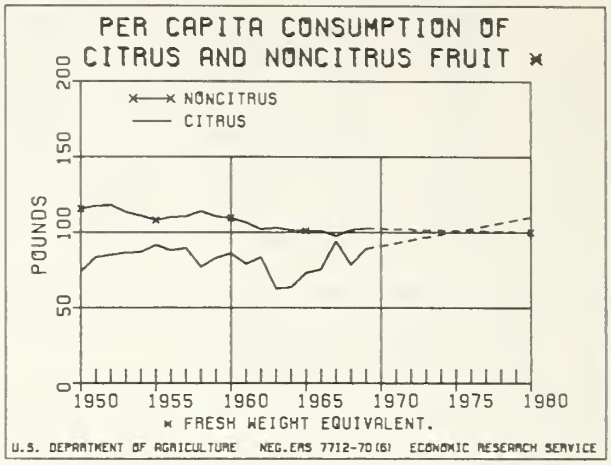

Figure 8

Consumption of all vegetables and melons on a per capita basis has been relatively stable in recent years. However, the form of consumption has shifted considerably from fresh to processed uses, and this trend is expected to continue. Per capita consumption in processed form during the decade may increase by 8 to 10 pounds above recent levels. Fresh consumption, however is expected to decline further, perhaps to around 90 to 95 pounds (fig. 9). Per capita consumption of potatoes

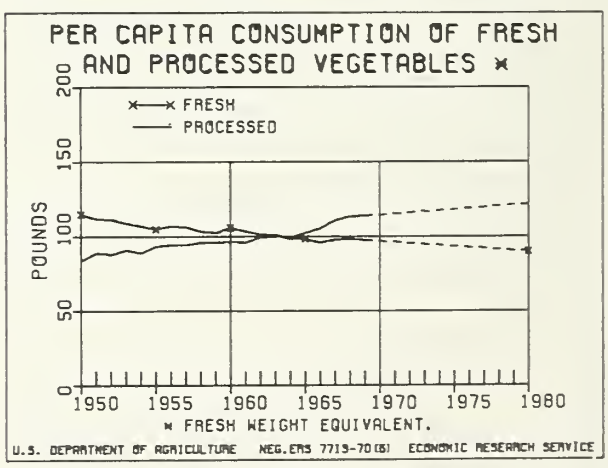

Figure 9

in all forms has been around 110 pounds for several years and may not change very much during the next decade.

The long-term downtrend in wheat consumption has moderated in recent years. Use per person in 1980 is projected to decline by perhaps 5 pounds or a little more from the 155 pounds in 1969. Food use of corn declined up to the midfifties, but has increased during the last 15 years, due largely to the increasing importance of corn sirup and sugar and partly to the introduction of new types of breakfast cereals and other processed products. Per capita consumption in the coming decade is expected to at least maintain the 60 pounds in 1969. Consumption of rice is trending upward while use of oats and other grains is about stable (fig. 10).

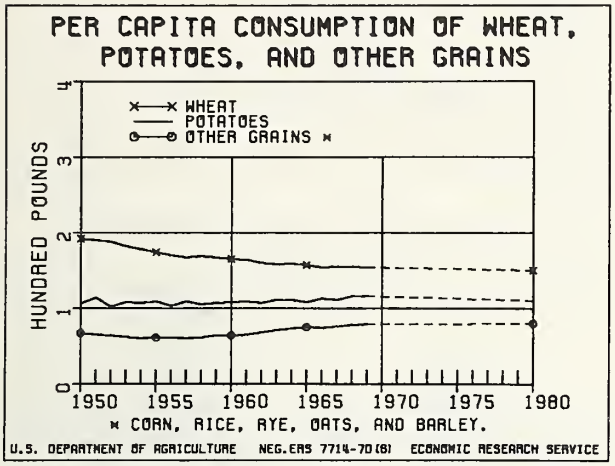

Figure 10

Feed Use

The quantity of feed concentrates used depends on the production level of livestock and livestock products and the rate of feeding per unit of production. Feeding rates in turn depend on the relative prices of feed and livestock products, the mix of production, and changes in feeding efficiency.

Total livestock production in 1980 is projected to increase by about 30 percent above the 1967-69 average. The feeding rate may rise slightly over the next decade if livestock-feed ratios continue relatively favorable. A larger part of milk and beef production is likely to come from concentrate feeding rather than from roughages even though physical feeding efficiency is expected to increase for most livestock items. Accordingly, the total of concentrates fed is projected to increase possibly around 35 percent by 1980 from the 171-million-ton average for 1967-69 (fig. 11).

Until the early sixties, use of high-protein feeds had been rising more rapidly than use of total feed concentrates. However, in the last few years, this rate of increase has slowed somewhat, apparently in response to the increasing use of urea for dairy and beef cattle feeding. Projected feed use for 1980 assumes some further increase in the use of urea and other protein feed substitutes such as petro-protein meal.

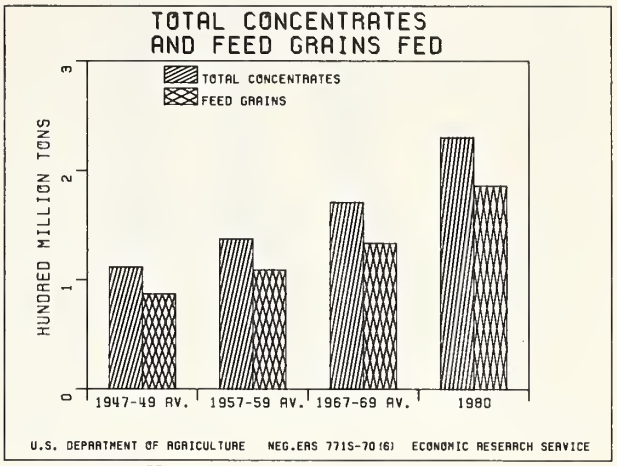

Figure 11

Export Projections

Export outlets for U.S. agricultural products expanded substantially after World War II but have leveled in recent years. Most of the gain was in commercial sales, even though exports under Government programs have been important, especially for food crops. Export markets, which may fluctuate considerably on a year-to-year basis, are important for many U.S. crops—especially rice, wheat, soybeans, and cotton. Exports of livestock products have increased during the last two decades, but the total remains small relative to crop exports.

Exports are influenced by many factors, including foreign and domestic programs and policies, international trade arrangements, trade relations with communist countries, and the growth of foreign demand. Population and income growth, and technological change as it influences the level of world agricultural production, are major forces affecting export demand.

Livestock exports are expected to continue to be a very small part of total production. Crop exports are projected to rise 35 to 40 percent above the 1967-69 level by 1980 (fig. 12).

Soybean exports are projected to continue to increase, although at a slower rate than over the past decade. Exports of soybeans, not including products, are projected to increase by around two-thirds (fig. 13). Feed grain exports in 1980 may increase by about 50 percent or more from the 1969 level (fig. 14).

Wheat and rice exports may trend upward slightly, with considerable year-to-year variation possible. Cotton

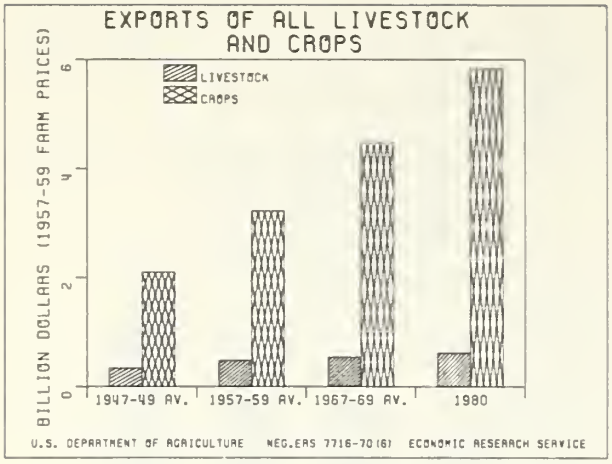

Figure 12

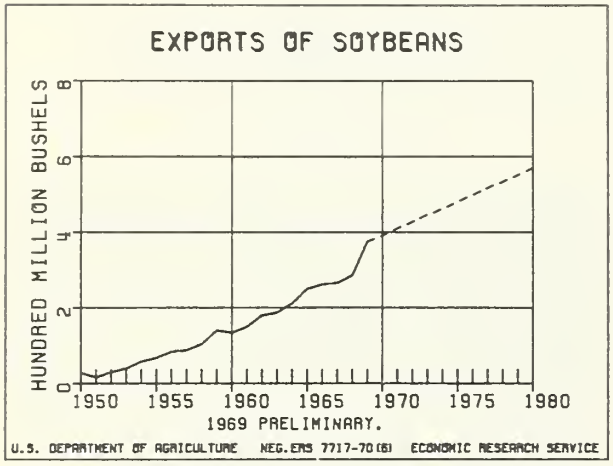

Figure 13

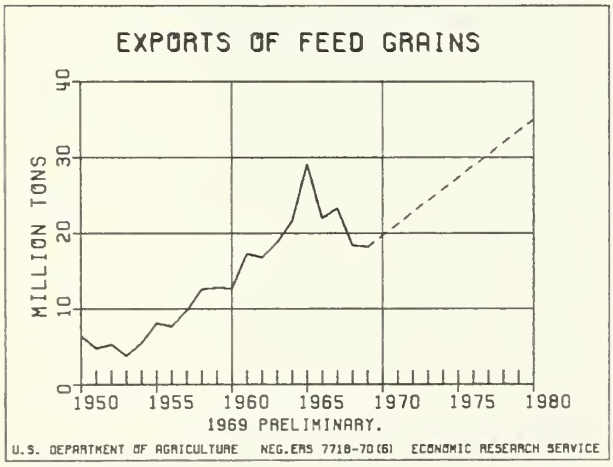

Figure 14

exports are projected to recover somewhat from the depressed level of 1969 and then perhaps to hold near the 1967-69 average. The uncertainties in international cotton trade include competition from synthetic fibers as well as among producing countries (fig. 15). On balance, exports are expected to continue to account for around a fifth or more of total crop output.

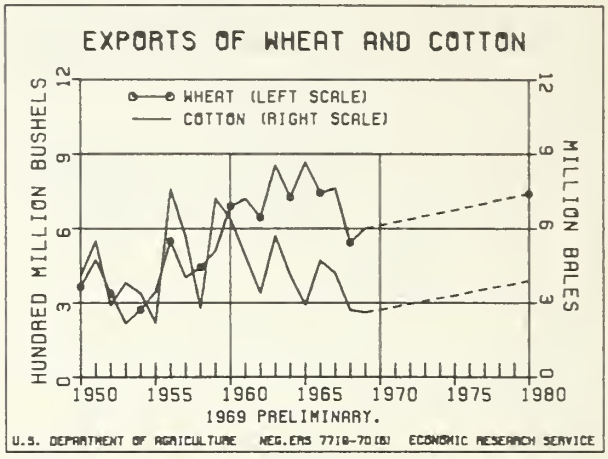

Figure 15

Imports of some commodities, expecially those which are labor intensive, are likely to rise in the next decade. The actual rate of increase will depend on both domestic programs and import restrictions as well as on growth in foreign markets.

Farm Prices, Production and Land Use

Prices of farm products in the coming decade will depend largely on the trend in the general price level and on the success of agriculture in adjusting resource use to market demands. These projections assume prices for major crops around levels of recent years. However, prices may trend upward for the more labor-intensive crops among the fruits, vegetables, and specialty crops. These price levels imply that some cropland will continue to be withheld from production.

Barring some substantial breakthrough in the technology of livestock production, prices for livestock products may rise somewhat over the next decade from the 1967-69 average and will probably continue to rise relative to crop prices. Efficiencies in production of poultry and eggs may limit gains in prices for these commodities even though market demand is expected to remain strong for poultry meat.

Although prices received by farmers for all farm products are not expected to rise in the next few years,

they may show a slight upward trend by 1980. Nevertheless, the increase may be somewhat less than the projected rise in general price levels (fig. 16).

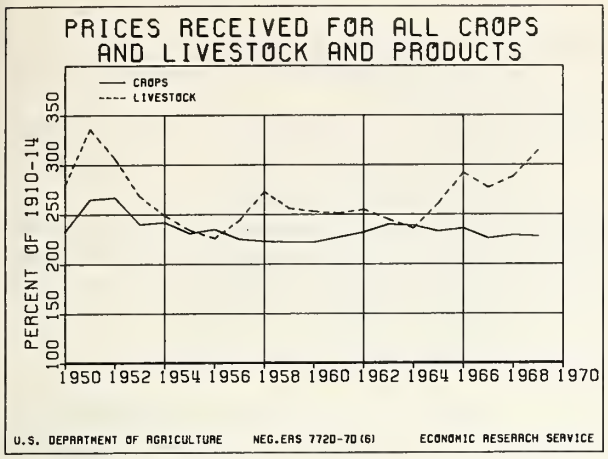

Figure 16

Crop output for 1980 is projected to rise around one-fourth from the 1967-69 average, due in large part to expanding demand for feed crops (fig. 17). Among livestock products, the largest increases over the 1967-69 average in production are projected for poultry (nearly 50 percent) and beef cattle (about one-third). Pork production may increase about in line with the growth in population. A somewhat smaller increase is projected for eggs, while output for milk may decline modestly or remain near recent levels.

Among the major field crops, production levels for feed grains are projected to increase by around 40 percent from 1967-69. Wheat production is expected to increase from the 1970 crop, but may change little from the 1967-69 average if exports expand moderately as expected. Cotton production will probably recover somewhat from reduced levels in recent years. But expansion will continue to depend heavily on domestic

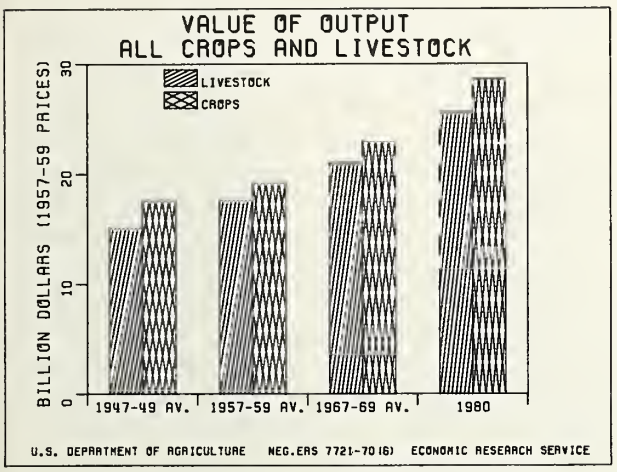

Figure 17

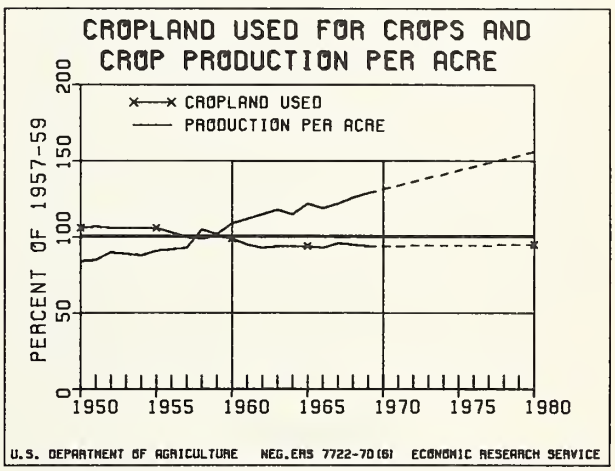

Figure 18

Table 1.—Yields per harvested acre for selected crops, selected averages and projections to 1980

Commodity	Average			Projected 1980
	1947-49	1957-59	1967-69	
Wheat, all . . . . . bu.	16.9	23.6	28.4	35
Rice . . . . . lb.	2,126	3,250	4,416	5,700
Corn for grain . . . . . bu.	36.6	51.4	80.4	109
Grain sorghum . . . . . bu.	19.2	33.4	52.8	76
Oats . . . . . bu.	33.4	40.2	51.9	62
Barley . . . . . bu.	25.4	30.1	42.9	55
Soybeans . . . . . bu.	20.0	23.6	26.2	31
Peanuts . . . . . lb.	721	1,076	1,767	2,470
Tobacco . . . . . lb.	1,208	1,552	1,984	2,200
Cotton . . . . . lb. lint	287	438	466	560
Hay . . . . . tons	1.34	1.68	2.00	2.3

and foreign market prospects. Tobacco production is projected to decline if cigarette consumption drops as expected. Vegetable and fruit crops are projected to increase by around 20 to 25 percent from the 1967-69 average.

Continued advances in technology—including more productive varieties and more efficient cultural practices—as well as increased use of fertilizer and other purchased inputs will further increase yields in the coming decade (table 1). The increase may about match projected growth in demand. This implies little overall change in crop acres harvested, in contrast to the downtrend in crop acres harvested over the last two decades (fig. 18). Changes in the proportions of total harvested acreage used for various crops will continue to reflect changes in demand and differential rates of expansion in production technology.

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A General Simulation Model for Farm Firms

By H. R. Hinman and R. F. Hutton

A generally accepted theory of firm behavior is incorporated into an abstract computerized simulation model capable of handling many different environments and organizations. This model provides a means of studying management problems using the simulation approach by providing, in most instances, only data needed to describe the problem situation. For cases in which the situation to be studied is different from the general logic of the model, link points are provided at which the basic logic of the model can be modified.

Key words: Farm firms, firm behavior, simulation, farm management, methodology.

Computer simulation has been widely accepted by agricultural economists.[1] However, one of the problems encountered in applications has been the time and expense involved in preparing computer programs to represent the environment and organization being studied. The model reported in this paper incorporates the generally accepted theory of firm behavior into an abstract computerized simulation model capable of handling many different farming environments and organizations. In addition, it provides convenient link points at which the basic logic can be modified. The object is to provide a means of studying management problems using the simulation approach by providing, in most instances, only the data needed to describe the problem situation. The definition of the problem at the level of data input eliminates or greatly reduces the need to develop computer programs specific to each problem.

All numeric coefficients and all activity, product, and input service identifications are entered as data. Physical resources controlled by the firm are described in terms of the type of input service they render, their quantity, and, if they are depreciable, their age. Production opportunities are described in terms of input services rendered and outputs produced. Output of each product may be treated as a probability event and, subject to modifications, may be considered to reflect alternative rates of efficiency.

The model permits expression of alternative sets of technical relationships for given enterprises and for alternative sets of enterprises. It allows expression of variability in crop and livestock production due to natural hazards—weather, plant or animal diseases, insect damage, ill health of the operator or his laborers, and other like sources of risk in farming. It also permits variability in product prices and allows expression of trend over time in product prices and in the value of assets. A full description of the features, logic, and instruction as to the use of this simulation model is contained in "A General Agricultural Firm Simulator."[2] The general theory and logic incorporated into this simulator are discussed in the following sections.

Characteristics

The general simulator is designed to handle any farm situation. Thus, the production alternative, or activities, and the resources, as represented by input services and products, are entered as technical coefficients relating input to product, costs and prices. The flow of operations performed by the general simulator follows that outlined by the solid lines of figure 1. The dashed lines represent modifications that are discussed later.

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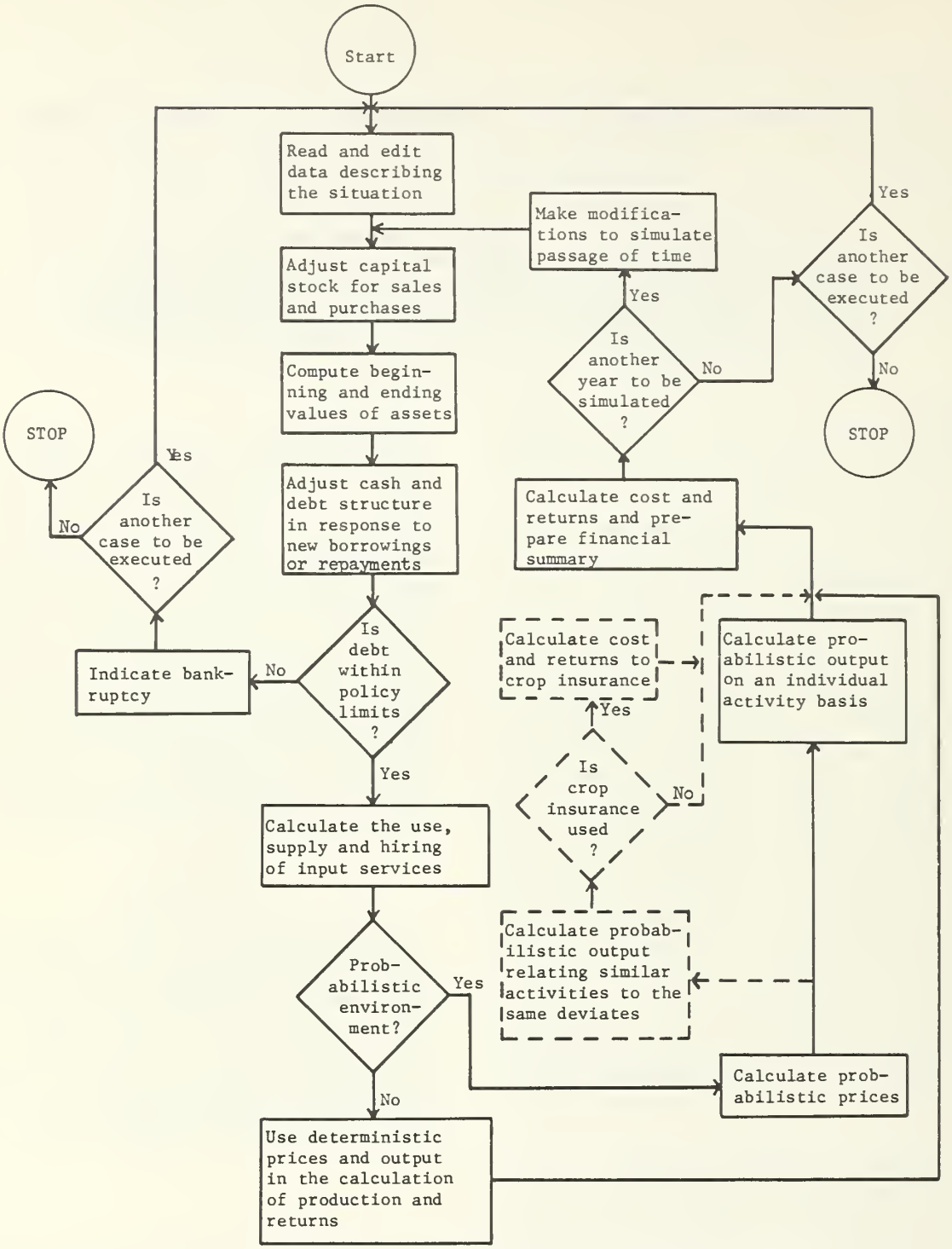
[3] H. R. Hinman. Appraising Results of Alternative Finance Management Practices by Use of Simulation. Unpublished Ph.D. thesis, Pa. State Univ., Dec. 1969.

Flow Chart of General Agricultural Firm Simulator



(Extensions and modifications are indicated by dashed lines and boundaries).

Figure 1

Capital Stock

The input data will identify the initial inventory of capital goods. The capital stock is adjusted for sales and purchases at the start of the year. The prices at which these assets are purchased or sold are specified as data. The prices may, at the option of the user, be subjected to trend values over simulated time and the assets purchased may be subjected to minimum quantity regulations.

Physical capital items owned by the firm are described in terms of the type of input service they provide, their value, and if depreciable, their age. Depreciation of capital is on a straight-line basis. When an item is fully depreciated, it ceases to provide input services. Assets, such as land, that have an infinite life can be identified in the input as nondepreciable. In the calculations of beginning and ending values the assets may be subject to appreciation or depreciation related to monetary inflation or deflation as well as depreciation over simulated time to reflect wear-and-tear and obsolescence.

Debt Structure

The initial financial status of the firm is specified in the input data. The cash balance and debt structure are adjusted each simulated year for any new borrowings or prepayment of debts. Up to three types of credit are provided for within the framework of the model. The terms for the credit are specific to the data presented by the user. For each type of credit the user must specify the type of collateral suitable for use as security, the length of the repayment period and the interest rate. It was anticipated in the model design that the three types of credit would be (1) long-term credit that needs real estate as security, (2) intermediate-term credit that needs either real estate or chattel as security, and (3) short-term credit that can use real estate, chattel, and the general standing of the firm as security. However, other alternatives may be used.

Credit of each type may have a minimum percentage of collateral required. If the security required for the debt cannot be met, after any relevant refinancing the farm is forced into simulated bankruptcy. If the debt structure is within the limits set by the policy governing debt management, the supply, use, and hiring of input services for the year are calculated.

Inputs

Input services required for the operation of the firm are provided by capital owned or controlled by the firm, by direct service purchases (renting), or by products of current production. The capital goods in inventory are considered first as a source of input services. Next in order as sources of inputs are the intermediate products, such as feed, produced during the year. Needed inputs not obtained from either of these sources are purchased on the open market. These purchases may be subject to minimum lot sizes and the purchase price may be subject to price trends. Unused services provided by physical capital can be left idle or sold directly. Intermediate products remaining after input demands have been satisfied may be sold on the open market or placed in inventory. Intermediate products in inventory may be used the following year as collateral for loans. In the following year these intermediate products may be sold, used to satisfy input needs, or allowed to remain in inventory.

Price and Yield

One of the options in the model permits prices and yields to be selected on a probabilistic basis. In the probabilistic calculation of yield, the average yield per unit, the standard deviation of yield, and the limits within which yield is allowed to vary must be specified.

For each product of each activity, a random deviate is drawn without replacement from a population with a mean of zero and a standard deviation of one. This deviate specifies the direction and extent of variation in yield from the average. If the selected deviate is outside the limit of variation specified by the input data, it is rejected and another is selected. If the selected deviate is satisfactory, the product of it and the standard deviation is added to the average output to obtain the base yield. This base yield is then adjusted to account for departure of management efficiency from the basic level to obtain the yield per unit for the year.

For example, assume that the simulator is at the point of selecting a year's yield of alfalfa hay. The user has specified that the average production of alfalfa is 3 tons, the standard deviation is .90, and production is not allowed to vary more than two standard deviations. The model selects a factor from a population with a normal distribution, having a mean zero and standard deviation of one, to determine the number of standard deviations yield departs from the average. If the factor selected is outside the range of -2 to 2, it is rejected and another is selected. Assume, however, that the factor selected is -.95. The deviation from average yield is calculated as follows:

Standard deviation		Random deviate		Deviation
.90	X	-.95	=	-.855 ton

The base yield per acre of alfalfa grown for the year is: 3 tons -.855 ton = 2.145 tons.

The base yield is subjected to the management efficiency adjustment specified in terms of percentage of yield, to determine the yield per acre of alfalfa grown for the year. For example, if the factor specified that this farmer's efficiency was 90 percent of standard, yield per acre for the year would be: 2.145 X .90 = 1.9341 tons.

If the deterministic mode of simulation is used, the yield per unit for the simulated activity is determined by multiplying the efficiency factor by the average product per unit. This would be the same as the above treatment if the random deviate was always zero.

Probabilistic prices are chosen in a manner similar to that outlined for yield. The user specifies the average price, standard deviation, and limit to variation. The average price may be adjusted for trend. If a trend adjustment is made, the standard deviation is also adjusted to maintain the original ratio of price to deviation. A random deviate is multiplied by the standard deviation and the resulting product is algebraically added to the trend-adjusted average price to obtain the price for the year.

If the deterministic mode of simulation is used, the price per unit of product is determined by adjusting the average price for trend value.

Returns

The returns to the farm are calculated on both a cash and a net income basis. The net income includes gains and losses resulting from asset appreciation and depreciation. Costs included in this calculation and not discussed previously in this paper are the opening and closing costs for loans, property taxes, insurance, direct cash cost related to each activity, and maintenance and repair costs.

Income and social security taxes are levied against the firm's cash income. In the calculation of taxable income, depreciation along with the normal allowances for dependents and the "standard" tax deductions are subtracted from cash income. A withdrawal for family expenditures and the payment of debt principal are made from the firm's cash reserves before the ending financial summary is calculated and the results for the year recorded.

The ending financial summary for a one-year simulation of a farming situation, run first in the deterministic mode and then in the probabilistic mode, is given in the appendix. In the particular instance the deterministic run yielded some $3,000 more net cash income than the probabilistic. After many replications of the probabilistic, the average would be expected to approximate that of the deterministic. However, a series of several replications of the probabilistic will yield information on income variability not available from the deterministic run.

Treatment of Time

If another year of the current situation is to be projected, the simulator makes the modifications needed to characterize passage of time. Prices and asset values will be updated in accordance with their respective trend in value if such trends were indicated by data. The age of each depreciable asset is increased by a year. Additional borrowings, purchases, or sales of capital assets, and change in the organization of the firm's enterprises may remain the same as that of the previous year or be modified for the coming year by one of two methods. One method is to provide data describing the borrowings, purchases, and sales of capital assets and the organization of the firm's enterprises for the coming year. The other method is to use a subroutine, called at the end of each year's run, which simulates the environmental conditions resulting in change in those variables. This subroutine is currently a "user" subroutine that can be designed by the user to reflect the conditions of the particular environment being simulated. This and other "user" subroutines are discussed in the following sections.

If an additional year is not to be projected for the situation, the ending results of this situation will be stored on a history file, and the simulator proceeds to read and edit the data describing another situation if one is offered. In this manner, several versions of similar situations, corresponding to different assumptions regarding either internal management or external environment, can be conveniently explored in a series.

Modification by User Program

The logic of this model is based upon a generally accepted theory of firm behavior. However, different environments or organizations may require a change from this logic or the objectives of an analysis may call for a more comprehensive simulation than that offered

in the general model. To provide for such eventualities without extensive reprogramming, subroutines are called at eight points in the analysis. These points were selected with the intent of providing exits at points where the user could conceivably be expected to offer alternatives to the logic of the general simulator. The subroutines entered at these exits may be written to the user's specifications to modify data to reflect change in logic. All major data arrays are in common storage locations and are easily addressed by such subroutines. The use of these subroutines is unlimited and extremely useful. For example, in a recent study that used this model to appraise alternative financial management practices,[3] subroutining was used in two ways to adapt the general model to the study. These revisions are indicated by the flows outlined by dashes in figure 1 and are described below.

The general model does not relate probabilistic yield of one activity with the probabilistic yield of another activity. In a nonirrigated farming situation, as was used in the above-mentioned study, similar crops grown and harvested during the same period of the year were generally affected in similar fashion by the environmental conditions. Therefore, a subroutine was used to revise the model so that crops grown and harvested during the same period of the year would be subject to the same deviate.

One of the purposes of the study was to evaluate crop insurance under different environmental and equity situations. The general model will not handle cost and returns of crop insurance; therefore, a special subroutine was used to modify the simulator to accommodate the analysis. Both of these changes were accomplished in less than 60 FORTRAN statements. This was a minor undertaking compared to the 1,600 executable statements in the main body of the simulation program.

One of the exits from the main model program to a subroutine is at the end of the writing of the "history" for each period. There is no limit to the variety of things the user can do at this point to reflect change in multiple-period runs. One example is the modification of input or output coefficients over simulated time. Another is the imposition of more complex changes in price or cost rates than the linear trend provided in the model. Still another is a modification that will lead to storage of results, on magnetic tape or a similar device, for use by subroutines to be called later in the analysis. Perhaps the most useful feature is that the simulation model offers an opportunity for incorporating a set of decision rules to carry the situation from one year to the next. In the study previously mentioned, this exit was used to incorporate a very comprehensive set of decision rules into the model. In this way, consequences of alternative decision rules over time could easily be traced.

A call to a subroutine is also made at the end of the simulation of a case. This is either at the expiration of the indicated number of periods or at the completion of the indicated number of replications and number of periods. This exit is useful in processing the results of the simulation just completed by subjecting the information generated in all the runs for the case to statistical or other appropriate analysis. This is also the point at which a "report writing" routine could be used to summarize the results of the analyses.

Appendix: Sample Output

The sets of output in tables 1 to 6 result from a specific farming situation run in both the deterministic and probabilistic modes of the simulator. All output printed is done so at the option of the user. The table headings and footnotes explaining the purpose of the output are not part of the output.

[3] H.R. Hinman. Appraising Results of Alternative Finance Management Practices by Use of Simulation. Unpublished Ph.D. thesis, Pa. State Univ., Dec. 1969.

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Table 1.—Summary of capital transactions and adjustments made in the inventory stock and the borrowing schedules for the year*

1. DETERMINISTIC - CASE 1 1970

CAPITAL CLASS	BOUGHT	SOLD	PRICE	VALUE
TRACTOR		1.0	1400.00	1400.00
COMBINE		1.0	1875.00	1875.00
GEN BARN	1.0		3200.00	3200.00
FEEDERS	10.0		125.00	1250.00
FEEDERS	10.0		124.50	1245.00
FEEDERS	10.0		124.00	1240.00
FEEDERS	10.0		123.50	1235.00
FEEDERS	10.0		123.00	1230.00
FEEDERS	10.0		122.50	1225.00
FEEDERS	10.0		122.00	1220.00
FEEDERS	10.0		121.50	1215.00

1.00 UNITS OF BALER WERE DROPPED FROM INVENTORY
80.00 UNITS OF FEEDERS WERE DROPPED FROM INVENTORY
CASH FELL BELOW MINIMUM LEVEL BY 2785.01
CLASS 1 DEBT EXCEEDS SECURITY VALUE
REDUCE CLASS 1 AND INCREASE CLASS 3 DEBT BY 46.02

*This table is the same for the probabilistic version of this situation and therefore will not be illustrated for the sample probabilistic run.

Table 2.—Supply and use of input services*

1. DETERMINISTIC - CASE 1 1970

INPUT CLASS	SUPPLY	USE	HIRE-IN	HIRE-OUT	$ AMOUNT
TRACTOR	800.00	1139.00	339.00	0.0	1190.00
PLOW	500.00	99.00	0.0	401.00	0.0
MOWER	200.00	37.00	0.0	163.00	0.0
BALER	250.00	37.00	0.0	213.00	0.0
DRILL	100.00	6.80	0.0	93.20	0.0
COMBINE	0.0	14.20	14.70	0.0	90.40
PLANTER	120.00	35.00	0.0	85.00	0.0
PICKER	200.00	47.50	0.0	152.50	0.0
HARVESTER	200.00	30.00	0.0	170.00	0.0
SPREADER	350.00	348.00	0.0	2.00	0.0
BARN DAIRY	20.00	20.00	0.0	0.0	0.0
GEN BARN	2400.00	2000.00	0.0	400.00	0.0
LAND II	60.00	80.00	20.00	0.0	400.00
LAND III	50.00	50.00	0.0	0.0	0.0
LAND VI	40.00	80.00	40.00	0.0	200.00
LABOR 1Q	640.00	1122.00	482.00	0.0	723.00
LABOR 2Q	640.00	1210.00	570.00	0.0	855.00
LABOR 3Q	640.00	1086.00	446.00	0.0	669.00
LABOR 4Q	640.00	992.00	352.00	0.0	528.00
FEED GRAIN	2560.00	2200.40	0.0	359.60	0.0
SUPPLEMENT	0.0	154.00	154.00	0.0	832.50
HAY	408.00	270.00	0.0	138.00	0.0
CASH COST	0.0	10264.00	10264.00	0.0	10264.00
DAIRY COWS	20.00	20.00	0.0	0.0	0.0
HARROW	200.00	30.10	0.0	169.90	0.0
FEEDERS	80.00	80.00	0.0	0.0	0.0

*This table is the same for the probabilistic version of this situation and therefore will not be illustrated for the sample probabilistic run.

Table 3.—Summary of yield per unit, number of production units, total production, and product prices for deterministic version*

1. DETERMINISTIC - CASE 1 1970						
ACTIVITY	PRODUCT	PROD/UNIT	NO. UNITS	TOTAL PROD	PRICE	$ VALUE
DAIRY I	MILK	130.00	20.00	2600.00	4.41	11465.99
DAIRY I	CULL COWS	0.20	20.00	4.00	150.35	601.40
STEERS	BEEF	10.00	80.00	800.00	24.95	19958.38
CORN II	FEED GRAIN	56.00	30.00	1680.00	2.31	3880.80
CORN III	FEED GRAIN	44.00	20.00	880.00	2.31	2032.80
WHEAT II	WHEAT	40.00	20.00	800.00	1.50	1200.00
SILAGE II	HAY	5.30	30.00	159.00	30.90	4913.09
HAY III	HAY	3.50	30.00	105.00	30.90	3244.50
PASTURE VI	HAY	1.80	80.00	144.00	30.90	4449.59

*In the deterministic version, production per unit is fixed and prices received are subject to specified price trends.

Table 4.—Summary of yield per unit, number of production units, total production, and product prices for probabilistic version*

1. PROBABILISTIC - CASE 1 1970						
ACTIVITY	PRODUCT	PROD/UNIT	NO. UNITS	TOTAL PROD	PRICE	$ VALUE
DAIRY I	MILK	82.76	20.00	1655.20	4.42	7321.54
DAIRY I	CULL COWS	0.17	20.00	3.44	147.82	508.24
STEERS	BEEF	9.78	80.00	782.13	26.00	20334.45
CORN II	FEED GRAIN	69.37	30.00	2081.21	2.36	4909.27
CORN III	FEED GRAIN	26.32	20.00	526.41	2.36	1241.71
WHEAT II	WHEAT	32.61	20.00	652.11	1.58	1030.92
SILAGE II	HAY	4.53	30.00	135.87	31.34	4258.39
HAY III	HAY	4.08	30.00	122.40	31.34	3836.00
PASTURE VI	HAY	1.93	80.00	154.26	31.34	4834.77

*In the probabilistic version, production per unit is subject to random deviations. Product prices are subject to random deviations and specified price trends.

Table 5.–Results of the simulated year's operations for deterministic version of the farm situation.

1. DETERMINISTIC - CASE 1 1970.

RESOURCES AND ORGANIZATION	
ASSETS	
TRACTOR	233.33
PLOW	552.00
MOWER	854.00
DRILL	525.00
PLANTER	222.00
PICKER	750.00
HARVESTER	300.00
SPREADER	125.00
BARN.DAIRY	5500.00
GEN BARN	3040.00
LAND II	16853.98
LAND III	9922.48
LAND VI	2080.80
DAIRY COWS	8000.00
HARROW	38.00
CASH	13560.90
TOTAL ASSETS	62557.47
DEBTS	
REAL ESTATE DEBT	20856.28
CHATTEL DEBT	2000.00
OTHER DEBT	1665.52
TOTAL DEBTS	24521.79
NET WORTH	38035.68
LABOR	
FAMILY HOURS	2560.00
HIRED.HOURS	1850.00
TOTAL LABOR	4410.00
MAN EQUIV.	1.47
LIVESTOCK	
DAIRY I	20.00
STEERS	80.00
CROP	
CORN II	30.00
CORN III	20.00
WHEAT II	20.00
SILAGE II	30.00
HAY III	30.00
PASTURE VI	80.00

FINANCIAL SUMMARY	
OPERATING INCOME	
MILK	11465.99
BEEF	19958.38
FEED GRAIN	830.68
HAY	4264.18
CULL COWS	601.40
WHEAT	1200.00
CASH OPERATING INCOME	38320.62
CAPITAL ASSETS SOLD	3274.99
GROSS FARM INCOME	41595.62
OPERATING EXPENSE	
REPAIR AND MAINTENANCE	476.85
PROPERTY TAXES	501.28
INSURANCE	230.44
INTEREST	1916.96
OTHER LOAN COST	180.00
TRACTOR	1190.00
COMBINE	90.40
LAND II	400.00
LAND VI	200.00
LABOR 1Q	723.00
LABOR 2Q	855.00
LABOR 3Q	669.00
LABOR 4Q	528.00
SUPPLEMENT	832.50
CASH COST	10264.20
CASH OPERATING EXPENSE	19057.63
NET CASH OPERATING INCOME	19263.00
INVENTORY DECREASE	534.38
CAPITAL PURCHASES	13060.00
GROSS FARM EXPENSE	32652.00
NET FARM INCOME	8943.61
INCOME TAX (CASH BASIS)	1032.98
SOCIAL SECURITY TAX	405.90
PAYMENT ON DEBT PRINCIPAL	3263.21
INTEREST ON INVESTMENT	2955.83
LABOR AND MGT. RETURNS	7904.75
RETURNS PER MAN	5377.38
OFF FARM INCOME	2000.00
WITHDRAWALS	4000.00

Table 6.—Results of the simulated year's operations for probabilistic version of the farm situation.

1. PROBABILISTIC - CASE 1 1970.

RESOURCES AND ORGANIZATION	
ASSETS	
TRACTOR	233.33
PLOW	552.00
MOWER	854.00
DRILL	525.00
PLANTER	222.00
PICKER	750.00
HARVESTER	300.00
SPREADER	125.00
BARN.DAIRY	5500.00
GEN BARN	3040.00
LAND II	16853.98
LAND III	9922.48
LAND VI	2080.80
DAIRY COWS	8000.00
HARROW	38.00
CASH	10589.82
TOTAL ASSETS	59586.39
DEBTS	
REAL ESTATE DEBT	20856.28
CHATTEL DEBT	2000.00
OTHER DEBT	1665.52
TOTAL DEBTS	24521.79
NET WORTH	35064.60
LABOR	
FAMILY HOURS	2560.00
HIRED HOURS	1850.00
TOTAL LABOR	4410.00
MAN EQUIV.	1.47
LIVESTOCK	
DAIRY I	20.00
STEERS	80.00
CROP	
CORN II	30.00
CORN III	20.00
WHEAT II	20.00
SILAGE II	30.00
HAY III	30.00
PASTURE VI	80.00

FINANCIAL SUMMARY	
OPERATING INCOME	
MILK	7321.54
BEEF	20334.45
FEED GRAIN	960.57
HAY	4467.11
CULL COWS	508.24
WHEAT	1030.92
CASH OPERATING INCOME	34622.83
CAPITAL ASSETS SOLD	3274.99
GROSS FARM INCOME	37897.82
OPERATING EXPENSE	
REPAIR AND MAINTENANCE	476.85
PROPERTY TAXES	501.28
INSURANCE	230.44
INTEREST	1916.96
OTHER LOAN COST	180.00
TRACTOR	1190.00
COMBINE	90.40
LAND II	400.00
LAND VI	200.00
LABOR 1Q	723.00
LABOR 2Q	855.00
LABOR 3Q	669.00
LABOR 4Q	528.00
SUPPLEMENT	832.50
CASH COST	10264.20
CASH OPERATING EXPENSE	19057.63
NET CASH OPERATING INCOME	15565.20
INVENTORY DECREASE	534.38
CAPITAL PURCHASES	13060.00
GROSS FARM EXPENSE	32652.00
NET FARM INCOME	5245.82
INCOME TAX (CASH BASIS)	356.78
SOCIAL SECURITY TAX	355.38
PAYMENT ON DEBT PRINCIPAL	3263.21
INTEREST ON INVESTMENT	2955.83
LABOR AND MGT. RETURNS	4206.95
RETURNS PER MAN	2861.87
OFF FARM INCOME	2000.00
WITHDRAWALS	4000.00

A Note on "Squared Versus Unsquared Deviations for Lines of Best Fit"

By David M. Bell

This note comments on an article by Harold B. Jones and Jack C. Thompson, "Squared Versus Unsquared Deviations for Lines of Best Fit," which appeared in the April 1968 issue of Agricultural Economics Research. The purpose of that article was "to compare and contrast the two approaches in the hope that more effective utilization of both techniques will result." The authors point out that alternatives to the least squares technique exist and that these alternatives should be considered for each problem so that the most appropriate procedure may be chosen. They suggest that the differences between the two concepts are frequently unrecognized or ignored except in mathematical theory studies (4, p. 64).[1]

Given their purpose, the paper falls short in two ways. First, the treatment of squared versus unsquared deviations is less than complete. And second, a significant part of the discussion is not closely related to the primary issue, and may confuse readers with limited statistical background—those to whom the article was primarily directed.

As an illustration of the latter, while discussing least squares the authors state that "... the attempt to substitute probability for logic or cause and effect relationships carries one beyond the realm of true scientific inquiry" (4, p. 65). This is true. Statistical techniques provide only probability statements that the researcher must then interpret. But this sheds little light on the basic issue—the choice of estimation technique.

Regression as an Estimation Procedure

Jones and Thompson assume that, usually, once a regression line is fitted to the data all statistical work is completed: the line is given—it is absolute. If this were the case, their argument would be more tenable, and if a regression line fitted by absolute deviations resulted in better estimators for the given purpose than those derived from squared deviations, then that technique would be preferable. But alternatives to squared deviations other than absolute deviations may also be considered.

Consider the general equation

$$\sum_{i=1}^{N} \left| (Y_i - \tilde{Y}_i)^{\alpha} \right|$$

where Y_i equals the observed value of Y corresponding to X_i and $\tilde{Y}_i$ is the "predicted" value of that Y_i. If $\alpha = 1$, we have the absolute deviations case; if $\alpha = 2$, the squared deviations case. But α could also be set equal to .5 or 1.5 or 4 or any other value. The basic question is which value of α should be chosen.

In fact, the choice of α should be determined by the loss function (8, p. 15).[2] Simply stated, the loss function is an approximation of the cost of making a wrong or bad decision. For example, suppose that the true value of some variable, which may range from 0 to m, is A (fig. 1). The loss may then be stated as some

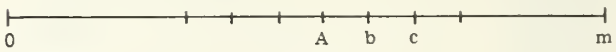

Figure 1

function of the difference between our estimate and the true value A. This function, which is determined by the characteristics of the situation, establishes weights on varying degrees of error. If deciding that c is the true value is twice as costly as deciding that b is the true value, the loss function would be linear; and in terms of

[1] Underscored numbers in parentheses indicate items in the References, page 79.

[2] We are under the assumption that no tests will be made on the line. Otherwise, other considerations to be discussed later would also be important.

regression, absolute deviations ($\alpha = 1$) would be most appropriate. If choosing c is four times as costly as choosing b, the loss function would be quadratic, and squared deviations ($\alpha = 2$) would be appropriate for the regression. α then, is determined by the nature of the loss function, and one could easily conceive a situation where $\alpha = .5$ or $\alpha = 4$ would be most appropriate.

Seldom does the researcher know precisely the true nature of the loss function. Consequently, he assumes a quadratic loss function in the belief that it is the best approximation. But if the researcher knew the loss function to be approximately linear, it would be wise to use absolute deviations. Even this does not remove all the possibility of error, however, since other values close to $\alpha = 1$ may be more appropriate.

Tests on Regression Estimators

But fitting the regression line is often only the beginning of the statistical tests. A well-developed theory exists for testing various aspects of the least squares regression line. Alternatively, the theory for testing various characteristics of the absolute deviations estimators is less developed. Some statisticians say no such test statistics exist. Others say they do, but are much too complicated to justify their use. Regardless of which is correct, one seldom sees them used.

It could be argued that statisticians should make an effort to develop these tests. But until they do, methods other than those of squared deviations will be less fruitful.

Other Considerations

Some contend that a study will be most useful when it is structured so that other researchers can interpret the findings. Following this philosophy, if tests do exist for absolute deviation estimators, but few understand them, the researcher might be well advised to use squared deviation techniques so that others could interpret the findings, and consequently use them. The authors agree with this, concluding their article with, "In the final analysis, it is only when research results are disseminated to others that anything worthwhile can be achieved . . . Any given method should be used but only where it is appropriate and preferably where the results are easily understood by those concerned with the problem. With this kind of philosophy, we can expect a wider acceptance of our research results" (4, p. 68). While I do not accept this argument entirely,[3] it does have some merit.

[3]If researchers continually used familiar and common techniques, progress would not be forthcoming.

The ease of fitting a regression line is not unimportant. Simple calculating procedures have been developed for fitting the line by using squared deviations. For smaller problems, hand calculators can be used while larger problems can be solved by using standard regression programs on electronic computers. Fitting the regression by using absolute deviation is more difficult. In extremely simple problems involving only one independent variable, graphic methods can be used on a trial and error basis. Otherwise, a linear programming procedure is necessary. Electronic computers can handle both least squares regression and linear programming models with great speed, but the relative ease associated with least squares makes it less expensive and easier to manipulate for the average researcher.

Conclusions

In conclusion, the authors have two acceptable hypotheses in their article. The first may be interpreted as: Researchers use "popular" statistical techniques in their problem solving without fully understanding the techniques. Two aspects of this hypothesis are undoubtedly true. First, researchers often use a "popular" statistical technique without being certain it is most appropriate for their problem, although this does not, in itself, justify abandoning the "popular" technique. And second, many researchers do not fully understand the technique they utilize.

The second hypothesis is: In certain situations, the absolute deviation technique may be superior to squared deviations for fitting a regression line, and in such cases it should be used. I agree. There are situations where the objectives are best served by the absolute deviations method, and in those situations use of squared deviations would not be logical.

Separating these hypotheses would have enriched the usefulness of the article by eliminating the source of confusion to those with limited statistical background.

Had the authors more clearly set forth the merits and shortcomings of both techniques, more judicious use of the two would have been possible. Instead, they present a paper supporting and recommending increased use of absolute deviations—a technique many researchers consider sterile.

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Squared Versus Unsquared Deviations for Lines of Best Fit: A Reply

By Harold B. Jones and Jack C. Thompson

We appreciate David M. Bell's comments since one of the main objectives of our paper was to stimulate additional interest in squared versus unsquared deviations. It is only through such interchanges that progress will be made in discovering other and hopefully more useful techniques.

We want to make two points clear at the start: (1) We are not advocating absolute deviations as a panacea for all estimating problems, and (2) we do not deny that least squares is a legitimate and highly useful technique. However, in view of the apparent wide differences in results that could be obtained from the two methods, obviously a choice must be made when formulating a research problem. The real issue is whether least absolute deviations might be an even more useful method than least squares if properly developed. This is the main thrust of our original article.

At the beginning of his discussion (in the third paragraph), Bell states that "statistical techniques provide only probability statements that the researcher must then interpret." He then says that this sheds no light on the choice of estimation technique. It should be obvious, however, that statistical measures state certain facts and relationships of a nonprobability nature also. Probability statements are only one segment of the science of statistics. Furthermore, the implication that choice of statistical techniques is not related to the interpretation of results cannot be substantiated. We contend that the two processes cannot be entirely separated. The choice of technique will certainly affect the interpretation of results. Statistics cannot be practiced in a vacuum. From a research standpoint, the key to solving a problem successfully is the choice of a relevant method. This particular point and a number of other issues discussed at the beginning of our original paper (that Mr. Bell believes are not closely related to the primary issue) were presented to lay the groundwork for what we proposed as a possible alternative for traditional least squares.

Given the fact that least squares is only a method of approximation and that it is "best" only in the sense of least squares, then the issue is whether there is some other approximation that would be more appropriate. This point is worth examining in more detail. Deviations can be measured by any one of a number of possible methods. Mr. Bell states this point very well in his general equation where he concludes that α could have a wide range of possible values. However, it is our contention that if any other value but $\alpha = 1$ is used there should be some logical basis or criteria that would justify this use.

The loss function could be one useful type of decision criterion, but since we seldom, if ever, know the true nature of this function we have very little basis for making such a decision without including some arbitrary assumptions. It is seldom that anyone knows the real cost of making a wrong decision. Moreover, the loss function concept ignores one of the crucial points in our paper—that historically observed facts are one thing but predicting future events is another. A wrong decision in choice of method is just as important as a wrong decision in the assumptions that justify the use of a particular method. As a result, Bell's statement that the researcher should (or does) assume a quadratic loss function in the belief that it is the best approximation has no logical foundation. He is correct, however, in stating that if the researcher knew the loss function to be approximately linear, it would not be unwise to use absolute deviations.

Even if the relationship was not considered "absolute" in a probability sense, this fact alone would still be no basis for a choice criterion. Whatever method might be most appropriate for fitting a line representing the entire population would be equally valid for fitting a line from a sampled population as long as the objective of the analysis remained the same. In the sampled distributions you want to eliminate the possibility that the relationship is due to chance, but this does not mean that you can ignore the possible cause and effect relationship. One cannot be substituted for the other

over the entire range of possible relationships. Similarly, one cannot be used as a choice criterion at the expense of the other.

Methods of performing tests on statistical estimates based on absolute deviations are within the realm of possibility, and they should provide some interesting research areas for those willing to accept the challenge of unorthodox methods. The ease of calculation when using standard techniques cannot be overemphasized, as Mr. Bell states. However, the issue revolves around the complexity of calculating versus the complexity of the concept itself. Conceptually, the use of absolute deviations is simpler than any other basis for fitting a regression line. Do you sacrifice what could possibly be a more accurate or logical method for a less accurate or less logical method simply because the former is harder to calculate given the present state of knowledge? Since there appears to be a considerable difference in the results obtained from the two methods, the burden of choice rests on those who have to live with their research results.

Book Reviews

A Theory of Economic History

By John Hicks. Clarendon Press, Oxford. 1969. 181 pages. $5 cloth; $1.95 paper.

Professor Hicks, an eminent theorist, has known eminent economic historians. Historical ideas that were planted in his fertile mind grew from a theoretical viewpoint. The result is now available as an expanded set of lectures, originally given in 1967 at the University of Wales and reworked in seminars and lectures in Canberra, Oxford, and Vienna.

The central problem is to account for changing economic arrangements of human society in a logical way. This is what Marx attempted. And like Marx, Hicks draws on history for illustrative materials. But his method is nondeterministic and, therefore, non-Marxian. The result is a brief, profound, and yet fascinating work, treating of the big transformations of mankind with the most simply stated insights that economics has to offer, yielding a plausible and often persuasive account of how changes over 4,000 years could come about and where they could be heading.

Some main lines of argument can be given. Premarket economies are of two pure types. One has a corpus of tradition to govern how each person functions, without his depending on centralized direction; the other has a power center to direct his duties. (That most nonmarket economies are mixed types can be put aside.) The traditional economy has most staying power, the command economy usually emerges only when there is a threat to society (real or imagined) and dissolves when the threat disappears. The reason: A king needs dependable revenues to sustain his armies and servants. When armies are dispersed, the lords are nearer the source of produce than the king is, and they will hand over, out of their collections, only what they think proper. (A ruler might forestall this erosion of power by creating a civil administration. But without market institutions, a civil service is hard to maintain. It must be fortified by a spy (audit) system; a system of promotion, or just moving people around; and a system of fresh recruitment to forestall hereditary succession, e.g., like classical bureacracies of Egypt and China.)

From the two pure types can emerge a third, the mercantile economy, whenever conditions favor specialization upon trade. Nonmarket economies do have both specialization and trade but no specialized trading class. Conditions for the rise of such a class are not hard to find. Religious harvest festivals evolve into village fairs when the trading is beneficial; the weekly fair makes room for the specialized stockholder—one who extracts his living by tiding produce over from one week to the next (shopkeeping), relieving the peasant of hauling wares back and forth. (The shopkeeper might transform this produce during the week, but his role is essentially a trader.) Even the king's servants assume a trader's role in the conduct of certain duties—i.e., they need a free hand to swap part of the goods gotten in one place for those obtainable in another, if they are to act in the king's interest. (Thus, piracy need not be the mainspring of a trading class.)

When traders, from whatever origin, become numerous, they ally themselves for protection of property and contract. But for trade to grow requires more; it requires social status. Status is best conferred when the head of state is himself a trader. External trade confers more status than internal trade. Hence, the rise of a remarkable entity called the city-state. It is a small, closely knit mercantile community in which external trade can be large relative to internal trade. "The fact that European civilization has passed through a city state phase is the principal key to the divergence between the history of Europe and the history of Asia . . . The city state of Europe is a gift of the Mediterranean."

Hicks reasons why trade must widen into a network among city-states; why colonies are established; why tendencies to diminishing returns cannot be forestalled indefinitely; and why formidable struggles, or agreements to limit competition among city-states, ensue.

City-states that do not meet a violent end (having enriched trading partners who, then, can do them in) usually come under the protection of a stronger, semimercantilized state. This economic organization was standard throughout most of history, and led to development of the second or middle phase of the mercantile economy.

In this phase, the barriers between mercantilized and nonmercantilized areas are down. The story is one of the market's penetration of the nonmercantilist environment and the effects of such penetration on the character of the state itself. In four chapters, Hicks attempts to unravel the inner logic of the origins and development of money, property law, credit, and finance; fiscal and

monetary systems; the mercantilization of agriculture; and the labor market. Each topic is brought through its evolution, with stimulating illustrations and asides.

These four chapters are too meaty to summarize without damage. They are at the heart of Hicks' edifice. Readers now will be able to go (patiently to be sure) back to their European history books and make more sense out of them. Many will be able to better choose among the outpourings of economic literature. Readers particularly interested in the current movement of monied interests into U.S. farming will see, in deep perspective, wherein the market system "is penetrating, or 'colonizing', relatively refractory territory . . . a struggle, which begins very early, and continues . . . into our own day."

Two final chapters deal with the modern phase. This era begins when investment in fixed capital goods (as opposed to circulating capital) incorporates findings of science and technology, and thus can make capital goods reasonably cheap (when machine tools are made by machine tools rather than by hand). It also depends on having financial arrangements to mobilize necessary savings to lock up as durable capital.

The consequences are remarkable: "Once the initial fixed capital stock has been accumulated (and we shall now be under no temptation to minimize the pain and grief involved in that initial accumulation), it will itself, by further technical progress, gain productive power; this later growth imposes no strain upon savings, so that it has a purely favourable effect upon the demand for labour. This is the point—we shall now be able to understand why it took so long to reach it—when the surplus of labor can be absorbed, and real wages can begin decisively to rise"—an idea appearing in skeletal form in Ricardo, as Hicks explains.

An inference is that science-based industry of this century has tremendous expansive power—enough to absorb all the increase in human population in the next two generations, at least. But there are basic constraints.

This slim volume, in purely literary style, is a penetrating work. The sources of ideas are generously given. And the work is "modern"—nearly half the citations bear dates from 1958 to 1969. Only history will show how far Hicks' theory of economic history will penetrate the market in ideas. Coherence is achieved by stubbornly adhering to the notion that the main insights that economics has to offer in the study of history come from analysis of the institutions of exchange. Hicks has wanted to go right up to the boundaries of economics; and he did. One can think of few other "unifying" works that have the necessary scope, relevance, insight, and simplicity for use in fruitful interdisciplinary discussion.

Allen B. Paul

Subsistence Agriculture and Economic Development

Edited by Clifton R. Wharton, Jr. Aldine Publishing Company, Chicago. 481 pages. 1969. $12.50.

Social scientists are "nonbook" prone. At the conclusion of almost any conference or seminar someone usually is given the task of bringing together all the papers and related discussions into a publishable whole. This volume represents such an effort, following a seminar on Subsistence and Peasant Economics, Honolulu, February 28 to March 6, 1965. The book not only includes the seminar papers, but also has other materials which, according to the editor, "fit the format of the book and therefore merit inclusion." As always with a nonbook one is hard pressed to do an adequate review. This volume is no exception, as some 38 authors are listed. A characteristic, not increasing the ease of a review, is that different disciplines were brought together in the seminar "to pool their thinking, exchange ideas, criticize each other's analysis, and stimulate more widespread study of this important topic." This multidisciplinary group included economists, agricultural economists, sociologists, rural sociologists, anthropologists, social psychologists, and political scientists.

Such interdisciplinary seminars, like churchgoing, are supposed to result in something good. Yet one is always left with a gnawing inability to draw out that good. Each discipline practitioner spends considerable time defining his own terms and approach, and usually there is no one single paper which performs the role of interdisciplinary integration. This volume is no exception in this respect. The goal of "cross fertilization" led to the important conclusion on need for "greater multidisciplinary attacks upon the problem of subsistence agriculture."

Yet with the above said about the book, there is much to commend it to the student. Its 14 chapters, organized around social, economic, political, and anthropological issues in peasant production, are highly rewarding in small and separate doses. The volume is well suited to this manner of reading. Most of the papers have been published before, though some case reports present interesting and original materials. However, prior publication does not detract, as materials and sources are so wide ranging that the reader will find much of interest and value. A facet of this range is related to the multinational nature of the participants—some 12 to 14 nationalities. It is always revealing to see the various approaches and conclusions arrived at by students, often depending as much on their environment and culture as on their discipline.

The editor performed a commendable task in arranging these papers for publication. Also, his part V briefing

of Research Priorities on Subsistence Agriculture is a contribution.

As an aside, it is worth noting that the introductory speaker, John D. Rockefeller III, in his address said: "My considered belief is that unchecked population growth is as critical as any problem facing mankind today . . . It becomes, therefore, a paramount task of our time that man work to stabilize population growth . . . " The seminar proceeded by ignoring this number one issue.

John H. Southern

Vertical Coordination in Livestock Marketing

Proceedings of a Workshop held by the Southern Regional Livestock Marketing Research Committee, March 11-14, 1969, at Houston, Tex. Reproduced and distributed by the Department of Agricultural Economics, University of Tennessee, Knoxville. 178 pages. 1969.

Francis Bacon once wrote: "Reading maketh a full man; conference a ready man; and writing an exact man. And therefore if a man write little, he had need to have great memory; if he confer little, he had need to have a present wit; and if he read little, he had need to have much cunning."

These words still ring true and a well-planned workshop should serve all three purposes. The preparation forces the participants to organize and state their thoughts more exactly. The interplay of discussion sharpens the wit. And the reading thereafter increases the combined cunning, or knowledge, of participants and others who read the proceedings.

This workshop had 16 active participants, 13 of whom prepared technical papers, one acted as chairman, and two summarized.

The stated purposes of the workshop were to explore the concept of vertical coordination in relation to the livestock industry, to indicate researchable hypotheses, and to develop a draft of a regional project proposal.

This reviewer, unknown to himself, was a silent partner in the workshop, because the planning committee stipulated that the Mighell-Jones definition of vertical coordination be used as a guideline. This definition considers vertical coordination to be the general term that includes all means of coordinating successive stages in production. Open markets, contracting, vertical integration, and cooperation are different forms of vertical coordination.

The workshop participants were mainly from the South but included also Lloyd C. Halvorson, Alden C. Manchester, Richard J. Crom, and Gerald Engelman, U.S. Department of Agriculture, and Samuel H. Logan, University of California, Davis.

The topics range from definitional description of vertical coordination, through theoretical considerations, to specific discussions of stages of production with special reference to livestock and conditions in the South. One paper considers livestock futures markets.

Manchester's opening paper carries the assertion that vertical coordination is not an appropriate area of research because it is too large and nebulous. Specific problems must be selected. Succeeding papers focus on theory and researchable problems. Gerald Engelman presents a 10-year overview that lends stability to the discussion. Others consider the special characteristics of cattle and hog production in the South and how these can be taken into account.

Donald E. Farris, Texas A&M University, in his brief introduction sets the stage and J. C. Williamson, Jr., Associate Director of Research, North Carolina Agricultural Experiment Station, in his concluding remarks brings the workshop to an end with dispatch and the hope that improved insight will speed efficient adjustment to change.

The reader is not told whether a regional project was developed. But the other objectives were well accomplished. Any student of vertical coordination will find it worthwhile to read this report. Here will he find an aid to memory, a sharpener of wit, and a support to cunning.

Ronald L. Mighell

Rural Industrialization—The Impact of Industrialization on Two Rural Communities in Western Ireland

By Dennis I. F. Lucey and Donald R. Kaldor. Geoffrey Chapman, London. 198 pages. 1969.

What happens in low-income rural areas when industry appears? Using two low-income areas in the west of Ireland as their domain, Lucey and Kaldor consider the economic consequences that followed the introduction of small manufacturing plants. Their study shows that the plants had measurable, positive effects on the areas' employment, population, incomes, expenditures, and agricultural output.

The new plants drew much of their labor force from farms, yet aggregate farm output and incomes increased. Farm operators who accepted industrial employment tended to come from relatively small, low-income farms. Increased output on these farms resulted from the substitution of family labor for the operator's labor, with operators working a longer day to do their farm chores and their plant work; increased inputs of land, livestock, fertilizer, and machinery, made possible

largely by the extra income earned in industry; and, in general, a shift from labor-intensive to labor-extensive enterprises.

These findings led the authors to conclude that industrialization made a positive contribution to the areas' economic development. Since the decisions regarding the type of plant, location, and capital requirements were made within the scope of Irish regional industrial development policy, the plants' success stories provide good examples of how national policies can be directed towards fulfillment of regional goals.

A statement on the book's flyleaf to the effect that the study ". . . makes an important contribution to the theory of rural development" may be somewhat ambitious. The study does verify some theoretically basic propositions about the effects of new industry on income and employment, and the way humans behave in the face of economic choices. But these propositions are hardly new or peculiar to rural development. Nevertheless, since "rural renewal" is one of the catch-phrases of the contemporary American scene, this study is particularly timely. It shows that in Ireland, where the Government has backed its commitment to rural development with action, industrialization can be successful. But conditions for success in the United States may be quite different than in Ireland. It should be noted that the plants were heavily subsidized by the Irish Government; they faced little or no domestic competition for their products—some of which were exported; distance, from the perspective of markets for products and nonlabor inputs, was not too critical; and finally, the development areas were rather small in comparison with U.S. development areas. All the same, these differences are but minor elements of the larger problem that is common to both countries. This is the inability of poor rural areas to "pull themselves up by their bootstraps" and the failure of the invisible hand to obtain in fact what it claims in form. Both Ireland and the United States have plumped for publicly supported regional development to help solve their problem; this study leaves one discerning the determination with which the Irish are acting.

Other researchers and policymakers interested in future or past effects of industrialization on rural development might do well to look at the study's methodology and results. The former is notable for its clarity and simplicity. The latter are well expressed and vindicate the authors' careful a priori reasoning of the expected impact of industrialization on rural economies.

The book is well organized and technically accurate. Its readability, however, is diminished by an abundance of "thesis-type" jargon and explanation, and a surprising lack of warmth or spirit. As a general note, I would recommend that a prospective reader start with the excellent summary and conclusions chapter before deciding whether he needs to read the whole book or just parts of it.

Neville J. G. Doherty

The Rise and Development of Japan's Modern Economy

By Kamekichi Takahashi. Translated by John Lynch. The Giji Press, Tokyo. 374 pages. 1969.

This Japanese-published translation of a condensation by the author of his monumental history of Japan during the last century presents many insights which deserve to be noted by economists. It is an interpretive account of the beginnings and progress of economic development in a setting which has many parallels in today's developing world. Japan at the time of the Meiji restoration in 1868 was short on capital and had a plentiful supply of cheap labor. Natural resources were undeveloped, and to a great extent unexplored. There was a rigid class structure. Power and wealth were concentrated in the hands of a few. Education was limited to the sons of the elite.

The catalyst which started Japan on the road to modernization was the fear of economic and political domination by the Western powers. Trading concessions made by the Shogunate to the Western powers were a direct cause of the revolution which restored power to the Emperor Meiji. The slogan of the revolutionaries, "a strong and prosperous country," became the driving force behind modernization, serving the same purpose that the Protestant ethic served in the West—i.e., promoting honesty, industry, thrift, and intense nationalism in all segments of society.

The measures undertaken to introduce modernization included, first, the abolition of feudalism, the conversion of feudal incomes into allowances paid by the control government and then into interest-bearing Government bonds, and the establishment of a national banking system using these bonds as paid-in capital. This development took 20 years. By 1888, interest rates had fallen from levels usual in underdeveloped societies to those prevailing in industrial societies.

Second, human resources were developed. Compulsory elementary education was decreed by the Government in 1872, and 71.66 percent of school-age children were attending school by 1882. Higher education was opened to all who could meet the academic requirements and secure the financial backing. Emphasis was shifted from literature and culture to scientific and technical fields.

Third, the importation of Western technology was achieved through the contractual hiring of Western

technicians at all levels to teach and demonstrate. Concurrently, large numbers of Japanese were sent to the West for education and training. In the beginning much capital was invested in Western machinery but this proved disappointing as it was too sophisticated and too large in scale for Japanese conditions at the time. However, by the end of the first 15 years, the Japanese had learned to select, adapt, and produce machinery suited to their conditions.

Fourth, Government-owned industries were established and supported as research, training, and demonstration projects, which never proved economically viable but which built up reservoirs of trained manpower.

Fifth, prerestoration trade treaties with the Western powers prevented the development of protectionism, forcing Japanese industry to become efficient through competition for the domestic market. This greatly facilitated entry into foreign markets as production capacity developed.

Sixth, industries selected for development were labor intensive. This included labor-intensive agriculture. Agriculture was the major base for development in the Meiji era. Land taxes provided over 80 percent of government revenues. Agricultural exports including raw silk provided over 80 percent of all exports from 1868 to 1877, and over 68 percent from 1883 to 1887. Farmers were the major market for manufactured products, both consumer goods and agricultural inputs. Literate farm youth supplied the labor force for industry. Agricultural productivity increased slowly until the end of the third Meiji decade (1898). The completion of the country's rail network and the abandonment of the country's policy of agricultural self-sufficiency proved to be prerequisites for the concentration on crops in which Japan had a comparative advantage and the subsequent rapid development in agriculture.

The author states that in 20 years " the basic conditions of genuine development were more or less fulfilled. That was the most difficult beginning stage when labor was great and results had not yet surfaced." The Japanese economy reached the takeoff stage during the third Meiji decade, 1888-98.

Jane M. Porter

National Incomes Policy of Inflation Control

By Charles E. Rockwood. Florida State University Press, Tallahassee, 184 pages. 1969. $5.

Many efforts are being made by economists to clarify and solve one of the most important eeonomic problems of our time. The problem of inflation is a matter of vital concern to our country which wishes to sustain economic growth while having reasonably stable prices and full employment.

The book is divided into three parts, with the core of the work concentrated in the latter half of part II. Although the work is primarily theoretical, Dr. Rockwood made an earnest attempt to examine the efficacy of a national income policy for inflation when used with price stabilizing monetary and fiscal policy.

It is important to have a properly structured national income policy which can eliminate the adverse side-effects of unemployment and output decline while keeping price-level stability.

The study essentially analyzes an incomes policy to fight wage inflation in the classic case of demand-pull inflation. In this respect, Dr. Rockwood's examination is somewhat limited in scope. There is a widespread belief that the American economy is experiencing a new kind of inflation, different from the kind which is frequently called "classical"; the new kind is being "built into" the present nature of our economy, signaling a continuing inflationary trend in peacetime and the absence of the classical causes.

In the classical type of inflation, prices are conceived as pulled up by an excess of total monetary demand over the limitations that are set on the supply side. In the new type, prices are apparently pushed up by direct action of sellers, without any prior demand.

As long as the inflationary trend maintains a slow pace, it is not necessary to be fearful. What is more important, however, is to arrest the growing belief in the inevitability of inflation, which could possibly alter incentives and attitudes and change the nature of our cconomic system.

Jack Ben-Rubin

M. L. Wilson and the Campaign for the Domestic Allotment

By William D. Rowley. University of Nebraska Press, Lincoln. 219 pages. 1970. $8.50.

The period between the two World Wars, as students of economic history know, was beset with near disaster. It called for a drastic reappraisal of things as they were and a somewhat agonizing search for a way out. A college professor, M. L. Wilson, who was backed by innovative research and hard experience, led the way toward a brighter prospect. His proposal, domestic allotment, called for the Government to assure farmers a fair price for their share of production for the domestic market and to help export surpluses at world prices.

Two quotations in the Rowley book particularly catch one's eye. In the first, columnist Walter Lippmann said the domestic allotment approach "is the most daring experiment ever seriously proposed in the United States." In the second, Congressman Christigau said overproduction was "due partly to . . . the historical emphasis on production rather than on economics and farm management." Both men were pointing out that a major change in thinking and in practices was underway.

It had become obvious that the situation must change. Research in the physical and the economic areas had shown that it could be done. This was particularly true in the spring wheat area. The author notes that wheat had become a symbol of distress and that M. L. Wilson's thinking was a product of the wheat country. The background of the campaign for domestic allotment is pinpointed still further by references to an innovative project designed to explore new concepts of farm management. This project was known as Fairway Farms.

The importance of the Fairway Farms' experimental innovations lies not only in having established some revised techniques of management but also in the exposure of Wilson and his associates to the same hard realities in which every other farmer was immersed. This experience undergirded the bridge between the academic world and the operational world. Building a bridge between the two worlds won the backing of the administrators of Montana State University. They gave Wilson, the Head of their Agricultural Economics Department, full support in his nationwide campaign to win the adoption of new policies.

The title for chapter 5 more nearly describes the happenings of the times than the title of the book itself. Actually there was a very dramatic "Reversal of Agrarian Tradition." However, the field is so broad that it is obviously a matter of wisdom to deal specifically with one very vital and significant phase such as the domestic allotment program.

As in all economic, political, and social adaptations, many persons must be convinced and must participate in the implementation. Many persons are named in the course of the story and Wilson is recognized as a catalytic personality, working with leaders in several sectors of the Nation's economy. He was the major strategist in crystallizing opinion and marshaling support.

Obtaining support was essential. However, a workable program was paramount. Many cases are known to history where support has been rallied for impractical endeavor. Therefore, the skepticism of a practical people had to be met and Rowley describes how various elements of theory and practice were welded together into an operational whole.

A workable structure had to be built around the theory as propounded by W. J. Spillman, John D. Black, and others. The legal requirements were met by means of a contract. Dangers of an administrative overload were resolved by a unique system of localized responsibility. Simplification was achieved through assignment of responsibility to each individual grower. Democratic process was made a keystone through local participation and through a referendum.

By putting all these elements together and by convincing the incoming President, Franklin D. Roosevelt, that this constituted a feasible program, the idea of a balanced production program became "the most daring experiment ever seriously proposed in the United States."

Elmer A. Starch

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