Research Review

AN APPLICATION OF RIDGE REGRESSION WITH VERIFICATION OF NEW PROCEDURES

*By Mike Belongia**

INTRODUCTION

In a recent attempt to calculate price and income elasticities for expenditures on meals and snacks, one of the most common problems of least squares regression was encountered. Data included in the statistical model were highly collinear. The problem was particularly troublesome because the regressors, income and a measure of relative prices, were both needed to derive the desired elasticities. The standard approach, elimination or combination of regressors, was clearly unacceptable.

As the problem was statistical in nature and did not involve model specification, an alternative method of estimation was used in place of ordinary least squares (OLS): Hoerl and Kennard's technique of ridge regression, especially designed to handle problems of multicollinearity (*3, 4*).[1] The purpose of this note is to outline the general ridge estimator, show its application in solving the elasticity problem mentioned above, and finally, test a new technique for evaluating the selection of ridge estimates.

RIDGE REGRESSION

To illustrate the concept of ridge regression, first consider the OLS estimator $\hat{B}$:

$$\hat{B} = (X'X)^{-1} X'Y \qquad (1)$$

where X is an $n \times p$ matrix of regressors standardized so that $X'X$ is a nonsingular correlation matrix, Y is an $n \times 1$ vector of observations on the dependent variable measured in terms of deviations from its mean, and $\hat{B}$ is a $p \times 1$ vector of calculated values for the true but unknown parameters, B. When problems of multicollinearity exist, the $X'X$ matrix has one or more small eigenvalues.[2] Because the literature holds many derivations of this relationship, let it suffice to say here that if the extent to which the vectors of the X matrix deviate from orthogonality increases, the eigenvalues become smaller and the distance between $\hat{B}$ and B can be expected to increase. That is, as the system deviates from orthogonality, the disparity between the true parameters and the estimated parameters will increase.

To overcome this problem, small biases may be added to the diagonal of the $X'X$ matrix, biases which give $X'X$ the characteristics of orthogonality. Thus, the ridge estimator of Hoerl and Kennard is:

$$B^* = (X'X + kI)^{-1} X'Y \qquad (2)$$

where k is the amount of bias and I is a $p \times p$ identity matrix. Of course, when $k = 0$, we have the OLS estimator.

Some may quarrel with the use of biased estimators. However, as Judge, Bock, and Yancy point out:

> The notion of unbiasedness which has been accepted by or perhaps forced on applied workers, although intuitively plausible, is an arbitrary restriction or property and has no direct connection with the loss due to incorrect decisions (*5*).

The advantage of reducing multicollinearity at the expense of introducing bias is clear when it is recalled that highly multicollinear data series are often the direct cause of "incorrect" signs on coefficients and of severe changes in the magnitudes of parameters after only negligible changes in the data set such as the addition of an extra observation. This problem is especially important when the magnitudes of the coefficients have economic interpretations.[3]

THE RESEARCH PROBLEM

Recently, a consistent and comprehensive data series for total U.S. food expenditures has been presented (*1, 6*). Previous estimates of price and income elasticities for food expenditures typically had been calculated using inconsistent subsets of total food expenditures. These subsets do not include all foods.[4] Thus, the new

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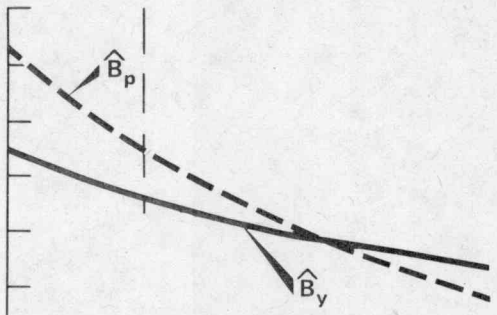
[1] Italicized numbers in parentheses refer to items in References at the end of this note.

[2] Eigenvalues are values of parameters for which a differential equation has a nonzero solution satisfying given conditions.

[3] See (*2*), for example.

[4] The two most widely used series have been the personal consumption expenditures reported by the Bureau of Economic Analysis (BEA), U.S. Department of Commerce, and the expenditures on U.S. farm-produced food published by ESCS, U.S. Department of Agriculture (often referred to as the "marketing bill"). The BEA series includes only



series provided the first opportunity to calculate elasticities truly representing *total* food expenditures for major expenditure categories, including the meals and snacks component. Few empirical studies have included this category of food expenditures, and existing estimates often have been based on inconsistent data or calculated from functions that do not provide both price and income elasticities.

The regressors used to estimate the elasticities for expenditures on meals and snacks were found to be highly correlated and they are the basis for the examples presented here.[5] The model estimated was:

$$EXPMS = f(Y, P) \qquad (3)$$

where:

EXPMS = *ln* [(per capita expenditures on meals and snacks ÷ all commodities CPI) x 100]

Y = *ln* [(per capita disposable income ÷ CPI for all commodities) x 100]

P = *ln* [(CPI for food away from home ÷ CPI for nonfood items) x100]

Although rarely estimated in this form, price can be used as a regressor in expenditure-dependent functions to determine quantity-price elasticities.[6] The model was estimated using annual time-series data from 1954 through 1977.

OLS RESULTS

The results obtained from estimating equation (3) by OLS are presented in the table. Equation (3) yields parameter estimates apart from those suggested by other empirical studies. Expenditures on meals and snacks appear to be less sensitive to price changes than are expenditures on all food although one would expect meals and snacks to be the most price sensitive expenditure category. The income elasticity is reasonable compared with those in other food expenditure studies.

[6] See (*10*) for the derivation.

THE RIDGE REGRESSION ESTIMATES

The elasticities derived from the first set of ridge regression parameter estimates are as follows:

Implied quantity-price elasticity	Expenditure-income elasticity
−0.355	0.560

An appropriate value for k was determined by the criteria established in (*3*). At that value of k, (1) parameter estimates will become stable and the system will have orthogonal characteristics; (2) the parameters will be of correct sign and reasonable magnitude; and (3) although R^2, by necessity, is lowered, the residual sum of squares will not be increased to unreasonable levels. Finally, a plot of B* against their associated values for the alternative levels of k, called the "ridge trace," helps in visualizing the point at which the system stabilizes. As originally formulated by Hoerl and Kennard, the selected value of k should be at a point associated with

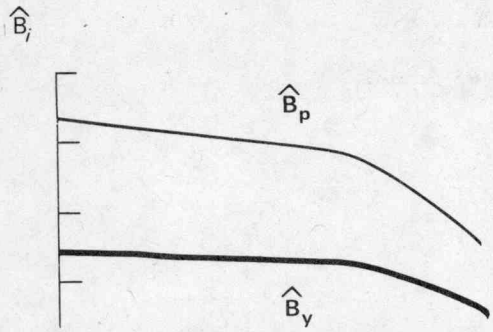
Results of the OLS parameter estimation[1]

Expenditure-dependent function	Implied quantity-price elasticity	Expenditure-income elasticity
(3) EXPMS = 0.831 x P + 0.647 x Y (.26)[a] (.121)	[2] −0.169	0.647
R^2 = .99 F = 954.11 S_y = 0.19		
MSE = .00038		

[1] Values in parentheses are standard errors. [2] Calculated from the formula: expenditure-price elasticity = quantity - price elasticity + 1.

personal consumption expenditures; it excludes business meals, institutional purchases, home production, and the value of food purchased through military exchanges or Government food programs. By contrast, the marketing bill excludes the value of imports, fish, and all foods not originating on U.S. farms. Neither is a measure of *total* food expenditures.

[5] The simple correlation coefficient between the two independent variables was 0.98.



the flattening of the two curves (*3*, 4). The ridge trace in figure 1 suggests that the system stabilizes at a value of k greater than 0.5.

However, McDonald and Galarneau have found that the ridge trace is a poor indicator of stability (*7*). Vinod has confirmed these suspicions by showing that "the absolute value of the changes in B* for a given change in k is smaller for large k. Thus, the k scale has the unfortunate property that the ridge trace may *appear* to be more stable for larger k even for completely orthogonal data" (*8*). Vinod then derived a new plot consisting of B* against a new scale for the horizontal axis called the "multicollinearity allowance," or m, which is defined as:

$$m = p - \sum_i \lambda_i / (\lambda_i + k_i)$$

where p is the number of regressors, λ_i are the eigenvalues of the $X'X$ matrix, and k_i are the values of k for which B* are evaluated. Essentially, m indicates the deficiency in the rank of $(X'X)$. The ratio of m/p can be thought of as analogous to Theil's measure of the relative contributions of the sample and *a priori* information to the *a posteriori* precision of B* (*8*).

This new plot, shown in figure 2, indicates that selecting a k based on the Hoerl-Kennard ridge trace can lead to the selection of an inflated value of k. For a point where the slope of the curves changes only slightly, or not at all, the plot derived by Vinod suggests a value associated with $m = 1.083$ or $k = 0.2$, instead of $k = 0.5$ as suggested by figure 1. This discrepancy between values for k would change the elasticities for equation (3) from 0.560 and −0.355 to 0.387 and −0.726, respectively. While both changes are substantial, the price elasticity is changed by the larger amount, a factor of 2.

Vinod also derived a new statistic which indicates which value for k moves the system closest to orthogonality. This measure, the Index of Stability of Relative Magnitudes (ISRM) is defined for $m < p$ as:

$$\text{ISRM} = \sum_i [(p\,\delta_i{}^2 / \bar{S}\,\lambda_i) - 1]^2$$

where p = the number of regressors, λ = the eigenvalues of $X'X$, $\delta i = \lambda_i/(\lambda_i + k_i)$ and

$$\bar{S} = \sum_i \lambda_i/(\lambda_i + k)^2.$$

ISRM, which will be zero for completely orthogonal systems, provides one more indicator of an appropriate amount of bias to be introduced into the estimator. That is, the value of k which produces the smallest ISRM will make the system most like an orthogonal system. When $k = 0.2$, the value suggested by the plot of m, the smallest ISRM is produced. Finally, note that $k = 0$, the OLS estimator, produces the largest ISRM. Together, the plot of m, the ISRM and the *a priori* considerations concerning the signs and magnitudes of coefficients all support the choice of $k = 0.2$ and the resulting quantity-price elasticity of −0.355 and expenditure-income elasticity of 0.560. For the derivations of these statistics and other implications for the selection of m and what m represents, see (*8*).

In Earlier Issues

D. Howard Doane concludes that the greatest opportunity for the American farmer is to perform some of the services now handled by the "middleman," and thus retain for himself a part of the margin between the price paid for raw farm products and the price paid by the consumer. . . . He presents many ideas on how farmers might profitably expand (through vertical integration). . . . He takes some verbal sideswipes at horizontal integration.

Carl P. Heisig
(Review of: *Vertical Farm Diversification* by D. Howard Doane)
April 1951, Vol. 3, No. 2, p. 62

FIGURE 1
Discrepancy Between Old and New Methods for Selecting K

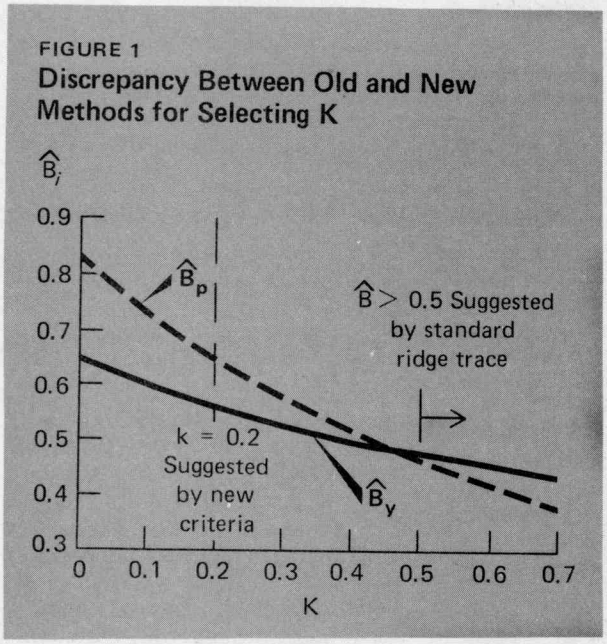
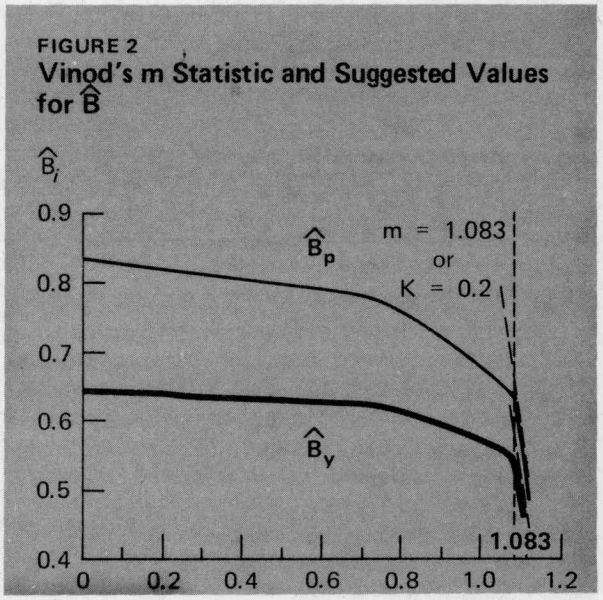


FIGURE 2
Vinod's m Statistic and Suggested Values for $\hat{B}$



REFERENCES

(*1*) Belongia, Mike and Alden C. Manchester. "Total Food Expenditures: Some Further Delineations." *National Food Rev.* NFR-5, Econ., Statis., and Coop. Serv., U.S. Dept. Agr. Dec. 1978.

(*2*) Brown, William G., and Bruce R. Beattle. "Improving Estimates of Economic Parameters by Use of Ridge Regression with Production Function Applications." *Am. J. Agr. Econ.*, Vol. 57, No. 1, Feb. 1975.

(*3*) Hoerl, Arthur E., and Robert W. Kennard. "Ridge Regression: Biased Estimation for Non-Orthogonal Problems." *Technometrics*, Vol. 12, No. 1, Feb. 1970.

(*4*) _____. "Ridge Regression: Applications for Non-Orthogonal Problems." *Technometrics.* Vol. 12, No. 1, Feb. 1970.

(*5*) Judge, George G., Mary E. Bock, and Thomas A. Yancey. "Post Data Model Evaluation." *Rev. Econ. and Statis.* Vol. 56, May 1974.

(*6*) Manchester, Alden C. "Total Food Expenditures—A New Series." *National Food Rev.*, Econ., Statis., and Coop. Serv. U.S. Dept. Agr., Apr. 1978.

(*7*) McDonald, Gary C., and Diane I. Galarneau. "A Monte Carlo Evaluation of Some Ridge-Type Estimators." *J. Am. Statis. Assoc.* Vol. 70, No. 350, June 1975.

(*8*) Vinod, Hrishikesh. "Application of New Ridge Regression Methods to a Study of Bell System Scale Economies." *J. Am. Statis. Assoc.* Vol. 71, No. 356, Dec. 1976.

(*9*) _____. "A Survey of Ridge Regression and Related Techniques for Improvements Over Ordinary Least Squares." *Rev. Econ. and Statis.* Vol. 60, No. 1, Feb. 1978.

(*10*) Wold, Herman and Lars Jureen. *Demand Analysis: A Study in Econometrics.* John Wiley and Sons, N.Y., 1953.

CHANGES IN THE PRESENTATION OF THE NATIONAL I/O TABLES

*By Gerald Schluter and Gene K. Lee**

Events within the U.S. food and fiber system during the seventies have constantly reminded us of the many close ties both among its subsectors and between it and the rest of the economy. The national input-output (I/0) tables periodically supply measures of these close ties. With the publication of the most recent table, the interindustry accounts for the 1972 U.S. economy, the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) has adopted much of the format of the United Nation's System of National Accounts (SNA) as well as incorporating other changes in the definitions and procedures used in earlier tables.[1] This note reviews the SNA approach to I/O accounting, identifies the other changes, contrasts the new with the previous presentation, and discusses ways in which the latter change may affect users of I/O data.

THE SYSTEM OF NATIONAL ACCOUNTS

First published by the United Nations in 1953,[2] the System of National Accounts (SNA) was revised, after 15 years of intensive review, in 1968.[3] The system integrates and links the definition and classification of product flows and stocks into a coherent structure within an economy. Industries, and therefore commodities, are grouped using a single international standard classification of all economic activities. The system also serves as a basis for reporting of comparable national accounting data to the United Nations and other international bodies. Finally, it provides for coordination of international guidelines and standards relating to more specialized bodies of economic, financial, and other statistics.

In a simplified form, the system is designed to present all transactions (flows) in a national economy in four national accounts. These are production (domestic product account), consumption (income and outlay account), accumulation (capital transaction account), and the rest of the world (balance of payments account). Assets and liabilities (stocks) are represented by opening and closing balance sheets; they are linked by revaluations that adjust assets previously acquired or liabilities previously issued to the prices existing at the closing date.

THE INPUT-OUTPUT ACCOUNTS

Within the national accounting format, the input-output accounts are an expansion of the production account. This account can be specified by commodity or industry. A commodity production account reports production of a specific commodity regardless of industry origin. Similarly, an industry production account reports output of a given industry, including its primary and secondary products. Unfortunately, the data required for constructing an I/O table are seldom available systematically in either commodity or industry form. In fact, users of I/O tables usually want both commodity and industry analyses.[4] The I/O accountant thus must allocate the required inputs of a commodity (or service) among the several possible industrial sources of the commodity, unless all of the commodity is primary output of one industry.

ADVANTAGES OF SNA APPROACH

To illustrate changes made by the SNA approach, consider the production of ice cream within the Fluid Milk industry (SIC 2026). Ice cream is a primary product of SIC 2024, Ice Cream and Frozen Desserts. The I/O table should (and does) account for this reality. The I/O accounting problem hinges on how this secondary output is handled. Although almost any solution is likely to be imperfect, the SNA approach adopted by BEA is more straightforward than most.

Earlier Treatment of Secondary Output

Previously, BEA analysts redefined some secondary output; that is, they excluded secondary activities

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[1] U.S. Department of Commerce. *Survey of Current Business*. Vol. 59, No. 2. Bur. Econ. Anal., Feb. 1979.

[2] United Nations. *A System of National Accounts*. (Proposals for the Revision of the SNA 1952, E.CN.3/320, Econ. and Social Council, Feb. 1965, mimeog.

[3] United Nations. *A System of National Accounts*. ST/STAT/SER.-F/SREV.3, Dept. Econ. and Social Affairs, N.Y., 1968.

[4] At the risk of oversimplifying, we consume commodities and industries produce them. Thus, persons analyzing demand often use commodity data, and persons analyzing supply response use industry data.

and associated inputs from the producing industry and included them in the primary industry. All other secondary output was transferred; it was treated as though the producing industry sold it to the primary industry, thus adding to the primary industry's output.

Basically, this procedure allowed the outputs to appear in a single sector. However, the secondary transfers were counted twice, as outputs of the producing and receiving industries. The producing industry's distribution of its output to customers was distorted, as was the receiving industry's composition of inputs. In other words, the ice cream produced by fluid milk processors showed up in the published table as a sale from Fluid Milk to Ice Cream processors. Fluid milk purchased as an input for ice cream production would be included in this published transaction as would the value of ice cream produced by fluid milk processors. This reporting distorts statistics on both the sales distribution of fluid milk processors and also the input composition of the ice cream processors. The treatment of secondary products in BEA's 1972 I/O tables eliminates most of these difficulties.

A Graphic Illustration of SNA Changes

To further explain the SNA approach used in the 1972 table, consider a set of production accounts in the following table.

The matrix U in the table has commodities in the rows and industries in the columns. Thus, it is a commodity-by-industry matrix. Its typical elements in a row j and a column k shows the amount of commodity j used up in production by industry k. The matrix U is sometimes called an absorption (or use) matrix as the row shows how commodities are "absorbed" as intermediate inputs by industries (the elements of U). The row sums of this matrix represent the total industrial intermediate use of commodities; the column sums represent the intermediate use of commodities by industries.

Flows	Commodities	Industries	Final demand	
Commodities		U	f	q
Industries	V			g
Value added		y'		η
	q'	g'	η	

Note: A capital letter denotes a matrix, a small letter denotes a column vector, a small greek letter denotes a scalar, and a $'$ denotes a transposed vector. Rows read across and columns read down.

If one assumes that intermediate inputs of commodities are proportional to the industry outputs into which they enter, then:

$$U = B\hat{g}, \text{ or} \quad (1)$$

$$B = U\hat{g}^{-1} \quad (2)$$

where a circumflex ($\hat{}$) over the symbol indicates that elements of that vector are spread out to form a diagonal matrix. The superscript -1 represents a matrix inversion. Thus $\hat{g}^{-1}$ denotes a diagonal matrix of the reciprocals of industry outputs. Equation (2) shows that commodity inputs are required in fixed proportions by each industry. The columns of matrix B give these fixed input requirements.

The matrix V in the table has industries in the rows and commodities in the columns. This "make" matrix tells in which industry each commodity was made:

$$D = V\hat{q}^{-1} \quad (3)$$

Equation (3) states that commodities are produced in fixed proportions by the industries that make them. The columns of matrix D give these fixed market shares. If we post-multiply the commodity-by-industry direct requirements matrix, B, from equation (2) by this fixed-market shares matrix D, we gain a new direct requirements matrix. In this matrix, B's coefficients, interpreted as direct input requirements of commodity i per dollar of output in industry j, have been reweighted by D's fixed-market shares. As a result, the coefficients of the product, BD, become direct input requirements of commodity i per dollar of output of commodity j. BD is now a commodity-by-commodity direct requirements matrix.[5] Thus:

$$q = (I\text{-}BD)^{-1}f \quad (4)$$

[5] The matrix multiplication used to estimate this direct requirements matrix assumes that all products (primary and secondary) of an industry have the same input requirements: this is the industry technology assumption. In an alternate approach called the commodity technology assumption, production of a commodity requires the same mix and proportions of inputs regardless of which industry produces it.

In our ice cream example, under the first assumption, the estimate of inputs required to produce ice cream in the fluid milk industry, and thus the inputs transferred, would be proportional to the inputs into the entire fluid milk industry. With the other assumption, a separate input

In this equation, q is a vector of domestic commodity outputs, f is a vector of final demands for commodities, and $(I\text{-}BD)^{-1}$ is a commodity-by-commodity total requirements matrix. The terms in $(I\text{-}BD)^{-1}$ are the total requirements for output of commodity i per dollar of final demand for commodity j.

Reweighting this total requirements matrix by premultiplying with the fixed-market share matrix again converts the terms. After this operation, the terms in the matrix $D(I\text{-}BD)^{-1}$ become the total requirements for the output of industry i per dollar of final demand for commodity j. $D(I\text{-}BD)^{-1}$ is now an industry-by-commodity total requirements matrix:

cost structure for ice cream production would be estimated and used in transferring the secondary production of ice cream from the fluid milk industry to the ice cream manufacturing sector.

In Earlier Issues

The use of electricity on farms is still in its infancy. . . . On most farms electricity seeps rather than surges into the farm organization. A farmer first has lights in the service buildings and service areas. A little later he installs something more—possibly an electrically operated pump jack—then a tool grinder—then a chick brooder—and so on. The effect of each individual use may be too small to measure accurately but the aggregate effect of all of them is decidedly significant on many farms. Electric power clearly has been instrumental in reducing labor requirements in American agriculture.

Joe F. Davis
July 1951, Vol. 3, No. 3, p. 86

Dr. Nourse is concerned first of all with what may be termed "groupism"—the tendency of organized agriculture, labor, and industry to make demands which, if granted, are certain to be detrimental to the economy as a whole. Second, he is concerned with the tendency, not only of these particular groups, but of people generally, to demand from the economy, in the name of security, more than they are willing to contribute. Third, he is concerned that excessive demands in the guise of military preparedness will result in an over-commitment of the Nation's industrial system and in the imposition of oppressive controls. Finally, he is concerned that, instead of rejecting excessive demands, an attempt will be made to meet them through a continuous process of general inflation that will seriously undermine the basic strength of the economy.

James P. Cavin (Review of: *The 1950's Come First* by Edwin G. Nourse)
July 1951, Vol. 3, No. 3, p. 104

$$g = D\,(I\text{-}BD)^{-1}f \qquad (5)$$

In summary, the national accounting approach allows the BEA to handle mechanically the problem of transferring secondary output of industries without double counting. The two crucial assumptions are that industry technology prevails (B) and fixed-market shares exist for industries producing each commodity (D). Obviously, the validity of these assumptions varies among sectors.

If a separate cost structure had been available for each commodity produced by each industry included in the table, the transfers could have been made manually by simple addition. Lacking these cost data, BEA judged the mechanical method based on matrix manipulations to be the best alternative. In many instances, the industry technology assumptions were clearly inappropriate, and the secondary output was redefined (shifted) to the primary industry manually.[6]

In the table the value added row would include all the value added originating in an industry. To this subtotal, one would need to add the amount of the product originating in government and households to get gross domestic product. To this total, to get gross national product, one would also add the amount of net product originating in the rest of the world; that is, wage, interest, or other factor income earned by or accruing to U.S. residents from foreign economic activity, less corresponding amounts accruing to foreigners from U.S. economic activity. BEA achieves this result by defining special industries in the intermediate sectors for the income originating in households, government, and the rest of the world.[7]

OTHER CHANGES IN I/O PRESENTATION

A second major change, this one independent of the national accounting approach, occurred in presentation of the 1972 I/O data. The transactions table carries domestic output data instead of total output data. Competitive imports, imports with a domestic counterpart which to an extent compete with domestic production, now appear as a negative entry in final demand in the row of the comparable domestic producer rather than as a row of transferred imports. When they were in the transferred imports row, they were treated as inputs into the comparable domestic industry. This change reflects the increasing importance of imports to the U.S. economy.

In addition, two dummy industries, office supplies and business travel and entertainment expenditures, were eliminated in the 1972 table. Allocations for these expenditures are now made directly from their producing industries. A new industry was added—eating and drinking places—which had been included in retail trade. The shift occurred because this activity differs from other retail trade; retail traders ordinarily buy and sell goods without changing their form, whereas eating and drinking places transform ingredients into prepared foods and beverages.

IMPLICATIONS

For agricultural economists, these changes in the national I/O tables should make I/O more useful in economic analysis. The conceptual basis for the table has been made more explicit and its use extended by the new handling of secondary products and the publication of related data. The shift to a domestic output base makes it easier to analyze the impacts of agricultural trade because competitive imports are now exogenous. The separate eating and drinking sector provides new opportunities for research.

Few advancements have no costs, however. Analysts who choose to use a level of detail other than the levels now published by BEA must calculate their own direct and total requirement matrixes. To do so, they must also rewrite their matrix manipulation routines.

[6] The six most important instances were: construction performed within industries by these industries, manufacturing done within the trade and service sectors, retail trade in service sectors, wholesale sales of purchased goods by manufacturers (resales), rental activities of all industries, and electricity produced and sold by mining and manufacturing industries and railroads.

[7] This procedure permits the value-added row to reflect GNP without having final demand purchases in the value-added row.

AGRICULTURAL SECTOR PLANNING: A GENERAL SYSTEM SIMULATION APPROACH

George E. Rossmiller, editor, Department of Agricultural Economics, Michigan State University, East Lansing, 1978, 430 pages, $8.

*Reviewed by Reuben N. Weisz**

Sixteen analysts from various disciplines who worked together during 1971-77 to develop, install, and use a general system simulation approach to agricultural planning in the Republic of Korea present a case study of their efforts in this book. As they describe the approach: "It facilitates and depends on strong and continuous interaction among administrators, investigators and affected people, as participants in the decision-making process. It is eclectic with respect to philosophies, data and information sources and types, model types, the use and nonuse of various maximizing techniques, assumptions, and dimensions" (p. 42).

In part I, "The Case Study Projects," the authors describe the historical, bureaucratic, and institutional working environment which shaped their point of view as they conducted their research for a specific clientele—government planners. It is possible, they state, and often highly desirable, to develop decision-making systems within the public sector that include the capacity to analyze and monitor through use of computer-based models. Their argument will contribute to the current debates between proponents and opponents of modeling in general, between advocates and antagonists of the methodology used here, as well as to the controversy between supporters and critics of the use of models in economic development.

"Improving Agricultural Decision Making," chapter 1 in part II, describes how decisions are made in agricultural development. Disciplinary, subject-matter, and problem-solving models compliment one another as they bring normative, positive, and prescriptive knowledge together for decisionmakers.[1] The general systems simulation approach —a means, not an end—can help people make decisions. If this approach enables decisionmakers to find better solutions to problems than they could have obtained with other modeling strategies, the approach can be deemed good, the authors state. "The proof of the pudding is in the eating." The reader who is used to more traditional criteria for evaluating models (*t*-statistics, R^2, number of turning points missed, and so on) may have a difficult time accepting the authors' simpler method of evaluation.

Initially, chapter 2, "Values and Policy Choices in Agricultural Development," appears to be a superfluous philosophical discussion. However, the authors make important points:

1. Policy choices must be specified before policy instruments (price controls, tax policies, and so on) can be defined as decision variables in the model.
2. Values must be specified before performance indicators (measuring balance of trade, employment, nutrition, and others) can be specified as output variables in the model.
3. The relationships within the agricultural sector, as well as between it and the rest of the economy and environment must be set out before they can be used to define relationships between policy variables and performance indicators.

"Theory and Practice of Model Building and Simulation," the concluding chapter in part II, digests conventional wisdom on the subject. The approach adopted in the study consists of a system built of regularly interacting parts. These building blocks may also be systems. Breaking down the overall research problem into these components reduces the complexity and magnitude of the problem. This process allows for a division of labor; each member of the research team is assigned to a component which corresponds to that researcher's training and experience. Eventually, connection of the individual components forms the general systems simulation model.

KASM, the Korean Agricultural Sector Model System presented in part III, contains five components:

1. population
2. national economy
3. technological change
4. resource allocation and production
5. demand, price, and trade

The authors give the data requirements and parameter estimation procedures, and they present applications of the general model and its individual components.

Part IV, "The Korean Grain Subsector Models," describes two smaller KASM modeling efforts related to grain management programs. Part V,

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[1] Normative refers to concepts of values; positive, to information about conditions, situations, or things not pertaining to their goodness and badness; prescriptive, relates the positive to the normative (pp. 36-37).

"Technology Transfer," focuses on the problems, requirements, and processes of incorporating the systems simulation approach into the decisionmaking structure of developing (or developed) countries. Some critics may not believe the Korean technology can be transferred to other countries.

I disagree. Although a few of the lessons learned are uniquely Korean, much of the knowledge could apply elsewhere. Many of the authors' ideas correspond to current ESCS research activities as reported on in the July 1978 issue of this *Journal*. For example, a compatible set of user-oriented systems (that can be used individually, interchangeably and/or interactively, depending on analysts' needs) underpins the design of the OASIS software. Also, the concept of viewing software as capital stock is imbedded in the LAWREMS library of data sets and models. Finally, the concept of transferring and institutionalizing modeling technology to developing countries is built into the CRIES system.

One of the advantages of the building block approach is that the model builder can draw on existing archetypes of models when designing individual components of the general model. Examples in KASM of archetypes include a standard cohort survival model (used in the population component), an input/output model (used in the national economy component), and a linear programming model (used in the resource allocation component). However, the use of archetypes may disappoint readers who are looking for innovative methodological breakthroughs.

The general systems simulation approach has been successfully used in other subject matter areas. However, the authors merit recognition and praise for being the first to successfully introduce the methodology into agricultural sector planning on such a massive, complex, and formal scale.

Any attempt to put together a multiple-author manuscript on the systems simulation approach may be fraught with the same problems encountered when applying the multiple-modeling approach to the decisionmaking process, such as, gaps, overlaps, and inconsistencies among components and chapters. However, the editor and authors have done an outstanding job in putting together a well-written exposition of this complex subject.

If a few more books such as this one were published, agricultural economics could be called the "interesting science." After applying the same criteria to this manuscript that the authors use to evaluate models (coherence, correspondence, clarity, and workability), I must rank this book among the best produced in 1978. I have not reviewed the $40, 1,200 page, six-volume technical documentation on the KASM system. But this shorter version should prove to be a standard reference that will reduce the credibility gap between the systems simulation true believers and agnostics.

In Earlier Issues

Agricultural price analysis was one of the hard cores around which the agricultural economics of the 1920's and early 1930's were built. Since then, in all too many cases the working economists have been too busily engaged in current operations to set down their appraisals of price-making forces in any formal way. Many have drifted from recognized statistical methods to a shorter-run, almost wholly intuitive, "market feel" approach. Some of the theoretical or teaching economists, especially the mathematically trained group, have gone in the opposite direction, stressing models, structural equations, and the substitution of symbols for statistics.

O. V. Wells
July 1951, Vol. 3, No. 3, p. 65

RURAL U.S.A.: PERSISTENCE AND CHANGE

Ford, Thomas R., editor, Iowa State University Press, Ames, Iowa, 1978, 208 pages, $9.95.

*Reviewed by Leslie Whitener Smith**

An underlying theme runs through this collection of 13 essays on rural society: continued cultural pluralism and diversity and the persistence of characteristics, attitudes, and behavior which have traditionally distinguished rural people from their urban counterparts. *Rural U.S.A.*, more than any other recent book, should end any lingering belief in the "mass society perspective" prevalent in the sociological literature of the sixties and early seventies.

For the last 50 years, proponents of this mass perspective have advanced the idea that social and technological developments in the United States had leveled all cultural differences between rural and urban people to create a sociocultural homogeneity across society. This notion has not been empirically substantiated. As Ford notes in his overview, "little in the available evidence indicates an early extinction of traditional [rural-urban] disparities." This persistence is not surprising to those following the ecological perspective and who believe that environment shapes the social and cultural patterns of an area. Ford explains that as long as the environmental milieux of the city and the country differ, rural-urban differences will continue. These ideas pervade the book. Yet, unfortunately, *Rural U.S.A.* will probably not end the controversy over the existence and relevance of the rural-urban distinction. The debate will continue, despite these authors' efforts to emphasize that explaining persisting rural attitudes, values, and behavior is as important as interpreting change and development.

Commissioned by the Rural Sociological Society (RSS), *Rural U.S.A.* examines persistence and change in rural America. The book was designed as an update to the earlier RSS-sponsored publication.[1] Contributors include demographers and rural sociologists from the Federal Government, universities, and private organizations concerned with rural affairs.

In organizing the book, Ford uses the ecological perspective as an analytical framework and emphasizes the effects of environment on the development and structure of rural culture. A close reading of his overview chapter is a "must" for understanding his organizational scheme. Essays in parts II and III focus on the rural habitat and characteristics of the population. Other sections examine the changing rural environment and its effect on human cultural adaptation, defined traditionally in terms of technological systems (part IV); value and normative systems (part V); and social organization systems (part VI). Part VII departs from the ecological framework to discuss the future of rural society. Wilkening and Klessig, describing changes in the rural habitat, emphasize the serious environmental concerns over pollution and land misuse resulting from the rapid and increased demand for food, energy sources, and recreational space. Beale's article builds on their treatment by depicting the recent reversal in the traditional rural-to-urban migration flow and the substantial population growth experienced by nonmetropolitan areas. Brown and Zuiches' essay on the changing characteristics of the rural population complements Beale's analysis.

Bertrand's essay focuses on human cultural adjustment to environmental changes—both the positive and negative aspects of new technologies, highly commercialized agriculture, and increasing rural industrialization. Larson, examining the value and normative structure of rural society, reverses his earlier position. He concludes that rural-urban differences in attitudes, beliefs, and values are not diminishing over time, clearly challenging the mass society perspective.

Additional chapters examine the socio-organizational structure of rural society and the persistence of traditional problems associated with minority status, sex, and rural poverty. Wilkinson considers difficulties experienced by rural communities that must adjust to the changing agricultural economy. Rainey and Rainey look at problems of meeting increased demand for public services within the community that lacks adequate finances or supporting government structure. While rural minorities have made some economic gains over the past few decades, Blacks, Hispanics, and especially American Indians, still suffer from discrimination and poverty, conclude Durant and Knowlton. In their somewhat speculative article, Flora and Johnson note that rural women face similar economic problems. They conclude that part of the reason for rural sexual inequality derives from the more traditional values and role

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[1] James H. Copp, editor. *Our Changing Rural Society: Perspectives and Trends.* Iowa State University Press, Ames, Iowa, 1964.

attitudes of rural women. Chadwick and Bahr present a more than adequate picture of rural poverty using 1970 Census data, although more current economic statistics are available for analysis.

Authors of essays in the concluding chapters attempt to predict the future state of rural society. Schaller notes that national rural policy will undoubtedly change its traditional focus from a commercial agricultural policy to a two-pronged approach emphasizing food and rural development strategies. Coughenour and Busch show us two scenarios: the first predicts a more varied and complex way of life, but one still based on the distinct and fundamental values of rural life; the second envisions a society based on a decentralized organizational structure and rational planning at the community level. Clearly these two scenarios are speculative; as Ford notes, "social scientists are not soothsayers." Nevertheless, they suggest plausible, markedly optimistic alternatives.

While *Rural U.S.A.* may not become a classic in the rural sociological literature, it certainly more than adequately samples the recent contributions of rural sociologists and the issues of concern to rural society. Ford's organizational scheme becomes somewhat lost as one reads each individual essay. However, each essay's concern with aspects of the rural renaissance and the implications for the structural organization of rural society helps to tie the essays together.

It is particularly interesting to compare *Rural U.S.A.* with its predecessor, *Changing Rural Society*, to observe shifting areas of emphasis over time. *Rural U.S.A.* shows an increased interest in the problems of rural women and racial/ethnic minorities—problems that clearly require additional research—and perhaps less interest in the changing structure of agriculture and the problems of farm-related people. No volume of readings can adequately cover all relevant, important issues facing members of rural society. Yet one sorely misses treatment of the changing rural family, quality of life, problems of rural youth and the aged, and the sociology of rural leisure. Additionally, although the book is designed to focus only on rural America, some attention to trends and conditions in rural society throughout the world would have been welcome. Far too often, readers and handbooks on rural development neglect the international and Third World perspectives.

In general, this book presents a current analysis of rural society in America. The authors examine change and persistence and they briefly identify important issues and concepts for future research. The book clearly represents a useful compendium.

In Earlier Issues

. . . a handful of statisticians, a few agricultural economists, and a few general economists, especially Keynes, have gone far toward bringing about a revolution in both economic theory and its application to current problems within the United States over the past 25 years or so. This thesis would rest not so much upon various theories which have been advanced but rather upon the concern of the statisticians, the agricultural economists, and equally Keynes, with the interweaving of economics and the problems of real life, with the endeavor not only to measure what was happening but also to relate the various facts to each other and fit them into some meaningful and useful framework.

O. V. Wells (Review of: *Economics with Applications to Agriculture* by Edwin F. Dummeier, Richard B. Heflebower, and Theodore Norman)
July 1951, Vol. 3, No. 3, p. 105

DECISION-MAKING AND AGRICULTURE

Dams, Theodor and Kenneth E. Hunt, editors, University of Nebraska Press, Lincoln, Nebr., and London, England, 1977, xiii and 603 pages, $21.50.

*Reviewed by G. Edward Schuh**

Proceedings of the sixteenth international conference of agricultural economists held in Nairobi, Kenya, in mid-1976, report on the central conference theme: decisionmaking and agriculture. As proceedings go, this one is unusual. The papers are meaty, provocative, well-edited, and readable.

Because of rising printing costs, the International Association of Agricultural Economists now publishes only summaries, not verbatim transcripts, of the general discussion at plenary sessions. Professor K. E. Hunt, Director of the Agricultural Economics Institute, University of Oxford, England, prepared these from written statements provided by speakers and from the taped record of the proceedings. Generally, these summaries are followed by concluding remarks of the readers of the main papers. This procedure has much to recommend it. We also are much indebted to Professor Hunt for putting the proceedings into their excellent final form.[1]

Of special note at this conference was the establishment of the Leonard Knight Elmhurst Memorial Lecture in memory of the Association's founder and president. Professor Theodore W. Schultz presented the first lecture in this proposed series: "On Economics, Agriculture, and the Political Economy." In this penetrating lecture, Schultz calls our attention to government's role in affecting the economic performance of agriculture and challenges economists to evaluate the economic effects of what governments do to agriculture. He notes the increasing opposition to economics in social and political thought, the debasement of economics by governments, and the unwillingness or inability of economists to challenge this adverse drift. He further warns us as professionals not to take the particular economic goals of governments as given, lest economies become hostage to government. As part of this salvo, he notes that agricultural economists are not known for their critical evaluations of the economic effects of various political institutions on agriculture.

While appropriate to the U.S. scene, this last criticism seems somewhat misplaced for agricultural economists in other countries. In Latin America particularly, professionals who identify themselves as agricultural economists provide ample challenges to the political institutions. Professionals in other low-income countries also challenge these institutions. Regrettably, economists from these countries were sadly underrepresented on the conference program—a point to which I will return below.

Characterizing the papers as a whole is not an easy task. For the most part it is a high-quality volume, with papers addressing a wide range of the various aspects of decision-making in agriculture. Perhaps most disappointing is the lack of research content, a point noted by Denis Britton in his synoptic view of the conference included in the volume. This undoubtedly reflects the fact that the volume contains only material from the plenary sessions, and plenary sessions generally are designed to appeal to a broad audience. However, it also may reflect the subject-matter theme of the conference, in contrast to one in which alternative solutions are posed.

This reviewer was struck by the lack of relevance of most of the papers to the burning issues of the day: (1) the North-South debate emphasizing international commodity markets and how well they work; (2) the challenge of feeding a world population that is expected to double in approximately 25 years; (3) the continued prevalence of poverty among most of the world's population, particularly among rural people; and (4) growing agricultural trade problems that create international political difficulties and distort domestic agricultural policies. One questions whether papers with high research content on such issues would not merit plenary interest.

Britton questions whether our large institutions such as the World Bank are still learning more by trial and error than by systematic research. If the papers in this volume truly reflect our profession's state of the art, the answer is most assuredly yes. But if that judgment is valid, then an important part of the next confer-

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[1] Only activities of the plenary session appear. A symposium on Kenyan agriculture was also held during the conference, and a special volume has been published as the introduction to that symposium. A day was devoted to food and population programs and the Association expects to publish the papers. The 24 contributed papers read at the conference have been published as the first of the new series of IAAE Occasional Papers.

Yet for our profession to contribute to the solution of the important problems before us, we need to address them more directly and be more willing to confront alternative perspectives in considering them.

ence might well be addressed to identifying world agricultural problems and to developing strategies for solutions.

The geo-political mix of persons invited to present papers may explain in part this failure to address important world problems. Of the 36 major papers, 17 were given by people from the advanced, market economy countries, 8 by people from centrally planned countries, and 9 by people from low-income countries. (Two papers did not identify the authors' countries.) For discussants, the bias was even more severe. No less than 33 came from advanced, market-economy countries; only 3 represented centrally planned countries; and 9 were from low-income countries.

This distribution of speakers may reflect the membership rolls of the Association. If so, legitimate questions can be raised as to whether membership in the Association is an appropriate criterion for selection. A more likely hypothesis, however, is that, consciously or not, members have wanted to keep the meetings from being politicized. This hypothesis is consistent with the rather neutral, subject-matter content of the conference theme, and with the lack of critics from the Third World and the centrally-planned economies on the program. Although such an approach obviously makes for less controversy, it also fails to use our analytical tools and insights in addressing the major issues of the day.

Developing a program for an international conference is not easy. The sheer task of knowing who is doing what is enormous, and the conflicting goals of various interest groups leads to compromise that can be stultifying. Professor Theodor Dams of the University of Freiburg, Federal Republic of Germany, who developed the program, and the others who organized the 1976 conference are to be commended for the generally high quality of the papers. Yet for our profession to contribute to the solution of the important problems before us, we need to address them more directly and be more willing to confront alternative perspectives in considering them.

The 36 papers in the volume cover such topics as economics, agriculture, and the political economy (Theodore W. Schultz, U.S.); the contribution of economists to agricultural policy-making (Glenn L. Johnson, U.S.); the role of models in agricultural decisions (Michael Petit, France); farm-level decision models (R. A. Richardson and others, Australia); regional and interregional planning models (Joseph Sebestyén, Hungary); agriculture and national economic policy (Kazushi Ohkawa, Japan); agricultural and economic policies under socialism (Augustyn Wos and Zdzislaw Grochowski, Poland); agricultural policy in India (M. L. Dantwala, India); and optimum pricing and marketing strategies in rural development (Uma Lele, World Bank). The presidential address on the conference theme was delivered by Samar R. Sen.

In Earlier Issues

The essence of economic progress is the orderly and continuous adaptation of the use of productive resources to changing conditions of production and demand.

Robert B. Glasgow
(Review of: *Agricultural Progress in the Cotton Belt Since 1920* by John Leonard Fulmer)
April 1951, Vol. 3, No. 2, p. 63

MURDER AT THE MARGIN

Marshall Jevons. Thomas Horton and Daughters, Glen Ridge, New Jersey 1978, 168 pages. $7.95.

*Reviewed by William E. Kost**

"Now let's get this straight, Professor. You think you know who the murderer is based on economic theory?"

"I am sure of it," Henry Spearman replied.

With a jacket blurb quote like that, I couldn't resist buying this book. The combination of a new application of my professional interests plus the economist as hero was too much to resist.

My microeconomic theory professor in graduate school once said that if he was a successful economics teacher, his students would find themselves applying economic principles to all their decisions in life; not just to economic decisions. I was, at first, skeptical, but later came around to doing just that. I now know who he studied under—Professor Henry Spearman.

Spearman provides a perfect role model of success and status for economists. He is a full professor at Harvard, a successful lecturer, columnist, and author, as well as a recipient of a Harvard distinguished teaching award. On top of all this, he is the living example of the economists' economic man—one who is well aware of microeconomics and opportunity cost concepts and makes all his personal decisions based on an analysis of his utility surface and on applications of marginal analysis. He believes that economics is best defined as the study of mankind as it goes about its ordinary business of existence. As a student and teacher of economics he is continually amazed at how regularly and consistently the "laws" of economics can be observed in real life. Professor Spearman delights in observing the ordinary daily economic behavior of his fellow humans.

It is just such behavior that involves him in racial unrest, murder, and intrigue on what was originally planned as a quiet vacation in the Virgin Islands. Can he apply the tools of economics to the dismal events that occur at a plush Caribbean resort? Spearman says, "I'm sure of it." And he is right. You will be amazed at the logical deductions Professor Spearman draws by applying the "immutable" laws of economics to both the quite ordinary and extraordinary behavior of his fellow guests at Cinnamon Bay.

Observing peoples' behavior with the proper perspective explains many things. The proper perspective, of course, includes profit maximizing criteria, opportunity cost analysis, supply-demand analysis, capital theory, and game theory. With the proper perspective, solving the mystery does become elementary—elementary economics, that is. With his deductive powers and economic way of thinking, Professor Henry Spearman could join Rabbi Small in providing a new dimension to murder mysteries.

If you are an economist, you will find this book great fun. In real life, the professor might come across as somewhat of a bore. The economic way of thinking, while being a good way to make decisions, is a bit much when it enters into all conversations.

This narrow focus characterizes everyone in the book, not just Spearman. All are one dimensional. Each views the world solely from a perspective based on the precepts of his or her profession. In one sense this bias causes the characters to seem shallow and unrealistic. In another sense, it heightens the sense of satire. I would guess we all view the world with our own biased visions.

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In Earlier Issues

. . . scientists have worked wonders in solving natural limitations and opening new opportunities. But such success can make us too optimistic, for there is no substitute for natural resources as a whole, and there are limits to which one resource can be substituted for another.

H. H. Wooten (Review of: *American Resources; Their Management and Conservation* by J. Russell Whitaker and Edward A. Ackerman)
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