TECHNIQUES TO MEASURE SOCIAL BENEFITS AND COSTS IN AGRICULTURE: A SURVEY

By Jitendar S. Mann

INTRODUCTION

In the last few years, great interest has been shown in evaluating the social benefits and costs of various public policies and programs. The cost-benefit technique has been used extensively in the evaluation of specific projects, such as those on river basins. The recent trend has been to measure changes in consumer's and producer's surplus associated with a specific program and to compare with program costs the benefits thus computed. A well-known example is Hayami and Peterson's study of the Statistical Reporting Service's crop forecasting (*41*).[1] The technique has been used extensively by Harberger (*37*, *39*), particularly for measuring the effect of taxes.

Abstract: Development is traced of the concepts of consumer's and producer's surplus, and the uses and limitations of these concepts for public policy analysis are examined. The applications to price stabilization and policy programs are surveyed. The use of decision theory as an alternative to measurement of surplus is also examined.
Keywords: Consumer's surplus, producer's surplus, stabilization, policy analysis, decision theory.

In this article, I survey techniques used to measure social benefits and costs.[2] I also examine existing controversies as to the theoretical validity of the techniques. A brief history of the concept of surplus appears first, in the following section. An earlier survey of consumer's and producer's surplus is that by Currie (*21*.) The focus of my survey is the use of consumer's and producer's surplus. The more traditional types of cost-benefit analysis is treated extensively by Prest and Turvey (*77*), Krutilla (*57*), Lesourne (*59*), and Mishan (*70*).

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

[2] This survey is by no means exhaustive. The selection of studies included in the discussion is influenced by the author's biases.

THE CONCEPT OF SURPLUS

The idea of measuring social benefits was first proposed by Dupuit (*27*) in 1844 and developed further by Hotelling (*48*). Without recognizing the theoretical difficulties in measuring utility, Dupuit (*27*) distinguished between total and marginal utility. An engineer by training, he was trying to determine criteria for the social value of collective goods such as roads, canals, and bridges. He argued that the value of a social good is greater than the price actually paid, that most people would be willing to pay more than they actually do. He measured the total benefit by the aggregate of maximum prices that would be paid for successive units of the commodity. The difference between this total benefit and the total cost of the product to the consumer he called "Consumer's Surplus". It was measured as the area under the demand curve and above the price line. Dupuit considered the effect of an increase in tax on a commodity, concluding that the loss of utility associated with a heavier tax increases as the square of the tax. He recognized that the yield of a tax to Treasury is no measure of the loss to society. Dupuit neglected the dependence of surplus on the consumption of other goods and services, the problem of aggregation, and the difficulties of measuring utility.

Dupuit distinguished between total and marginal utility. . . . He argued that the value of a social good is greater than the price actually paid, that most people would be willing to pay more than they actually do. . . . The difference between this total benefit and the total cost of the product to the consumer he called "Consumer's Surplus."

Reiterating the ideas of Dupuit, Marshall based his concept of consumer's surplus on the principle of diminishing marginal utility of a commodity (*63*). According to him, "the excess of price which he [the consumer] would be willing to pay rather than go with-

out the thing, over that which he actually does pay, is the economic measure of this surplus satisfaction. It may be called consumer's surplus." This benefit is derived from a man's opportunities, from his environment, or "conjuncture." Marshall developed similar concepts for worker's surplus and saver's surplus. He recognized that the area under the demand curve and above the price line provided an unambiguous measure of consumer's surplus only if the marginal utility of money is constant. He also noted that the demand curve may be asymptotic to the price axis and that the area under the curve is infinite. (See also Samuelson, *80*).

Marshall discussed the effect of tax and subsidy on consumer's surplus. In recognition of the difficulty of measuring the area, he limited his applications to changes in surplus. Considering separately commodities produced under constant, diminishing, and increasing returns, he concluded that there is net social loss from subsidy to an industry producing under diminishing returns. For an industry with increasing returns, the decrease in consumer's surplus from a tax is greater than the revenue to Treasury. Thus there is a net loss in social welfare from a tax on an increasing returns industry. The desirability of subsidy to such an industry is based on the observation that the industry will otherwise operate at less than the optimum output. It will do so because, for decreasing cost, the price exceeds the marginal cost. A positive measure, such as a subsidy, is needed to push output toward the optimum level. Marshall concluded that "if therefore a given aggregate taxation was to be levied ruthlessly from any class it will cause less loss of consumers' surplus if levied on necessaries than if levied on comforts." Ironically, this would imply a tax on an industry which produces necessities of life (much of agriculture) and subsidization of increasing returns industries that produce luxuries.[3]

These ideas of Dupuit and Marshall were, as mentioned, developed further by Hotelling (*48*). He considered whether services of a public project (such as a railway) should be sold at a price high enough to cover total cost. He considered a set of n commodity demand functions, and a set of n marginal cost functions. Defining excess demand functions as the difference between the demand and cost functions, one measures the total net benefit by the line integral of that function. The integral is independent of the path of integration if certain integrability conditions are met. The same measure was established by Hotelling through the use of the ordinal indifference curves. He derived a fundamental theorem:

> If a person must pay a certain sum of money in taxes, his satisfaction will be greater if the levy is made directly on him as a fixed amount than if it is made through a system of excise taxes which he can to some extent avoid by rearranging his production and consumption.

[3] For a different interpretation of Marshall's ideas on increasing returns, see Young (*105*).

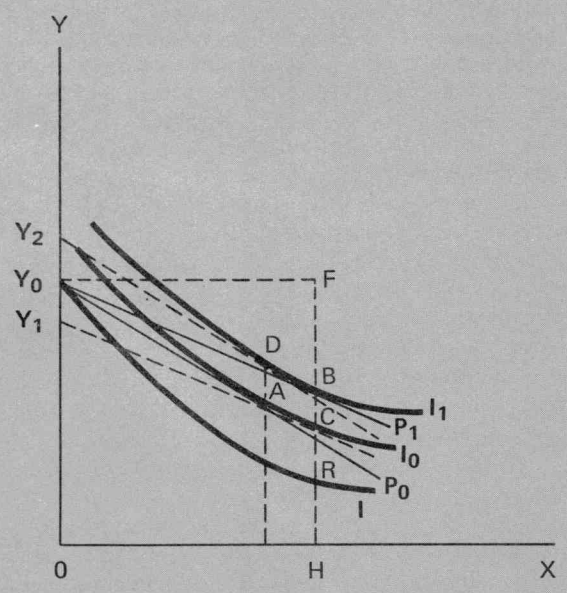
Boulding discussed the elementary concepts of consumer's and producer's surplus using demand-supply curves and also indifference curves (*12*). He pointed out the difference in the measures when one drops the assumption of constant marginal rate of substitution between the commodity and money. Hicks showed what happens in this case: "What ceases to hold is true equivalence between the consumer's surplus and triangle [under the demand curve] and a correction has to be introduced to overcome the discrepancy (*44*).

The earlier analyses are based on the condition that individual preferences can be added into community preferences. This possibility requires the assumption that all persons have identical, homothetic preferences, and the implication is that the marginal utility of income is the same for persons at all income levels. For an examination of implications of these assumptions about marginal utility, see Samuelson (*80*.)

Hicks attempted to reformulate the concept of consumer's surplus by using indifference curves to overcome the objection to the measurability of utility. (*44, 45*). Measuring income on the Y axis and the commodity on the X axis places the consumer with an initial income of Y_O (and no X) on indifference curve I (fig. 1). At a price given by the slope of Y_OP_1, he buys OH and moves to indifference curve I_1. He is willing to pay FR (in money) to stay on indifference curve I after the commodity is introduced. He has to pay FB for OH of X if the price is P_1. The difference, BR, is the consumer's surplus. This, however, does not allow for the variation in marginal utility of money. To meet this last criticism, Hicks introduced the concept of four types of surplus (*21, 45*):

- Compensating variation is the amount of compensation that will leave the consumer in his initial welfare position following a price change, if he is free to buy any quantity of the commodity at a new price. It is the most that the consumer will pay for the privilege of buying at the new price. For a fall in price from P_O to P_1 in figure 1, the compensating variation is Y_OY_1.
- Compensating surplus is the amount of compensation that will leave the consumer in his initial welfare position following a change in price, if he is constrained to buy at the new price the quantity he would have bought without compensation. In figure 1, the compensating surplus equals BC.
- Equivalent variation, Y_OY_2 in figure 1, is the amount of compensation that will leave the consumer in his subsequent welfare position without a change in price, if he is free to buy any quantity at the old price. It is the most amount of money that the consumer must be paid so that he is as well off without the new price.
- Equivalent surplus is the amount of compensation that will leave him in his subsequent welfare position without a price change, if he is constrained to buy at the old price the quantity he would have bought at that price with no compensation. It is AD in figure 1.

FIGURE 1
Hick's Principle of Variation



In Earlier Issues

The problem in regard to sugar in the early years of the war was essentially one of shipping; in the later years it was one of production. Prices were held at the lowest level too long, for the value of the savings to consumers at high levels of prosperity was questionable when higher prices would have been more encouraging to producers than the uncertain and deoayed CCC programs. Great increases in production in Cuba returned a substantial profit, but the bulk of its crop was sold to us at a reasonable price. Many of the programs to encourage the production of domestic beets were of the category of too-little and too-late; domestic beet processors were worse off than any other branch in the industry in the 1943-45 period because of apparent lack of interest in their problems at official policy levels. Sugar rationing, despite its shortcomings, was the most successful of the food-rationing programs and, unlike rationing of other foods, was not removed until adequate supplies were available. Equitable distribution of sugar throughout the country was one of the outstanding achievements of the OPA—made possible through the wholehearted cooperation of the entire sugar industry which was subject to more rigid controls than any other industry.

"Review of: *Sugar and Its Wartime Controls, 1941-47* (Earl B. Wilson) by Maxwell I. Klayman. AER, Vol. I, No. 3, July 1949, p. 103.

These ideas are generalized to a simultaneous change in several prices by the use of Paasche and Laspeyres index numbers. When the income effect of a price change is zero, the above four measures give identical results. Note that the compensating variation for a rise in price is equal to the equivalent variation for an equal fall in price. Conversely, the compensating variation for a fall in price equals the equivalent variation for an equal rise in price.

Dissatisfaction among economists about the usefulness of consumer's surplus has brought outright condemnation by Samuelson (*79*) who remarks: "The subject is of historical and doctrinal interest, with a limited amount of appeal as a purely mathematical puzzle."[4] Graaff further points out the difficulty of applying the tool of consumer's surplus to finite, indivisible changes, the problem of redistribution of gains and losses, and the effect of proposed policy changes on prices (*33*). On the other hand, Harberger (*40*) makes an appeal to accept three postulates of applied welfare economics as a part of the traditional framework of analysis:

- The competitive demand price for a given unit measures the value of that unit to the demander;
- The competitive supply price for a given unit measures the value of that unit to the supplier;
- When evaluating the net benefits or costs of a given action, one should normally add the costs and benefits accruing to each member of the relevant group without regard to the individuals to whom they accrue.

However, Harberger also admits (*37*) that "workers in this field must be ready to content themselves with results that may be wrong by a factor of 2 or 3 in many cases." This is a very important statement which users of the analysis should remember.

Willig derived exact upper and lower limits in approximating the compensating and equivalent variation with consumer's surplus (*102*). The limits depend on the consumer's base income and income elasticity of demand. He shows that, for example, if the consumer's income elasticity of demand is 0.8 and the area under the demand curve between the old and new prices is 5 percent of income, then the compensating variation is within 2 percent of the surplus measured as area under the demand curve. This simply rewords Hotelling's observation that consumer's surplus "breaks down if the variations under consideration are too large a part of the total economy of the person." However, Willig did not consider the issue of aggregation from consumer's surplus to social benefit to the society.[5]

Mishan has expressed concern about the advisability

[4] Note, however, that Samuelson used the concept under the name of social payoff in (*81*).

[5] His concluding sentence is noteworthy. "At the level of the individual consumer, cost-benefit welfare analysis can be performed rigorously and unapologetically by means of consumer's surplus."

of measuring producer's surplus (*69*). He considers a person maximizing his utility function subject to the constraint that the sum of expenditures and earnings is zero (*66*). The person is considered to supply goods and services. He points out that here there is no income effect, and he uses the term "welfare effect." He suggests the concept of rent as economic surplus which should be measured as a compensating or an equivalent variation. Economic rent is a money measure of welfare change from a movement in factor prices.

Mishan further points out the importance of distinguishing between shortrun and longrun supply functions (*69*). The area above the supply curve measures producer's surplus only for a special type of supply curve; namely, one for a period during which output can be increased by adding to the fixed factor quantities of other factors which are imperfect substitutes but perfectly elastic in supply. When all the factors are variable, we cannot derive a producer's surplus from a supply curve. It is not clear whether the producer is an entrepreneur or the owner of factors of production. Mishan recommends that the ambiguity can be avoided by banishing the term "producer's surplus" and concentrating on economic rent as a measure of surplus. The issues raised by Mishan are faced by Peterson in his study of poultry research (*76*) and by Ayer and Schuh in their study of cotton research in Sao Paulo, Brazil (*5*). After analyzing economic surplus, Ayer and Schuh discuss the effect of research expenditures on capital, value of land and labor income.

Winch has shown that consumer's gain can be estimated within certain limits allowing for compensation in the sense of Hicks (*103*). The net gain or loss resulting from aggregation is a valid measure only if the society is indifferent to the redistribution of gains and losses.

As pointed out by Little (*61*, chapter 10), consumer's surplus is based on partial analysis only. It is assumed that no significant price change occurs elsewhere in the economy. This assumption is possible in the longrun only by assuming constant costs. Alternatively, the product under discussion may be independent of all other goods, using only a very small fraction of the available resources. Further price must be equal to marginal cost—pure competition—everywhere. Little concludes that consumer's surplus is a totally useless theoretical toy because it cannot provide a practical, objective criterion for public policy.

APPLICATIONS TO PRICE STABILIZATION

There has been a long debate on the effects of price instability and the social benefits and costs of stabilization programs. Waugh, assuming a negatively sloped, stable demand curve, studied the effect of shifts in supply (*98*). Total consumer's surplus from a series of variable prices will be greater than if the price were stabilized at the arithmetic average. He stated a theorem on the benefits of price instability:

> Let the price of any commodity or service be P_1 in one period of time and P_2 in another equal period. If these prices are unequal, every individual consumer of the commodity or service will enjoy a greater average consumer's surplus in the two periods than if the price were stabilized at the arithmetic mean, $P_o = \frac{1}{2}(P_1 + P_2)$.

He compared the constant price P_o with the price P_1 in one period and P_2 in the other. When the price is OM, the loss in consumer's surplus (compared with the constant price OL which is average of OM and OG) is MNJL (fig. 2). When the price is OG, the gain in consumers' surplus is LJEG. Evidently, there is a net gain compared with behavior in a stable price situation.

According to Waugh, the net gain in consumer's surplus from instability is the areas NQJ and JRE, assuming a linear demand curve. Over time, the net gain in consumers' surplus is approximately:

$$\tfrac{1}{2} \Sigma \delta_k \Delta_k$$

where δ_k is change in price, Δ_k the associated change in quantity, and k is a time index. The gain in consumer's surplus is approximately proportional to the square of the price variation.[6] A doubling of price variation quadruples the net gain in consumer's surplus.

Commenting on Waugh's theorem, Howell raised several objections (*49*). He pointed out that Waugh had not shown that the specified price (arithmetic mean) was the only one, or the most feasible one, at which prices may be stabilized. He demonstrated that "if prices were stabilized at or below the weighted average of P_1 and P_2, every individual consumer of the commodity or service would enjoy a larger average consumer's surplus than if the prices were not stabilized at all." In determining the feasibility of price stabilization, one should also consider the effects on producers' income and quantities consumed:

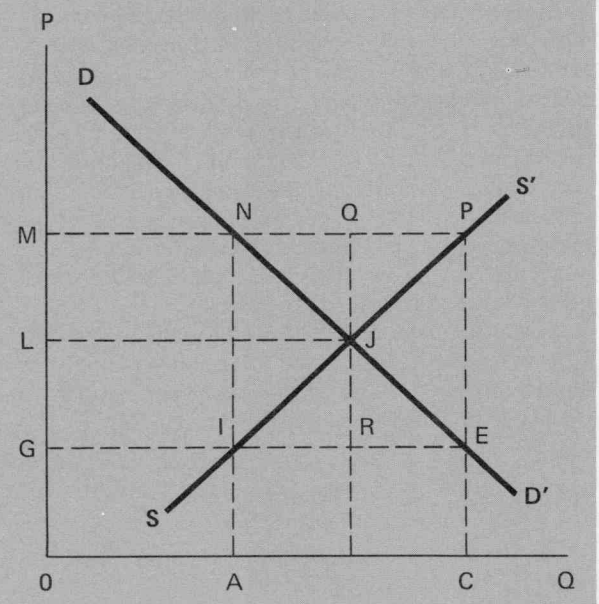
> Price stabilization operations may give results varying all the way from increases in average consumer's surplus, in gross income to producers, and in average quantity demanded to decreases in average consumer's surplus, in gross income to producers, and average quantity demanded, including various combinations of those results, depending upon the point at which prices are stabilized and upon the shape of the demand curve.

Howell also pointed out that, in measuring consumer's surplus, an assumption of constant marginal utility of money had been made.

Similar objections to Waugh's analysis were also raised by Lovasy (*49*). She stated that the Waugh theorem is correct only if demand is stable and if the

[6] This fact has been used by researchers to analyze the problem with quadratic programming.

FIGURE 2
Schematic Diagram of
Social Costs and Benefits



In Earlier Issues

Early in that period of industrial growth (1865-1918) . . . (Henry C. Adams) had caught its meaning when he asserted that the central problem of economics "is properly to correlate public and private activity so as to preserve harmony and proportion between the various parts of organic society." . . . This history causes one to ponder the view that the English have held a monopoly on the development of economic theory; for men like Walker, Adams, Clark, Taussig, Davenport, and Mitchell, were exploring the unknown in as profound a sense as their British cousins. . . . pure competition theory was probably no more applicable to the nineteenth century than to the twentieth. . . . The emphasis on marginalism and other tools of analysis in the development of theory had the immediate effect at least of removing economic theory from the arena of economic action. . . . Economists cloistered in academies of higher learning were refining the theory of pure competition as the operators were engaged in organizing and reorganizing business firms into monopolistic combinations.

"Review of: *The Economic Mind in American Civilization* (Joseph Dorfman) by Willard W. Cochrane. AER, Vol. I, No. 3, July 1949, pp. 99-100.

prices of different goods do not vary in constant ratio to one other.

Waugh replied by rewording his theorem (*49*):

> Let the price of any commodity or service in n equal periods of time be $P_1, P_2, -P_n$. Assuming that demand is stable and that the demand curve slopes downward to the right, stabilization of the price at or above the simple arithmetic mean $\frac{1}{n}(P_1 + - - + Pn)$, would reduce the consumer's surplus of each individual consumer, while stabilization of the price at or below the weighted mean, $\frac{P_1Q_1 + - - + P_nQ_n}{Q_1 + - + Q_n}$, would increase the consumer's surplus of each individual consumer.

Unaware of Waugh's work, Oi enunciated a similar proposition for the producer: "Given a fixed expected value of price, P, the greater the variability of price about the expected value, the greater will be the expected profit" (*74*). He assumed that firms maximize shortrun profits during each period, and that the marginal cost curve of each firm is upward sloping throughout the relevant range. Given a convex profit function, it follows that the average of profits for varying price is greater than the profit at average price. Tisdell pointed out that the errors of price forecast by producers will lead to different results (*92*).

Samuelson stated a theorem in terms of the compensation principle and showed that Waugh's theorem is a special case (*82*). However, he demonstrated that, "in a closed system, when it goes from stable prices to unstable prices it must necessarily have those unstable prices average out to higher than the stable prices." Thus, he doubted the feasible application of Waugh's theorem, even as a special case.

Massell integrated the two approaches and considered sources of disturbance both in demand and supply (*64*). He showed the benefits of error elimination to consumers and producers. He assumed linear demand and supply curves and additive stochastic disturbances. Massell set up a model including supply and demand curves which incorporate continuously distributed random shifts:

$$S = ap + x$$

$$D = -\beta p + y$$

where S = quantity supplied, D = quantity demanded, p = price, a and β are constants, and x and y are random variables with means Mx and My, variances σ_{xx} and σ_{yy}, and covariance equal to zero. The expected value of gains from stabilization of price at expected value are:

$$E(G_p) = \frac{(a + 2\beta)\,\sigma_{xx} - \propto\sigma_{yy}}{2\,(a + \beta)^2}$$

$$E(G_c) = \frac{(2a + \beta)\,\sigma_{yy} - \beta\sigma_{xx}}{2\,(a + \beta)^2}$$

where G_p and G_c are given to producers and consumers. Total gain is

$$E(G) = \frac{\sigma_{yy} + \sigma_{xx}}{2\,(a + \beta)} = \left[\frac{a + \beta}{2}\right]\sigma_{pp}$$

where σ_{pp} is the variance of price. Massell made these conclusions:

- Producers lose (gain) from price stabilization if the price instability is due to random shifts in demand (supply). This is Oi's case which was criticized by Tisdell.
- Consumers lose (gain) from stable price if the price instability is due to random shifts in supply (demand).
- Where both demand and supply shift randomly, the gains to each group are indeterminate and depend upon the relative sizes of the variances and upon the slopes of the demand and supply curves.
- Provided neither the demand curve nor the supply curve is perfectly elastic, the total gains from stabilization are always positive, with gainers being able in principle to compensate the losers. With infinitely elastic functions, all gains tend to zero.

Massell recognized the problem of compensation by the gainers to the losers. However, he gave no operational plan for redistribution of benefits. Massell assumed that the commodity under discussion is a very small part of producer sales and consumer purchases so that the change in its price leaves the marginal utility of money unchanged. Turnovsky generalized the results by considering errors following a Markov process (*94*). He considered the case wherein supply decisions are based on price expectations of two types—adaptive and rational. Turnovsky's major conclusions appear below:

- The Oi's proposition that producers lose from price stabilization if price instability is due to demand fluctuations depends on how the expectations are generated and on the moving average properties of the error term.
- If the expectations are formed rationally, Oi's result holds, provided the errors in the demand function have positive or negative serial correlation.
- If the expectations are formed adaptively, Oi's proposition will not hold, unless the error terms in the demand function have high positive serial correlation.
- The Waugh proposition for consumers will hold under either form of expectation.
- Massell's result that producers and consumers gain from stabilization holds in both cases.
- Massell's quantitative results remain unchanged under rational expectations. Some differences result with adaptive expectations.

Analysis is based on the assumption that total welfare can be measured by the sum of producer's and consumer's surplus. Subotnik and Houck extended the analysis to problems when consumption is stabilized (*90*). Assuming rational expectations, they compared the benefits from stabilizing prices at their mean to those of stabilizing consumption and production at their means.

Most researchers ignored the so-called "middleman" when analyzing the distribution of gains and losses. Bieri and Schmitz examined the case in which monopolistic middleman would gain by destabilizing prices to producers (*9*). They considered a case of two time periods with demand and supply functions defined for each period. They also include a storage cost function in their model. Finally, they examined the case of a pure middleman who maximizes profit and the case of a producer marketing board which maximizes returns (including producer's surplus) to producers.

In another, later article, Massell examined the effects of a buffer stock on expected value and variance of producer's income (*65*). He considered an agricultural commodity with demand and supply curves:

$$D = -\beta p + y$$

$$S = x$$

where D = demand, S = supply, p = price and y and x are random variables. The stabilization program involves a transformation of the demand curve. Massell examines the effect of stabilization in two stages: (1) eliminating the stochastic term in the demand curve and (2) rotating the demand curve to increase its slope. He shows that stabilization increases expected value and decreases variance of producer's income. Thus he includes producer's risk aversion in his analysis. He analyzes the welfare implications of stabilization by using indifference curves.

While Massell's analysis was limited to a single market, Hueth and Schmitz examined internationally traded goods in a two-country, spatial price equilibrium model (*50*). They discussed separately the case of final product and an intermediate good which a country imports and uses in domestic production of final goods, some of which are also imported. An appropriate example is wool, which has been examined by Dardis (*22*) and Dardis and Dennison (*24*). In the Hueth-Schmitz model, the source of price instability is shifts in demand and supply in the foreign market. The instability is carried on to the domestic market which adjusts by movements along the demand and supply curves. Hueth and Schmitz showed that both producers and consumers prefer price instability to price stability. This conclusion depends on the fact that price instability is generated by movements along the demand and supply schedules.

The above studies of Waugh-Oi-Massell and their followers assume linear demand and supply curves with additive disturbances. Turnovsky developed a general model including nonlinear demand and supply functions with multiplicative disturbances (*95*). Theoretical justifi-

cation for nonlinear functions with multiplicative errors is given by deriving a supply curve from a homogeneous production function and a demand curve from an indirect utility function. An important conclusion is that the desirability of price stabilization (increase in social welfare) of either producers or consumers does not depend on the source of price instability.

In most studies, the analysts have considered random fluctuations in demand and supply and the effect of various stabilization programs on equilibrium prices and quantities. Anderson and Riley consider welfare implications of price uncertainty for a country which specializes in production of export goods (*3*). They show that social welfare for such a country is less with fluctuating prices compared with fixed prices.

APPLICATIONS TO POLICY AND PROGRAMS[7]

The early attempts at measuring social returns compared the cost with additional output. Griliches compared the cost of research on hybrid corn with the value of increased production from the adoption of hybrid corn seed (*34*). Evenson tried to assess the benefits from research by using expenditures on research and extension in an aggregate production function (*28*). Earlier, Waugh had tried to show the effect of market prorates on social welfare (*97*). He was criticized by Stigler for being oblivious to the problem of interpersonal comparisons of utility (*89*). Following Griliches and using economic surplus, Peterson studied the benefits of poultry research, and he found that the improved techniques resulting from research bring about a shift in the supply curve. He developed an approximate method for measuring the surplus from the shift in supply (*76*).

The social costs and benefits of U.S. farm programs were measured by Nerlove (*73*, pp. 222-235) and Wallace (*96*). Nerlove used his estimates of supply elasticities to measure welfare cost of alternative price support programs. He considered three types of programs: (1) The Government sets a support price above the equilibrium price and purchases and destroys all excess crop; (2) the support price is set above the equilibrium price; farmers are allowed to sell all they produce in the open market and the Government pays a per unit subsidy equal to the difference between support price and the market price; (3) the output is restricted by direct controls to bring about the desired price.

Nerlove assumes that the supply curve is the marginal social cost of the resources used to produce the commodity and that the demand curve is the marginal value of the commodity to the community (fig. 2). He assumes that each program aims to attain a price OM. Welfare loss is taken as the difference between Government expenditures and the net benefits to consumers and producers. The net losses of the three programs are given by the areas ANJPC, JPE, and NJI, respectively. Nerlove concludes that programs of types 2 or 3 can never involve a social loss of welfare greater than that of program 1. He derived formulas for net loss in terms of the proportion by which the support price exceeds the equilibrium price (x), and the elasticities of demand (η) and supply (ϵ). The three formulas are:[8]

$$L_1 = x(1 + x)(\eta + \epsilon) - \tfrac{1}{2}x^2(\eta + \epsilon)$$

$$L_2 = \tfrac{1}{2}x^2\epsilon\left(1 + \frac{\epsilon}{\eta}\right)$$

$$L_3 = \tfrac{1}{2}x^2\eta\left(1 + \frac{\eta}{\epsilon}\right)$$

Nerlove stated that the relative magnitude of the loss of under types 2 and 3 programs will depend on the difference between the support price and the equilibrium price and upon the elasticities of demand and supply. Wallace demonstrated that, for a given support price (*96*):

$$\text{NSL (3)} \gtrless \text{NSL (2)}$$

$$\text{as } \eta \gtrless \epsilon$$

Wallace also analyzed the effects of output restriction through control of input (for example, acreage allotments). He had two premises: (1) the total area under the demand curve to the left of a given quantity represents total utility for that quantity and (2) the supply curve reflects opportunity costs of variable resources used to produce each quantity. The type 3 program is called the Cochrane Proposal by Wallace. Wallace's formula in premise 2 (*96*, p, 582) is identical to Nerlove's formula for L_3 except that Nerlove measures the loss as percent of the value of the crop. In the type 2 program, called the Brannan Plan, Wallace's formula is Nerlove's formula for L_2.

The same framework of analysis was used by Johnson to estimate the net social cost of the tobacco program (*53*). He took into account U.S. monopoly power in the world market. Johnson recognizes the problem of the second-best solution in estimating the social cost of the tobacco program (*53*). He estimates three types of costs for the flue-cured and burley tobacco acreage allotment program:

[7] Not included here are studies of restrictions on international trade. These have been summarized in an article by Corden (*20*).

[8] The absolute values of elasticities are considered in this discussion.

248-264 O - 77 - 2

- The social cost is estimated by the "triangle Method:"

$$SC = \tfrac{1}{2} p_0 q_0 \eta \tau^2 \left(1 + \frac{\eta}{\epsilon}\right)$$

where τ is the percentage increase in price over the free market equilibrium price.

- The monopoly rent gained from foreigners through export demand is estimated as the price increase times the quantity exported.
- Efficiency loss in producer surplus due to input (land) restriction is estimated as follows: He assumes a Cobb-Douglas production function with a supply curve $Q=AP^{\epsilon}$, and a demand function $Q=BP^{-\eta}$. Given price increases equal to τ, the efficiency loss is calculated as:

$$\frac{\epsilon}{1+\epsilon} p_0 q_0 \left[(1+\tau)^{1-\eta} - (1+\tau)^{-\eta} \frac{(\epsilon+1)}{\epsilon}\right]$$

Welch studies supply controls with marketable quotas. He introduced uncertainly into his analysis. Harberger discussed what he called "the economics of the nth best" (*38*). He was concerned with measuring the social cost associated with the economy being in any nonoptimal position. He called the social cost "deadweight loss."

Hayami and Peterson developed an analytical framework for social returns to Government expenditure on statistical reporting of agricultural commodities (*41*). Two models are considered: inventory adjustment and production adjustment. The inventory adjustment model includes cases wherein production cannot be changed in response to output forecasts and reactions to forecasts occur as stock adjustments. Assuming linear demand, the net welfare loss due to symmetric errors in forecasts is estimated as:

$$\Delta NB = \epsilon^2 pq \frac{1}{a}$$

where q is the true quantity of production, p is the equilibrium price, ϵ is the error in quantity of products as a proportion of the true production, and a the price elasticity of demand.

In the production adjustment models the producers adjust output in response to changes in price expectations. The net social cost of error in production reporting in this case:

$$\Delta NB = \tfrac{1}{2} \epsilon^2 pq \left(\frac{\beta}{a^2} + \frac{\beta^2}{a^3}\right)$$

where β is the elasticity of supply and other symbols are as defined above.

Bullock has developed a model including a cost of storage function along with the demand for storage stocks (*13*). According to Bullock, sheer magnitude of the forecast error need not be of concern—reducing the average forecast error will not generate social benefits (which was the Hayami-Peterson assumption). The key variable is how the frequency of forecasts has changed in the process.

STUDIES USING DECISION THEORY

The studies discussed above are based on the classical principles of welfare economics. Another approach is to use statistical decision theory. A survey of decision theory with applications to agriculture is given in Dillon (*26*). More analysts have used the consumer-producer surplus approach than the decision theory method; however, the latter is receiving more attention in program evaluation. Lave studied the value of better weather information to the raisin industry (*58*). A grower can use it in making the following decisions: (1) how high a yield to plan, (2) when to pick the grapes, and (3) whether to sell for crushing. The first task is to optimize the yield decision by under- or fully cropping. Once this decision has been made, growers have three actions open: (a) pick grapes 21 days before the first expected rainfall, (b) sell for crushing at any time, and (c) pick the grapes when ripe and pay no attention to the weather. A payoff matrix is obtained given the probability of rain during any of the six consecutive 10-day periods, the first starting September 1.

Byerlee and Anderson developed a method for assessing the monetary value of additional information in the response process (*17*). Three classes of inputs are considered: controlled, uncontrolled and known at the time of the decision, and uncontrolled and not known at the time of the decision. They illustrate the analysis by using a rainfall predictor in determining optimal application of nitrogen to wheat. The response function includes several factors: applied nitrogen, growing season rainfall, soil moisture, total soil nitrogen, and initial soil nitrate. The function includes interaction between nitrogen and rainfall: interaction is a necessary condition for additional information on rainfall to have significant economic value. A prior distribution for growing season rainfall is developed from historic data. A matrix of conditional probabilities of growing season rainfall, given the annual rainfall, was developed from this matrix and the posterior probabilities of growing season rainfall calculated. The expected profit is calculated from the posterior distribution. The rainfall predictions for six different intervals are used to decide the optimum level of nitrogen. The difference between expected profits with and without rainfall predictions is the value of the information.

Baquet, Halter, and Conklin measured the economic value of frost forecasts to pear orchardists in Jackson County, Oregon, using a Bayesian decisionmaking technique (*7*). The decision is whether to turn on the heaters to protect the pear orchards against frost. The temperature forecast during the frost season is provided by the U.S. Weather Service. The conditional probabilities of forecast temperatures and recorded temperatures are developed from historic data. Using historic prior probabilities of nighttime low temperature readings, the posterior probabilities are developed. A utility function is estimated for each of the eight orchardists studied. The utility payoff matrix is multiplied by the posterior

probabilities to obtain the optimal action for each forecast. The value of forecasts is the difference between the monetary outcome of Bayes action and the monetary outcome of the optimal prior actions.

These studies using decision theory approach are microanalyses of a few producers. Generalization of the technique to aggregate studies provides a challenge for further work.

A CRITIQUE AND CONCLUSIONS

Most studies of measurement of social costs and benefits assume a perfectly competitive system with perfect knowledge and perfect mobility. It is well known that a perfectly competitive system leads to Pareto optimal social welfare. However, in practice there is no such thing as perfect competition. Once additional restrictions—lack of perfect knowledge—are allowed for, Pareto optimum is not attainable or desirable (Lipsey and Lancaster, *60*). As a matter of fact, if the system were perfectly competitive, we would not need some programs, such as crop forecasting. Once imperfections are admitted, it follows that the removal of any one constraint may affect welfare either by raising, lowering, or leaving it unchanged (Lipsey and Lancaster, p. 12). Commenting on the Oi's finding that "price instability is a virtue and not a vice," Tisdell showed the importance of the two assumptions of perfect mobility and perfect knowledge (*92*). Perfect mobility implies that producers can readily adjust output to changed price. Perfect knowledge implies that they can accurately forecast the price. In the absence of perfect forecasts and perfect adjustment, Tisdell derived the opposite of Oi's results. The extension of the analysis to a noncompetitive economy will be a useful topic for research.

So long as one's analysis is partial equilibrium, it is of limited validity. The study of one particular program or commodity does not concern itself with global welfare and, according to Lipsey and Lancaster, "piecemeal welfare economics" is futile (p. 17). Hushak, who recognized the interaction between one crop and others took a step in the right direction (*51*). Most analysts studying social benefits and costs have used the classical welfare economic tools of consumer's and producer's surplus without worrying about their theoretical validity. These researchers only point out the high social benefit-cost ratio of particular proposals. The general problem of ranking all the programs under consideration in a general equilibrium system has not been successfully attempted.

REFERENCES

(1) Akino, Masakatsu and Yujiro Hayami. "Efficiency and Equity in Public Research: Rice Breeding in Japan's Economic Development." *Am. J. Agr. Econ.* Vol. 57, No. 1, Feb. 1975, pp. 1-10.

(2) Anderson, J. E. "A Note on Welfare Surplus and Gains From Trade in General Equilibrium." *Am. Econ. Rev.* Vol. 64, Sept. 1974, pp. 758-762.

(3) Anderson, James E., and John G. Riley. "International Trade with Fluctuating Prices." *International Econ. Rev.* Vol. 15, No. 1, Feb. 1976, pp. 76-97.

(4) Arrow, Kenneth J., and Tibor Scitovsky (eds.). *Readings in Welfare Economics.* Richard D. Irwin, Inc., 1969.

(5) Ayer, Harry W., and G. Edward Schuh. "Social Rates of Return and Other Aspects of Agricultural Research: The Case of Cotton Research in Sao Paulo, Brazil." *Am. J. Agr. Econ.* Vol. 54, No. 4, Nov. 1972, pp. 557-569.

(6) Bailey, Martin J. "Analytic Framework for Measuring Social Costs," *J. Farm Econ.* Vol. 44, No. 5, 1962, pp. 564-575.

(7) Baquet, A. E., A. N. Halter, and Frank C. Conklin. "The Value of Frost Forecasting: A Bayesian Appraisal." *Am. J. Agr. Econ.* Vol. 58, No. 3, Aug. 1976, pp. 511-520.

(8) Bergson, Abram. "A Note on Consumer's Surplus." *J. Econ. Lit.* Vol. 13, No. 1, Mar. 1975, pp. 38-44.

(9) Bieri, Jurg and Andrew Schmitz. "Market Intermediaries and Price Instability: Some Welfare Implications." *Am. J. Agr. Econ.* Vol. 56, No. 2, May 1974, pp. 280-285.

(10) Biondillo, A. *Social Cost of Production Instability in Grape-Wine Industry: Argentina.* Ph.D. thesis, Univ. Minn. 1972.

(11) Boadway, Robin W. "The Welfare foundations of Cost-Benefit Analysis." *Econ. J.* Vol. 84, No. 336, Dec. 1974, pp. 926-939.

(12) Boulding, Kenneth E. "The Concept of Economic Surplus." *Am. Econ. Rev.* Dec. 1945, pp. 851-869.

(13) Bullock, J. Bruce. "Social Costs Caused by Errors in Agricultural Production Forecasts." *Am. J. Agr. Econ.* Vol. 58, No. 1, Feb. 1976, pp. 76-80.

(14) Burns, Michael E. "A Note on the Concept and Measure of Consumer's Surplus." *Am. Econ. Rev.* Vol. 63, No. 3, June 1973, pp. 335-344.

(15) Burt, Oscar R., and Durnard Brewer. "Estimation of Net Social Benefits from Outdoor Recreation." *Econometrica*, Vol. 39, No. 5, Sept. 1971, pp. 813-827.

(16) Buxton, Boyd M., and Jerome W. Hammond. "Social Cost of Alternative Dairy Price Sup-

port Levels." *Am. J. Agr. Econ.* Vol. 56, No. 2, May 1974, pp. 286-291.

(17) Byerlee, D. R., and J. R. Anderson. "Value of Predictors of Uncontrolled Factors in Response Functions." *Australian J. Agr. Econ.*, Vol. 13, No. 2, Dec. 1969, pp. 118-127.

(18) Cicchetti, Charles J., Anthony C. Fisher, and V. Kerry Smith. "An Econometric Evaluation of a Generalized Consumer Surplus Measure: The Mineral King Controversy." *Econometrica*, Vol. 44, No. 6, Nov. 1976, pp. 1259-1276.

(19) Corden, W. M. "The Calculation of the Cost of Protection." *Econ. Record*, Vol. 33, Apr. 1957, pp. 29-51.

(20) Corden, W. M., "The Costs and Consequences of Protection: A Survey of Empirical Work." Peter B. Kenen, ed., *International Trade and Finance: Frontiers for Research*, Cambridge Univ. Press, 1975, pp. 51-91.

(21) Currie, John Martin, John A. Murphy, and Andrew Schmitz. "The Concept of Economic Surplus and Its Use in Economic Analysis," *Econ. J.* Vol. 81, No. 324, Dec. 1971, pp. 741-799.

(22) Dardis, Rachel. "Intermediate Goods and the Gain from Trade." *Rev. Econ. and Statis.* Vol. 49, 1967, pp. 502-509.

(23) Dardis, Rachel. "The Welfare Cost of Grain Protection in the United Kingdom." *J. Farm Econ.* Vol. 49, No. 3, Aug. 1967, pp. 597-609.

(24) Dardis, Rachel, and Janet Dennison. "The Welfare Cost of Alternative Methods of Protecting Raw Wool in the United States." *Am. J. Agr. Econ.* Vol. 51, No. 2, May 1969, pp. 303-319.

(25) Dardis, Rachel, and Elmer W. Learn. *Measures of the Degree and Cost of Economic Protection of Agriculture in Selected Countries.* U.S. Dept. Agr., Econ. Res. Serv. Tech. Bull. 1384, Nov. 1967.

(26) Dillon, John L., "An Expository Review of Bernoullian Decision Theory in Agriculture: Is Utility Futility?" *Rev. Marketing and Agr. Econ.* Vol. 39, No. 1, Mar. 1971, pp. 3-80.

(27) Dupuit, Jules. "On the Measurement of the Utility of Public Works." *International Econ. Papers*, Vol. 2, 1952, pp. 83-110 (reprinted in *4*).

(28) Evenson, Robert. "The Contribution of Agricultural Research to Production." *J. Farm. Econ.* Vol. 49, No. 5, Dec. 1967, pp. 1415-1425.

(29) Foster, E., and Hugo Sonnenschein. "Price Distortion and Welfare Economics." *Econometrica*, Vol. 38, No. 2, Mar. 1970, pp. 281-297.

(30) Foster, C. D., and H. L. I. Newberger. "The Ambiguity of the Consumer's Surplus Measure of Welfare Change." *Oxford Econ. Papers*, Vol. 26, 1974, pp. 66-77.

(31) Freebairn, J. W. "The Value and Distribution of the Benefits of Commodity Price Outlook Information." *Econ. Record*, Vol. 52, 1976, pp. 199-212.

(32) Glaister, Stephen. "Generalized Consumer Surplus and Public Transport Pricing." *Econ. J.* Vol. 84, No. 336, 1974, pp. 849-867.

(33) Graaf, J. deV. *Theoretical Welfare Economics.* Cambridge Univ. Press, 1967.

(34) Griliches, Zvi. "Research Costs and Social Returns: Hybrid Corn and Related Innovations." *J. of Polit. Econ., Vol. 66, No. 5, Oct.* 1958, pp. 419-431.

(35) Gustafson, Robert L. *Carryover Levels for Grain.* U.S. Dept. Agr., Tech. Bul. 1178, October 1958.

(36) Haessel, Walter, and Edward Vichery. "The Social Profitability of Subsidies for Agricultural Exports: The Case of Ghana, " *Am. J. Agr. Econ.*, Vol. 57, No. 1, Feb. 1975, pp. 11-20.

(37) Harberger, Arnold C. "Using the Resources at Hand More Effectively." *Am. Econ. Rev.*, Papers and Proceedings, Vol. 49, No. 2, May 1959, pp. 134-146.

(38) _____. "The Measurement of Waste." *Am. Econ. Rev.*, Papers and Proceedings, Vol. LIV, No. 3, May 1964, pp. 58-76.

(39) _____. "Taxation, Resource Allocation, and Welfare." NBER, *The Role of Direct and Indirect Taxes in the Federal Revenue System*, Princeton Univ. Press, 1964, pp. 25-70.

(40) _____. "Three Basic Postulates for Applied Welfare Economics: An Interpretive Essay." *J. Econ. Lit.* Vol. 9, No. 3, Sept. 1971, pp. 785-797.

(41) Hayami, Yujiro, and Willis Peterson. "Social Returns to Public Information Services: Statistical Reporting of U.S. Farm Commodities." *Am. Econ. Rev.* Vol. 62, No. 1, Mar. 1972, pp. 119-130.

(42) _____. "Social Return to Public Information Services: Statistical Reporting of U.S. Farm Commodities: Reply." *Am. Econ. Rev.* Vol. 63, No. 5, Dec. 1973, pp. 1020-1021.

(43) Hause, John C. "The Welfare Costs of Disequilibrium Exchange Rates." *J. Polit. Econ.* Vol. 64, No. 4, Aug. 1966, pp. 333-352.

(44) Hicks, John R. "The Rehabilitation of Consumer's Surplus." *Rev. Econ. Studies*, Vol. 9, 1941, pp. 108-16 (reprinted in *4*).

(45) Hicks, John R. *A Revision of Demand Theory.* Oxford, Clarendon Press, London, 1959.

(46) Hirshleifer, Jack. "The Private and Social Value of Information and Reward to Inventive Activity." *Am. Econ. Rev.* Vol. 61, No. 4, Sept. 1971, pp. 561-574.

(47) Hotelling, Harold. "Edgeworth's Taxation Paradox and the Nature of Demand and Supply

Functions." *J. Polit. Econ.* Vol. 40, No. 5, Oct. 1932, pp. 577-616.

(48) _____. "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates." *Econometrica*, Vol. 6, No. 3, July 1938, pp. 242-269.

(49) Howell, L. D. "Does the Consumer Benefit from Price Instability," Gertrud Lovasy, "Further Comment," Frederick V. Waugh, "Reply," *Quar. J. Econ.* Vol. 59, No. 2, Feb. 1945, pp. 287-303.

(50) Hueth, Darrell, and Andrew Schmitz. "International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices." *Quar. J. Econ.* Vol. 86, No. 3, Aug. 1972, pp. 351-356.

(51) Hushak, Leroy J. "A Welfare Analysis of the Voluntary Corn Diversion Program, 1961 to 1966." *Am. J. Agr. Econ.* Vol. 53, No. 2, May 1971, pp. 173-181.

(52) Johnson, Harry G. "The Cost of Protection and the Scientific Tariff." *J. Polit. Econ.* Vol. 68, No. 4, Aug. 1960, pp. 327-345.

(53) Johnson, Paul R. "The Social Cost of the Tobacco Program." *J. Farm Econ.* Vol. 47, No. 2, May 1965, pp. 242-255.

(54) Josling, T. "A Formal Approach to Agricultural Policy." *J. Agr. Econ.* Vol. 20, 1969, pp. 175-195.

(55) Just, Richard E. *A Generalization of Some Issues in Stochastic Welfare Economics.* Agr. Expt. St., Okla. State Univ. Res. Rpt. P-712, Apr. 1975.

(56) Kawamata, Kunio. "Price Distortion and Potential Welfare." *Econometrica*, Vol. 42, No. 3, May 1974, pp. 435-460.

(57) Krutilla, John V. "Welfare Aspects of Benefit-Cost Analysis." *J. Polit. Econ.* Vol. 69, 1961, pp. 226-235.

(58) Lave, Lester B. "The Value of Better Weather Information to the Raisin Industry." *Econometrica*, Vol. 31, No. 1-2, Jan.-Apr. 1963, pp. 151-164.

(59) Lesourne, Jacques. *Cost-benefit Analysis and Economic Theory*, North-Holland Publ. Co., 1975.

(60) Lipsey, R. G., and Kelvin Lancaster. "The General Theory of Second Best." *Rev. Econ. Studies*, Vol. 24, No. 63, Dec. 1955, pp. 11-32.

(61) Little, I. M. D. *A Critique of Welfare Economics.* Oxford Univ. Press, 1957.

(62) Magee, Stephen P. "The Welfare Effects of Restrictions on U.S. Trade." *Brooking Papers on Econ. Activity*, No. 8, 1972, pp. 645-707.

(63) Marshall, Alfred. *Principles of Economics.* Macmillan & Co., London, 1966.

(64) Massell, Benton F. "Price Stabilization and Welfare." *Quar. J. Econ.* May 1969, pp. 284-298.

(65) Massell, Benton F. "Some Welfare Implications of International Price Stabilization." *J. Polit. Econ.* 1970, pp. 404-417.

(66) Mishan, E. J. "Rent as a Measure of Welfare Change." *Am. Econ. Rev.* Vol. 49, June 1959, pp. 386-95 (reprinted in *68*).

(67) _____. "A Survey of Welfare Economics, 1939-1959." *Econ. J.* Vol. 70, No. 278, 1960, pp. 197-256, (reprinted in *68*).

(68) _____. *Welfare Economics: Five Introductory Essays.* Random House, 1964.

(69) _____. "What is Producer's Surplus?" *Am. Eco. Rev.* Vol. 58, No. 5, Part I, Dec. 1968, pp. 1269-1282.

(70) _____. *Cost-Benefit Analysis.* Praeger, 1976.

(71) Mohring, Herbert. "Alternative Welfare Gain and Loss Measures." *West. Econ. J.* Vol. 9, Dec. 1971, pp. 349-368.

(72) Musgrave, Richard A. "Cost-Benefit Analysis and the Theory of Public Finance." *J. Econ. Lit.* Vol. 7, No. 3, Sept. 1969, pp. 797-806.

(73) Nerlove, Marc. *The Dynamics of Supply.* Johns Hopkins Press, 1958.

(74) Oi, Walter Y. "The Desirability of Price Instability Under Perfect Competition." *Econometrica*, Vol. 29, No. 1, Jan. 1961, pp. 58-64.

(75) Oi, Walter Y. "The Consumer Does Benefit from Feasible Price Stability: A Comment." Frederick V. Waugh, "A Comment," Paul A. Samuelson, "Rejoinder." *Quar. J. Econ.* Vol. 86, No. 3, Aug. 1972, pp. 494-503.

(76) Peterson, Willis. "Return to Poultry Research in the United States." *J. Farm Econ.* Vol. 49, No. 3, Aug. 1967, pp. 656-659.

(77) Prest, A. R., and R. Turvey. "Cost-Benefit Analysis: A Survey." *Econ. J.*, 1965.

(78) Reutlinger, Shlomo. "A Simulation Model for Evaluating Worldwide Buffer Stocks of Wheat." *Am. J. Agr. Econ.* Vol. 58, No. 1, Feb. 1976, pp. 1-12.

(79) Samuelson, Paul A. *Foundations of Economic Analysis.* Harvard Univ. Press, 1947.

(80) _____. "Constancy of the Marginal Utility of Income." Oscar Large, ed., *Studies in Mathematical Economics and Econometrics*, Univ. Chicago Press, 1947.

(81) _____. "Spatial Equilibrium and Linear Programming." *Am. Econ. Rev.* Vol. 42, No. 3, June 1952, pp. 283-303.

(82) _____. "The Consumer Does Benefit from Feasible Price Stability," *Quar. J. Econ.* August 1972, pp. 476-493.

(83) Schmalensee, Richard. "Consumer's Surplus and Producer's Goods." *Am. Econ. Rev.* Vol. 61, No. 4, Sept. 1971, pp. 682-687.

(84) Schmitz, Andrew and David Seckler. "Mechanized Agriculture and Social Welfare: The Case of the Tomato Harvester." *Am. J. Agr. Econ.* Vol. 52, No. 4, Nov. 1970, pp. 569-577.

(85) Sillerberg, Eugene. "Duality and the Many Consumer's Sur-

pluses." *Am. Econ. Rev.* Vol. 62, No. 5, Dec. 1975, pp. 942-952.

(86) Smith, Lawrence N., and Bruce A. Scherr. "Social Return to Public Information Services: Statistical Reporting of U.S. Farm Commodities: Comment." *Am. Econ. Rev.* Vol. 63, No. 5, Dec. 1973, pp. 1017-1019.

(87) Smyth, David J. "Effect of Public Price Forecast on Market Price Variation: A Stochastic Cobweb Example." *Am. J. Agr. Econ.* Vol. 55, No. 1, Feb. 1973, pp. 83-88.

(88) Snape, R. H. "Sugar: Costs of Protection and Taxation." *Economica*, Vol. 36, 1969, pp. 29-41.

(89) Stigler, George J. "Social Welfare and Differential Prices," Frederick V. Waugh, "Rejoinder." *J. Farm Econ.* Vol. 20, No. 3, Aug. 1938, pp. 573-589.

(90) Subotnik, Abraham and James P. Houck. "Welfare Implications of Stabilizing Consumption and Production." *Am. J. Agr. Econ.* Vol. 58, No. 1, Feb. 1976, pp. 13-20.

(91) Tintner, G., and M. Patel. "Evaluation of Indian Fertilizer Projects—An Application of Consumer's and Producer's Surplus." *J. Farm Econ.* Vol. 48, Aug. 1966, pp. 704-10.

(92) Tisdell, Clem, "Uncertainty, Instability, Expected Profit," Walter Y. Oi, "Rejoinder," *Econometrica.* Vol. 31, No. 1-2, Jan.-Apr. 1963, pp. 243-248.

(93) Trout, Rader. "The Welfare Loss from Price Distortions." *Econometrica*,, Vol. 44, No. 6, Nov. 1976, pp. 1253-1257.

(94) Turnovsky, Stephen J. "Price Expectations and the Welfare Gains from Price Stabilization." *Am. J. Agr. Econ.* Vol. 56, No. 4, Nov. 1974, pp. 706-716.

(95) Turnovsky, Stephen J. "The Distribution of Welfare Gains from Price Stabilization: The Case of Multiplicative Disturbances." *International Econ. Rev.* Vol. 17, No. 1, Feb. 1976, pp. 133-148.

(96) Wallace, T. D. "Measures of Social Costs of Agricultural Program." *J. Farm Econ.* Vol. 44, No. 2, May 1962, pp. 580-594.

(97) Waugh, Frederick V. "Market Prorates and Social Welfare." *J. Farm Econ.* Vol. 20, No. 2, May 1938, pp. 403-416.

(98) _____ . Does the Consumer Benefit from Price Instability?" *Quar. J. Econ.* Vol. 59, Aug. 1944, pp. 602-614.

(99) _____ . "Consumer Aspects of Price Instability." *Econometrica.*, Vol. 34, No. 2, Apr. 1966, pp. 504-509.

(100) Wegge, L. L., S. H. Sosnik, and P. S. George. "The Effect of Price Stabilization on Consumer Welfare." *West. Econ. J.* Vol. 9, Sept. 1971, pp. 289-298.

(101) Welch, Finis. "Supply Control with Marketable Quotas: The Cost of Uncertainty." *J. Farm Econ.* Vol. 49, No. 3, Aug. 1967, pp. 592-595.

(102) Willig, Robert D. "Consumer's Surplus Without Apology." *Am. Econ. Rev.* Vol. 66, No. 4, Sept. 1976, pp. 589-597.

(103) Winch, David M. "Consumers' Surplus and the Compensation Principle." *Am. Econ. Rev.* Vol. 55, No. 3, June 1965, pp. 395-423.

(104) Wisecarver, Daniel. "The Social Costs of Input-Market Distortions." *Am. Econ. Rev.* Vol. 64, No. 3, June 1974, pp. 359-372.

(105) Young, Allyn A. "Increasing Returns and Economic Progress." *Econ. J.* Vol. 38, 1928, pp. 527-542, (reprinted in *4*).

(106) Zucker, Albert. "On the Desirability of Price Instability: An Extension of the Discussion." *Econometrica*, Vol. 33, No. 2, Apr. 1965, pp. 437-441.

In Earlier Issues

As the years roll by we are able to reflect on the influences in the world of agricultural economics that grew out of Professor [Benjamin Horace] Hibbard's teaching at the University of Wisconsin. He was not the kind of professor who taught a doctrine and expected the students to remember everything that was in his lectures or the textbook. Rather, he was a leader in thought who developed a philosophic understanding of the economic phenomena in agriculture. He was a humanist in the sense that human welfare and human behavior were always of foremost interest to him.

Professor Hibbard . . . has kept out [of his book] quantitative data and . . . theoretical points which would have greatly expanded the scope of the book, thereby limiting the readership and wide use which it deserves . . .

M. L. Wilson
Volume 1, Number 2, p. 66
April 1949
