EVALUATION OF POTENTIAL AGGREGATE ECONOMIC IMPACTS OF THE RELEASE OF PUBLIC PRODUCTION AND PRICE FORECASTS: A DETERMINISTIC SIMULATION APPROACH

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CHAPTER I

INTRODUCTION

Background

In recent years, it has become somewhat fashionable to be skeptical about the general use of tax revenue to finance public programs. Presumably, this skepticism is an expression of taxpayers dissatisfaction regarding the efficiency with which those resources have been put to use in the past (Norton and Davis). As part of such a trend, the use of public funds by the United States Department of Agriculture (USDA) to collect and publish agricultural statistics has been questioned. The questioning, within the farming community, has been revealed through scientific surveys (Jones et al.) and in a number of newspaper editorials (Denver Post, Wall Street Journal).

Traditionally, USDA information has been criticized on the grounds of accuracy and timeliness. Other forms of criticisms are also expressed. Some disgruntled farmers and ranchers, apparently, believe that the revelation of such information has a depressing effect on farm prices resulting in income transfers from farmers to nonfarmers (Jones et al., Bullock, 1981).

The pressure to scrutinize such use of public funds has already begun and resulted in a reduction of expenditures on data gathering and distribution. Slater estimated the overall statistical budget reductions for 1983 at about 20%, in real terms, relative to 1980. In a single announcement in 1983 the administrator of the Statistical Reporting Service (SRS) of the USDA eliminated 26 reports and eliminated or reduced the frequency of data series in other reports as a result of budget reductions (Just, 1983). The content and emphasis of the remaining ongoing reports are under continuous review, in line with current budget constraints and priorities.

A fear is developing among public decision makers, and academia, that the decline in future flows of publicly originated data, which has so far, mostly, affected minor crops, may continue in years ahead and become even more serious. This could have profound adverse social consequences (Schuh). In 1983, for instance, the American Agricultural Economics Association (AAEA) organized a symposium on "The Dilemma of Agricultural Economists in an Era of Dwindling Data Sources". In this symposium Agricultural Economists outlined their perceptions and qualitative assessments of the possible impacts on the farming and research communities of a continued public disinvestment in agricultural information.

Doubting the usefulness of information is a new development and somewhat ironic, too. The potential positive contribution of information on the various economic decisions commonly made by market participants has historically been taken for granted (Bullock, 1981). Only about eight years ago, for instance, one of the main foci of the annual meetings of the AAEA was on how to improve and find new areas of investment in information and data on the agricultural economy (Just, 1983). Why was the faith in information so strong in the first place and why has it changed?

Theoretical arguments of a positive social value for information are often based on a perfectly competitive market structure (Newman). Such market organization, typically assumes that: (a) all economic agents are informed at least to the extent that all relevant variables of their decision-making environment are known with a definite probability[1] and (b) all information is available instantaneously and costlessly. Under these conditions, agricultural information has been perceived as always benefiting producers and consumers of agricultural commodities, since they can allocate their respective resources more efficiently.

Another feature that gave information a special treatment in the literature is that it is, generally, perceived as a public good. Typically, such goods are inappropriable and, when consumed collectively, each member of society can gain satisfaction from them, or at least no one's utility is diminished by so doing (Henderson and Quandt p. 229). A number of reasons explain why information falls in the public goods category. Producers of information cannot normally charge for further uses of information. Once disseminated, the returns on information supply are not fully appropriable. Further users of information are able to employ or transmit information received at a lower cost than the original supplier; that is, information may be subject to increasing returns in use. Furthermore, information is not an infinitely divisible commodity.

These difficulties in the supply of information, unlike the supply of private goods, led Arrow (1962) to conclude that in a

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[1]Preferably with a probability of one. Borch analyzes cases where the probability is less than one.

competitive market structure information will be under-produced if left to the private sector. Consequently, it was viewed that information production and dissemination would not likely attract sufficient private investment. Given the hypothesized potential benefit to society from having information available to all, the allocation of public resources to such activities was deemed necessary. Such a commitment was reflected even in U. S. legislation as early as 1939, since one of the two first assignments given to the public agency, which evolved into what is now known as the U. S. Department of Agriculture, was to collect agricultural statistics (SRS, 1983). A division of statistics within the USDA was created in 1863. It, too, evolved into what is now known as SRS whose size and information producing activities grew over the years. The present SRS budget is estimated at approximately fifty million current dollars (Gardner, 1983).

The perception of information in the economics literature is now quite different. First of all, few would argue that the perfectly competitive market is a common occurrence[2]. Most agricultural markets, and the rest of the economy for that matter, are characterized by imperfections and distortions in one form or another (Tomek and Robinson). Information is not perfect either. The economics of its quality, accuracy and timeliness are increasingly debated in the literature. Due to these imperfections, a number of private firms have found incentives to invest in the production of

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[2]This does not, however, denigrate its usefulness as a norm for judging economic efficiency of markets. (Tweeten, 1979, chapter 16).

information[3]. Consequently, information has lost some of its public good nature. It is sometimes argued, in the literature, that information can be viewed like other goods that are produced, bought and sold (Newman). Not only does its production involve a cost, its acquisition does too. Hence, the evaluation of information is, typically, performed along cost-benefit guidelines.

This academic questioning of the once indisputable role public information plays in society reinforces the public concern to further scrutinize the use of budget expenditures in financing public programs in general (Norton and Davis) and agricultural data gathering and distribution in particular, (Bullock, 1981). As a result, public decision makers in the agricultural sector are increasingly being called upon to document the value of publicly supported commodity forecasts and reports and to investigate whether the potential returns are sufficiently large to warrant the use of public expenditures to produce and disseminate agricultural information.

Scope of the study

Approximately 300 reports are published annually by SRS alone. While these reports provide the primary data base for the published information, other agencies of the USDA such as the Economic Research Service (ERS) and the Foreign Agricultural Service (FAS) perform equally important tasks by integrating information on domestic and foreign markets and distributing it to potential users in a timely

[3] Just (1983) provides examples of such firms involved in producing and selling agricultural information.

fashion[4]. The released information takes the form of basic data, forecasts, planting intentions, technical information and results of economic analyses. The main purpose of the dissemination of these statistics is to improve efficiency both at the production and marketing levels of agricultural products (Knowles, 1983).

The frequency of production and distribution of USDA reports varies with the time frame for which the information is relevant and with commodities, too. Agricultural census data, for example, are compiled every four years, the last one being completed in 1982. At the other extreme there are SRS monthly crop reports, leaving aside the more frequently distributed weekly or daily but regional bulletins. In between are the ERS outlook and situation reports many of which are produced on a quarterly basis. These ERS reports synthesize SRS and FAS reports and reflect combined information on production data and available knowledge on the demand sectors (domestic and exports) to establish supply-utilization tables upon which price projections are made. Each new report updates the preceding one based on newly available information.

The purpose of this study is to evaluate the impact of a portion of the flow of information released in a typical crop year. Given the multitude of USDA reports for the various commodities, this study focuses on a few of the reports. Information revealing agricultural producers' planting intentions, since it comes before crops are put in the ground and is most likely to affect actual farmers' decisions, will be the primary emphasis of the analysis. In June of every year

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[4]A calendar indicating the timing, sequencing and origin of the various reports published in a given year can be found in USDA, 1983.

SRS publishes planted acreage forecasts for all crops which are estimates of actual plantings. In July/August the first attempt is made to forecast production. Second production estimates do not come in until October/November. The impacts of these reports, individually, simultaneously and sequentially will be analyzed.

The overall objective of the study is then to measure the impacts associated with the publication and dissemination of those acreage and production forecasts on producers and consumers of agricultural commodities. Such results are needed to help public decision makers assess and order crop production report priorities when allocating limited public resources.

Procedure

In the absence of complete information on future production and price prospects, resource reallocations or adjustments by agricultural producers, consumers and inventory holders are continually occurring as new information enters the market. Timely and accurate forecasts of demand, supply, and price ratios of agricultural products are signals that could be interpreted as incentives for decision makers to adjust their economic processes toward market equilibrium. This adjustment toward more efficient use of resources is a source of value for the information that is released. Hence, one way to value new information is in terms of improved resource allocation (or equivalently, social cost reduction) associated with better prediction of supply and demand of agricultural commodities. Moreover, information about future production or price prospects for a given crop not only affects the market for that crop, but also markets of related commodities that interact at production and consumption levels. Furthermore, actions by producers or inventory holders in response to new information in the current time period may significantly affect inventories and hence prices and quantities supplied and demanded for the entire set of crops flowing from a response to the information. Consequently, the evaluation of USDA reports requires a framework that allows modification of production and inventory decisions following the release of new reports. In addition, the conceptual framework should (a) allow the underlying agricultural commodities to interact among one another and (b) be dynamic in the sense that reactions by market participants to a specific report not be limited to the time period in which the report is released but also include indirect impacts in future time periods.

Thus, to adequately capture the interactions among the various agricultural sectors through time, a model or representation of the agricultural sector which includes the major crop and livestock subsectors is needed. The National Agricultural Policy Simulator (POLYSIM), available at Oklahoma State University, has these characteristics (Ray and Richardson). An expanded version of the model will be used to measure changes in consumers and producers welfare resulting from the response by market participants to commodity information released by the of USDA. Of special importance will be the issues of accuracy, timeliness and believability of these reports and how changes in these characteristics affect producers and consumers of agricultural products. Specifically, the study will investigate the following areas:

a. Magnitude of the impacts on producers, consumers and society associated with the release of an individual prospective plantings report.

b. Impacts on producers, consumers and society associated with the release of a prospective plantings report as a function of believability and accuracy.

c. Impacts on producers, consumers and society when a group of prospective planting reports are considered.

d. Impacts on producers, consumers and society associated with the June acreage forecast assuming

   (i) No prior acreage information

   (ii) A prior release of prospective plantings information

e. Impacts on producers, consumers and society associated with the release of the August and November production forecasts assuming

   (i) No prior public acreage and/or production information

   (ii) A prior release of public acreage and/or production forecast.

   The results of (d) and (e) will be used to make inferences about the value of forecast timeliness

f. Extent of value trade-offs between timeliness, accuracy and believability of the information.

Hypotheses

An attempt will be made to test the following hypotheses:

a. Prospective plantings information is potentially more valuable to society than information released in the middle or late during the production season.

b. When information on more than one commodity is considered, offsetting impacts take place which reduce the overall value of information.

c. Secondary cross-commodity and dynamic impacts of information augment the overall value of reports.

Organization of the Study

This chapter has introduced the subject matter of the study. Chapter II presents an overview of the literature pertaining to the economics of information in general and some of the empirical work that other researchers have conducted to evaluate public information systems. Chapter III proposes a model to address the questions raised in this study and the objectives set for it. Chapter IV elaborates on a number of theoretical concepts that are used in developing the theoretical model. The structural components of the simulator (POLYSIM) that were used in this study are the subject of the next chapter. The emphasis is on outlining how POLYSIM has been adapted for the measurement of welfare impacts that are associated with the release of USDA information. Chapter VI presents selected empirical results for those welfare impacts corresponding to the publication of prospective plantings. Results obtained for the June acreage and succeeding production forecasts are presented in Chapter VII. Chapter VIII summarizes the overall results, discusses the limitations of the study, provides policy recommendations and presents some thoughts on future follow-up research. The baseline data used by the simulator are presented in an appendix.

CHAPTER II

VALUE OF INFORMATION: REVIEW OF LITERATURE

When referring to information in general, but particularly in the context of agriculture, a number of authors use the terms data, data system, statistics, information, information system, forecasts and predictions almost synonymously. Strictly speaking, these terms may all be different. Bonnen makes the point that data and information are not the same and discusses their relationship to each other, to economic analysis, and to decision making. He points out that information includes production, analysis and interpretation of data. A distinction needs to be made between raw data and processed data or information resulting from analyses using those data. However, most data series or other forms of published statistics by the USDA or its agencies have been processed or analyzed[5]. While the levels of processing of the published numbers may vary, they all are assumed to carry some information content regardless of which sector or variable of the agricultural economy they pertain to. For this reason, no distinction will be made between those terms throughout this thesis.

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[5]As an example, the Statistical Reporting Service publishes a document outlining the various methods and tools used not only in collecting the data but also in summarizing it (SRS, 1983)

Economics of Information

The economics literature associates the economics of information with the economics of uncertainty. Hey (1979) argues that risk and uncertainty[6] can be described as lack of information. He states that "With complete information, appropriately defined, one would have complete certainty". Thus the process of acquiring information can be considered as a means of reducing the amount of uncertainty present in a given decision problem. The economics of uncertainty and the economics of information are sometimes characterized as corresponding to two different responses to the same problem; lack of information or, equivalently, limited knowledge (Hirchleifer and Riley). According to these authors, the economics of information involves an active response whereby individuals try to overcome uncertainty by engaging in informational activities. Such actions are referred to as non-terminal in that a final decision is deferred while awaiting or actively seeking new evidence which will, likely reduce uncertainly. The economics of uncertainty is a passive response to imperfect information and economic agents are limited to terminal actions permitting them only to adapt to uncertainty. Thus, terminal actions represent making the best of one's existing combination of information and ignorance.

[6]Knight defines risk as a situation in which outcomes are random with a known probability distribution and uncertainty as a situation where outcomes are random but with an unknown distribution. In the real world, however, decision makers do not have complete knowledge of the parameters of their subjective probability distribution concerning the occurrence of future events, nor are they totally ignorant about them. Consequently, the two concepts will be used interchangeably in this study.

Incorporating risk and/or uncertainty into economic models is of comparatively recent origin. However, the volume of work on the subject is growing at a very significant pace (Varian, p. 231). The increased treatment of uncertainty in the literature is a recognition of the inadequacy of the perfect information[7] assumption made in traditional perfectly competitive economic models. Indeed, the traditional theory of those markets presupposes that all information is costless and fully and equally available to all participants. Such theories do not apply to agricultural markets in which there are both information asymmetries and market power (Perloff and Rausser).

Stigler was among the first to recognize the role information plays in economic decisions and the lack of attention it received from the economics profession. The Scandinavian Royal Academy of Sciences (1983) recognizes him as one of the pioneers in the economics of information literature. In his 1961 seminal article on the economics of information he explicitly recognized information as a scarce and costly resource to individual firms. Stigler's foundation has been extended over time so that the role of information may be viewed as a general problem of maximizing profits through optimal information search. Important contributions by McCall, Arrow, Wilson and others have provided search criteria for optimality. For example, McCall's work provides optimal stopping rules in the context of job search.

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[7]Perfect information characterizes a market where all consumers, producers, and resource owners possess perfect knowledge of present as well as future prices, wages and costs (Gould and Ferguson).

Hirshleifer and Riley provide a survey of the theoretical work related to the economics of information. For the most part, the literature emphasizes that information is a scarce good which has a cost as well as a value. According to traditional theory, the result of optimization and market processes should be that every commodity, except for transportation costs, is sold for one and the same price everywhere. But in practice, price variation is observed on most markets. This can be explained if the costs of searching for and diffusing information about goods and prices are incorporated in the model along with production and transportation costs. A market participant's lack of knowledge about goods and prices can be alleviated by collecting and furnishing information. The amount of information a firm or household acquires is guided by the same comparisons between costs and benefits as the production of any commodity. That is, information is gathered until the expected utility of further search no longer outweighs additional search costs. Hence, some argue (Varian) that in particular instances it may pay an individual not to be informed. Perloff and Rausser generalize this idea by asserting that, given the economic imperfections, even an improvement in information will move the economy from one second-best world to another. With this change, there is no assurance that society's welfare will be enhanced. They go on to say that "what at first may seem a paradox, improved information may be harmful, is a general result that should be expected".

A wealth of research topics regarding the economics of information is available in the literature. Examples of frequently debated topics are the issues of adverse selection[8] resulting from asymmetric information[9] (Akerlof) in which signals (Spence) might be used to reduce risk. Moral hazards[10] (Shavell), a term frequently used in insurance markets, are also possible consequences of asymmetric information. All these concepts refer to situations characterized by imperfect information, thus risky, in which market participants either take different actions based on probabilistic random elements in order to cope with imperfect information or search for more information in order to reduce the amount of uncertainty they are faced with.

Another area of debate in the general economics literature is the informational content of market prices. In the context of atomistic agents, Grossman shows that information has a public element which may lead to under investment in information where uninformed agents with rational expectations may be able to use prices as a sufficient

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[8] Adverse selection arises because prices reflect the average quality or productivity of goods in a group that cannot be distinguished by buyers. As a result, holders of high-quality items may have an incentive to withdraw from the market, inducing unraveling and eventually, market breakdown.

[9] Asymmetric information prevails in situations such as commodity trading when the quantity and/or quality of information available to one or more partners differs from the information available to other partners. For example a car dealer may have considerably more information about the cars he sells than his prospective car buyers.

[10] Moral hazards arise whenever the liability of the insurance company is affected by actions of the insured party about which the insurance company has incomplete information.

statistic[11]. Where prices are not sufficient statistics, however, he shows that it may pay to invest in obtaining information. In his examples, there are social gains to collecting information from better intertemporal allocation of a crop; yet there may be little or no private gains in equilibrium because some or all of the information will be reflected in market prices. Grossman and Stiglitz also showed that, in a stationary equilibrium, prices may communicate information in the sense that a group of uninformed market participants will be able to infer information known to other informed participants as a function of a market clearing price. They also showed that in some cases an equilibrium price may be a perfect aggregator of information, in that it efficiently reveals all the information known by each participant. In the presence of such a perfect aggregator, the particular items of information available to any individual becomes redundant. Garbade, et al. studied a special case of whether dealers acquire valuable information from observation of the reservation purchase and sale prices of their competitors, and whether they are led to change their own quotations as a function of those observations. Their results lead to the rejection of the hypothesis that observed prices convey no information, which is a confirmation of Grossman and Grossman and Stiglitz' findings. However, they also rejected the hypothesis that the mean observed price contains all information. This is an indication that economic agents, even though

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[11] A statistic is said to be sufficient, statistically, if it uses all information that is contained in the sample that was used to generate that statistic (Freund, p. 262). In this context, a price is sufficient, if it reflects all market information available at a given point in time.

they use market prices as indicators of information, do not consistently treat their own information, some of which may be subjective, as redundant after obtaining their competitors prices.

Some conclusions can be drawn from the general literature on the economics of information. First information available for economic decisions is far from complete or perfect. Imperfect information may adversely affect resource allocation, but the acquisition of more complete information, however socially desirable, involves a search cost which could more than offset the associated expected benefit. The extent to which market prices alone reflect all information needed to carry out decision making, hence, there would be no need to have information producing activities (public or otherwise), is a subject of debate in the literature.

Empirical Studies

A number of studies have attempted to estimate the value of certain information packages: Hayami and Peterson, Baquet, et al., Bradford and Kelejian and Marquis and Ray; to name a few. The area of forecasting (crop productions, weather, etc.) has received major attention. The premise of these studies is that a typical decision maker will search for information, or will use information available to him, only if the expected net benefit is positive. Following Eisgruber, the basic problem can be formulated as one of maximizing the difference D between the expected benefit of using or searching for information and the expected associated cost. More formally the problem can be written as:

$$\text{Maximize } D = E(g) - E(k) \tag{2.1}$$

where,

D : Expected net benefit associated with the selection of a particular information package

E(g): Expected gross payoff from using that information

E(k): Associated expected cost

The implementation of this general model usually takes one of the following two forms: the decision theoretic approach or the net social benefit approach.

The Decision Theoretic Approach

This approach has its roots in statistical decision theory. Following this approach, typically, a decision maker is faced with choosing among discrete actions A_i (i=1,...,m) and states of nature S_j (j=1, ...,n). If action A_i is chosen and state S_j occurs, then the outcome will be x_{ij}. Further, assume S_j will occur with probability p_j. The expected value of action A_i can be written as:

$$E(A_i) = \sum_{j=1}^{n} p_j x_{ij} \quad ; i=1, 2,\ldots,m \tag{2.2}$$

where E is the expectation operator and Σ is the summation sign. Let V(.) denote expected utility. Then, with a given state of knowledge the expected utility of action A_i, $V(A_i)$ will be

$$V(A_i) = \sum_{j=1}^{n} p_j V(x_{ij}) \quad ; \quad i=1, 2, \ldots,m \tag{2.3}$$

$V(A_i)$ represents then the expected utility of action A_i for a given state of knowledge S_j. If new information, such as a USDA production forecast, is released, the approach assumes that the probabilities p_j will be modified according to Bayes' rule[12]. Let the modified (posterior) probabilities be identified by $p_j|\Omega$ where represents the forecast, or more generally, a new information set. If there is a cost $C(\Omega)$ associated with obtaining this information, the value of that information will be given by

$$V(A_i|\Omega) = \sum_{j=1}^{n} p_j|\Omega \, V(x_{ij}) - C(\Omega) \quad ; \; i=1,\ldots,m \tag{2.4}$$

Several studies have attempted to implement this framework[13]. Baquet et al., for example, used it to estimate the economic value to orchard producers in Oregon of frost forecasting by the regional U.S. weather bureau. The decision faced by those producers was whether to turn on heaters to protect pear orchards against frost, the occurrence of which was uncertain. The conditional probabilities of forecast temperatures and recorded temperatures were developed from historic data. Using prior probabilities of nighttime low temperature readings based on past data, posterior probabilities were developed. A utility function was estimated for each of eight orchardists studied. The utility payoff matrix is multiplied by the posterior probabilities to

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[12] Bayes' rule, or theorem, can be found in almost every statistics book and is usually expressed somewhat differently for the continuous case than for the discrete one. Folks (p.76) gives a formulation.

[13] Lawrence, in his annotated bibliography, gives a large number of examples.

obtain the optimal action for each forecast. The value of forecasts was the difference between the monetary outcome of Bayes action and the monetary outcome of the optimal prior actions. Nightly frost forecasts were evaluated, on the average, at 5.39 dollars per day per acre, with forecasts having their highest value to producers not using their prior knowledge when making decisions.

Bayerlee and Anderson extended the analysis to cases where decision makers maximize returns in a risky environment. They consider the value of information in three different settings. First, there is the value of information with profit maximization which is expressed as the difference between expected profits computed on the basis of prior information and expected profits using a predictor. Then, there is the value of information with utility maximization. This case is identical to the previous one except that the decision maker compares the expected values of the utility of profit with and without the new information, as opposed to profits themselves. Third, there is the value of information to a decision maker in terms of the effect of information on the expected value and variance of profits. Assuming a quadratic utility function of profits, they derive the E-V frontier based on the posterior probability function. The value of information is then expressed as the difference between the expected values of the optimal actions in the prior and posterior situations.[14] The authors applied their methodology to the

[14]Optimal actions in this case, are those that correspond to tangency points of the E-V frontier and indifference curve of the decision maker.

evaluation of long-range rainfall forecasts in a decision to hold drought fodder reserves in livestock production.

Bayerlee and Anderson showed that the value of information has two components corresponding to (a) a change in expected profits and (b) a change in variance of profits. The importance of the latter term is related to the degree of risk aversion of the decision maker. They challenged what they think is often assumed: Additional information reduces variance in a decision problem, and therefore, has more value to a risk averse decision maker. According to their findings, new information may not reduce variability because there are two types of risks associated with a decision problem. First, when the decision maker has received a particular piece of information, he is still faced with some risk as measured by the posterior variance. Second, the decision maker, in making the decision to purchase a particular information generating process, does not know a priori what information will be forthcoming, and the decision to purchase information is therefore a risky decision.

A major difficulty with using the decision theoretic approach lies in the determination of the likelihood or prior probabilities p_j of the various states of nature, or events. Furthermore, although this approach can be conducted in monetary terms (Eidman), often the outcomes of events are transformed in their utility equivalents (Baquet, et al.). This requires some elicitation of the utility function of the decision maker. Numerous problems are associated with eliciting and econometrically estimating individual utility functions (Knowles, 1984). In this study where aggregate measures are needed the estimation of utility functions at the level of producers and consumers as single groups becomes even more difficult. This, together with the problem of identifying prior probability distributions, makes the decision theoretic approach to evaluate the impacts of USDA reports, at the present time, impractical.

Net Social Benefit Approach

This approach, again, uses the general procedure of comparing benefits generated from an information system to the expected cost of using that system. Typically, consumer and producer surplus measures are used to make the comparison.

The concept of consumer surplus dates back to Dupuit who, in 1844, claimed that a buyer may receive a surplus from a transaction. He defined this surplus as the difference between the sacrifice which the purchaser would be willing to make in order to get it and the purchase price he has to pay in exchange. Marshall, not only popularized consumer surplus, but also introduced an analogous concept for producers called producer surplus. The latter is defined for a seller who, when he makes a sale, derives a revenue that is higher than the value of the resources given up to produce the commodity being sold. Consumer surplus is defined as the area between demand function, the price axis and above the price paid for a commodity. Producer surplus, on the other hand, corresponds to the area between the supply curve, the price axis and the price level. More formally, let

$$P_d = D(Q) \quad (2.5)$$

$$P_s = S(Q) \quad (2.6)$$

represent the inverse demand and supply functions of some commodity, respectively. Furthermore, assume Q^* is the quantity of a commodity traded between consumers and producers at a given point in time so that $P_d = P_s$. The surplus measures can be expressed as

$$CS = \int_0^{Q^*} D(Q)dQ - D(Q^*)\,Q^*$$

and

$$PS = D(Q^*)\,Q^* - \int_0^{Q^*} S(Q)dQ$$

where,

CS: Consumer Surplus

PS: Producer Surplus

The net social benefit approach consists of maximizing an objective function, commonly labeled social welfare function and traditionally defined as the sum of the consumer and producer surplus measures. In the context of information evaluation the approach holds that the lack of information (or wrong information) is equivalent to a shift in the perceived supply (or demand) functions relative to the true supply (or demand) and thus impacts on net social benefits (NSB). With perfect information the market of a given commodity would be in equilibrium and NSB would be maximized. Imperfect information on, say, available supply will affect pricing and inventory operations, which later will have to be adjusted as additional information about supply becomes available. The result is reduced NSB. The value of an improved information system is $NSB_1 - NSB_2$, where NSB_1 and NSB_2 are, respectively, the value of NSB evaluated in terms of the improved and the old information systems.

Hayami and Peterson (HP) were probably among the first to put the net social benefit methodology into practice. They applied it to estimate the marginal benefit-cost ratio for a reduction in sampling error in crop and livestock estimates made by SRS. Their analysis was based on the assumption that erroneous information causes producers to make erroneous production decisions and also distorts optimal inventory carryovers. Hence, marginal improvements in the accuracy of these statistics reduce the social cost of misinformation, which in turn can be considered as an increase in net social welfare. By relating marginal improvements in net social welfare to the marginal cost of providing more accurate information they estimate marginal social benefit-cost ratios for various levels of accuracy of information.

To empirically measure the marginal social returns of reducing the sampling error of crop and livestock statistics, HP distinguished between commodities for which production cannot be changed significantly in response to output predictions, but there is an opportunity for inventory holders to adjust stocks, from commodities that exhibit only a production adjustment. Typical of the former are food and feed grains, whereas livestock characterizes the latter. An inventory adjustment model and a production adjustment model were designed for each case, respectively. Assuming linear demand and supply functions, it was found that, in both situations, the net social welfare due to inaccurate reporting of agricultural statistics was inversely proportional to the square of the statistical error[15]. This means that a reduction in the error will be accompanied by an improvement in social welfare. Specifically, HP found that reducing the sampling error from 2.0 to 1.5 percent would bring an estimated 106 dollars of benefits for each dollar of sampling cost. The economically optimal sampling error, defined as the point where an additional dollar spent on sampling accuracy would be offset by an additional dollar gain in benefit, occurred for an average sampling error of less than .5 percent. Thus, it was concluded that more public funds can profitably be spent to improve crop and livestock reporting.

The HP models were not without drawbacks, however. Their inventory adjustment model did not include a storage cost function to offset the benefits of shifts in inventory holdings. An even more severe limitation is the lack of a production adjustment capability by crop producers within the production season. Furthermore, both frameworks were conceived to analyze forecast impacts in a two-time period setting and for a commodity at a time. Multiple commodity interactions as well as lagged response to the published information in succeeding time periods were not allowed. Despite these limitations, a number of authors continue to view the HP methodology as a solid framework to quantitatively value statistics. In a 1984 study, Walker applied both models, as they were initially developed, to measure the value of the Canadian Census of Agriculture. He

[15]Statistical error was defined to be the difference between the reported production forecast and true production as a proportion of true production.

concluded that the benefits to society generated by the production of that census exceeded its cost.

Bullock (1976) modified the HP models by including a cost of storage function in the inventory model and a supply response function in the production model. Although Bullock's models are extensions of the HP models, his conclusions differed somewhat from theirs. He concluded that the value of USDA production reports may not be always inversely related to the magnitude of the statistical error of reporting a given production. There are situations where increasing the accuracy of a report alone may not achieve significant gains to society. One case in point is when the information does not generate any response by market participants, either when the information comes very late in the production season (for producers) or if it describes a situation that is close to what producers and inventory holders had already expected, thus, no adjustment takes place. This conclusion indicated that there might be an accuracy level beyond which other characteristics of reports such as timeliness and frequency, would be also of value. Thus, he suggested that forecast errors, alone, are not sufficient grounds to argue for additional expenditures to improve the accuracy of USDA forecasts.

While improving over the HP models, the Bullock framework still does not capture interactions between commodities, nor does it accommodate impacts of a given report, released at one point in time, in future time periods. Furthermore, it too treats inventory and production adjustments as mutually exclusive. Yet for some commodities (e.g., wheat, corn) both types of adjustment may occur simultaneously.

Bradford and Kelejian (BK) developed a model that attempts to capture the impact of information in the form of monthly crop bulletins on the state of current crops. Their approach translates information about current conditions, as viewed by inventory holders, into forecasts of harvest flows, and in turn, into price forecasts in a competitive market system. Improvement in the information system (e.g., more accurate observations) affects the commodity price distribution, and this change is evaluated in terms of consumer surplus changes. The speculators are assumed to use Bayesian decision rules, that is, they make their decisions by combining each period's new information with previously available information and with prior beliefs about the underlying stochastic processes. Specifically, BK proposed to model the economy as a market system in which storage decisions are made explicitly dependent on the crop forecasts by making conditional expectations of annual supply linear in the forecasts, and selecting the storage decisions as those which maximize expected economic value. The benefit produced by an information system is measured by its effect on the mean value of a 12-month stream of consumption given by the following expression

$$W = E \sum_{t=1}^{12} \left[\int_o^{Q_t} P_t(x)\, dx - \int_o^{Q_t^s} P^s(x)\, dx \right] \tag{2.7}$$

where,

E	:	Expectation operator
$P_t(x)$	:	Demand price in month t corresponding to the quantity x

and

$P^s(x)$: Marginal cost of holding inventories

Because inventory decisions are based upon forecasts of harvests which in turn involve measurement errors, W in (2.7) will depend on the moments of those forecasts and particularly their variances.

The value of an improved information system which reduces these variances is $W_1 - W_2$, where W_1 and W_2 are, respectively, the values of W evaluated in terms of the parameters of the new and old information systems. For purposes of comparison, BK calculate the value of information under two assumptions concerning the harvest forecast made in month t for a future month during the year. The first approach assumes sophisticated forecasters, in a Bayesian sense, who believe that the estimate provided by USDA may be subject to error, hence, use it only to update their prior information. Secondly, a naive forecasting scheme is used which assumes either of the following: (a) the measurements taken at time t are perfect or (b) the change in the harvest potentials is so great that past measurements are worthless. A social welfare loss function was derived in terms of forecast errors.

In both cases, the loss function increases with the forecast error. The form of the loss function, however, varies with the assumed speculative behavior of inventory holders. The loss is a linear function of the forecast error when speculators are sophisticated; i.e., Bayesians, and it is proportional to the square of the error, when they are naive. This is in agreement with the thrust of the HP findings. However, it points out the fact that forecast errors tend to generate lower social losses the more knowledgeable market participants are, thus making information most valuable to those endowed with limited knowledge to start with. In a follow-up article, BK (1981) broke down the overall welfare impacts of a forecast with a given quality (accuracy) into consumer surplus, inventory holders' profits, farmers' receipts, and industry surplus. Their conclusion, in this latter article, was that, while an increase in the quality of information leads to an increase in overall benefits, not all agents share these benefits. The exact distribution of those impacts varies with the type of feedback assumed. In general, some gain more than others; but some lose. This is an indication of possible income transfers among the various components of society associated with USDA reports of different qualities.

An important contribution of BK is the conceptualization of the manner in which inventory holders formulate inventory decisions in terms of price expectations. However, the social impacts from improved information quality were measured assuming only within-year adjustments in inventories. The effects of lagged response on future year inventories were not taken into account. More importantly, production response to new public information was not analyzed in their model and no commodity interactions were allowed.

Marquis and Ray (MR) estimated the value of improved foreign crop forecasts via satellite. The National Agricultural Policy Simulator (POLYSIM) was used in this study. Forecast export levels of U.S. crops were drawn at random about an assumed mean final crop export level. These export forecast levels were used to estimate expected current year prices which, in turn, were used with the previous year prices to form the producer price expectations for making production decisions. Prices and all other endogenous variables are then reestimated. Subsequently, producer and consumer surpluses were computed. These computations were performed under three accuracy levels of the crop export forecast, two timeliness levels and three supply-demands scenarios.

Marquis and Ray concluded that satellite-based information has a positive value when the new system is of higher accuracy than the current information system. Information which is both more accurate and timely showed higher value than information which is less accurate and less timely. The analysis for this study was conducted in a multicommodity and dynamic framework, but producer and inventory decisions represented by the model assume only one forecast is made per year. Furthermore, no short-run supply adjustment was allowed in response to forecast release.

Related Issues

While not attempting to estimate the value of a given piece of information directly, a number of authors have analyzed a number of important issues related to the pertinence of USDA reports. The evidence provided by these studies could help diminish some of the criticism facing public agricultural information. Among these, the issues of accuracy of the information and the impact of information release on market prices received special attention.

As for accuracy, Clough studied corn crop forecasts between 1929 and 1950 by comparing indicated acreages of corn to the actual acreages harvested and by comparing the December estimates of production to the estimates made in earlier months. He found that the forecasts in successive months became progressively nearer the December estimates, suggesting that the accuracy of USDA corn crop forecasts increased from month to month. Baker and Paarlberg and Gunnelloon, Dobson and Pamperin reached similar conclusions when studying wheat and feed grain reports, respectively. Pearson and Houck studied the accuracy of the USDA corn and soybean forecasts between 1963 and 1975 and concluded that (a) no systematic bias seems to occur and (b) a definite trend toward more accurate forecasts exists as the season progresses toward harvest time. More recently, Mlay and Tweeten studied projection errors made by the USDA in forecasting wheat carryouts. The following conclusions were reached (a) projection errors were unbiased, suggesting that carryout projections do not reveal a consistent tendency to overestimate or underestimate actual wheat carryout, (b) forecast errors were random among years, but not within a single year. This finding suggests a potential for forecasts to distort market prices and receipts within a marketing year and not from one year to the next and (c) wheat prices are highly responsive to carryout projections relative to utilization. Finally, Choi analyzed the monthly USDA corn crop forecast errors as defined between the monthly forecast and the final five-year revised crop estimate. He found that (a) the monthly forecast errors were normally distributed (b) the means of the monthly crop forecasts were not statistically different from the five-year revised estimate at the five percent significance level, and (c) the accuracy of forecasts improved over the reporting months from July to August.

In terms of the impact the publication of USDA reports has on market prices, Pearson and Houck analyzed the situation for grains and livestock production announcements. They concluded that the forecasts had an impact on the market price of corn, soybeans and spring wheat, but not winter wheat. Gorham ran a regression for a percentage change in prices on a percentage change in forecasts for soybeans, wheat and corn, and found that only corn demonstrated a statistically significant relationship between the price and the forecast. Hoffman, on the other hand, analyzed the impact of the quarterly livestock reports on cattle and hog prices by regressing the price differences between the periods before and after the release of USDA livestock reports on the percentage change in an appropriate quantity such as cattle on feed and sows farrowing. He found that, on the average, the prices before and after livestock reports were not significantly different. However, for specific reports, revealing such items as percentage change in placements of cattle on feed, sows farrowing or marketing intentions, the cash market seemed to respond while the futures market did not. On this ground, Hoffman concluded that the futures markets for cattle and hogs were more efficient than cash markets. Finally, Choi also looked at the impact of the USDA corn crop forecasts on daily cash and futures corn prices. The August forecast was found to be the only crop forecast to influence the cash and futures prices observed on the day immediately following the day of the crop announcement.

Chapter Summary

This chapter traced the chronological development of the methodological literature pertaining to the evaluation of agricultural information. Hayami and Peterson laid out the groundwork for empirical information analysis. Bullock made some qualitative extensions of those models by explicitly allowing production and inventory response to new public information as it becomes available. Bradford and Kelejian translated the information contained in the USDA reports on current conditions into forecasts of harvest flows and their impacts on consumption. Improvement in the quality of information affects the commodity price distribution, and this change is evaluated by measuring changes in consumer surplus. Finally, Marquis and Ray provided a more general framework where improved information on foreign crops via satellite could be analyzed. As for the accuracy of USDA reports, it appears there is a consensus in the literature that there is an improvement as the production season progresses. By that time, however, most production decisions have already been made and little, if any, or no advantage can be derived from the information by producers, in so far as altering their production plans is concerned. However, there may still be benefits from those reports society can generate through marketing activities.

Regarding the issue of USDA reports impacting on market prices unfavorably to producers, the literature is inconclusive. Moreover, all the work related to this matter looked at the immediate impact of information release on market prices. Lagged impacts have yet to be researched. The focus of this study will be on measuring the welfare impacts that are associated with the publication of USDA reports of a given level of accuracy, timeliness and believability. The welfare measures will, of course, depend on these characteristics as well as the price impacts public information generates.

The originality of this study is in measuring these impacts in an environment where agricultural products can interact on the demand and supply sides via direct and cross price elasticities. Furthermore, the impacts are not limited to reactions immediately following the release of information, since lagged effects through time are taken into consideration. A framework to address these issues is presented in the next chapter.

Chapter III

CONCEPTUAL FRAMEWORK

The purpose of this chapter is to present the conceptual framework that will subsequently be used in the simulation analysis to measure the impact on the agricultural economy following the release of within season acreage and/or production forecasts by the USDA or its agencies. To begin with, some background is provided for the purpose of delineating the agricultural setting within which those forecasts are to be evaluated. The actual methodology to capture the impacts of new information on agricultural markets, in a broad sense, is developed next. The presentation will emphasize the cross-commodity and dynamic features of the underlying simulation model which is assumed to capture the various states of the agricultural economy as it responds to information. Thirdly, this methodology is applied to the case where demand and supply of agricultural products are linear to derive explicit formulations for the information impacts on producers and consumers in a given time period. Secondary impacts occurring in succeeding time periods are discounted and added to current year impacts. Of particular interest are how those impacts change as accuracy, timeliness or the believability in the information by market participants change. The possibility of trade-offs between those characteristics will be examined.

General Considerations

Motivation

As previously indicated, one reason behind committing public resources to the gathering and dissemination of agricultural statistics, ranging from prospective plantings, to weather information, to prospects for exports, etc., is to keep producers and consumers of agricultural products as informed as possible about current and outlook conditions in order to take advantage of economic opportunities that may arise. These opportunities could consist of taking actions on the part of producers to avoid potential substantial decreases in market prices, a situation that may put some farming activities, or perhaps farmers themselves, in economic jeopardy. The information could also generate reactions on the demand side by inventory holders who, when faced with changing prospective price ratios, may alter the rate at which they store agricultural products or deplete them on the market. In either case the size, and possibly the composition of consumers' food basket, may be affected.

Interference with Other Government Programs

Producing and disseminating agricultural information is not the only way the public sector of the United States affects the performance of agricultural markets. The U.S. Government intervenes in the agricultural economy in a number of other ways: price supports, land set-aside programs, farmer-held-reserve schemes, direct payments, etc. These federal commodity programs are designed to augment and stabilize farm prices and incomes. Agricultural markets go through periods of adjustments whenever these policy instrument levels change. They may also adjust when new information regarding existing and future supplies is made available. Both adjustments take place simultaneously. In order to minimize confounding of economic impacts of changes in commodity program levels with the valuation of publicly generated information on commodity markets, the following analysis assumes normalized conditions that allow free operation of agricultural markets.

Interference with Other Sources of Information

A unique source of information will be considered in this study. While private sources, such as private trading firms, do compete with the USDA in making information available to the public, it is argued by some (Just, 1983), that those sources base their predictions, at least partly, on public forecasts. This study, even though conceptually independent of the source of information, nonetheless assumes the agricultural economy reacts to predictions emanating from the public sector only. The extent to which private information interferes with public information, by either supplementing it or substituting for it in generating market response, is beyond the scope of the present work.

Demand and Supply Structure of the Agricultural Economy

The proposed framework to quantitatively appraise the impacts of public agricultural information assumes an economy with a large number of consumers faced with a group of producers of agricultural commodities. Consumers are assumed to behave as utility maximizers subject to budget constraints. Moreover, these consumers are assumed not to react directly to USDA information regarding potential crop harvests or prospective commodity prices[16]. Rather, they adjust their consumption levels as commodity prices change. Producers are assumed to behave as profit maximizers, but operate in an uncertain environment regarding the size of future crop harvests and the effective market demand for those crops. The initial allocation of resources among agricultural products and therefore agricultural supply, is based on price expectations formed prior to making production decisions. Demand, on the other hand, is a function of current prices. The following set of equations is assumed to characterize the agricultural economy in the absence of disturbances.

$$A_{it} = A\left[(P^e_{it}, P^e_{jt}) \mid \Omega_{t-1}, P^I_t, T_t\right] \quad (3.1)$$

$$Y_{it} = Y\left[(P^e_{it}, P^e_{jt}) \mid \Omega_{t-1}, P^I_t, T_t\right] \quad (3.2)$$

$$Prod_{it} = A_{it} * Y_{it} \quad (3.3)$$

$$S_{it} = Prod_{it} + I_{it-1} \quad (3.4)$$

$$I_{it} = I(P_{it} \mid \Omega_{t-1}, P_{it-1}, SC_{it}) \quad (3.5)$$

such that:

$$I_t \geq o \text{ whenever } (P_{it} \mid \Omega_{t-1} - P_{it-1}) \geq SC_{it} \quad (3.6)$$

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[16] This may be justifiable on the ground that food occupies a small share in the budget of a typical U.S. consumer.

$$Dom_{it} = D(P_{it}, P_{jt}, Z_t) \quad (3.7)$$

$$EX_{it} = E(P^{W}_{it}, X_t) \quad (3.8)$$

$$D_{it} = Dom_{it} + I_{it} + EX_{it} \quad (3.9)$$

$$D_{it} - S_{it} = 0 \quad (3.10)$$

$i=1,\ldots,n$

$j=1,\ldots,n$ such that $j \neq i$

where,

A_{it} : Aggregate acreage allotted to crop i

P^{e}_{it} : Price of crop i expected in period t-1 to prevail in time period t

T_t : Index representing non-price supply shifters, such as technology.

P^{e}_{jt} : Expected prices, of related products to the commodity under consideration, to prevail in time period t

P^{I}_{t} : Index of prices paid by farmers

Y_{it} : Expected yield

$Prod_{it}$ Production

S_{it} : Supply

I_{it-1} : Carry in inventories

I_{it} : Carry out inventories

P_{it} : Current price

P_{jt} : Current prices of related commodities

SC_{it} : Per unit storage cost

Dom_{it}: Domestic demand (food or feed)

D_{it} : Total aggregate demand

Z_t : Index for non price demand shifters

P^W_{it} : Current world price of commodity i

X_t : Index for shifters of export demand

EX_{it} : Exports

Ω_{t-1} : Information set in time period t-1

Subscripts i and t everywhere refer to commodity i and time period t, respectively and n is the total number of crops considered in the model. Equations (3.1) to (3.4) describe the generation of supply, whereas equations (3.5) to (3.10) are for demand utilizations.

Examination of the above system reveals the degree to which multicommodity and dynamic interactions are incorporated in the model. The multiproduct nature is indicated by virtue of the fact that the model contains n commodities and demand and supply for each of the n commodities are function of the own price and prices of related commodities. The dynamic specification of the model, on the other hand, is expressed by the extent to which future supply is determined by current price expectations based on information known to producers in a previous time period, and the inventory side of the model which makes supply in a given time period a function of last period's inventories and the decision to stock additional amounts of the commodity a function of the difference between future and current prices.

Within this framework, consumers, producers and inventory holders are all assumed to behave rationally; i.e., as profit or utility maximizers and optimal allocations of their respective choice variables exist, given the information set available to them at one point in time. This requires a number of mathematical regularity conditions such as twice differentiability of the underlying behavioral equations. Furthermore, these decision makers are assumed risk averse in the sense that they prefer more information to less information[17].

A Conceptual Framework to Analyze Information Impacts on Agricultural Markets

The economics literature provides two ways of conceptualizing the manner in which new information affects individual or market decisions. The ex-post (after-the-fact) view which addresses the question of what a given piece of information would have been worth to a decision maker had he known about it prior to making decisions, but after plans had been implemented based on imperfect knowledge. The ex-ante view (before-the-fact) measures of the value of information should it come to a decision maker early enough that he may alter some or all of his future decisions (Antonovitz and Roe).

While ex-post measures may be acceptable and useful in a number of cases, they are not the concern of this study. Instead, the present

[17]Absolute risk aversion r(W) was defined by Pratt as the negative ratio of the second and first derivatives of the utility of wealth function W of an individual, i.e., $r(W) = - U_2(W)/U_1(W)$ where the subscripts 2 and 1 denote second and first derivatives, respectively. r(W) is positive for risk aversion (Anderson et.al. p. 88).

present analysis seeks to estimate benefits and costs associated with the release of a particular piece of information while there still is some possibility for future adjustment by market participants in response to the information. Hence, ex-ante measures are more appropriate for the problem at hand. To help set the groundwork for the actual measurement of the value of information at the aggregate level, the following distinction is made between expected, disturbed, reported and informed states of the world. .

Expected state

This state corresponds to the situation where economic agents make decisions based on the information available to them at one point in time. That is, all potential market disturbances are inoperative. Equivalently, the expected state in the model corresponds to the situation where all future variables are valued at their expected levels. Aggregate market demand and supply for commodity i in time period t in this case can be written as:

$$\text{Demand} \quad D_{it} = D(P_{it}, P_{jt}; \sigma) \tag{3.11}$$

$$\text{Supply} \quad S_{it} = \left[(P^e_{it}, P^e_{jt}) \,|\, \Omega_{t-1}; \gamma \right] \tag{3.12}$$

$$j=1,\ldots,n \quad \text{and} \quad j \neq i$$

where the superscript e in (3.12) refers to expectation formed for period t based on the information set Ω_{t-1}; that is, information available in time period t-1. The P's are prices and whenever they do not carry superscript e, they refer to current, as opposed to expected, prices. σ and γ are known (estimated) demand and supply parameter vectors, respectively.

Disturbed State

This is a situation where it is assumed that some shock has occurred in the agricultural economic system. The disturbance could be originating from the demand or the supply side of the economy. Examples of shocks include unexpected changes in prospective planted acreages, unfavorable weather conditions which eventually depress yields, or significant droughts abroad which may increase export demand. For analysis convenience, the disturbed state represents market clearing quantities and prices that would occur if a shock takes place but is not reported. Hence, the full economic impact would occur since decision makers had no opportunity to adjust decisions based on advanced information. The demand and supply equations for the disturbed state are:

$$\text{Demand}: \quad D_{it} = D\,(P_{it},\ P_{jt};\ \sigma) + U_{it} \qquad (3.13)$$

$$\text{Supply}: \quad S_{it} = S\left[(P^{e}_{it},\ P^{e}_{jt})\,|\,\Omega_{t-1}\ ;\gamma\right] + V_{it} \qquad (3.14)$$

$$j=1,\ldots,n \quad \text{and } j \neq i$$

where U_{it} and V_{it} are demand and supply disturbances, respectively. The initially perceived and disturbed states would be identical if no shock occurs.

Reported State

The reported state is a description of agricultural markets based on USDA information. If the reports accurately describe and interpret the shock, the reported state will be identical to the disturbed state. This, however, may not be always the case. Whenever they are different, the discrepancy will indicate the extent of inaccuracy implied by the report. Let this reported state be described as:

$$\text{Demand}: \quad D_{it} = D(P_{it}, P_{jt}; \sigma) + \mu_{it} \tag{3.15}$$

$$\text{Supply}: \quad S_{it} = S(P^{e}_{it}, P^{e}_{jt}) | \Omega_{t-1}, \gamma) + \nu_{it} \tag{3.16}$$

In the special case where the report perfectly describes the disturbed state, μ_{it} would be identical to U_{it} and ν_{it} would be identical to V_{it}. Otherwise, they would be different and the discrepancy will be a measure of precision (or error) associated with a report. Let α_{it} and β_{it} denote the relative differences $\mu_{it} - U_{it} / U_{it}$ and $\nu_{it} - V_{it} / V_{it}$, respectively.

Informed State

The informed state represents the supply and demand after market participants have responded to the information encompassed in the reported state. Disturbed and informed states would be the same whenever released information does not generate any response by market participants. On the production side, the adjustment takes place by rearranging input use in light with the new relative price information. On the demand side, the domestic response to new information is expressed in terms of a movement along the reported demand curve. Consider, for instance, information that suggests a severe drought abroad, possibly affecting corn production in the rest of the world. Domestically, the information translates in an outward shift of the aggregate demand for corn. If the information is accurate and there is complete believability in it by market participants, the response takes place along the demand suggested by the information. Denote the revised demand and supply parameters as σ^* and γ^*, respectively. The new demand and supply equations corresponding to this state can then be written as follows:

$$\text{Demand:} \quad D_{it} = D(P_{it}, P_{jt}; \sigma^*) \tag{3.17}$$

$$\text{Supply:} \quad S_{it} = S\left[(P^e_{it}, P^e_{jt}) \mid \Omega_t ; \gamma^*\right] \tag{3.18}$$

where,

$$\sigma^* = h\,\sigma$$

$$\gamma^* = k\,\gamma$$

The coefficients h and k indicate the extent of response to the new information set Ω_t on demand and supply, respectively. To reflect the impact of Ω_t on expected prices, the following is assumed:

$$P_{it} = \ell\, P_{it} \mid \Omega_t + (1-\ell)\, P_{it} \mid \Omega_{t-1} \qquad i=1,\ldots,n \tag{3.19}$$

where ℓ is the weight given to the public forecast when reacting to it. The expected price that finally enters the supply equations is a weighted average of the price previously expected and the one based on the new information. Furthermore, weight ℓ is a pure number that is between zero and one.

Assuming specific functional forms for aggregate supply and demand equations, it is possible to determine the impacts of information in a closed form. Let $V_{CS_{it}}$, $V_{PS_{it}}$ and $V_{W_{it}}$ represent the impact of information on consumers, producers and society. These value measures are expressed in the following general form.

$$V_{CS_{it}} = V(\alpha_{it}, \beta_{it}, k, h, \ell; \sigma, \gamma, U, V) \tag{3.20}$$

$$V_{PS_{it}} = V(\alpha_{it}, \beta_{it}, k, h, \ell; \sigma, \gamma, U, V) \tag{3.21}$$

$$V_{W_{it}} = V(\alpha_{it}, \beta_{it}, k, h, \ell; \sigma, \gamma, U, V) \tag{3.22}$$

That is, the value of information, from whichever point of view, is a function of the errors made in estimating demand (α_{it}) and supply (β_{it}), the extent of response on the demand (k) and supply (h), and believability (ℓ). A public agency can have an input on all these elements, by making information more accurate, more timely and credible. What the agency cannot do much about, however, are the intrinsic parameters of demand, σ, and supply, γ and the disturbances U and V themselves. Thus, using specific functional forms for demand and supply of agricultural products, it is possible to find optimal values for the choice variables which are in this case α_{it}, β_{it}, k, h and ℓ given the parameters σ, γ, U_{it} and V_{it}. Then comparative statistics as well as envelope results can be derived.

Value of Information in a Linear Supply and Demand Framework

Assume the following aggregate demand and supply equations are representative of a given commodity in some time period. Subscripts i and t are dropped, for now, to simplify notation.

Demand: $P = a_o + a_1Q \quad ; a_1<0$ (3.23)

Supply: $P = b_o + b_1Q \quad ; b_1>0,\ 0<b_o<a_o$ (3.24)

These equations are assumed to characterize commodities in the absence of shocks to the economic system and represent the expected or perceived state. Suppose that both supply and demand are affected by some exogenous factors in an additive way so that the disturbed state can be represented as:

$$\text{Demand:} \qquad P = a_o + a_1 Q + u \tag{3.25}$$

$$\text{Supply:} \qquad P = b_o + b_1 Q + v \tag{3.26}$$

where u and v reflect shifts in demand and supply, respectively. Agencies of the USDA continuously appraise the magnitude of those changes. If they estimate them with complete accuracy, the disturbed state will be reported. Generally there is an error involved. Let the reported state be represented as:

$$\text{Demand:} \qquad P = a_o + a_1 Q + \mu \tag{3.27}$$

$$\text{Supply:} \qquad P = b_o + b_1 Q + \nu \tag{3.28}$$

Let $\alpha = (\mu - u)/u$ and $\beta = (\nu - v)/v$. Parameters α and β represent the relative magnitude of the errors involved in estimating demand and supply, respectively. With the information made available, market participants react by adjusting either production, inventories or both. If believability in the information and its timeliness were perfect the market will respond along equations (3.27) and (3.28). To relax the believability question, it is assumed that supply, in the informed state, will be a function of a price P_3 which is a weighted average of equilibrium prices P_1 and P_2 obtained from the expected and reported states, respectively. More explicitly,

$$P_1 = (a_o b_1 - a_1 b_o)/(b_1 - a_1) \tag{3.29}$$

$$P_2 = (a_o + \mu) b_1 - a_1 (b_o + \nu)\ (b_1 - a_1) \tag{3.30}$$

and

$$P_3 = \ell\ (a_o + \mu) b_1 - a_1 (b_o + \nu) + (1- \ )(a_o b_1 - a_1 b_0)/b_1 - a_1)$$

which can be rewritten as:

$$P_3 = [\ell(b_1 \mu - a_1 \nu) + (a_o b_1 - a_1 b_o)]/(b_1 - a_1) \tag{3.31}$$

If the information reaches producers at a time when most of their production decisions have been made, can respond little to P_3. To accommodate timeliness of information, it is assumed that the market reaction function to the information will be derived from the initial supply function by modifying its slope parameter b_1 using a constant k greater than or equal to one[18]. If k=1, the information is timely and response takes place along the planned supply curve. The higher k gets the less timely information becomes. On the demand side, it is assumed that the response does not necessarily take place along (3.16), since it implies no believability in the information, nor does it take place along (3.20), because that would imply total believability. Instead, the adjustment by market demanders will be

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[18] In fact the modification affects more than one slope parameter since the more complete form of the supply equation is: $q_1 = d_o + d_1 P_1 + d_2 P_2 + \ldots + d_n P_n$, where $P_1, \ldots, P_n$ is a series of prices of commodities interacting in the model.

along the initial demand function, but shifted by the quantity $\ell\ \mu$, to accommodate the possibility of discounting the information. Consequently, the demand and supply for the informed state will look as follows:

Demand: $P = (a_o + \ell\ \mu) + a_1 q$ (3.32)

Supply: $P = b_o + kb_1 q$ (3.33)

The concepts of consumer surplus (CS) and producer surplus (PS) are used to express the welfare impacts of new information on consumers and producers, respectively. In each case, the impact is defined as the difference between the surplus measures that would be that would be computed in the informed and reported states. The following is an illustration of those impacts in their algebraic form.

1. Impact of Information on Consumers:

Reported State

$$CS_1 = -\tfrac{1}{2}\, a_1\, Q_1^2 \quad (3.34)$$

Informed State

$$CS_2 = -\tfrac{1}{2}\, a_1\, Q_2^2 \quad (3.35)$$

The impact of information on consumers, V_{CS}, is equal to:

$$V_{CS} = CS_2 - CS_1$$

$$= -\tfrac{1}{2}\, a_1 (Q_2 - Q_1) \quad (3.36)$$

Clearly, if information generates a greater quantity on the market of a given commodity, consumers are better off, and vice versa.

2. Impact of Information on Producers

Reported State

$$PS_1 = (a_o+\mu-b_o-\nu)Q_1 +(a_1-\tfrac{1}{2}b_1)Q_2^2 \tag{3.37}$$

Informed State

$$PS_2 = (a_o + \ell\mu - b_o)Q_2 + (a_1 - \tfrac{1}{2}kb_1)Q_2^2 \tag{3.38}$$

The impact of information on producers, V_{PS}, is equal to

$$\begin{aligned} V_{PS} &= PS_2 - PS_1 \\ &= (a_o-b_o)(Q_2-Q_1)+ (\ell\mu Q_2-(\mu-\nu)Q_1 \\ &\quad +a_1(Q_2^2-Q_1^2)-\tfrac{1}{2}b_1(kQ_2^2-Q_1^2) \end{aligned} \tag{3.39}$$

3. Impacts of Information on Consumers and Producers Combined:

Reported State

$$W_1 = (a_o+\mu -b_o -\nu)Q_1 +\tfrac{1}{2}(a_1-b_1)Q_1^2 \tag{3.40}$$

Informed State

$$W_2 = (a_o+\ell\mu-b_o)Q_2+\tfrac{1}{2}(a_1-kb_1)Q_2^2 \tag{3.41}$$

The overall impact of information on both groups, producers and consumers, W can be written as

$$W = W_2 - W_1$$
$$= (a_o - b_o)(Q_2 - Q_1) + \ell\mu Q_2 - (\mu - \nu)Q_1$$
$$+ \tfrac{1}{2}a_1(Q_2^2 - Q_1^2) - \tfrac{1}{2}\, b_1(kQ_2 - Q_1) \qquad (3.42)$$

Expressions (3.36) , (3.41) and (3.42) are formulations for the impacts the release of information generates in the market place but looked at from the point of view of producers, consumers and society respectively. Furthermore, these impacts are only for a given commodity in a single time period. In the simulator commodities and time periods are interconnected. The result of the simulation process, however, gives equilibrium solutions for each commodity in every time period. The conceptual framework described so far applies once the simulation work is carried out and assumes linearity in the demand and supply equations around the equilibrium price and quantities solved for. The following is a sketch of comparative statics results to illustrate how the value of information to producers, consumers and in total change as changes occur in (a) the information variables timeliness (k), accuracy (α and β) and believability (ℓ), and (b) information parameters, which are in this case the slope to demand (a_1), slope of supply (b_1) and the disturbances u and v.

Comparative Statics

To simplify the analysis, the investigation will proceed by considering typical special cases and then progressively include additional variables.

Case 1

This case looks at the situation where there is information about a disturbance that affected the demand of a given commodity. It is assumed that the information was reported accurately and the believability in it, by market participants, is complete. That is, $\alpha=o$, $\beta=0$, $v=0$, and $\ell=1$. Under these circumstances, equations (3.36), (3.41) and (3.42) which express the impact of information on consumers, producers and in total, respectively, become:

$$V_{CS} = -\tfrac{1}{2}a_1(Q_2^2-Q_1^2) \tag{3.43}$$

$$V_{PS} = (a_o-b_o+\mu)(Q_2-Q_1) + a_1(Q_2^2-Q_1^2) - \tfrac{1}{2}b_1(kQ_2^2 - Q_1^2) \tag{3.44}$$

$$W = (a_o-b_o+\mu)(Q_2-Q_1) + (Q_2-Q_1) - \tfrac{1}{2}b_1(kQ_2^2 - Q_1^2 \tag{3.45}$$

where

$$Q_1 = (a_o + u - b_o)/(b_1 - a_1)$$

and

$$Q_2 = [b_1\mu+a_0-b_0]/b_1k(b_1-a_1)$$

The changes in V_{CS}, V_{PS} and W are indicated by the following relationships:

$$\frac{\partial V_{CS}}{\partial k} = a_1 Q_2 \cdot b_1 \mu + a_0 - b_0 / b_1 (b_1 - a_1) k^{-2} \qquad (3.46)$$

This expression is clearly negative. Since Q_2 involves the expression (1/k), the overall change in the value to consumers is proportional to the cube of its timeliness. Ordinarily k is greater than one. Timeliness is perfect when k equal 1, hence the value of information to consumers is maximum, ceteris paribus. As k increases and goes to infinity, the slope of the reaction function becomes very steep and the value of information to consumers declines and goes to zero, for the market equilibrium quantity does not change as a result of the information.

$$\frac{\partial V_{PS}}{\partial k} = (b_1 - \frac{2a_1}{k}) Q_2^2 \; (a_0 - b_0 + \mu) \; \frac{Q_z}{k} \qquad (3.47)$$

This expression is positive for all values of Q_2 greater than $(a_0 - b_0 + \;)/(kb_1 - 2a_1)$. This ratio is a small number and the quantities involved are much larger. Hence, the value of information to producers increases in most cases as timeliness improves.

$$\frac{\partial W}{\partial k} = (b_1 - \frac{a_1}{k}) Q_2^2 - (a_o - b_o + \mu) \; \frac{Q}{k} \qquad (3.48)$$

This relationship is also positive in all reasonable cases of quantities. This confirms that society benefits from timely information; everything else held constant.

Case 2

Consider now the case where information is timely, completely believable, but possibly involving an error in estimating the shift in demand. That is, $\beta=0$, k=1, v=0 and $\ell=1$, but possibly $\alpha\neq0$. In this situation, the following holds:

$$V_{CS} = -\tfrac{1}{2}a_1(Q_2^2-Q_1^2) \tag{3.49}$$

$$V_{PS} =(a_o-b_o+u(1+\alpha))(Q_2-Q_1) + (a_1-\tfrac{1}{2}b_1)(Q_2^2-Q_1^2) \tag{(3.50)}$$

$$W =(a_o-b_o-u(1+\alpha))(Q_2-Q_1) +\tfrac{1}{2}(a_1-b_1)(Q_2^2-Q_1^2) \tag{3.51}$$

where,

$$Q_1 = (a_o+u(1+a)-b_o)/(b_1-a_1)$$

and

$$Q_2 = b_1 \ (1+\alpha)u-b_o(b_1-a_1) \ /b_1(b_1-a_1)$$

Changes in V_{CS}, V_{PS} and W with respect to error in estimating demand were found to be as follows:

$$\frac{\partial V_{CS}}{\partial\alpha} = \frac{1}{2} a_1u[b_o(b_1-a_1)+a_o-b_o]/(b_1-a_1)^2 \tag{3.52}$$

This expression is positive whenever u is negative, corresponding to a inward shift in the demand function, and negative in the opposite case. This means that, with an outward shift in demand, the value of information to consumers decreases as the error in estimating that demand increases and vice versa.

$$\frac{\partial V_{PS}}{\partial \alpha} = u(a_1-\frac{1}{2}b_1)[b_o(b_1-a_1)+a_o-b_o]/(b_1-a_1) \qquad (3.53)$$

and

$$\frac{\partial W}{\partial \alpha} = \frac{1}{2}u(a_1-b_1)[b_o(b_1-a_1)+a_o-b_o]/(b_1-a_1) \qquad (3.54)$$

Expressions (3.40) and (3.41) are both negative for a positive u, meaning an outward shift in demand. This suggests that, the value of information declines as the error made in estimating demand increases.

Case 3

This case examines the impact of believability on the welfare of producers and consumers following a market reaction to information. Hence, it will be assumed that accuracy and timeliness are perfect. That is, $\alpha=0$, $k=1$ but $\ell=1$. If so, the following holds.

$$V_{CS} = \frac{-1}{2} a_1(Q_2^2-Q_1^2) \qquad (3.55)$$

$$V_{PS} = (a_o-b_o)(Q_2-Q_1) + \mu(Q_2-Q_1) + (a_1- \frac{1}{2}b_1)(Q_2^2-Q_1^2) \qquad (3.56)$$

$$W = (a_o-b_o)(Q_2-Q_1) + \mu(\ell Q_2-Q_1) + \frac{1}{2}(a_1-b_1)(Q_2^2-Q_1^2) \qquad (3.57)$$

where,

$$Q_1 = (a_o + \mu - b_o)/(b_1 -a_1)$$

and

$$Q_2 \quad = [\ell\mu+b_o(a_1 - b_1)]/(b_1 - a_1)$$

Changes in the three welfare measures as believability ℓ varies are derived as follows:

$$\frac{\partial V_{CS}}{\partial \ell} = -a_1\mu[\ell\mu + b_o(b_1 - a_1)]/2(b_1 - a_1)^2 \tag{3.58}$$

$$\frac{\partial V_{CS}}{\partial \ell} = \mu^2[\frac{b_1}{b_1-a_1}]\ell + (\frac{a_o-b_o}{b_1-a_1})\ell + \frac{a_1b_o\mu}{b_1-a_1} \tag{3.59}$$

$$\frac{\partial W}{\partial \ell} = \mu^2[\frac{5}{2}\frac{1}{(b_1-a_1)}]\ell + (\frac{a_o-b_o}{b_1-a_1})\mu + \frac{3}{2}b_o \tag{3.60}$$

Expressions (3.42), (3.43) and (3.44) are clearly positive whenever $u > 0$. If $u < 0$, which corresponds to information that reveals a downward shift in the demand curve for a commodity, those signs become unclear. However, this case may not be very likely. Furthermore, the three expressions suggest that the value of information changes in a linear fashion with believability as the latter changes.

Implementation

The first phase in implementing the previous framework is to make use of a simulator whose structure follows equations (3.1) through (3.10). Such a simulator solves for all equilibrium quantities and prices of the interacting crops in each year. Examples of information shocks deviations of prospective plantings, June planted acreage estimates, August production forecasts and November end-of-season production estimates from respective previous market expectations. In each situation a certain level of discrepancy between either acreages (or production) and the corresponding previously expected plantings (or production) and the simulator will be run to determine a new path of prices and quantities if the shock were to occur and would not be reported. Then, the resulting price information will be integrated in the model assuming different believability levels. This is the informed state. Consumer and producer surplus measures will be computed for every crop and each time period. The difference in producer surplus between the informed and the reported states is a proposed measure of the value of information to producers, and similarly for consumers. Hence, assuming linearity in the aggregate demand and supply around the simulated equilibrium qualities and prices for all crops in all time periods considered, the explicit formulas for the value of information in each case are going to be:

$$V_{CS} = \tfrac{1}{2}\, a_1 \, (Q_2^2 - Q_1^2)$$

$$V_{PS} = (a_o - b_o)\,(Q_2 - Q_1) + (a_1 - \tfrac{1}{2}\, b_1)\,(Q_2^2 - Q_1^2)$$

$$V_w = (a_o - b_o)\,(Q_2 - Q_1) + \tfrac{1}{2}\,(a_1 - b_1)\,(Q_2^2 - Q_1^2)$$

where,

V_{CS} Value of information to consumers

V_{PS} Value of information to producers

V_W Value of Information in Total

Q_1 Equilibrium quantity of a given crop under the reported state.

Q_2 Equilibrium quantity of a given crop under the a_o, a_1, b_o, and b_1 are defined as in the previous sections.

Chapter Summary

This chapter has presented the overall features of the underlying demand and supply framework characterizing the commodities to be studied. Such a framework is the essence of the adopted simulator for the study. The methodology to value specific cases of information was introduced next. The methodology was then used in the case of linear supply and demand equations to derive explicit formulations for the value of information to producers, consumers and in total. Finally, selected comparative statics results were presented. These results indicated, in most cases, that the value of information is positively related to improvements in timeliness, accuracy and believability.

CHAPTER IV

RELATED CONCEPTUAL ISSUES

The previous chapter introduced the conceptual framework that is proposed to measure the welfare impacts generated by the release of USDA crop reports. Since the emphasis was on developing the model, insufficient details were provided regarding the precise meaning of the concepts involved and the controversies surrounding some of them. This chapter digresses to examine in some detail the issues pertaining to (a) the measurement of welfare of consumers and producers, (b) supply response or reaction function, (c) information quality, (d) demand for storage and finally and (e) the Gauss-Siedel technique used for solving simultaneous relationships in the simulation model.

Welfare Measurement

Consumer and producer surplus measures, almost since their introduction to the economics literature by Dupuit and Marshall, respectively, have been used extensively in empirical work related to the measurement of social Welfare (Waugh, Husak, Johnson, Peterson, Griliches, Turnovsky). For a long time too, however, concern has been expressed by a number of economists regarding the validity of these concepts and their relevance in accurately measuring society's welfare. The upshot of the debate is that consumer surplus is a controversial concept. Producer surplus, on the contrary, has been adopted with no major criticism, with the only exception that it may have been improperly labelled to begin with.

Consumer surplus

Three issues related to consumer surplus are discussed in this section. First, the constant-marginal-utility of income controversy is presented. The so-called path dependency problem is examined next. The consumer surplus discussion concludes with some guidelines regarding a proper interpretation of the concept in empirical work. The interpretive remarks will also be extended to the case of commodities which are consumed only indirectly by humans. A case in point is the feed grains sector which, for the most part, provides an output that reaches consumers not as grain but in the form of livestock products.

Marginal Utility of Income. The early theoretical formulations of consumer surplus implied that the concept would be rigorously justified if marginal utility of income was constant with respect to all its arguments (Dixit and Weller). Samuelson pointed out the ambiguity implied by such a condition, since marginal utility of income is a function of prices and income, and cannot consistently be constant with respect to all those variables. He further showed that requiring independence between marginal utility of income and prices is equivalent to assuming that consumer preferences are homothetic. Mathematically, a homothetic function is any function $U(x)$ such that $U(x) = f(g(x))$, where $g(x)$ is any linear homogeneous function. Practically, homotheticity implies that a given proportionate increase in money income will lead to the same gain in utility no matter what level of utility the consumer starts at (Silberberg, p. 239). This property has generated harsh and continuous criticism of the consumer surplus concept by a number of economists. Samuelson, in his Foundations of Economic Analysis (p. 195), states that, in view of the constancy of marginal utility of income, "The subject, is of historical and doctrinal interest, with a limited amount of appeal as a purely mathematical puzzle". More recently Just et al. showed there is no two-way relationship between consumer surplus and the constancy idea. According to them, the constancy of marginal utility of income guarantees uniqueness of consumer surplus, but not vice versa. They go on to argue that a necessary and sufficient condition for the surplus concept to be a theoretically valid measure of welfare change is for income effects (elasticities) of all goods, for which prices change, to be zero. Making such an assumption may satisfy some theoretical requirements of consumer surplus, but does not make it any closer to reality.

Path dependency. Typically, consumer surplus is defined in terms of ordinary demand functions formulated by consumers. The mathematical derivation of such demand functions is obtained by considering an individual whose objective is to maximize the utility function U(.) he derives from consuming quantities $q_1, \ldots, q_n$ subject to a budget constraint M. The Lagrangian expression L for such a situation can be stated as follows:

$$L = U(q_1, \ldots, q_n) + \lambda(M - \sum_{i=1}^{n} P_i q_i) \tag{4.1}$$

where P_i is the price of good q_i, Σ is the summation sign and λ is the Lagrangian multiplier. Maximizing (4.1) requires the first order conditions are satisfied. That is,

$$U_i - \lambda P_i = 0 \; ; \; i = 1,\ldots,n \tag{4.2}$$

$$M - \sum_{i=1}^{n} P_i q_i = 0 \tag{4.3}$$

where $U_i = \dfrac{\partial u}{\partial qi}$. If the second order conditions[19] are satisfied equations (4.2) and (4.3) can be solved, implicitly, to yield

$$q_i = q_i^m (P_1,\ldots, P_n,M) \qquad ; \; i=1,\ldots,n \tag{4.4}$$

the superscript m denotes optimal (equilibrium) values. Equations (4.4) are the ordinary or money-held constant demand functions. With a price change of commodity i from P_i^0 to P_i^1 the associated consumer surplus can be written as

$$CS = \int_{P_i^0}^{P_i^1} q_i \; dP_i \tag{4.5}$$

The integral in equation (4.5) is not an ordinary one but is called a line integral. Its evaluation yields different results depending upon which path prices take when they change, even though the beginning and ending points are the same for all possible paths. That is, different paths taken by a given price change translate into different

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[19] Requiring that the Jacobian associated with equations (4.2) and (4.3) does not vanish, as well as some other mathematical regularity conditions.

changes in consumer surplus. Thus, changes in consumer surplus may not reflect exact changes in welfare. The possible nonuniqueness of consumer surplus changes led Silberberg (1972) and others to question its usefulness as a measure of welfare change. To illustrate the importance of this point, the following example, depicting an economy in which the prices of two commodities are changed, is presented.

Consider the Figure 4.1 below where the prices of commodities q_1 and q_2 change from P_1^0 and P_2^0 to P_1^1 and P_2^1, respectively. Assume there are only two possible paths of adjustment as depicted in panel a. Along path L_1, the price of q_1 is first changed from P_1^0 to P_1^1, generating a gain of area u under the initial demand curve $D_1(P_2^0)$ in panel b. In the process, the demand curve for q_2 shifts from $D_2(P_1^0)$ to $D_2(P_1^1)$ in panel c; thus an additional gain of area x + y results in subsequently moving the price of q_2 from P_2^0 to P_2^1.

Alternatively, if path L_2 is followed, a gain of area x is first generated in the q_2 market; then a gain of area u + v is obtained in the q_2, market. The resulting measures of welfare change associated with paths L_1 and L_2, areas u + x + y and u + v + x, respectively, need not be equal. If more paths were considered, the outcome would be different in each case. This is the essence of the problem known as path dependency.

In an attempt to resolve this issue, Hicks proposed to measure welfare of consumers by means of compensating variation (CV) or equivalent variation (EV). Both CV and EV require knowledge of compensated (Hicksian) demand as opposed to ordinary (Marshallian) demand. The former is derived through minimization of the cost of a

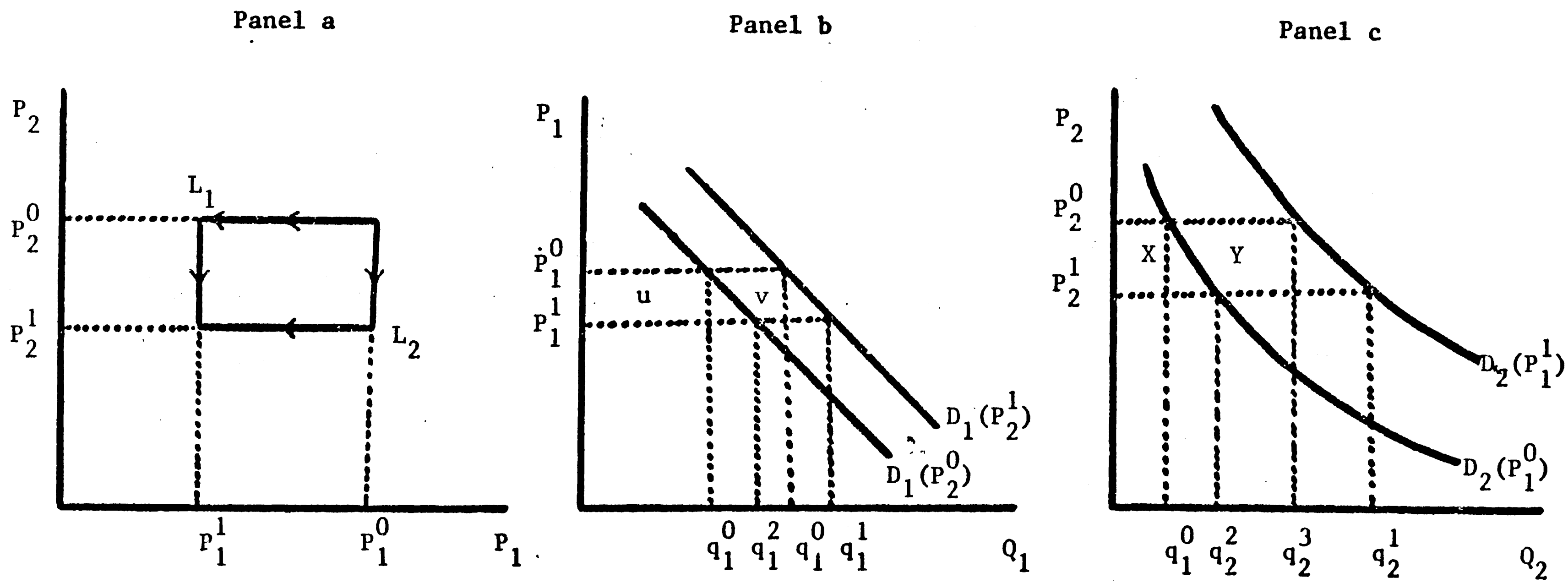


Figure 4.1. Path Dependency Problem.

bundle of commodities consumed $q_1,\ldots,q_n$ subject to maintaining a given level of utility. By analogy to equation (4.1), a Lagrangian expression can be set up.

$$G = P_1q_1 + \ldots + P_nq_n + \mu(\bar{U} - U(q_1,\ldots,q_n)) \tag{4.5}$$

minimizing G with respect to q_i and μ (Lagrange multiplier) yields

$$P_i - \mu U_i = 0 \quad , \quad i = 1,\ldots,n \tag{4.6}$$

$$\bar{U} - U(q_1,\ldots,q_n) = 0 \tag{4.7}$$

With the second order conditions corresponding to (4.6) and (4.7) satisfied it is possible to derive the compensated demand curves in the following implicit form:

$$q_i = q_i^u (P_1,\ldots,P_n, U) \quad , \quad i=1,\ldots,n \tag{4.8}$$

where the superscript u also denotes optimality conditions but optimality here is associated with a given level of utility as opposed to a level of income.

Compensating variation is defined to be the <u>amount of compensation</u> that will leave a consumer in his <u>initial welfare</u> following a price change if he is free to buy any quantity of the commodity at a <u>new price</u>. Equivalent variation, on the other hand, is also an <u>amount</u> of <u>compensation</u> that will leave a consumer, not in his initial, but his <u>subsequent welfare position</u> without a change in price if he is free to buy any quantity at the <u>old price</u> (Hicks).

In terms of equation (4.8), CV and EV can be written as

$$CV = \int_{P_i^0}^{P_i^1} q_i^u(P_1,\ldots, P_n,U^0)\, dP_i \tag{4.9}$$

$$EV = \int_{P_i^0}^{P_i^1} q_i^u(P_1,\ldots,P_n,U^1)\, dP_i \tag{4.10}$$

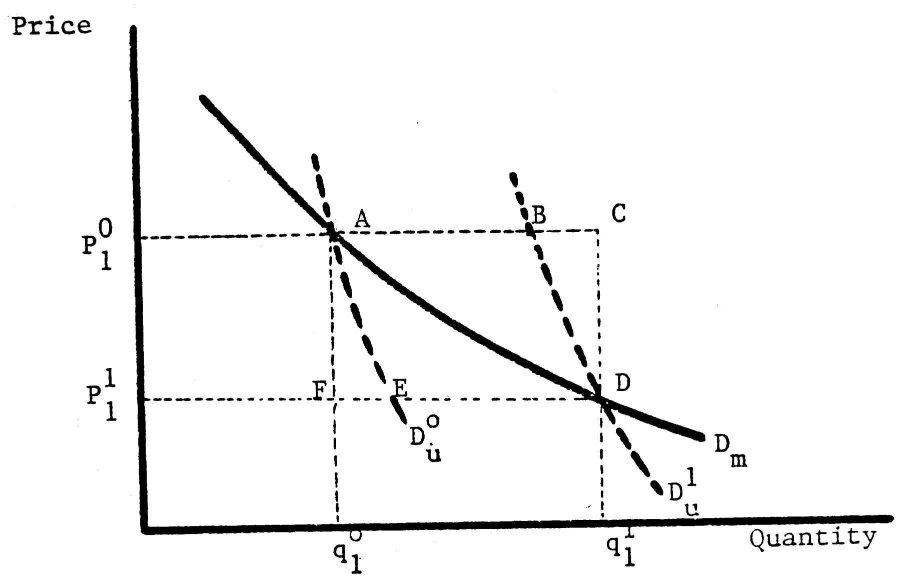
where the movement from P_i^0 to P_i^1 indicates the magnitude of price change of commodity i and the superscripts 0 and 1 on the compensated demand function refer to the demand functions corresponding to the utility levels associated with the initial and final price levels, respectively. It is shown (Dodgson) that CV and EV are exact measures of welfare change since they are path-independent and hence unique for any given multiple price change. Moreover, Willig (1976) shows that the ordinary consumer surplus is always bounded by the equivalent variation and the compensating variation associated with a price change. Figure 4.2 below provides a graphical illustration of the three welfare measures in question.

In terms of Figure 4.2, the equivalent variation, compensating variation and consumer surplus associated with a price decrease from P_1^o to P_1^1 can be expressed as

$$CV = P_1^0 AEP_1^1 \tag{4.11}$$

$$CS = P_1^0\ P_1^1 AD \tag{4.12}$$

$$EV = P_1^0 BDP_1^1 \tag{4.13}$$



where,

D_m : ordinary(Marshallian) demand curve

D_u^0 : compensated demand curve corresponding to the level of consumer utility prior to a price change, and

D_u^1 : compensated demand curves corresponding to the level of consumer utility following a price change.

Figure 4.2: Illustration of consumer surplus, compensating variation and Equivalent Variation.

Clearly from the above, but also proven by Willig (1976),

$$CV \leq CS \leq EV \qquad (4.14)$$

or equivalently for a price increase

$$EV \leq CS \leq CV$$[20]

From an empirical welfare measurement point of view, one is faced with a dilemma. On one hand, both EV and CV are mathematically exact measures of welfare change but their measurement requires knowledge of the underlying Hicksian demand functions which are unobservable. On the other hand, the measurement of consumer surplus, which, it is true, is an approximate measure of welfare change, requires only knowledge of ordinary demand functions which are, in principle, estimable using observable data. The issue, at the theoretical level has not been resolved yet. Vartia seems to have developed an algorithm that permits the derivation of equivalent variation based only on knowledge of ordinary demand functions. But even if his algorithm proves usable, there still remains the question of which utility level one should use in practice since CV and EV are defined in terms of initial and final utility levels, respectively. That still needs to be resolved.

McKenzie introduced another concept of welfare change and attempted to show its superiority over CS, EV and CV. The concept involves taking a Taylor series expansion of the equivalent variation function. The series would include more and more terms until the additional members become small enough that they do not significantly affect the value of the function any more. At such time, no more

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[20] EV for a price increase is identical, in absolute value, to CV for a price decline and vice versa.

terms will be added to the series. Willig (1979) showed that McKenzie's procedure involves serious errors. Futhermore, using this procedure requires knowledge of the equivalent variation which is not, in general, available anyway.

In an earlier article, Willig (1976) proposed a basis for using consumer surplus in applied welfare measurement. He argued that whenever consumer's income elasticity of demand is low, which is the case of agricultural products in the U.S. (Tweeten, 1979, p. 337), and the area under the demand curve between the old and the new prices is within five percent of income, which is likely in most applications, consumer surplus provides a reasonable approximation of compensating variation which he contends is an exact, but nonobservable measure of welfare change. Moreover, Willig (1973) goes as far as recommending that if a researcher is concerned with reducing errors of approximation, probably more would be gained by improving the data base and choosing proper functional forms or estimation techniques than in worrying about how close to a mathematically exact welfare measure consumer surplus is. Hence, to use his words "cost-benefit welfare analyses can be performed rigorously and unapologetically by means of consumer surplus".

<u>Interpretation of Consumer Surplus Change</u>. As a general rule, and in view of the problems mentioned above, Silberberg (1978, p. 361) proposes that the expression "gains from trade" be understood when referring to changes in consumer surplus. He, in particular, makes the point that the fact that there is no unique evaluation of this gain (or loss) should not constitute a denial that such gains (or

losses) exist. However, arguing that consumer surplus is an acceptable approximation of, say, compensating variation as Willig did may not be fruitful. Doing so, according to him, implies attempting to approximate behavior that may not be definable or measurable.

This study uses the ideas of both Willig and Silberberg. First, in the measurement of the impact of information on consumers the consumer surplus concept is adopted. Second, to follow the idea of Silberberg, the results to be presented in the subsequent chapters, may not represent "true" changes in the welfare function of consumers, which he argues may not exist. Rather, they are to be interpreted as possible gains or losses associated with trading a given piece of information, i.e., when adopting it and/or reacting to it.

Another point of interpretation, in applied work, concerns cases in which the commodity being studied is not consumed directly. Corn is such an example. For that matter, all feed crops included in the simulator: corn, barley, oats and grain sorghum fall in this category. Explicit demand elasticities for those crops are available. Therefore, computation of consumer surplus impacts are possible. Do all of those impacts represent changes in final consumers surplus? Just and Hueth showed that the area behind a general equilibrium demand curve in an intermediate market does not measure benefits to buyers in that market alone, but rather measures the sum of rents to producers selling in all higher markets plus final consumer surplus. Furthermore, they demonstrate that when a market price is altered, as is the case when there is reaction to information, total change in sector welfare is given by the producer and consumer surplus change measured from the general equilibrium[21] supply and demand functions of the altered market. Collins and Ray generalized this result to the multi-factor and multi-product case.

Producer Surplus

Producer surplus is usually defined as the area delimited by a supply curve, the price axis and the price level. Mishan is the only economist who has expressed concern about measuring producer's welfare with producer surplus. He considers a person maximizing his utility function subject to the constraint that the sum of expenditures and earnings is zero. 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 short-run and long-run supply functions. The area above the supply curve measures producer 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, he argues, we cannot derive a producer surplus from a supply curve. Mishan recommends that the ambiguity can be avoided by banishing the term "producer surplus" and concentrating on economic rent as a measure of producers welfare.

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[21] General equilibrium refers to a situation where a number of single markets are simultaneously in equilibrium.

Since the problem, essentially, can be solved by changing the nomenclature, the meaning of producer surplus used in this study will be along the same lines recommended by Mishan. That is, even though reference is made to producer surplus in this study, what is actually meant and calculated in the simulator is economic rent or quasi-rent, as some other authors call it (Just et al and Gould and Ferguson). To picture what an economic rent is and how it is computed, the following illustration is provided.

Consider a competitive firm producing some commodity. Its marginal cost and average variable cost are MC and AVC, respectively, as shown in figure 4.3 below. At price P_o, the profit maximizing total receipts are given by the area below p_o and left of quantity q_o, or

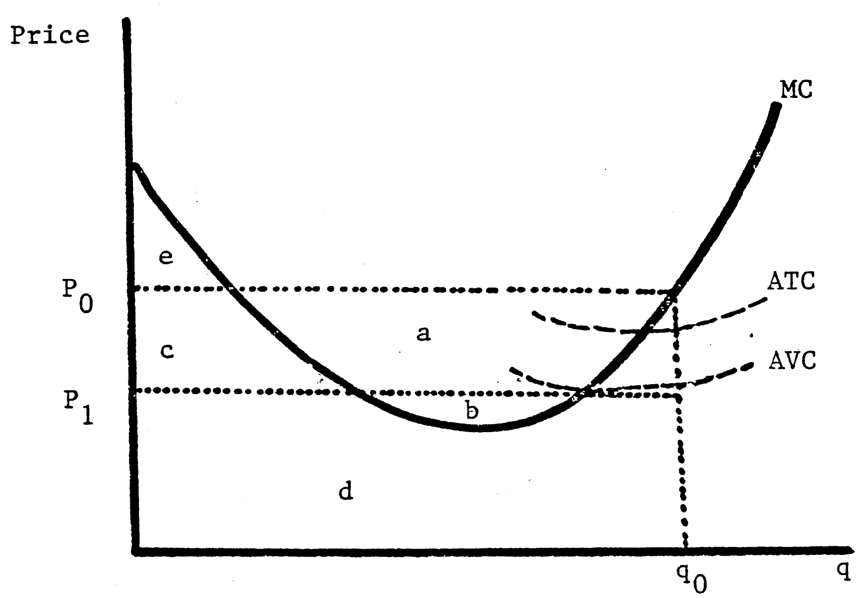

Figure 4.3: Illustration of Producer Surplus (Rent).

$$TR = \text{area } (a + b + c + d) = P_o \cdot q_o$$

One measure of total variable costs is the area below the marginal cost curve (and left of quantity q_o).

$$TVC = \text{area } (c + d + e)$$

Thus rent (quasi-rent) or producer surplus can be calculated as follows,

$$R = TR - TVC = \text{Area } (a + b - e)$$

More generally, if a firm uses inputs X_i; $i=1,\ldots,n$ and produces output q_o that it sells at price P_o, then the associated economic rent is given by

$$R = TR - TVC = p_o q_o - \sum_{i=1}^{n} W_i X_i$$

where W_i is the price of input X_i. Hence, producer surplus is expressed as the difference between gross receipts and total variable costs obtained by multiplying simulated total harvested acres and the variable cost per acre.

Reaction Function

In the presentation of the model and throughout the study the concept of supply response is used a great deal. The response in question is not the traditionally known supply response function. Tomek and Robison make a distinction between a supply function and a supply response. Consider the following function:

$$S = f(P_1, P_2, \ldots, P_n) \tag{4.21}$$

where S refers to supply of a given commodity, P_1 is its price and $P_2, \ldots, P_n$ are price of related commodities. The relationship of S to P_1, holding all other prices constant is usually referred to as a supply function. On the other hand, if all prices are changing then a supply response (or more correctly a supply surface) is generated. Supply response tends to be generally more elastic than supply function. Graphically, one has the following situation.

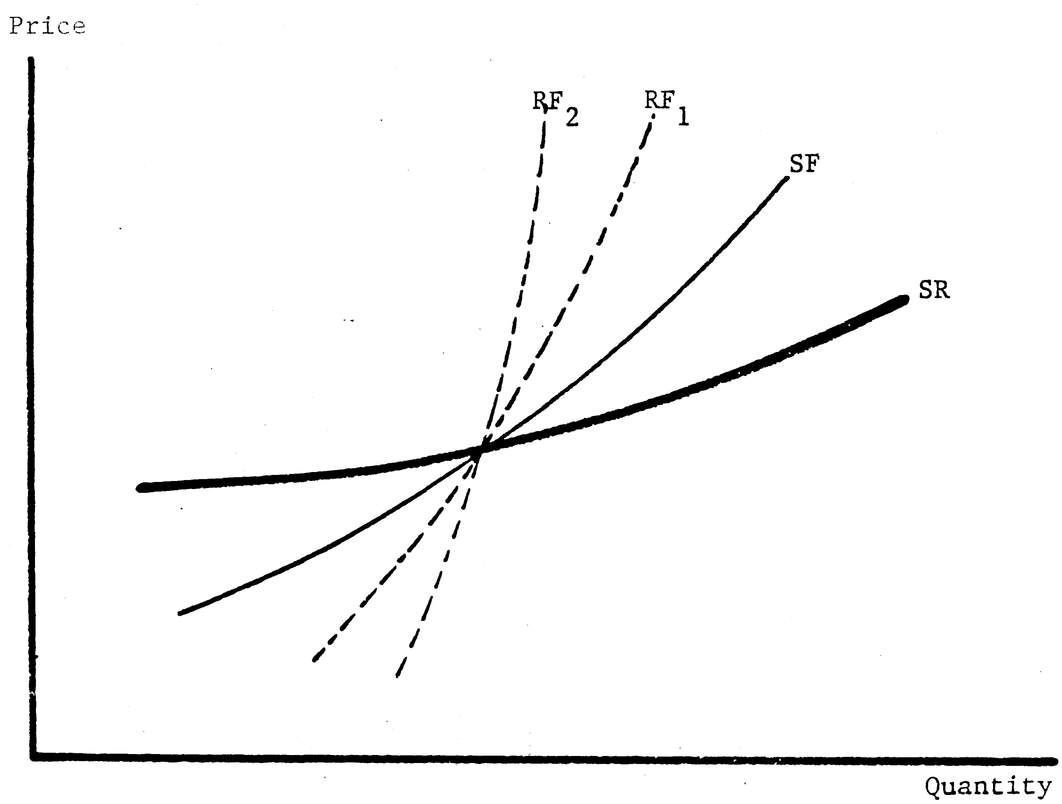

Figure 4.4: Illustration of supply response (SR), supply function (SF) and possible reaction functions (RF_1 and RF_2).

The response or reaction function used in the previous chapter is of a different type. It expresses the extent of supply flexibility, still possible, at a point in time during the production season. The more flexibility there is, as opposed to the fewer resources are committed to production processes, the higher the chances agricultural producers can react to and make use of new information regarding future outcomes. For instance, if information is released near or at harvest time, very little production adjustment, if any, can take place that may alter the magnitude of crop harvests. At that time, supply is very inelastic. Conversely, predictions released early on regarding future size of crops, possible demands for them and the resulting market prices can potentially generate a great deal of production adjustment on the part of agricultural producers, provided that the information is believed. To avoid confusion with the more traditional concept of supply response, the short-run adjustment function by agricultural producers to new information will be called reaction function. The Le Chatelier principle guarantees that this function be no more elastic than the supply function. A sketch of this principle follows.

The Le Chatelier Principle

Consider a commodity whose output is Y. Let Y be function of inputs $X_1, \ldots, X_n$. Further assume P and W_i as the prices of Y and X_i; $i=1,\ldots,n$, respectively. Profit Π can then be written as

$$\Pi = P\,Y - \sum_{i=1}^{n} W_i X_i \tag{4.22}$$

or

$$\Pi = Pf(X_1,\ldots,X_n) - {}_{i=1} W_i X_i \quad (4.23)$$

The first order conditions of the maximization of with respect to X_i yield

$$P\frac{\partial f}{\partial X_i} - W_i = 0 \quad ; \quad i=1,\ldots,n \quad (4.24)$$

If the second order conditions are satisfied, optimal input levels can be derived.

$$X_i = X_i^* (P,W_1,\ldots,W_n) \quad (4.25)$$

Substituting result (4.25) into the production function and into the profit function generates

$$Y = Y^* (P, W_1,\ldots,W_n) \quad (4.26)$$

$$\Pi = \Pi^* (P, W_1,\ldots,W_n) \quad (4.27)$$

Note that the optimal levels of output and profit are functions of only the parameters P and $W_1,\ldots,W_n$. In the long run inputs $X_1,\ldots,X_n$ are all variable. By the envelope theorem, the corresponding supply response can be determined by differentiating the optimal profit function with respect to P

$$\frac{\partial \Pi^* (P,W_1,\ldots,W_n)}{\partial p} = \frac{\partial \Pi(X_1,\ldots,X_n;P,W_1,\ldots,W_n)}{\partial p}$$

$$= Y^* (P_1 W_1,\ldots,W_n) \quad (4.28)$$

Relating changes in output to changes in prices holding the W's constant yields the conventional supply curve. Allowing the W's to change, together with P, determines supply response. Determining the proposed reaction function consists of assuming some or all of the inputs become fixed. For exposition purposes, suppose only the ith input X_i is held fixed at X_i^o. The optimization process is repeated to obtain equations for supply functions similar to (4.26) and (4.27). The only difference is the number of inputs that have become fixed. In this case, only one X_i is held constant. The corresponding short-run supply function, and possibly reaction function too, can be written as follows

$$Y = Y^s(P,W_1,\ldots,W_n,X_i^o) \qquad (4.26)'$$

$$\Pi = \Pi^s(P,W_1,\ldots,W_n,X_i^o) \qquad (4.27)'$$

where the superscript s refers to short-run.

Applying the envelope theorem again to equation (4.27)' yields a short-run supply function

$$\frac{\partial \Pi^s}{\partial P} = \frac{\partial \Pi}{\partial P} f\ (X_1^*,\ldots,X_i^o,\ldots,X_n^*) = Y^s(P,W_1,\ldots,W_n,X_i^o) \qquad (4.25)$$

Silberberg (1978, p.273) shows that, around the optimal values of the X_i's, the following holds

$$\frac{\partial^2 \Pi^*}{\partial P} \geq \frac{\partial^2 \Pi^s}{\partial P} \qquad (4.26)$$

Since $\frac{\partial^2 \Pi^*}{\partial P} = \frac{\partial Y^*}{\partial P}$ and $\frac{\partial^2 \Pi^s}{\partial P} = \frac{\partial Y^s}{\partial P}$

it follows that

$$\frac{\partial Y^s}{\partial P} \leq \frac{\partial Y^*}{\partial P} \tag{4.27}$$

which suggests that the short-run response function is always flatter (steeper) in a quantity-price (price-quantity) quadrant than supply response, which corresponds to a situation where all inputs are variable. In a way, reaction functions are nothing more than a set of supply functions corresponding to shorter and shorter lengths of run. For this reason, graphically, they are pictured somewhat steeper than supply functions.

Irreversibility of the Reaction Function

Since the reaction function is a special case of what is generally referred to as supply response, there is need to discuss the proposition that the elasticity of the function with respect to a price increase may be different relative to a price decrease. This is known in the literature as supply irreversibility phenomenon (Tomek and Robinson).

Cochrane first proposed that the output response relation is not reversible because technological advance, once adopted, is rarely given up. Hence, it is argued that supply function traces out one output path with rising prices and another with falling prices. The estimation methodology being a separate matter, Tweeten and Quance found that this is the case of aggregate agricultural supply and particularly so in the long run. Trail, Colman and Young confirmed this finding when studying onion supply response. Burt, on the other hand, argues that finding irreversibility in a supply function with respect to price changes is a symptom of specification error associated with the dynamic structure of the model. He further suggests that a sufficiently high order of differencing in the supply response variable jointly with a relatively short distributed lag on price, and possible other exogenous variables, should remove the irreversibility problem. More recently Woods, Tweeten, Ray and Parvin could not find significant evidence in support of the irreversibility hypothesis.

In view of the lack of clear evidence supporting the irreversibility of supply of response hypothesis, together with its questionable theoretical foundation, the framework to simulate the response to new information assumes reversibility in the supply equations.

Estimation of the Reaction Function

Even though this may, generally speaking, fall under supply response estimation, upon which there is a vast literature, the case is so special that it is different. What is needed for this study is an appraisal of the degree of potential reaction by agricultural producers to the release of information, preferably as frequently as a monthly basis. To our knowledge no empirical estimates are available on such a response. Tyner and Tweeten suggested a methodology for estimating production parameters and applied it at the aggregate level. Carrying out the same approach on a commodity basis, however, requires data most of which are not available. Furthermore, what is sought is not so much parameters (i.e., elasticities) but the proportions by which those parameters can vary on a monthly or quarterly basis. An assumption is made in this regard within this study. The extent of response to new information is determined by the type and magnitude of variable inputs still variable at the time a given USDA report is released. USDA Area Budgets for all crops and for the entire country are prepared by Firm Enterprise Data System (FEDS) of the Economic Research Service. These budgets use information derived from a number of sample surveys. The budgets include tables of monthly estimates of variable costs by crop and area.

An analysis of the latest set of such budgets (FEDS, 1983) for all crops included in the simulator by category (e.g., various types of wheat) and for all states was performed. For the chosen report release dates (February, June, August, and November) the following procedure is adopted. A cost, or equivalently a factor, that is variable at the beginning of a production season becomes fixed[22] if it has been incurred between the last day of the month in which harvest of a previous crop took place and the last day of the month in which a report is released. In the latter case, the last day is chosen, as opposed to the day of release itself, to allow a reasonable amount of time for the information to reach the producer.

The types of variable resources that become fixed at a given point in time vary with the crops. Furthermore, for a given crop, say wheat, there are variations in resource immobility depending on

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[22] Fixity in costs (or resources) is to be distinguished from what is usually referred to as fixed or inescapable costs. The interest here is in the variable costs (resources) that are no longer variable once they are committed to production processes.

whether it is spring wheat or winter wheat or even the same type of wheat in different locations of the country. To approximate this increasing inflexibility in resources at time t, corresponding to the release of a given report, a weighted average is computed for each of the seven crops in the model. To illustrate the averaging process, denote the following

FC_{ijt} : Proportion of variable costs that become fixed, computed based on the FEDS monthly summaries

HA_{ijt} : Harvested acres reported in the budgets

i : Crop i

j : Area j of in the country occupied by crop i

t : Time of release of a given report.

The weighted average of variable costs becoming fixed over all areas at time t, WA_{it}, can be expressed as

$$WA_{it} = \frac{\sum_{j=1}^{n} HA_{ijt} \cdot FC_{ijt}}{\sum_{j=1}^{n} HA_{ijt}}$$

The results obtained using this formula are summarized in Table 4.1.

The agricultural year under consideration begins in January and ends in December. As we move from beginning to end of that year the numbers decline in magnitude. This reflects the fact that more and more variable resources become as harvest time approaches. The increased fixity translates in a limited potential adjustment by agricultural producers to the information.

Table 4.1: Proportion of Variable Costs Out of Total Variable Costs the Production Season Yet to be Incurred in the Production Season.

	February	June	August	November
Soybeans	.98	.44	.15	.00
Corn	.94	.20	.03	.00
Wheat	.36	.06	.01	.00
Grain Sorghum	.95	.29	.07	.00
Oats	.96	.08	.00	.00
Barley	.95	.04	.00	.00
Cotton	.99	.36	.11	.00

Information Quality

Three aspects of information (report) quality are considered in this study: Timeliness, accuracy and believability.

Timeliness

Economic wisdom suggests that information is timely if it reaches a potential user by the time it is needed to make decisions. Following Bullock (1981), timeliness is more formally defined in terms of the response a report generates in the market place. Agricultural producers, for instance, would consider a report A to be more timely than report B if the former reaches them at a time when relatively fewer resources have been committed to production processes than when report B is released. In practice, distinguishing reports according to the particular reaction function they generate or according to their timeliness is conceptually equivalent. That is to say, increasingly inelastic reaction functions and decreasing timeliness of reports convey the same message.

Believability

Implicit in the present methodology is that market participants will react somewhat to new information. This is, basically, how they can generate a benefit from information. The higher the believability the higher the reaction. A common way the value of information is measured in the literature is with the use of a Bayesian framework. Typically, new information is incorporated in decision making through revision of prior probability functions held by decision makers in the absence of new information. As mentioned earlier, the prior set of information used in the simulator is the baseline set of data. Such baseline reflects what is assumed or expected to occur in future time periods by market participants in the absence of new public information. When the information is released, participants will react if the information is believed. Let Y_t^* and Y_t^{**} represent the privately expected and publicly released, respectively, forecasts of some variable, say, a price of a given commodity. Market participants make their decisions based on Y_t^* only if they think the public forecast Y_t^{**} is not credible. Conversely, if they have complete faith in Y_t^{**}, they will ignore totally their private forecast.

Reality is probably between these two extreme situations. Following Chiang, it is assumed that market participants base their decisions not on Y_t^{**} alone, nor Y_t^* alone but on a weighted average of both, call it Y_t^{***}. Formally, we can write

$$Y_t^{***} = W.Y_t^{**} + (1-W).Y_t^* \quad , \quad 0 \leq W \leq 1$$

where W denotes Chiang's acceptance or believability weight. This study considers the weights of .00, .25, .50, .75 and 1.00 reflecting no, low, average, high and complete believability in the public forecast, respectively.

Accuracy

Accuracy of public information, particularly in the form of forecasts, has generated a number of controversies. It is well known, and explicitly stated in USDA reports, that predictions included in those reports are based upon the information collected prior to their release. The extent to which a response to the information might take place and therefore make the final outcome deviate from the initial forecast is not included in the forecast. Christ went as far as arguing that the reaction of observed individuals always falsifies predictions in which they are involved as dramatis personae and counteracts policies based on such predictions. Grumberg and Modigliani analyzed the validity of such claim. Specifically, they looked at the conditions under which public forecasts are self-fulfilling and self-invalidating. Their conclusion was that whenever market agents react to public predictions, they will alter the course of events. However, they argue, market agents' reactions can conceptually be known and taken into consideration. They further showed that if private predictions can be determined accurately, it is possible for public predictions to be self-validating. Knowles (1983), building upon Grunberg and Modigliani's framework, showed that a public forecast is self-validating (self-fulfilling) whenever the following holds

$$(Q_h^f - Q_h^c) \frac{\partial Q_h^f}{\partial Q_h^c} \geq 0$$

where Q_h^c and Q_h^f are quantities based upon current production plans and public forecast, respectively, of the hth crop. That is a public forecast will be self-fulfilling if it causes suppliers to change their behavior toward the forecast.

Because of the possibility of bias, public predictions may introduce in the market system, thus participating in their own invalidation, some argue that forecast error is a difficult concept to define (Bullock, 1981). The argument goes as follows. Assume that a public agency, when formulating and/or releasing a forecast $\hat{y}_t$ pertaining to a given crop, uses the information set Ω_t available at time t. Further, assume that both private market participants and the agency use the same information set. Releasing the forecast automatically augments the previously held information base Ω_t to, say, Ω_t^*. Let the final outcome, whose prediction was initially made, be $\hat{y}_t$. To the extent that the forecast y_t generates market response of some magnitude, the final or realized outcome $\hat{y}_t$ is going to be function of $\hat{y}_t$. Defining forecast error as $e = (y_t - \hat{y}_t)$, as is frequently done in the literature, may not be accurate or fair to the agency since $\hat{y}_t$ was based on Ω_t whereas the realization of y_t was function of Ω_t. Unless Ω_t and Ω_t^* are identical, which implies that the forecast does not have an impact on the market system at all, the error e will be always biased. Put differently, the basis on which public agencies predict future outcome <u>changes</u> between the time a forecast is made and the actual outcome materializes. Furthermore, USDA estimates of events (production, prices, demands etc.) are not considered final even at harvest time. Usually, an estimate is not considered final until five years have passed (Choi). Even then, no claim is made that truth has been found, some feel that studies that recommend further spending on agricultural statistics solely on accuracy grounds alone may not have adequately analyzed the real world (Bullock, 1976). Outcomes, the prediction of which was initially sought, are not generally observable. Therefore, attempts to define prediction errors as differences between forecasts formulated at one point in time to USDA estimates of quantities and prices are always biased so long as those predictions are assumed to generate a market response.

In view of these difficulties to clearly define accuracy of information, this study will attempt to capture its impacts indirectly. The analysis will be conducted for different deviations from expectations of acreages, production or exports on the assumption that the information is completely accurate in each case. The impact of inaccuracy will be expressed as follows. Suppose we have the outputs of two simulation runs corresponding to acreage shock levels L_1 and L_2. L_1 and L_2 could be, for instance, 1 and 2% deviations of reported acreages from expected acreages. Let the associated welfare measures be CS_{L_1}, CS_{L_2}, PS_{L_1}, PS_{L_2}, W_{L_1}, and W_{L_2}. CS, PS and W refer to consumers surplus, producer surplus and general welfare, respectively. The impact of reporting L_1% when reality L_2% is the true state of the world can be estimated (a) for consumers, by comparing CS_{L_1} and CS_{L_2}, (b) for producers by comparing PS_{L_1} and PS_{L_2} and (c) for society by taking the difference between W_{L_1} and W_{L_2}.

Derivation of Demand for Storage Elasticity

The purpose of this section is to suggest a method for computing the elasticity of demand for storage. Such elasticity is needed in the appraisal of consumer surplus associated with inventory change following the release of information. The proposed procedure makes use of elasticities of demand and supply in two successive time periods. Consider two time periods t-1 and t. Each is characterized with its demand and supply structure. Let D_{t-1} and S_{t-1} represent time period t-1 and D_t and S_t represent period t. Further assume period t-1 exhibits an excess supply, ES_{t-1}, whereas period t is characterized by an excess demand, ED_t. Following Bressler and King, demand for storage, DS_t, is the difference between ED_t and ES_{t-1}. That is, if

$$ES_{t-1} = S_{t-1} - D_{t-1} \text{ and } ED_t = D_t - S_t \tag{4.30}$$

then

$$\begin{aligned} DS_t &= ED_t - ES_{t-1} \\ &= D_t + D_{t-1} - S_t - S_{t-1} \end{aligned} \tag{4.31}$$

Totally differentiating DS_t with respect to price P yields:

$$d\,DS_t = d\,DS_t = \frac{\partial D_t}{\partial P} dP + \frac{\partial D_{t-1}}{\partial P} dP - \frac{\partial S_t}{\partial P} dP - \frac{\partial S_{t-1}}{\partial P} dP \tag{4.32}$$

Multiplying and dividing through (4.32) by P and DS_t, respectively, generates

$$\frac{P}{DS_t} d\,DS_t = \left[\left(\frac{\partial D_t}{\partial P}\frac{P}{DS_t} + \frac{\partial D_{t-1}}{\partial P}\frac{P}{DS_t} - \frac{\partial S_t}{\partial P}\frac{P}{DS_t} - \frac{\partial S_{t-1}}{\partial P}\frac{P}{DS_t}\right) dP\right] \tag{4.33}$$

Multiply each member on the right-hand side by the appropriate unity ratio such as $\frac{D_t}{D_t}$.

$$\begin{aligned} \frac{P}{DS_t} \cdot \frac{dDS_t}{dp} = \Bigg[& \frac{\partial D_t}{\partial P} \cdot \frac{P}{D_t}\frac{D_t}{DS_t} + \frac{\partial D_{t-1}}{\partial P}\frac{P}{D_{t-1}}\frac{D_{t-1}}{DS_t} \\ & - \frac{\partial S_t}{\partial P}\frac{P}{S_t} \cdot \frac{S_t}{DS_t} - \frac{\partial S_{t-1}}{\partial P}\frac{P}{S_{t-1}}\frac{S_{t-1}}{DS_t}\Bigg] \end{aligned} \tag{4.34}$$

or

$$\varepsilon_{dst} \left[\varepsilon_{dt} \frac{D_t}{DS_t} + \varepsilon_{dt-1} \frac{D_{t-1}}{DS_t} - \varepsilon_{st} \frac{S_t}{DS_t} - \varepsilon_{st-1} \frac{S_{t-1}}{DS_t} \right] \qquad (4.35)$$

where

ε_{dst} : Elasticity of demand for storage

ε_{dt} : Elasticity of demand in period t

ε_{dt-1} : Elasticity of demand in period t-1

ε_{st} : Elasticity of supply in period t

ε_{st-1} : Elasticity of supply in period t-1

That is, the elasticity of demand for storage is a weighted average of the elasticities of demand and supply in two successive time periods, each being weighted by the ratio of demand or supply over the amount of inventories being carried over from one time period into the next. Hence, using the elasticities of demand and supply plus the amount of inventories the simulator computes, it is possible to derive the storage elasticity of demand to compute consumer surplus.

Gauss-Seidel Iterative Technique

As discussed earlier, the chosen simulator involves simultaneous relationships. A number of mathematical routines based on Taylor series expansions or other forms of Newtonian numerical techniques

(Womack and Matthews) are available. Most of these methods, however, require derivatives of functions, matrix inversions and eigen value computations. Making use of these techniques, particularly in the case of large simulation models, is uneconomical and cumbersome. Hein et. al. describe an alternative approach called the Gauss-Siedel technique, which is somewhat less uneconomical and easier to handle than the more sophisticated approaches. The Gauss-Siedel technique solves a system of equations iteratively. To illustrate how the technique works, consider a set of normalized equations stacked in the following form:

$$y_1 = f_1 (y_2, y_3, \ldots, y_G, x_1, x_2, \ldots, x_k)$$

$$y_2 = f_2 (y_1, y_3, \ldots, y_G, x_1, x_2, \ldots, x_k)$$

$$\vdots$$

$$y_G = f_G (y_1, y_2, \ldots, y_{G-1}, x_1, x_2, \ldots, x_k)$$

where the y's are endogenous variables and the x's are predetermined variables.

The methodology requires knowledge of some starting values. Let those be

$$y^0 = (y_2^0, y_3^0, \ldots, y_G^0)$$

In our case the baseline data are used as a set of initial values. With those numbers known, a first round of y's can be computed.

$$y_1^1 = f_1\ (y_2^0, y_3^0, \ldots, y_G^0,\ x_1, x_2, \ldots, x_k)$$

$$y_2^1 = f_2\ (y_1^1, y_3^0, \ldots, y_G^0,\ x_1, x_2, \ldots, x_k)$$

$$\vdots \qquad\qquad \vdots$$

$$y_G^1 = f_G\ (y_1^1, y_2^1, \ldots, y_{G-1}^1,\ x_1, x_2, \ldots, x_k)$$

These values, in turn, can be used to generate a new set of values, say, y_i^2; $i=1,\ldots,G$. The iteration scheme is repeated until some specified tolerance level is reached so that

$$|(y_i - y^{k-1})\ /y_i^{k-1}\ | \leq \delta$$

where i refers to the ith endogenous variable, k is the kth iteration and δ some predetermined positive number indicating the conveyance level. In the case of our simulator δ was chosen to be .00001.

One major problem characterizes this approach. The solution is not usually guaranteed when starting and a trial and error process is involved. However, Hein et al. suggests that convergence can be speeded up the closer equations and variables are set up in a lower triangular matrix thus making the system of equations look as recursive as possible.

Chapter Summary

This chapter has elaborated on some of the key concepts presented in Chapter III. First the meaning and then the basis on which consumer surplus was chosen as an indicator of welfare were discussed.

It is concluded that even though the concept is imperfect, the literature does not offer a more workable alternative. Producer surplus was then discussed. It was argued that producer surplus is equivalent to what Mishan has called economic rent. Next, the concept of a reaction function was discussed which was hypothesized to capture producers response to information. It was shown that reaction functions corresponded to ordinary supply curves except that they tend to be steeper and become more steep as the end of a production season nears. Information characteristics were then discussed. Timeliness was shown to be expressible in terms of reaction functions. Discounting the information for believability simply meant combining market participants price expectations with newly released predicted prices. Finally, an approach was discussed to get around the controversy surrounding the accuracy question of information. The last two points involved (a) a way to approximate the elasticity of demand for storage and (b) a brief presentation of the resolution technique used to numerically solve the simultaneous equations included in the simulation model.

CHAPTER V

SIMULATION MODEL

The simulator used for this study is the National Agricultural Policy Simulator, abbreviated as POLYSIM. Detailed descriptions and historical developments of this model can be found in Ray, Ray and Moriak, Ray and Richardson, and Parvin (Chapter 3). This chapter summarizes the model and explains the modifications that were made for its use in this study.

Briefly, POLYSIM is a dynamic multi-commodity simulator designed to analyze the impacts of alternative Government farm programs, policy provisions or instruments on the agricultural economy. The analysis is conducted in terms of deviations from a predetermined reference or baseline future path of the major agricultural sector variables, which the USDA establishes through the various projections they regularly make. The working time frame for those baseline projections is variable and goes anywhere from four to ten years. Their formulation is based on explicit assumptions concerning population, income, consumer preferences, technology, other demand and supply shifters and, particularly, a specific set of Government farm programs. Commodity supply and demand elasticities, also, represent a fundamental part of POLYSIM. While the driving forces of the model are the initial and subsequent changes in commodity prices resulting from changes in policy conditions, the magnitude of those changes are determined by the direct and cross supply and demand elasticities.

Commodities included in the model are soybeans, corn, wheat, grain sorghum, barley, oats, cotton and livestock. POLYSIM provides estimates of acreage, yield, production, variable expenses, total supply, market price, domestic demand, exports, carry-over, cash receipts and Government payments for each and every commodity included in the model. Estimates for the various commodity variables are summed and added to exogenous data for commodities not included in the model to develop aggregate estimates of production expenses, government payments, gross income and realized net farm income.

Operation of the Model

The operation of POLYSIM has been, for the most part, standardized. There are, however, variations from one application of the model to another. The structure below, while inheriting much of previous work (Parvin), describes only the components that are used to arrive at the empirical measurement of the impacts of USDA reports.

The first step in using POLYSIM to determine the impacts of new information on producers and consumers is to generate or identify the perceived (subjective) state based on the information available at the beginning of the simulation process. In this particular case, it is assumed that the USDA baseline data reflect the perceived state. Hence, the operation of the simulator begins by reading the baseline information. With the data read in, the model starts simulating for the first year by calculating livestock production and prices. Production levels are calculated for cattle and calves, hogs, sheep and lambs, chickens, turkeys, eggs and milk. The production information is used to estimate feed demand for the crops. The next step is to incorporate the newly released information by the USDA in the model. Examples of such information are: Prospective plantings, June acreage forecast or August and November production forecast. Specifically, the information could be in the form of (a) an unexpected acreage change, (b) unusual weather conditions, possibly affecting yields, thus production, in a significant way, or (c) a change in demand for exports. Furthermore, the information could be pertaining to only one commodity or a group of them, to a single report or a collection of reports. Supply is calculated and then balanced with the demand sectors. Determination of domestic demand, exports, inventories and prices are determined in a simultaneous fashion following the Gauss-Siedel methodology. Furthermore, the demand sectors are computed in separate subroutines for (a) soybeans, (b) wheat and feed grains, and (c) cotton. Market prices are determined at this stage too.

The output obtained at this level corresponds to what was described as the disturbed state which the USDA reports on. Assuming the information is completely accurate, this output corresponds to the market situation that would prevail if the USDA does not report the information. At the end of this first simulation run, surplus measures associated with each commodity and in every-time period are computed, discounted to the present, and summed to reflect the overall simulated welfare of producers and consumers when information is not reported. The next step consists of making use of the market price vector generated for the seven crops included in the simulator, by

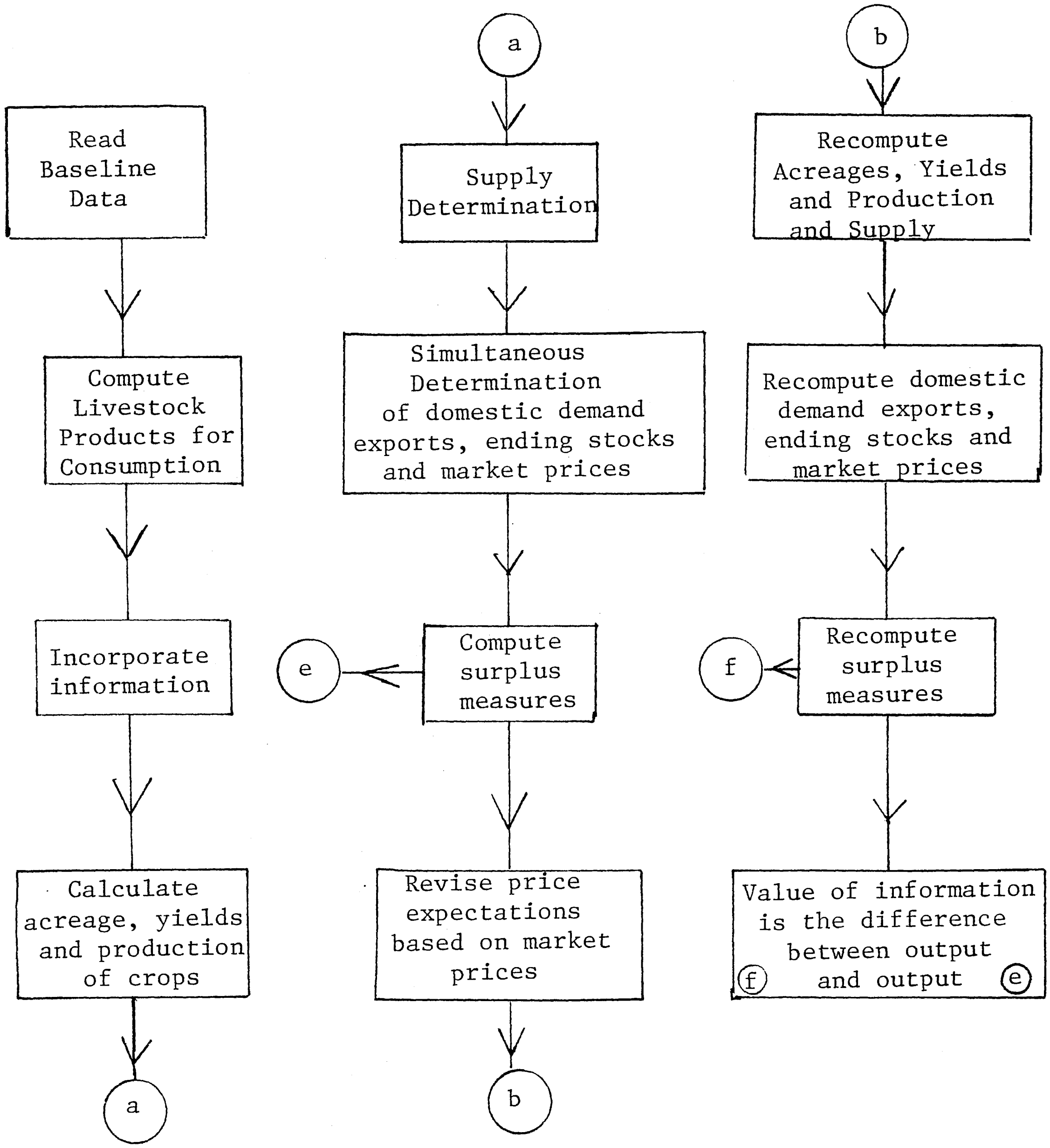

Figure 5.1. Structure of the Simulation for the Value of Information Study.

revising price expectations in the acreage and yield equations. The revision is obtained by taking a weighted average of the prices resulting from simulation run and baseline prices, lagged one time period. Again, market prices and associated demand and supply for all crops are recomputed. The overall simulation output is used to compute new surplus measures. The difference in surplus quantities for producers, consumers and in total between the measures just computed and those derived in the first simulation step are attributable to the release of information by the USDA and the subsequent response to it. Hence, those welfare changes are a source of value of the information.

Structure of the Simulation Process

Let the agricultural economy be characterized by a system of already estimated derived reduced form equations of the following form.

$$\hat{Y}_t = X_t \hat{\Pi}_t \qquad (5.1)$$

where,

$\hat{Y}_t$: vector of predicted values for a number of endogenous variables in time period t.

X_t : matrix of forecasted values for some predetermined (exogenous or lagged endogenous) variables in time period t, and

$\hat{\Pi}_t$: vector of econometrically estimated equation parameters.

$\hat{Y}_t$, in this case, could be a vector of simultaneous prices and quantities of agricultural commodities. Holding all non price variables such as income, on the demand side, and technology, on the supply side, constant, typical of these equations would be:

$$Q_i^d = Q_i^d (P_1, P_2, \ldots, P_n) \tag{5.2}$$

$$Q_i^s = Q_i^s (P_1, P_2, \ldots, P_n) \tag{5.3}$$

where,

(5.2) expresses the demand for commodity i as a function of n prices, one of which being its own. Similarly, equation (5.3) is a representation of supply of the same commodity as a function of the relevant expected prices.

Taking the total differential of either (5.2) or (5.3) yields

$$dQ_i = \frac{\partial Q_i}{\partial P_i} dP_i + \ldots + \frac{\partial Q_i}{\partial P_n} dP_n \tag{5.4}$$

Dividing through by Q_i and the right-hand side members of (5.4) by the appropriate $\frac{P_i}{P_i}$ which is equal to 1, one obtains

$$\frac{dQ_i}{Q_i} = \frac{\partial Q_i}{\partial P_i} \frac{P_i}{Q_i} \frac{dP_i}{P_i} + \ldots + \frac{\partial Q_i}{\partial P_i} \frac{P_n}{Q_i} \frac{dP_n}{P_n} \tag{5.5}$$

With ε_{ij} being the demand price elasticity of commodity i with respect to price of commodity j, the following relationship can be derived

$$\frac{dQ_i}{Q_i} = \varepsilon_{ii} \cdot \frac{dP_i}{P_i} + \ldots + \varepsilon_{in} \frac{dP_n}{P_n} \tag{5.6}$$

or more compactly,

$$\frac{dQ_i}{Q_i} = \sum_{j=1}^{n} \varepsilon_{ij} \frac{dP_j}{P_j} \tag{5.7}$$

which suggests that the relative change in the quantity demanded of a given crop is the summation of the relative changes in the prices of the related commodities weighted by their respective elasticities, again holding all non-price arguments of these demand, or supply, functions constant. Hence, knowing elasticities, which are either in (3.1) above or some linear function of it, and relative changes in prices one can predict changes in quantities, too. Assuming the elasticities are valid in future time periods it is possible to determine the impacts of changes on prices to changes in predetermined variables on quantities, simultaneously.

Approximating the mathematical differentials in (5.7) by changes of some observable magnitude such as:

$$\Delta Q_i \cong da_i = Q_i - Q_i^o \tag{5.8}$$

and

$$\Delta P_i \cong dP_i = P_i - P_i^o \tag{5.9}$$

where Δ signifies change and the superscript o on Q_i and P_j refers to some starting point at which the agricultural sector is assumed to be observed. In terms of the new notation and taking the changes from the assumed starting position,

$$\frac{\Delta Q_i}{Q_i} = \sum_{j=i}^{n} \varepsilon_{ij} \frac{\Delta P_i}{P_j} \tag{5.10}$$

or equivalently

$$Q_i = Q_i^o \left[1 + \sum_{j=i}^{n} \varepsilon_{ij} \frac{\Delta P_j}{P_j} \right] \tag{5.11}$$

If in addition one asserts that quantities are in a continuous adjustment of a Nerlovian type toward equilibrium (Johnston, p. 300-321), (3.11) can be expanded as follows

$$Q^d_{it} = Q^o_{it}\left[1 + \sum_{j=i}^{n} \varepsilon_{ij} \cdot \frac{\Delta P_j}{P_j}\right] + (1-\sigma_i)(Q_{it-1} - Q^o_{it-1}) \tag{5.12}$$

where is a coefficient reflecting the speed with which there is adjustment toward equilibrium.

On the supply side, a similar structure is assumed to characterize agricultural commodities except that elasticities of supply instead of elasticities of demand, are used. Hence,

$$Q^s_{it} = Q^o_{it}\left[1 + \sum_{j=i}^{n} \eta_{ij} \frac{\Delta P^e_j}{Pj}\right] + (1-\mu_i)\ (Q^s_{it-1} - Q^o_{it-1}) \tag{5.13}$$

where Q^s_{it} refers to quantity supplied, η_{ij} is the elasticity of supply of commodity i with respect to expected price to commodity j, and μ_i is a long-run adjustment coefficient of supply.

In their general form, equations (5.12) and (5.13) are assumed to represent the demand and supply, respectively, of all commodities under consideration. Given the parameters and using structures of the types shown in (5.12) or (5.13), it is possible to predict deviations of quantities supplied or demanded from a given baseline, which is denoted by the superscript o in the above equations. A number of shifters that ordinarily appear as arguments in demand and supply equations such as population, income, consumer tastes and preferences, technology and a number of Government farm program instruments are held constant. The analysis focuses on price related changes and how they affect the performance of major macroeconomic variables characterizing the agricultural sector.

In the absence of stochastic elements, knowledge of the parameters in such equations relates changes in exogenous variables to changes in endogenous variables. The role of information, say USDA prospective planting reports, is in informing market participants about the extent of current exogenous disturbances affecting the system. The value of such information is measured in terms of the potential ability of the users of that information to respond and internalize some or all of those shocks.

Simulation Steps in POLYSIM

Equations (5.12) and (5.13) illustrate the basic simulation logic POLYSIM is built upon. The actual computations, even though they follow the same procedure, are performed on a somewhat disaggregated level. Supply, for example, is not simulated at the real aggregate level. Rather it is arrived at piece by piece. Specifically, supply of a given commodity is obtained by adding simulated production to carry in inventories to imports, if any. Production, for its part, is equal to the product of harvested acres times yields. It is the computation of these last two elements that follows the structure represented by equation (5.13). Similarly, there is no structural equation for aggregate demand. There is, instead, an identity. The components of aggregate demand are, however, computed following the specification in equation (5.12).

The following is a brief presentation of the actual simulation steps and their equational form. The elasticities used in each case are also shown.

Acreages

To estimate the harvested acreage for crop i in time period t, A_{it}, the baseline harvested acreage value, A_{it}, is adjusted for farmer response to changes in expected crop prices from their respective baseline levels. Percentage changes in crop price and prices of other commodities included in the model are weighted by the direct and cross supply elasticities to arrive at the percentage adjustment in the base acreage value. An example of the calculation approach is given below.

$$A_{it} = A^{o}_{it}\left[1+\sum_{j=1}^{n}\varepsilon_{ij}\left(\frac{P^{e}_{jt}-P^{o}_{jt}}{P^{o}_{jt}}\right)\right]+(1-\sigma_{i})(A_{it-1}-A^{o}_{it-1}) \qquad (5.14)$$

where the superscripts o and e refer to baseline and expected value, respectively, and σ_i is a long run acreage adjustment coefficient for commodity i. The specific acreage elasticities ε_{ij} used in the model are summarized in Table 5.1 below.

Yields and Costs Per Harvested Acre

The general form of equation (5.1) is also used to compute simulated yields and per harvested acre variable costs, except that the variable A_{it} would represent yield or variable costs, as the case may be, of crop i in year t, instead of harvested acres. The specification of crop yield equations in POLYSIM allows expectation of crop prices to affect yields by changing input usage, therefore cost per acre. Farmer response to these price changes are reflected by the elasticity of

Table 5.1: Acreage Elasticities

Item	Soybean price	Corn price	Wheat price	Sorghum price	Oats price	Barley price	Cotton price
Soybeans acreage	.25 (.75)	-.15 (-.45)	-.02 (-.06)	-.03 (-.09)	.00 (.00)	.00 (.00)	-.03 (-.09)
Corn acreage	-.09 (-.27)	.15 (.45)	-.02 (-.06)	-.03 (-.09)	.00 (.00)	.00 (.00)	-.01 (-.03)
Wheat acreage	-.03 (-.06)	-.05 (-.10)	.20 (.40)	-.02 (-.10)	-.01 (-.02)	-.03 (-.06)	-.01 (-.02)
Grain sorghum acreage	-.05 (-.15)	-.01 (-.03)	-.03 (-.09)	.097 (.27)	.00 (.00)	.00 (.00)	.00 (.00)
Oats acreage	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.15 (.72)	-.15 (-.72)	.00 (.00)
Barley acreage	.00 (.00)	-.017 (-.09)	-.08 (-.45)	-.017 (-.09)	-.083 (-.45)	.20 (1.08)	.00 (.00)
Cotton acreage	-.10 (-.20)	-.05 (-.10)	-.10 (-.02)	.00 (.00)	.00 (.00)	.00 (.00)	.25 (.60)

Source: Parvin p. 46.
Long-run elasticities are in parentheses.

Table 5.2: Yield Elasticities

Item	Soybean price	Corn price	Wheat price	Sorghum price	Oat price	Barley price	Cotton price	Index of prices paid
Soybean yield	.10 (.20)							-.10 (-.20)
Corn yield		.15 (.30)						-.10 (-.20)
Wheat yield			.10 (.20)					-.10 (-.20)
Grain Sorghum yield				.10 (.20)				-.10 (-.20)
Oats yield					.19 (.38)			-.10 (-.20)
Barley yield						.30 (.60)		-.10 (-.20)
Cotton yield							.15 (.60)	-.10 (-.40)

Source: Parvin p. 51.
Long-run elasticities are in parentheses.

Table 5.3: Elasticities of Variable Costs of Production

Item	Soybean price	Corn price	Wheat price	Sorghum price	Oat price	Barley price	Cotton price	Index of prices paid
Soybean	.10 (.20)							-1.0 (-2.0)
Corn		.15 (.30)						-1.0 (-2.0)
Wheat			.10 (.20)					-1.0 (-2.0)
Grain Sorghum				.10 (.20)				-1.0 (-2.0)
Oats					.19 (.38)			-1.0 (-2.0)
Barley						.30 (.60)		-1.0 (-2.0)
Cotton							.15 (.30)	-1.0 (-2.0)

Source: Parvin p. 54.
Long-run elasticities are in parentheses.

interactions between agricultural commodities. The general form of those equations is also analogous to (5.1) above except that the quantities involved are quantities demanded and elasticities are for demand rather than supply. More detail on these specifications are available in Parvin or Richardson and Ray. The present version of the model is different from the previous ones only in one important respect. Previously, stocks were determined as a residual between total supply and total demand. In its current form, POLYSIM computes inventories simultaneously as it determines domestic consumption, exports and prices. The information on wheat, soybeans and feed grains stocks, available from Tweeten (1983), was used as baseline values for those variables. The actual calculations are performed separately for soybeans, wheat and feed grains, and cotton. The computations of the variables included in each of these three groups are carried out in separate subroutines. As an illustration of the computations involved in the demand sector of the simulation, Figure 5.2 is provided to describe how corn is simulated.

The simultaneity of the above four equations refers to computing exports, ending inventories, feed demand and price of corn at the same time, given knowledge of supply previously determined in the simulator. Furthermore, the actual calculations involve not only these four equations for corn but also similar equations for wheat, grain sorghum, oats, barley and cotton. Hence, this subroutine involves the computation of approximately twenty variables based on a system containing the same number of equations and identities. The Gauss-Siedel technique, presented earlier, is used in the resolution of all equations. The soybean and cotton demand relationship are yield, per harvested acre, with respect to expected price and input prices as given in Table 5.2 below.

Harvested acre costs are positively related to expected output price and negatively related to input price. As the expectation of price of the output from a productive process increases, the decision maker (the agricultural producer in POLYSIM) is willing to use more of an input, all other things equal. The calculation of per acre costs is done similarly to acreages and yield. The elasticities needed to perform those calculations are summarized in the following table.

Having calculated the per acre yield and variable cost, using the above information, the production of a particular crop is obtained by multiplying yield and harvest acreage of that crop. Total supply of a crop is defined as the sum of production, imports and carry-in stocks. Total variable costs are computed by taking the product of harvested acres times cost per acre.

Crop Utilization and Prices

Crop utilizations (or demands) and prices are determined endogenously and simultaneously in POLYSIM. The general structure of demand equations is dictated by economic theory which suggests that the demand for a particular commodity is a function of its price, the prices of related commodities, consumer income and tastes and preferences. Non-price variables are assumed to be reflected through the baseline data used by the simulator. Consequently, the crop demand equations were specified to consider only the price

$$\text{Corn exports}_t = \text{Baseline exports}_t \left[1 + \begin{pmatrix}\text{Elasticity}\\ \text{of corn}\\ \text{export w.r.t}\\ \text{corn price}_t\end{pmatrix} \begin{pmatrix}\text{\% Change}\\ \text{corn price}\\ \text{from}\\ \text{baseline}_t\end{pmatrix} + \begin{pmatrix}\text{Elasticity of}\\ \text{corn exports}\\ \text{w.r.t. corn}\\ \text{production}_t\end{pmatrix} \begin{pmatrix}\text{\% Change}\\ \text{soybean price}\\ \text{from}\\ \text{baseline}_t\end{pmatrix} \right]$$

$$+ \begin{pmatrix} 1 - \begin{matrix}\text{long run}\\ \text{adjustment}\\ \text{coefficient}_t\end{matrix}\end{pmatrix} \begin{pmatrix}\begin{matrix}\text{corn}\\ \text{exports}_{t-1}\end{matrix} - \begin{matrix}\text{baseline}\\ \text{corn}\\ \text{exports}_{t-1}\end{matrix}\end{pmatrix}$$

$$\text{Corn Stocks}_t = \text{Baseline corn stocks}_t \left[1 + \begin{pmatrix}\text{Elasticity}\\ \text{of corn}\\ \text{stocks w.r.t.}\\ \text{corn price}_t\end{pmatrix} \begin{pmatrix}\text{\% Change}\\ \text{corn price}\\ \text{from}\\ \text{baseline}_t\end{pmatrix} + \begin{pmatrix}\text{Elasticity}\\ \text{of corn stocks}\\ \text{w.r.t. corn}\\ \text{production}_t\end{pmatrix} \begin{pmatrix}\text{\% Change}\\ \text{corn}\\ \text{production}\\ \text{from}\\ \text{baseline}_t\end{pmatrix} \right]$$

$$+ \begin{pmatrix} 1 - \begin{matrix}\text{long-run}\\ \text{adjustment}\\ \text{coefficient}_t\end{matrix}\end{pmatrix} \begin{pmatrix}\begin{matrix}\text{corn}\\ \text{stocks}_{t-1}\end{matrix} - \begin{matrix}\text{baseline}\\ \text{corn}\\ \text{stocks}_{t-1}\end{matrix}\end{pmatrix}$$

$$\text{Corn feed demand}_t = \text{corn production}_t + \text{carry in Inventories}_t + \text{Imports}_t - \text{carry out inventories}_t - \text{Exports}_t - \text{Non feed demand}_t$$

$$\text{Corn price}_t = \text{Baseline corn price}_t \left[1 + \begin{pmatrix}\text{Reciprocal}\\ \text{of elasticity}\\ \text{of corn feed}\\ \text{demand w.r.t}\\ \text{corn price}_t\end{pmatrix} \cdot \begin{pmatrix}\text{Relative}\\ \text{deviation}\\ \text{of corn feed}\\ \text{demand from}\\ \text{baseline feed}\\ \text{demand}_t\end{pmatrix} \right]$$

Figure 5.2. Basic Equational Structure of POLYSIM.

solved similarly. Tables 5.4 through 5.6 below show the elasticities used in carrying out the computations described above.

With the quantities demanded (domestic, exports and inventories), production and production expenses computed, consumer and producer surpluses are derived for each year simulated. Call these CS_{it}^{1} and PS_{it}^{1}, respectively, where the subscript t is for time period and i for commodity. The next step is to combine the prices generated at this level with previous price information to revise price expectations for use in the acreages and yields equations to obtain new estimates of acreages and yield, production and subsequently supply. The same simulation steps are repeated to derive market price and quantity estimates which are used to compute new producer and consumer surplus measures corresponding to what was called the informed state. Denote the consumer and producer welfare magnitudes in this case by CS_{it}^{2} and PS_{it}^{2} where i and t are the same as above. Let the value of information in year t be expressed for consumers, producers, and society as V_{CSit}, V_{PSit} and W_{it}, respectively. The following can be written

In terms of consumer surplus

$$V_{CSit} = CS_{it}^{2} - CS_{it}^{1} \tag{5.15}$$

In terms of producer surplus

$$V_{PSit} = PS_{it}^{2} - PS_{it}^{1} \tag{5.16}$$

In terms of total welfare

Table 5.4: Soybeans and Soybean Meal Demand Elasticities

Item	Soybean price	Soybean Oil price	Soybean meal price	Soybean production	Livestock production units	Corn price	Index of price Received
Soybean meal exports			-.489				
Soybean Oil Exports		-.68					
Soybean Exports	-.25		.21				
Soybean Oil demand		-.14					
Soybean meal domestic demand			-.15		1.71	.52	.47
Soybean stocks	-1.37			1.40			

Source: Parvin p. 62

Table 5.5: Cotton Demand Elasticities

Item	Cotton price	Cotton production
Domestic mill demand	- .10	
Cotton stocks	-1.37	1.4
Cotton Exports	- .50	

Source: Ray and Richardson

Table 5.6: Feed Grains and Wheat Demand Elasticities

Item	Corn price	Sorghum price	Oat price	Barley price	Wheat price	Soybean price
Corn feed	-.42 (.84)					.06 (.12)
Corn export	- .50 (-2.50)					
Sorghum feed	.15 (.30)	- .59 (-1.18)				
Sorghum export		-.50 (2.50)				
Oats feed	.25 (.50)		- .79 (-1.58)			
Barley feed	.30 (.60)			-1.08 (2.16)		
Wheat food					-.10 (.20)	
Wheat feed	.33 (.66)				-.30 (-.60)	
Wheat export					-.50 (2.50)	

Source: Parvin, p. 66.
Low-run elasticities are in parentheses.

$$W_{it} = V_{CSit} + V_{PSit} \tag{5.17}$$

The welfare measures for the seven major commodities included in POLYSIM are obtained by summing the individual components over all commodities.

$$V_{CSt} = \sum_{j=1}^{7} V_{CSit} \tag{5.18}$$

$$V_{PSt} = \sum_{j=1}^{7} V_{PSit} \tag{5.19}$$

$$W_{t} = \sum_{j=1}^{7} W_{it} \tag{5.20}$$

The overall impacts of new information on all seven crops over the six time periods considered, expressed in current dollars using a discount rate of τ, are expressed as:

$$V_{CS} = \sum_{t=1}^{6} \frac{V_{CS_t}}{(1+\tau)^t} \tag{5.21}$$

$$V_{PS} = \sum_{t=1}^{6} \frac{V_{PS_t}}{(1+\tau)^t} \tag{5.22}$$

$$W = \sum_{t=1}^{6} \frac{W_t}{(1+\tau)^t} \tag{5.23}$$

This methodology is used whenever a response by the production sector to new information is possible, i.e., when a report is timely enough that some resources are still variable to be reallocated between commodities. To the extent that production can no longer be altered, inventory holders are assumed to use USDA information to help them determine optimal rates of depletion or storage, as the case may be, of the various commodities. The discrepancy between current prices and those expected to occur in future time periods, based on the report is used in determining the optimal level of stocks through time. The actual computations of consumer and producer surplus magnitudes follow the formulas given in the previous chapter.

Chapter Summary

This chapter has sketched the structure of the simulator, POLYSIM, used in the study. The model is much more general and complex since it was designed to analyze a wide range of policy variables. The only features of it that were needed for this study were the supply generation and the simultaneous determination of prices and the various quantities demanded. Because the impact of information is analyzed in terms of its influence on supply and demand of agricultural products, only those components of the model were developed. Elasticity parameters used by the simulator are also presented. The next two chapters make use of this summation framework in an attempt to measure the impacts on the producers, consumers and in total that are associated with market response to specific pieces of information ordinarily collected and disseminated by the USDA.

CHAPTER VI

SIMULATION RESULTS I: VALUE OF INFORMATION ON PROSPECTIVE PLANTINGS

The estimated value of information from SRS prospective plantings reports for corn, soybeans and wheat is discussed in this chapter. Simulation results for selected additional reports continue in the next chapter. For all simulations a baseline set of acreages, prices, and utilizations is assumed to represent the perceived state of information prior to release of the report. A summary of this baseline, which is adapted from USDA baseline, is presented in Appendix A. The report (prospective plantings in this case) provides information that suggests a different acreage level than the prior or expected information set. Assuming the new information is correct, the market will eventually discover it and react accordingly. Without the report, the acreage level is the same, but since it is unreported, the market will learn about it well after the acreage has been planted. This will eventually cause a disturbance in the market and potentially sharp price changes. This no-report situation is then compared to the situation in which market participants are informed of the acreage and they readjust their actions. The adjustment toward more efficient use of resources given the new information, relative to not making any adjustment, is the source of value of prospective plantings reports.

Value estimates are presented reflecting the impact on other major crops in addition to the one for which a prospective planting report was issued. Impacts of the report on succeeding production periods are also reported. Furthermore welfare impacts estimates are presented for each of the groups of consumers, producers and in total, assuming complete believability at first. Then the question of how changes in believability affect the overall impacts is examined. From there on, all impacts are reported for average believability.

The first part of this chapter discusses the impacts of prospective plantings for corn in detail. The next part focuses on comparing impacts of corn acreage information to that of wheat and soybeans assuming no interference between the different types of information. The third section analyzes how some of those individual impacts change when a collection of reports are considered simultaneously.

Value of Prospective Planting Information for Corn

General Results

Simulation results were obtained corresponding to ten possible reported corn acreage deviations from baseline, or expected, acreage values ranging from minus five to plus five percent. Table 6.1 shows the impacts of reports revealing those deviations on producers, consumers and in total. The results reflect impacts, not only on corn, but all seven major commodities included in the simulator. Furthermore, the impacts occurring in future years are expressed in terms of their present value, using an arbitrary ten percent discount

Table 6.1: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages.

Acreage Discrepancy	Producers	Consumers	Total[a]
	------------- Million Dollars[b] ----------		
-5%	-496.86	977.04	489.18
-4%	-423.26	753.27	330.02
-3%	-337.13	543.86	206.73
-2%	-238.01	348.39	110.39
-1%	-123.99	167.25	43.26
+1%	137.62	-152.73	-15.13
+2%	291.56	-288.83	2.72
+3%	457.79	-409.80	47.98
+4%	637.30	-514.77	122.55
+5%	830.84	-603.27	227.54

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming complete believability.

rate, and summed over six years, assuming complete believability in the information.

Examination of these results suggests the following. From the point of view of producers and consumers combined (last column of Table 6.1), prospective corn plantings information appears to be highly beneficial in nine out of the ten cases reported, as benefits generally outweigh corresponding losses in most case. As a group, producers and consumers tend to benefit more from information revealing lower intended acreages relative to expected acreages than from information suggesting higher acreages than expected. The distribution of the impacts is, however, different. Producers benefit if USDA reports indicate larger prospective acreages than they had anticipated since such information induces them into cutting back on future corn plantings which eventually results in higher market price which translates into more revenue for producers since the aggregate demand for corn is inelastic. Information revealing lower intended acreages than expected has an opposite effect on producers for the same reason. Consumers, on the other hand, benefit from information that causes producers to lose and vice versa. For a given demand function, information resulting in lower market prices than would have been the case had the report not been released always generates a larger surplus to consumers. The opposite also holds. The results also show that the release of corn prospective plantings is associated with greater impacts the larger the acreage discrepancy between market participants initial anticipations and the reported state of the world, assuming the information is reported accurately.

Another way to interpret the results is to express all impacts on a one percent basis of the acreage discrepancy between reported and perceived acreages (Table 6.2). These acreage impacts are computed by dividing each row of dollar amounts in Table 6.1 by the number of associated percentage points in the same row.

Negative acreage discrepancies have a decreasing negative impact on producers but an increasing positive impact on consumers thus making the impact in total increasingly positive. Positive acreage deviations, on the other hand, are increasingly beneficial for producers but have decreasing negative impacts on consumers. The general tendency for losses to be smaller than gains, in absolute value, is explained by the convergent nature of agricultural markets which is guaranteed by the higher inelasticity of supply relative to demand functions.

A third way of presenting the results shown in Table 6.1 is to express them on an additional or marginal percentage deviation basis. That is, knowing the total impacts for the various acreage events corresponding to, say, minus four and minus five percent situations, it is possible to compute the additional impacts on producers, consumers and in total associated with a movement from minus four to minus five percent. Such calculations were performed and the results appear in Table 6.3.

On an additional percentage point deviation too, the results indicate that in all cases losses are increasingly smaller but gains are increasingly larger. When comparing average and marginal impacts, it appears that the latter exceed the former almost always. This makes marginal impacts of acreage information, from the point of view

Table 6.2: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; on a One Percent Basis.

Acreage Discrepancy	Producers	Consumers	Total[a]
	- - - - - - - - - - Million	Dollars[b] - - - - - - - - - -	
-5%	- 99.37	195.41	97.84
-4%	-105.83	188.32	82.51
-3%	-112.38	181.29	68.91
-2%	-119.01	174.20	55.20
-1%	-123.99	167.25	43.20
+1%	137.62	-152.73	-15.13
+2%	145.78	-144.42	1.36
+3%	152.60	-136.60	15.99
+4%	159.33	-128.69	30.64
+5%	166.17	-120.65	45.51

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming complete believability.

of producers and consumers combined, greater than average impacts over the range of discrepancies considered.

Assuming plus and minus deviations of reported to expected acreages are equally likely; that is, plus and minus x percent acreage deviation occurring with probability .5, the impacts reported in Tables 6.1 through Table 6.3 can be reformulated on an expected value basis. Expected or average impacts have been computed corresponding to total, average and marginal impacts summarized in Tables 6.1, 6.2 and 6.3, respectively, and are reported in Table 6.4.

The first three lines of results in Table 6.4 illustrate the expected magnitude of report impacts associated with releasing different deviation levels of prospective plantings to expected acreages. In total, the results suggest that the benefits to producers range from 6.82 to 166.99 million dollars for reports revealing one to five percent acreage deviations, respectively; whereas the impacts on consumers are estimated at 7.26 and 186 million dollars over the same range. Society, defined as the set of producers and consumers, would value information suggesting one percent deviation at 14.07 and five percent deviation at 358.36 millions of dollars.

When the numbers are expressed on a one percent basis (next three lines of numbers of Table 6.4), information suggesting larger deviations in intended plantings, because of greater market adjustment, is valued higher by producers and consumers, relative to smaller deviations. The last three rows of numbers in Table 6.4 illustrate marginal valuations of additional percentage point deviations to producers, consumers and combined. Examination of these

Table 6.3: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; on an Additional Percent Deviation Basis.

Acreage Discrepancy	Producers	Consumers	Total[a]
	- - - - - - - - - - Million Dollars[b]	- - - - - - - - - - -	
-5%	- 73.60	223.77	159.16
-4%	- 86.13	209.41	123.29
-3%	- 99.12	195.47	96.34
-2%	-114.02	181.14	67.13
-1%	-123.99	167.25	43.26
+1%	137.62	-152.73	-15.13
+2%	153.94	-136.10	17.85
+3%	166.23	-120.97	45.26
+4%	179.51	-104.97	74.57
+5%	193.54	- 88.27	104.99

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming complete believability.

Table 6.4: Economic Gains of Information Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; Overall, on an Average and Marginal Bases.

Group	Acreage Discrepancy				
	1%	2%	3%	4%	5%
	Million Dollars[b]				
1. Total[a]					
Producers	6.82	26.78	60.33	107.02	166.99
Consumers	7.26	29.78	67.03	119.25	186.89
Society	14.07	56.56	127.36	226.29	358.36
2. Average					
Producers	6.82	13.39	20.11	26.75	33.40
Consumers	7.26	14.89	22.35	29.82	37.38
Society	14.07	28.28	42.45	56.58	71.68
3. Marginal					
Producers	6.82	19.96	33.56	46.69	59.97
Consumers	7.26	22.52	37.25	52.22	67.75
Society	14.07	42.49	70.80	98.93	132.08

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming complete believability.

results leads to the following conclusions: (a) marginal valuations of information on prospective plantings are higher than corresponding average values and (b) marginal values, and therefore average values, increase over the 1 to five percent range.

Using the concept of production function, with information as one of the variable inputs, the results suggest that acreage deviations of about five percent are not high enough to correspond to what is known as Stage II of a production function which begins at the point where marginal product intersects average product and both are declining thereafter (Gould and Ferguson)[23]. This is an indication that larger than five percent deviations would be valued higher and higher but probably only up to a point where average values begin to exceed marginal values, on the assumption that information behaves similarly to ordinary production inputs. Information revealing larger and larger deviations of acreages, possibly resulting from external or internal shocks to the agricultural economy, can be thought of as corresponding to additional input use in an ordinary production process. If interpreted this way, the results shown so far indicate the possibility of increasing returns to information. This could be a ground to warrant additional use of resources to collect and report the information particularly at times when the agricultural economy is significantly disturbed from within or from an outside source.

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[23]This is at least the case for a linear homogeneous production function. More generally stage II of a production process begins when the ratio of marginal physical product to average physical product becomes smaller than the degree of homogeneity of the production function, but is still positive.

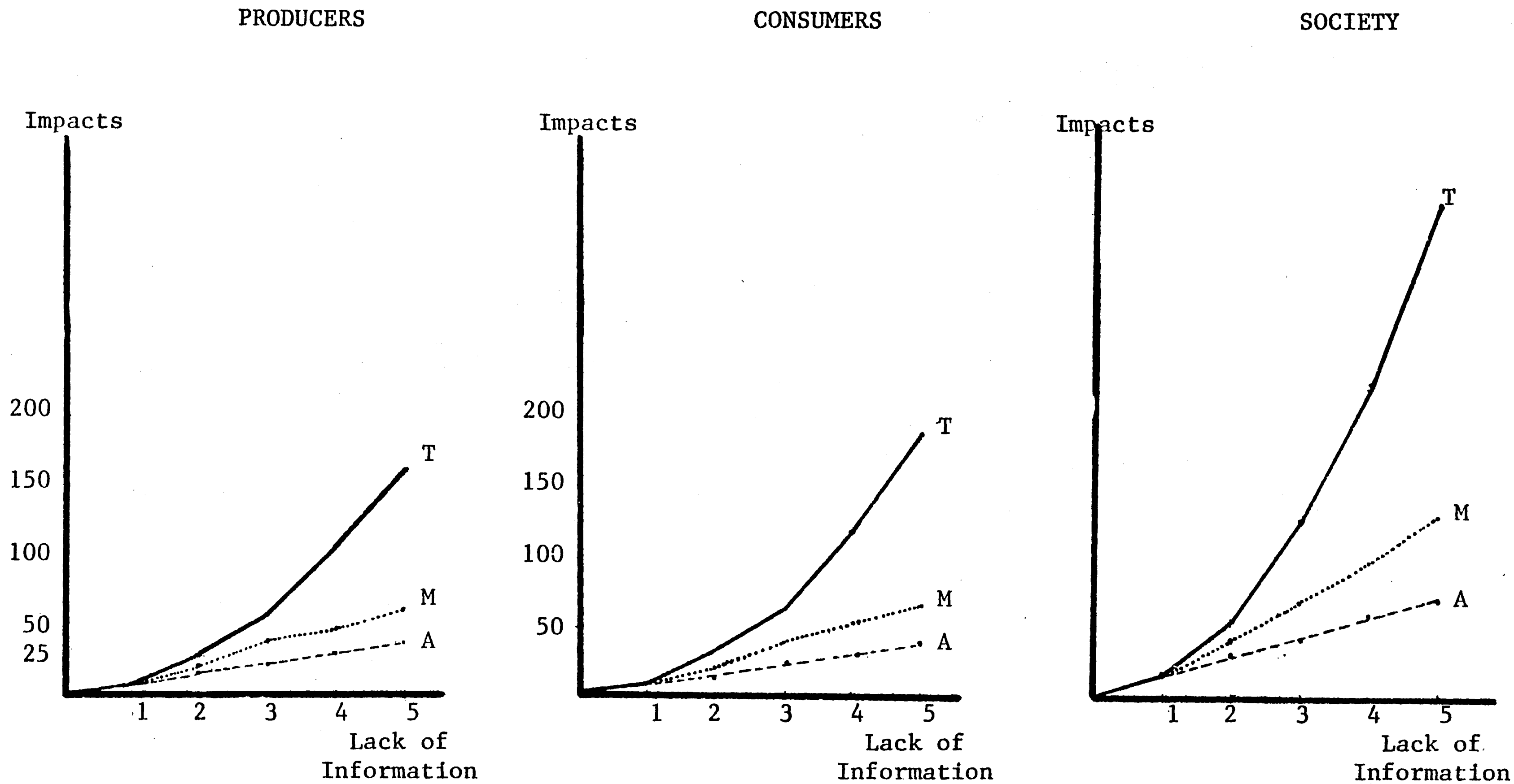

Figure 6.1. Empirical Production Functions of Information. T: Total Product; A: Average Product and M: Marginal Product.

Figure 6.1 is a sketch of what may be called a production function of information. The results of Table 6.4 were used to draw such production functions for producers, consumers and in total. In each case the total, average and marginal curves were plotted. Notice that in the three cases marginal impacts of information lie above the average impacts, but both increase almost linearly as the degree of acreage discrepancy between the anticipated and true states of the world (i.e., lack of information) becomes larger. The curves corresponding to total impacts tend to increase at an increasing rate, all suggesting potential large benefits to producers, consumers and in total from having the information collected and reported, again assuming complete believability and perfect accuracy.

Believability

The results of the previous section assume complete believability in the public information. The purpose of this section is to relax that assumption by allowing market participants to combine their prior information with prices implied by the new information. This is accomplished by giving different weights from 0.00 to 1.00, in the supply and inventory equations, to the price information resulting from SRS corn prospective plantings reporting. Results of such computations are shown in Table 6.5 for the four believability levels and separately for consumers, producers and in total. Furthermore, only one and three percent deviations of reported acreages to expected acreages are reported.

Hence, instead of responding solely to previously held price expectations, markets participants (especially agricultural producers) include newly generated prices based on the released information. The final expected price that enters the supply and inventory equations becomes a weighted average of both types of prices.

As expected, when believability declines the impact of information on producers and consumers diminishes, the direction of the impacts remains the same, however. The magnitude of the gain in each situation exceeds the loss, thus making information beneficial overall. Again, assuming equally likely acreage events the results of Table 6.5 can be expressed on an expected value basis. The results of such calculations are reported in Table 6.6.

When believability diminishes from complete to high (weights 1.00 to .75, respectively) the impacts on producers are reduced by as much as 35 percent for a one percent acreage deviation, but only by 16 percent when the average deviation is three percentage points. For the same reduction in believability the impacts on consumers decline is about the same whether the deviation of reported intended plantings from expected acreages is one or three percent.

The same phenomenon is observed when believability in the information moves from high to average to low, that is, weights .75, .5 and .25, respectively. In terms of percentage reduction in the impacts of information, the results indicate that they are much smaller for producers than consumers. That is, even with the lowest believability level considered, information tends to impact relatively more on producers than consumers, in expected value terms. When believability is average or low, the magnitude of the impacts on producers become higher than on consumers thus making information more critical for the former group. Thus, given the generally more

Table 6.5: Ecomonic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; in Relation to Believability.

Acreage Discrepancy	Believability			
	Complete	High	Average	Low
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -			
1. Producers				
-3%	-337.13	-247.72	-161.77	- 79.21
-1%	-123.99	- 93.72	- 61.99	- 31.84
+1%	137.62	102.54	70.21	35.34
+3%	457.79	348.85	236.35	120.15
2. Consumers				
-3%	-543.86	403.53	265.93	131.50
-1%	-167.25	124.62	82.78	41.22
+1%	-152.73	-115.68	- 76.68	- 38.52
+3%	-409.80	-311.73	-210.61	-106.86
3. Total[b]				
-3%	206.73	155.80	104.16	52.30
-1%	43.94	30.89	20.81	10.40
+1%	- 15.13	- 13.10	- 6.48	- 3.18
+3%	47.98	37.11	25.73	13.29

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, and (ii) impacts resulting from interactions between commodities and (iii) assuming completely accurate information.

[b]Numbers may not add up exactly due to rounding.

final expected price that enters the supply and inventory equations becomes a weighted average of both types of prices.

As expected, when believability declines the impact of information on producers and consumers diminishes, the direction of the impacts remains the same, however. The magnitude of the gain in each situation exceeds the loss, thus making information beneficial overall. Again, assuming equally likely acreage events the results of Table 6.5 can be expressed on an expected value basis. The results of such calculations are reported in Table 6.6.

When believability diminishes from complete to high (weights 1.00 to .75, respectively) the impacts on producers are reduced by as much as 35 percent for a one percent acreage deviation, but only by 16 percent when the average deviation is three percentage points. For the same reduction in believability the impacts on consumers decline is about the same whether the deviation of reported intended plantings from expected acreages is one or three percent.

The same phenomenon is observed when believability in the information moves from high to average to low, that is, weights .75, .5 and .25, respectively. In terms of percentage reduction in the impacts of information, the results indicate that they are much smaller for producers than consumers. That is, even with the lowest believability level considered, information tends to impact relatively more on producers than consumers, in expected value terms. When believability is average or low, the magnitude of the impacts on producers become higher than on consumers thus making information more critical for the former group. Thus, given the generally more inelastic supply functions of agricultural commodities relative to

Table 6.6: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; in Relation to Believability.

Acreage Deviation	Believability			
	Complete	High	Average	Low
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -			
1. Producers				
1%	6.82(100)[b]	4.41(65)	4.11(60)	2.25(33)
3%	60.33(100)	50.57(84)	37.29(62)	20.47(34)
2. Consumers				
1%	7.26(100)	4.47(62)	3.05(42)	1.35(19)
3%	67.03(100)	45.90(68)	27.66(41)	12.32(18)
3. Total[c]				
1%	14.07(100)	8.90(63)	7.17(51)	3.61(26)
3%	127.36(100)	96.46(76)	64.95(51)	32.80(26)

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, and (ii) impacts resulting from interactions between commodities.

[b]Numbers in parentheses express percentage reductions as the believability level to changes.

[c]Numbers may not add up exactly due to rounding.

Table 6.7: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; Assuming Average Believability.

Corn Acreage Deviation	Corn	Other Crops	Total
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -		
1. Producers			
-1%	-88.17	26.18	-61.99
+1%	96.30	-26.09	70.21
2. Consumers			
-1%	99.39	-16.61	82.78
+1%	-93.12	16.44	-76.68
3. Total[b]			
-1%	11.20	9.61	20.81
+1%	3.17	-9.65	- 6.48

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]Numbers may not add up due to rounding.

demand, small revisions in price expectations have larger impacts on producers' revenues than on consumption.

Cross-Commodity Impacts

The results presented so far in this chapter indicate the value of corn prospective plantings reports, not only on producers and consumers of corn but also of the six other agricultural commodities included in the simulator (wheat, soybeans, grain sorghum, oats, barley and cotton). Table 6.7 gives the composition of corn prospective plantings impacts on corn itself as well as the other commodities with which it interacts in the simulator. Note also, the results express the impacts that may take place following and during the year of release of the report and the five years beyond, all discounted at ten percent and assuming average believability.

A prospective plantings report indicating one percent discrepancy in corn acreage relative to previously expected acreage impacts mostly on producers and consumers of corn. However, producers and consumers of other crops are affected by the information, too. Whenever producers of corn gain from the information those who produce other crops lose, and similarly for consumers. This result follows from the fact that agricultural commodities represented in the simulator are substitutes in production and consumption. Assuming plus and minus one percentage point deviations of reported to expected acreages are equally likely, the value to producers and consumers of corn and the other crops are reported in Table 6.8.

Table 6.8: Economic Gains of Information for Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; Assuming Average Believability.

Corn Acreage Discrepancy	Corn	Other Crops	Total
	- - - - - - - - - - Million Dollars[a]	- - - - - - - - - - - -	
1. Producers			
1%	4.07	.05	4.11
2. Consumers			
1%	3.14	- .09	3.05
3. Total			
1%	7.19	- .02	7.17

[a]Results include (i) secondary impacts for five years beyond year of release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

Expressed in this form, the results reveal that having corn prospective plantings information available to the public, even it reports discrepancies between expectations and reality as low as one percent, society benefits by as much as 7.17 million dollars. Such information benefits both producers and consumers, with the former group having an advantage. The results also indicate that over 90 percent of the report impacts concern producers and consumers of the commodity for which the information was made available. Producers and consumers of related commodities are also affected by the information but not greatly.

Dynamic Impacts

Having presented some of the impacts of corn prospective plantings information in total and then on corn itself versus other related crops, the purpose of this section is to investigate the extent to which information released in a given crop year has impacts beyond the year of information release; that is, in succeeding years. Market adjustments to information about disturbances occurring in year t affects production, consumption and therefore prices in that year, which, in turn, will affect inventories to be carried into succeeding time periods as well as price expectations of crops to be harvested future time periods. The results are expressed in terms of their present value for producers, consumers and in total and are shown in Table 6.9. Furthermore, yearly impacts corresponding to plus one and plus three percent acreage deviations only are reported, assuming average believability. Delayed impacts occurring in the five years

Table 6.9: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; on an Annual Basis and for Average Believability.

Acreage Discrepancy	1984	1985	1986	1987	1988	1989	Total
			Million Dollars[a]				
1. Producers							
-3%	-254.94	164.89	-131.97	77.02	-38.53	21.76	-161.77
-1%	- 92.07	54.86	- 45.17	26.04	-13.06	7.41	- 61.99
+1%	99.49	- 54.80	46.24	-26.53	13.32	- 7.51	70.21
+3%	320.34	-163.64	142.13	-80.41	40.63	-22.72	236.35
2. Consumers							
-3%	275.53	- 52.66	49.12	-12.09	6.88	- .85	265.93
-1%	88.39	- 19.39	15.99	- 4.22	2.31	- .30	82.78
+1%	- 84.96	21.28	- 15.48	4.49	- 2.31	.30	- 76.68
+3%	-243.04	69.74	- 45.02	14.02	- 7.04	.73	-210.61
3. Total[b]							
-3%	20.60	112.23	- 82.86	64.94	-31.66	20.91	104.16
-1%	- 3.67	35.47	- 29.18	21.83	-10.75	7.11	20.81
+1%	14.53	- 33.52	30.76	-22.05	11.01	- 7.22	- 6.48
+3%	77.32	- 93.90	97.11	-66.39	33.59	-22.00	25.73

[a]Results include (i) secondary impacts for five years beyond year of release discounted at ten percent, and (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]Numbers may not add up exactly due to rounding.

beyond the release time of the information have been discounted at ten percent. Note, also, that the results reported, herein, would probably be different had a different discount rate or a different simulation time frame been used.

As expected, most of the impacts of the information are in the current year. The impacts from 1985 through 1989 exhibit an oscillating phenomenon and tend to dampen down over the years. This converging feature is in fact predicted in view of the relatively higher inelasticity, in absolute value, of supply relative to demand of corn, .3 and -.44, respectively.

Just like cross-commodity interactions, dynamic impacts tend to offset some of the impacts that take place during the year information is released. To use an example, consider the results corresponding to the -three percent acreage deviation in Table 6.9. The release of a report announcing that corn prospective plantings are going to be three percent short of acreage expectations has a negative impact on producers evaluated at -254.94 million dollars in that year. Over the next five years producers recuperate about 93 million dollars thus making the net loss to producers of only about 161 million dollars. The benefit of the report to the consumers during the first year is about 275 million dollars. About ten million dollars would be lost as a result of the adjustments that will take place over the six year simulation time frame, thus making consumers net gainers of 265.93 million dollars. Overall society not only gains during the first year about 20 million dollars, but also picks up another 80 (four times as much) during the five years to come.

Having presented cross-commodity and dynamic impacts associated with the release of a corn prospective intentions report, separately, it may be worthwhile illustrating and comparing both impacts. Information on plus and minus one percent acreage deviations is used as an example to illustrate these concurrent impacts. The results obtained based on average believability were used to highlight this point and the distribution of the impacts in question are shown in Table 6.10. Again, most of the impacts are on producers and consumers of the crop for which information is released and during the first year. Furthermore, cross-commodity impacts during the release year of the corn information tend to be of approximately the same magnitude, in absolute value, as the dynamic impacts on corn itself. The size of the other impacts tends to be, generally, smaller.

Expressing the results reported in Table 6.10 in terms of their expected value, assuming equal probability of occurrence of plus and minus one percent of corn acreage deviation, yields a somewhat different picture that is summarized in Table 6.11.

Composition of Consumer Impacts

The results reported so far are aggregate in nature. They measure the value of adjustment that takes place following the release of information in terms of movements along the aggregate supply and demand functions. The interpretation of producers impacts is rather straightforward since they correspond to the returns to the fixed factors of production that are owned by agricultural producers, in aggregate. The interpretation of consumers impacts is, however, more

Table 6.10: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; in a Cross-Commodity and Dynamic Setting.

Group	Current Year			Other Years			
	Corn	Other Crops	Total[a]	Corn	Other Crops	Total[a]	Grand Total[a]
	Million Dollars[b]						
1. Producers							
-1%	-139.55	47.47	-92.07	51.38	-21.30	30.08	-61.99
+1%	147.03	-47.54	99.49	-59.73	21.45	-29.28	70.21
2. Consumers							
-1%	+126.92	-38.54	88.39	-26.89	21.29	-5.61	82.78
+1%	-123.83	+38.88	-84.96	30.71	-22.43	8.28	-75.68
3. Total[a]							
-1%	-12.63	8.96	-3.67	24.49	0.01	24.50	20.81
+1%	23.20	-8.66	14.53	-20.02	-0.98	-21.01	-6.48

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

Table 6.11: Economic Gains of Information to Producers, Consumers and Society Resulting from Decision Makers' Response to a Single Corn Prospective Plantings Report With Reported Acreages at Selected Percentage Deviations from Perceived Acreages; in a Cross-Commodity and Dynamic Setting.

Group	Current Year			Other Years			
	Corn	Other Crops	Total[a]	Corn	Other Crops	Total[a]	Grand Total[a]
	Million Dollars[b]						
1. Producers							
1%	3.74	-0.04	3.71	0.33	0.08	0.40	4.11
2. Consumers							
1%	1.55	0.17	1.72	1.91	-0.57	1.34	3.05
3. Total[a]							
1%	5.29	0.14	5.43	2.24	-0.49	1.75	7.17

[a] Numbers may not add up exactly due to rounding.

[b] Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

complex. First, there is the domestic component which is due to adjustment in domestic consumption of the commodity. Notice, incidentally, that since the commodity under consideration is corn, its major consumers are not humans. Corn is used mostly as a feed in the United States. As argued in Chapter IV, this consumer impact that is captured in this case is partly an impact on consumers of the final products, (livestock commodities) and partly another impact on producers who use corn, i.e., livestock producers. Next, there are the impacts on exports. Gainers and losers, in this second case, are foreign consumers, since it is their surplus that is measured by the model. However additional consumption of U.S. agricultural commodities corresponds to additional revenue to the U.S. economy since demand for corn exports is inelastic. A third group in society which might be affected by the release of information is inventory holders. If the content of a given USDA report is such that it generates more supply than in the absence of information, inventory holders may have the incentive to store more of the commodity because market prices are low and could be expected to go higher in future time periods. Table 6.12 contains results based on simulation runs for plus and minus one and three percent deviation between reported and expected acreages of corn. With minus one percent acreages reported, as an example, producers expect higher prices to prevail at the end of the period and therefore might see it advantageous to increase acreages. Supply increases as a result, making domestic consumption and export levels higher than would have been the case otherwise and their respective consumers more satisfied. Middlemen, in the process, faced with larger supplies on the market and, therefore, lower market prices, may find it beneficial to engage more heavily in export marketing activities or store more of the commodity. The plus one percent scenario illustrates the opposite situation to the minus one percent case. As for the plus three percent scenarios the direction of the impacts is consistent with the previous cases, only the magnitudes are different.

The impact of information on domestic consumption can be interpreted in terms of gain or loss of utility from consuming more or less of the commodity, be it at the intermediate or final levels. The impacts on exports is interpreted also the same way, except that consumers are located in another country. Another way the impacts on exports can be interpreted, and similarly for changes in inventories, is that they result from actions that middleman may choose to take upon knowledge of the new information. Evidence exists that market speculators are always watching market information and depending on what they see fit, may engage in marketing activities either domestically, by altering inventory holders, or in foreign markets, by adjusting export levels of a given commodity. Interpreted this way suggests that information has an impact (benefit or loss) not only in terms of the adjustments that take place in terms of production and consumption, but also in terms of possible market transactions that particular economic agents might choose to engage in.

Impacts of Corn Prospective Planting Information in Relation Inventory Levels

An argument frequently heard is that information would have more value when stocks are short relative to when they are abundant. This

Table 6.12: Composition of Corn Prospective Plantings Impacts on Consumers.

Group	Acreage Discrepencies -1%	+1%	-3%	+3%
	Million Dollars[a]			
1. Producers	-139.55	148.03	-397.14	463.48
2. Consumers	126.92	-123.83	389.78	-361.11
Domestic Consumption	83.10	- 81.24	254.60	-237.20
Exports	44.93	- 43.73	138.25	-127.15
Inventories	- 1.11	1.14	- 3.07	3.24
3. Total[b]	- 12.63	23.20	- 7.36	102.37

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

section presents an example that may shed some light on the question. Table 6.12 contains the summary of simulation runs corresponding to only plus and minus one percent acreage deviation cases. In each scenario, stocks of corn were shocked by plus and minus one and two standard deviation of corn stocks obtained from historical data. Tweeten (1983) reports the variance of feed grains stocks for the period 1976-82 as 385.1 millions of metric tons squared. Assuming that the portion of corn variation in this total variance is the same as the proportion of corn production out of the total feed grain production, which was 81 percent in 1982, the standard deviation of corn stocks is estimated at 110.82 million bushels. Hence, shocks of plus 110.82 and plus 221.64 were given to the baseline value of corn stocks (approximately 1880 million bushels). The results are summarized in the following Table.

The results reported in Table 6.13 seems to give credence to the idea that information might be more critical at times of low levels of stocks relative to when they are high. Indeed, judging by the magnitude of the impacts measured in the various cases, it appears that market reactions would be more pronounced when stocks levels are low. To help better see the picture, assume, again, that plus one and minus one percent corn acreage deviation between the reported and perceived states are equally likely. Under these conditions, Table 6.14 was constructed based on the results shown in the previous table.

Clearly, when viewed this way, the results indicate larger expected benefits to producers, consumers and in total, when the information is reported at times of low levels of inventories than when they are large.

Table 6.13: Impacts of Information on Corn Prospective Plantings Under Different Levels of Stocks.

Group	Baseline	+ σ	− σ	+2 σ	−2 σ
	---------- Million Dollars[a] ----------				
A. +1 Percent Acreage Deviation					
1. Producers	-137.62	70.21	163.89	56.32	181.13
2. Consumers	-152.73	-80.56	-168.11	-63.08	-183.48
3. Total[b]	- 15.11	-10.35	- 4.22	- 6.76	- 2.35
B. -1 Percent Acreage Deviation					
1. Producers	-123.09	-61.99	-144.12	-48.38	-156.71
2. Consumers	167.25	87.06	191.08	65.32	209.32
3. Total[b]	44.16	25.06	46.97	16.94	52.61

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]Numbers may not add up exactly due to rounding.

Table 6.14: Expected Value of Corn Prospective Plantings Information Impacts Under Different Levels of Stocks.

Group	Baseline	$+\sigma$	$-\sigma$	$+2\sigma$	-2σ
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -				
1. Producers	7.27	4.11	9.89	3.97	12.21
2. Consumers	7.26	3.25	11.49	1.12	12.92
3. Total[b]	14.53	7.36	21.38	5.09	25.13

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]Numbers may not add up exactly due to rounding.

Accuracy

Most previous studies that analyzed the value of information expressed its accuracy in terms of forecast or statistical error which is the difference between the forecast and some post-harvest estimate of a given variable (production, price, etc.). The argument, first presented by Grunberg and Modigliani then Bullock (1976) and Knowles (1983) elaborated on, suggests that because there is a possibility of market response to the forecast, the latter will always be a biased estimate of the true value of the variable. For this reason, a procedure was suggested in Chapter IV in an attempt to get around this problem.

Forecast error, in this context, is defined in terms of the difference between the impacts of two perfectly accurate reported states, one of them assumed to be the possibly inaccurately reported state and the second the true one. For example, using the simulation outputs corresponding to one and two percent acreage deviations, which were computed assuming complete accuracy of the report, overestimation error would correspond to reporting two percent deviation whereas in reality there is only one percent deviation. Under forecasting corresponds to the opposite case. The total impacts on society shown in Table 6.4 are used to illustrate the impacts of over and under-reporting acreage deviations. That is, the total impacts of 14.07, 56.56, 127.36, 226.29 and 358.36 corresponding to one, two, three, four, and five percent deviations of reported acreages to expected acreages are used in the analysis. The impacts of accuracy, from the point of view of both consumers and producers, is then summarized below.

The results reported in Table 6.15, illustrate the increasing magnitude of the social costs associated with over-reporting corn acreages. Those costs tend to increase in almost a linear fashion with the over forecast error, since the average (on a one percent basis) social cost of incorrectly reporting corn acreage is about 85 million dollars. These increasing costs do not, however, completely offset the value of the report since there is a residual benefit to society when information is reported versus when it is not. These results are in agreement with previous findings (Hayami and Peterson, for example) that the more accurate information the lower the associated social costs or, equivalently, the higher the social benefit, even if it is not completely accurate. Futhermore, errors made in under-reporting corn prospective plantings produces social costs that are identical to those obtained in the case of over-reporting suggesting some symmetry between the impacts of information in the two cases.

Comparative Analysis of Prospective Planting Reports

The purpose of this section is to continue to analyze the impacts on producers, consumers and in total of prospective plantings information. First, results for the major commodities wheat and soybeans are reported and compared to those of corn, assuming no interference between report impacts. Then, results for pairs of commodity reports (wheat-corn, wheat-soybeans and corn-soybeans) will be discussed.

The planting of most annual crops takes place after the release of SRS prospective plantings release in February, except for wheat.

Table 6.15: Social Costs and Benefits Associated with Over-Reporting Corn Planting Intentions.

Accuracy	Social Costs	Remaining Value of Information
	Million Dollars[a]	
A. One Percent error		
2%/1%[b]	- 42.49	14.07
3%/2%	- 70.80	56.56
4%/3%	- 98.93	127.36
5%/4%	-132.07	226.29
Average	- 86.07	106.07
B. Two percent error		
3%/1%	-113.29	14.07
4%/2%	-169.73	56.56
5%/3%	-231.00	127.36
Average	-171.34	66.00
C. Three percent error		
4%/1%	-212.22	14.07
5%/2%	-301.80	56.56
Average	-257.01	35.32
D. Four percent error		
5%/1%	-344.29	14.07

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]The first percentage is the reported acreage, the second is the true one.

By and large, wheat has two major components: winter wheat and spring wheat, corresponding to 70 and 30 percent in acreages; and 80 and 20 percent in production on the average, respectively.

When the so-called prospective plantings, or more generally acreage information, are made public, sometime in February of each year, winter wheat has already been planted and probably some land preparation for spring wheat, also has already taken place. Therefore, by that time, the extent of production response to USDA acreage information is greatly reduced. On the other hand, if acreage information were to be released prior to planting of winter wheat, say in July, then there is potential for full response to the information as far as wheat is concerned, but very little response, if any, by producers of other crops since by that time other crop harvests are relatively near. Hence, one would expect information on winter wheat acreages released in July to have significantly different impacts on producers and consumers of agricultural products in general than acreage information on spring wheat released in February. For this reason, the two timings of prospective plantings for wheat are also compared. All results to follow are computed on the assumption that believability in the information by market participants is average. Furthermore, only one percent deviations of reported acreages to expected acreages are reported. The comparison will be made first between information on winter and spring wheats, then between spring wheat, corn, and soybeans, with no interference between reports, and all three crops considered two at a time.

Winter Wheat Versus Spring Wheat

Prospective Plantings

A plus and minus one percent shocks to acreages of wheat using supply response proportions computed for the periods of July/August and January/February. The results are summarized in Table 6.16.

The comparison of results between winter wheat and spring wheat reveals that, overall, wheat prospective plantings information would be more valuable if it were to be released prior to winter wheat planting than if it were to come at the same time as prospective plantings for other crops are collected and distributed. When comparing individual impacts on producers and consumers, also, it is quite clear that the magnitudes are different. Indeed they are much smaller for the spring wheat information case. This follows from the fact that if prospective plantings were to be made available prior to winter wheat planting, relatively more response results which translates in large consumer and producer impact changes. Taking expected values, based on equal probabilities of occurrence, the results confirm that winter wheat prospective plantings would be more valuable than spring wheat prospective plantings. Both, however, have a net positive impact on producers, consumers and in total.

Corn Versus Soybeans Versus Winter Wheat Versus Spring Wheat

Prospective plantings impacts considered for one commodity at a time are now compared. The results obtained for plus and minus one percent acreage deviations are used as examples of possible shocks to the agricultural economy and appear in Table 6.17.

Table 6.16: Comparison of Prospective Plantings Impacts Between Winter and Spring Wheat.

Group	Winter Wheat	Spring Wheat
	---------- Million Dollars[a] ----------	
A. +1% Deviation		
1. Producers	69.52	9.37
2. Consumers	-70.88	-14.06
3. Total	- 1.36	- 4.68
B. -1% Deviation		
1. Producers	-66.03	- 7.85
2. Consumers	72.83	14.29
3. Total	6.81	6.76
C. Expected Value		
1. Producers	1.75	.76
2. Consumers	.98	.12
3. Total	2.73	.88

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

Table 6.17: Comparative Impacts of Prospective Planting Information Between Corn, Soybeans, Winter Wheat and Spring Wheat.

Group		Corn	Soybeans	Winter Wheat	Spring Wheat
		- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -			
A.	+1%				
	1. Producers	137.62	55.86	69.52	- 9.37
	2. Consumers	-152.73	- 52.55	- 70.88	- 14.06
	3. Total	- 15.13	3.31	- 1.36	- 4.68
B.	-1%				
	1. Producers	-123.99	- 50.32	- 66.03	- 7.85
	2. Consumers	167.25	53.62	72.83	14.29
	3. Total	43.26	3.30	6.81	6.44
C.	Expected Value				
	1. Producers	4.11	2.77	1.75	.76
	2. Consumers	3.05	.54	.98	.12
	3. Total	7.17	3.31	2.73	.88

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

The results indicate that existing prospective planting information or hypothetical one (wheat) is valuable to producers, mostly, but also to consumers and, therefore, in total. Information on corn acreages is potentially most beneficial, that on spring wheat is least beneficial and the information on soybeans and winter wheat is in the middle with approximately the same to slightly higher impacts for soybeans.

Concurrent Impacts of Prospective Planting Information on Corn and Soybeans

So far, only individual prospective planting reports were considered assuming no interference between information on a group of commodities. To illustrate in this case a number of scenarios were considered with offsetting acreage deviations. That is, if SRS reports that prospective plantings for corn are higher than expectations it is assumed that planting intentions for other crops are going to be below expected levels, and vice-versa. The results for the case where corn reported acreages are more than anticipated by plus one percent at the expense of soybean acreage, and conversely, are reported in Table 6.18.

As expected, when prospective planting information on more than one crop is considered there is a great deal of offsetting in the individual impacts that take place. For the cases considered, the positive impacts associated with reporting minus one percent acreage deviation in soybeans just about offset the negative impacts generated by reporting plus one percent acreage deviation in corn, making the

Table 6.18: Concurrent Impacts of Prospective Plantings Information for corn and Soybeans.

Group	Corn + 1% Soybeans - 1%	Corn - 1% Soybeans + 1%
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - - -	
Producers	21.44	- 2.38
Consumers	-22.01	33.82
Total	- .57	31.44

[a]Results include (i) secondary impacts for five years beyond year of information release discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]The first percentage is the reported acreage, the second is the true one.

net impact almost nil. Information revealing minus one percent in corn acreage, however, generates such large positive impacts, in general, that are not offset by the response due to reporting plus one percent soybean acreage deviation. Assuming the combination (plus one percent corn, minus one percent soybeans) and (minus one percent corn, plus one percent soybeans) occurring with equal probability .5 makes the expected value of these two scenarios equal to 9.53, 5.91 and 15.14 million dollars for producers, consumers and in total, respectively.

Chapter Summary

This chapter provided a discussion of the impacts on producers, consumers and in total associated with a response by market participants following the release of prospective plantings, mostly for corn. The results suggested that there are, on the average, significant benefits to having even partially accurate prospective plantings information made public. With every acreage scenario considered there were, in aggregate, gainers and losers. However, the gains always outweighed the losses. This is guaranteed by the stability of the demand-supply framework the simulator works with; that is, the elasticity of demand being larger, in absolute value, than that of supply for all commodities. The results shown included, in most cases, impacts of information on one commodity on producers and consumers of that commodity in a given time period but also on those who produce and consume related commodities and in succeeding time periods, discounted at ten percent. When the cross-commodity and dynamic impacts were analyzed, it appeared that both are important, particularly on a yearly basis. Those impacts, in general, tend to offset, and therefore reduce the magnitude of, the current impacts on the commodity for which information is released. These secondary effects are not however large enough to completely offset the primary information impacts and change their direction. When the questions of believability and accuracy of the information were examined, it became clear that the more accurate and the more believable information is the higher benefits in general. However, less than perfectly believable and less than accurate reports, to some extent, have a value, too.

The comparison of impacts of prospective plantings for corn, soybeans and wheat indicated that the information was most critical for corn, with the importance declining with soybeans and wheat, in that order. Finally when prospective planting information on corn was allowed to interfere with that of soybeans, some offsetting in the impacts generated by the response to the individual pieces of information took place. Moreover, the cases examined do suggest that, despite the offsetting effects of information interference, prospective plantings remain beneficial to producers and consumers in most cases.

CHAPTER VII

SIMULATION RESULTS II: VALUE OF INFORMATION ON PLANTED ACREAGES AND PRODUCTION FORECASTS

The purpose of this chapter is to present additional results for information impacts on producers, consumers and in total that are associated with the publication of planted acreage estimates released in June and production forecasts published in August and November by SRS for corn, to begin with, and then for corn in combination with other crops. These results will be compared to results obtained for the earlier released prospective plantings to make comparisons between reports and draw inferences regarding the value of information timeliness

June Acreage Forecasts

No Prior Acreage Information

Corn is again the crop that is used to illustrate comparative results for acreage information released in June relative to corn prospective plantings. In keeping with the states of the world notation presented in Chapter III and used in Chapter VI, plus and minus 1 and 3 percent planted acreage deviations between the expected and reported states of the world for corn and soybeans were considered as typical disturbances on which information may be forthcoming.

Table 7.1 summarizes the results obtained in those cases. For comparison purposes, numbers obtained when analyzing the impacts of prospective plantings for the same acreage deviations are provided in parentheses.

Notice, first of all, the significant reduction in magnitude of the impacts associated with a response to the June information versus prospective plantings. This reflects the limited market response to the information at that time of the production season, relative to February information when full adjustment was still possible. Another observation to be made is that the magnitude of the impacts which is significantly larger for soybeans than for corn or, equivalently, the reduction is much smaller for soybeans than corn. This is explained by the fact that the June acreage forecast comes just as soybean plantings are being completed, whereas most of the corn has been planted for sometime. Consequently, at the time the June forecast is released, there is little adjustment corn producers can make, but soybean producers still have flexibility to make decisions that may affect the final crop size.

Making the usual assumption that acreages discrepancies between the reported and expected states of the world are equally likely, the June acreage forecast impacts on producers, consumers and in total can be expressed in terms of their expected value. Such calculations for the 1 and 3 percent acreage events for corn and soybeans were performed and are reported in Table 7.2. Again in each situation, comparable numbers for prospective plantings are reported in parentheses. In the case of corn, the overall impacts on society of prospective plantings are approximately 4.5 times higher than those

Table 7.1: Economic Gains of Information to Producers, Consumers and Society, Resulting from Market Response to the June Corn and Soybeans Planted Acres Forecasts.

Acreage Discrepancy	Producers	Consumers	Total[a]
	---------Million Dollars[b]	----------	
A. Corn			
-3%	- 8.66 (-337.13)[c]	33.82 (543.86)	25.15 (206.73)
-1%	- 4.91 (-123.99)	10.08 (167.25)	5.18 (43.26)
+1%	6.94 (137.62)	- 8.95 (-152.73)	-2.01 (-15.13)
+3%	26.83 (457.79)	-22.56 (-409.80)	4.29 (47.98)
B. Soybeans			
-3%	-75.17 (-130.35)	90.67 (157.21)	15.50 (26.86)
-1%	-28.58 (- 50.32)	30.42 (53.62)	1.84 (3.30)
+1%	29.40 (55.86)	-31.24 (- 52.55)	- .81 (3.31)
+3%	98.85 (178.02)	-86.98 (-142.98)	11.85 (35.06)

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities (iii) assuming average believability.

[c]Numbers in parentheses are for prospective plantings.

Table 7.2: Economic Gains of Information to Producers, Consumers and Society Resulting from Market Response to the June Corn and Soybeans Planted Acres Forecasts.

	Producers	Consumers	Total[a]
	- - - - - - - - - -	Million Dollars[b]	- - - - - - - - - -
A. Corn			
1%	1.02 (4.11)[c]	.57 (3.05)	1.59 (7.17)
3%	9.09 (37.29)	5.63 (27.66)	14.72 (64.95)
B. Soybeans			
1%	.41 (2.77)	.09 (.54)	.52 (3.30)
3%	11.84 (23.84)	1.85 (7.12)	13.68 (30.96)

[a]Totals may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities (iii) assuming average believability.

[c]Numbers in parentheses are for prospective plantings.

associated with the release of the June planted acres forecast. For soybeans the reduction is not as significant as it is for corn. The primary reason explaining this phenomenon is the potentially significant production adjustment that may still occur with soybeans but not so much for corn. Overall, however, the information remains beneficial in both cases, particularly to producers.

With Prior Prospective Plantings Information

The impacts shown in the previous section were derived on the assumption that no prior acreage information was released, That is, the reaction to the June forecast is the first time the market adjusts to new information which is different from previous acreage information held by market participants. Let us now consider the case where the market had benefited from the prior release of prospective plantings. With the June information, the market adjusts not from baseline levels; i.e., all variables valued at their expected levels, but from the new path of the agricultural sector that the response to prospective plantings had generated. The results are as follows.

In comparison with the results shown in Table 7.1, which were obtained on the assumption that no prior acreage information was available to market participants, it appears that (a) the impacts of the June corn acreage forecast would be even smaller relative to the no prior information case and (b) the signs are reversed since the magnitude of adjustment in the second case is smaller than with prospective plantings. If initially a loss was incurred, the second time around it is still a loss, and the reduction in loss is a gain, and vice versa. The overall value of the June report continues to be positive in almost all cases considered.

Simultaneous June Acreage Information

on Corn and Soybeans

The next question to be examined is what happens when a group of reports are evaluated simultaneously. To illustrate the impacts corresponding to this situation, joint information on planted acres forecasts for corn and soybeans is used. Here too, it is assumed that if the forecast indicates plus x percent acreage deviation for corn, it must be the case that the soybeans acreage was reduced by the same x percent and vice versa. Shocks of plus and minus 1 percent only are reported and compared with the same scenarios obtained for prospective plantings. The summary of results obtained when primary impacts on the commodities and time period for which information is released, as well as secondary impacts on related commodities and in succeeding time periods, are all taken into consideration follow.

The fact that June forecasts come well into the corn growing season and past the undertaking of major soybean production operations explains why the magnitude of the numbers shown in Table 7.3 are much smaller than in comparable situations with prospective plantings. The offsetting of individual crop information impacts is also visible by comparing these results to those appearing in Table 7.2. Furthermore, the scenarios examined indicate that, even when simultaneous information on more than one crop is considered, the June acreage information is still beneficial to producers and consumers, on the

Table 7.3: Economic Gains of Information to Producers, Consumers and Society Resulting from Market Response to the June Corn Planted Acreage Assuming Prior Release of Prospective Plantings.

Acreage Deviation	Producers	Consumers	Total[a]
	- - - - - - - - -Million Dollars[b] - - - - - - - - -		
- 3%	7.32	- 6.13	1.2
- 1%	2.35	- 2.44	- .09
+ 1%	-2.11	3.65	1.55
+ 3%	-6.35	14.85	8.50

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities (iii) assuming average believability.

Table 7.4: Simultaneous Impacts on Producers, Consumers and in Total Resulting from Market Response to corn and Soybeans June Acreage Forecasts.

Group	Corn + 1% Soybeans - 1%	Corn - 1% Soybeans + 1%	Expected Value of both scenarios
	- - - - - - - Million Dollars[a] - - - - - - - - -		
Producers	6.12 (21.44)[b]	- 5.37 (- 2.38)	.38 (9.53)
Consumers	-6.33 (-22.01)	8.18 (33.82)	.93 (5.91)
Total[c]	- .21 (- .57	2.82 (31.44)	1.31 (15.44)

[a]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b]Numbers in parentheses are for prospective plantings.

[c]Number may not add up due to rounding.

average. However, it is much less beneficial than comparable information that would be revealed by prospective plantings.

August Corn Production Forecasts

The Statistical Reporting Service of the U.S. Department of Agriculture begins estimating and publishing production forecasts in August. The critical variable, here too, is how much these forecasts deviate from the prior-to-forecast market expectations. Since wheat is being harvested at that time and, in a number of areas in the country, corn is also approaching harvest time, limited impact August production forecasts for wheat and corn are expected to have on the market. The most that can happen is for inventory holders to decide to store more or less of the commodity, whose production is forecasted, than planned. As an example, the results shown in Table 7.5 provide a detailed picture of the impacts associated with the release of the August corn forecast.

The net impacts for all commodities, for all six time periods, are still positive. This continues to be the case because of the smaller elasticity of corn supply relative to the demand for corn, in absolute value. With each scenario, as usual, there are gainers and losers but the magnitude of the losses is, almost always, smaller than the magnitude of the gains. On an expected value basis (Table 7.6), the size of the impacts associated with the August corn production forecast appears to be even more miniscule, but nevertheless positive overall. Furthermore, the larger the discrepancy between the reported information (on the assumption it is accurate) and the prior market expectation the larger the benefit. This finding was expected, given

Table 7.5: Economic Gains of Information to Producers, Consumers and Society Resulting from Market Response to the August Corn Production Forecast.

	Producers			Consumers			
	Corn	Other Crops	Total	Corn	Other Crops	Total	Grand Total[a]
	Million Dollars[b]						
- 3%	- 2.23	12.89	10.66	4.97	-12.75	- 7.78	2.88
- 1%	- 1.12	4.33	3.21	1.32	- 4.28	- 2.96	.23
+ 1%	1.62	- 4.35	- 2.73	- 1.12	4.09	2.97	.25
+ 3%	6.11	-12.77	- 6.66	- 2.42	12.32	9.90	3.26

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for 5 years beyond year of information release, discounted at 10 percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

Table 7.6: Economic Gains of Information to Producers, Consumers and Society Resulting from Market Response to the August Corn Production Forecast.

	Producers			Consumers			
	Corn	Other Crops	Total	Corn	Other Crops	Total	Grand Total[a]
	- - - - - - - - - -	- - -	Million Dollars[b]	- - -	- - - -	- - - - - -	
1%	.25	-.01	.24	.10	-.10	-.01	.24
3%	1.94	.06	2.00	1.28	-.22	1.06	3.07

[a]Numbers may not add up exactly due to rounding.

[b]Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

the demand and supply structures the simulator uses, and has been confirmed in practically every scenario considered so far.

The impacts obtained with the August production forecast shown above assume no previous information release of any sort by the USDA. Simulation runs were obtained assuming prior release of prospective plantings and the June corn planted acreage. The results in this latter case were insignificant.

November Corn Production Estimate

Production statistics published by SRS between September and November are not so much forecasts of future harvests as they are end-of-season estimates of production of the various crops based on the information collected throughout the production season. Considering corn and soybeans again, and assuming no prior USDA information to the November production estimates, the simulation results corresponding to 1 and 3 percent deviation between reported and expected production are indicated in Table 7.7. Furthermore, only the expected value of the impacts are reported.

As expected very small impacts result when the market reacts to the announcement of production estimates. As a matter of fact, most of these impacts result from the adjustment in inventory levels held under the different scenarios. Futhermore, when the impacts were computed on the assumption that corn prospective plantings, June acreage information and August production forecasts had already been released, almost no market impact was observed following the release of the corn end-of-season production estimate.

Table 7.7: Average Impacts on Producers, Consumers and in Total Resulting from Market Response to Reporting Corn November Production Estimates.

Group	Production Discrepancy	
	1%	3%
	---Million Dollars[a]---	
Producers	.01	.01
Consumers	.16	2.13
Total	.17	2.14

[a] Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

Information Quality

So far in this chapter the emphasis or concern has been the measurement of the impacts that may follow the release of information by the USDA after crops have been planted through harvest time. The chosen examples were the June acreage and August production forecasts. In some sense, these reports convey the same type of information which is aimed at assessing the potential size of final crop harvests. By the same token, those reports are no different, in spirit, than prospective plantings, since they too provide an early indication of production potentials. What is different, however, is the timing of the availability of that information to market participants. Because prospective plantings are more timely than, say, the June acreage forecasts, the market may respond to them a great deal more than it will June information is made public. Table 7.8 contains results that illustrate the comparative impacts of the three types of information analyzed so far. Prospective plantings, June acreage information and the August production forecasts, all for corn. These reports are distinguishable, not in their ultimate goal which is the estimation of production levels of the various crops, but on the basis of their

From the point of view of producers it appears that information telling them about 1 percent acreage deviation between the real world and prior market anticipations would be worth little if it came in August, but would be worth 1 and 4 additional million dollars if it were released in the previous June or February, respectively.
timeliness.

Table 7.8: Average Impacts on Producers, Consumers and in Total Resulting from Market Response to Reports with Different Timelinesses.

Group	Corn Prospective Plantings	June Corn Planted Acres Forecast	August Corn Production Forecast
	- - - - - - - - - - Million Dollars[a] - - - - - - - - - -		
A. 1% Deviation			
Producers	4.11	1.02	.24
Consumers	3.05	.57	- .01
Total[b]	7.17	1.59	.24
B. 3% Deviation			
Producers	37.29	9.09	2.00
Consumers	27.66	5.63	1.06
Total[b]	64.95	14.72	3.07

[a] Results include (i) secondary impacts for five years beyond year of information release, discounted at ten percent, (ii) impacts resulting from interactions between commodities and (iii) assuming average believability.

[b] Numbers may not add up due to rounding.

Information on 3 percent deviation, on the other hand, would be worth 2, 9 and 37 million dollars if released in August, the June before or the previous February, respectively. Consumer gains also increase in the same order. From the point of view of society, information revealing 3% acreage deviation would be worth only 3 million dollars if released in August but would be worth, approximately, 11 and 62 million dollars if it became known in the previous June or February, respectively.

All of these numbers are computed assuming SRS reports the information accurately. To use the June corn acreage forecast as an example, it appears that if SRS over or under-reported the June acreage by 1% society would lose 6.57 (=(14.72 - 1.59)/2.) million dollars. Suppose, further, that SRS is faced with the situation of improving the accuracy of the June acreage by 1 percent versus making the same acreage information with the same accuracy (1 percent error) available to the market in February of the same year. In the first case society would gain 6.57 million dollars, whereas that in the second the average benefit is 100 million dollars higher (see Table 6.15 of Chapter VI).

This single observation strongly suggests the significant advantage, from society's viewpoint, information timeliness has over absolute accuracy. Consider, next, the situation where market believability in the information could be improved from average to high. Recall, this means, in terms of the present analysis, giving a weight of .75 to the price, resulting from market adjustment to the information, in the price expectation equation generating the final supply. If that were the case, the value of 1 percent deviation between the reported corn June acreage and the true state of the world increases by about 18 percent; meaning it goes up from 8.16 (=1.59+6.57) to 9.63 million dollars overall. Making believability complete approximately doubles the net overall impacts; i.e., from 8.16 to 15.89 million dollars. Interestingly enough, making a 3 percent acreage deviation corn June report perfectly accurate improves its value from 8.16 to 14.72 million dollars, which is almost the same as when believability is complete. However, the same report with the same error and with average believability would be worth approximately 100 million dollars more when the information is made available to the market in February than in June.

Chapter Summary

This chapter provided selected results for a few reports released beyond the February release of prospective plantings. Based on these results the following observations are made.

1. Both on an individual commodity basis and when information on more than one crop interfere, the June acreage information is much less valuable than prospective plantings.
2. Planted acreage information released in June is still valuable to producers and consumers.
3. When prior prospective plantings were considered, the June acreage information proved somewhat less valuable than when they were not.

4. August production forecasts and particularly the end-of-season November corn production estimate, generate limited market response. Their benefit to society, from this point of view only, appears to be small to insignificant.
5. When accuracy, believability and timeliness were compared, the first two characteristics of the June information exhibited similar impacts. However, timeliness had much more of a significant impact than believability and accuracy.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

General Remarks

This study is an attempt to contribute to the methodology of determining the value of information. The information in this case is represented by the large volume of agricultural statistics produced by the United States Department of Agriculture on a continuous basis.

A complete evaluation of such information requires the identification of all past, present and future potential economic and other decisions that have been, are or might be affected by the availability of that information, respectively. The realization of such a broad goal is no simple matter. Narrowing down the scope of the study was imperative. A subset of the information published by the USDA consisting of the flow of within-crop-year data was analyzed. Specifically, February prospective plantings, June planted crop acreage estimates, August crop production forecasts and November end-of-season production estimates by the Statistical Reporting Service were taken as examples of information that was evaluated. This is a small proportion of the total volume of public agricultural data. The conclusions reached in this thesis are then to be interpreted as pertaining only to this specific set of data. For other USDA statistics further research is needed.

The economics of information may be a recent development in the literature, but the field has grown so fast that the evaluation of a specific piece of information is not a novelty any more. Many studies have estimated dollar measures associated with a number of information packages, mostly using Bayesian framework. Some of the studies involved the elicitation of individual utility functions and others were carried out in monetary terms. These studies have certainly contributed to the understanding of the role information plays in economic decisions. However, they were all conducted in a partial equilibrium setting. The present study constitutes a departure from the mainstream methodology to measure the value of information. The evaluation of the impacts the release of USDA information generates was done from a market point of view; that is from the points of view of producers and consumers in aggregate. The study recognizes that when a specific piece of information is released for a given crop, not only the market of that commodity is affected by it but so are the markets of related crops. This follows from the various commodity interdependencies on the production and consumption levels, as expressed by the cross-price elasticities of supply and demand. Moreover, in view of the dynamic nature of production and inventory decisions it was hypothesized that the impact of information would not be limited to the time period in which the information was released. Some lagged impacts could still be observed in succeeding time periods. Consequently, the overall objective of the study was to empirically measure the aggregate economic impacts on producers, consumers and in total that are associated with the release of particular USDA reports in a multi-commodity and dynamic framework.

Prospective plantings, planted acreages reported in June, intial production estimates in August and end-of-season production numbers reported in November were taken as examples of information to be analyzed. Timeliness of reports was simply defined in terms of how early in the production season information is released. Hence, February prospective plantings were most timely, the timeliness declining with the June, August and then November information. Believability in the information was incorporated in the model via a weight given to the USDA price information in combination with previously held price expectations in the acreage yield and inventory equations of the model. The analysis was carried out, for the most part, on the assumption the released information is completely accurate. To avoid the possible bias associated with the market reaction to the information, an approach was suggested and implemented for the purpose of shedding some light on the accuracy question.

Findings

Demand and supply of the commodities considered in the study being inelastic, information that results in a lower market price generates a loss to producers, but consumers benefit from it and vice versa. The fact that supply is more inelastic than demand for all commodities included in the model guarantees a converging market behavior through time. This translates into social costs that are always smaller than social benefits as the market response to new information takes place.

Regarding the information characteristics timeliness, accuracy and believability, it was shown that there is a great deal to be gained in having timely, accurate and believable information made available to the public.

The methodology described in this study was applied to only that is produced by the USDA: Prospective plantings released in February, June planted acreage estimates, August production forecasts and November end-of-season production estimates.

In general information for corn proved most valuable, followed by soybeans followed by wheat and then the smaller crops. The same type of behavior was observed for all crops: Information revealing a state of the world indicating potential excess demand is beneficial to consumers but producers may lose from it. Conversely, information revealing potential excess supply is beneficial to producers but not to consumers. With almost each scenario considered, the net potential impacts on producers and consumers were positive for each crop, every time period and when all crops and all time periods are considered.

Prospective plantings reports exhibited the highest potential benefit. When offsetting prospective plantings information on more than one crop were considered, there were some offsetting impacts too, but the information remained clearly potentially beneficial.

The June acreage information was also potentially beneficial, but the magnitude of the benefits were significantly lower than comparable prospective planting information. The August information for soybeans and corn indicated a still positive net impact, but very small compared with previously released information. The November end-of-season production estimate virtually had no impact on the market.

When reports were analyzed in a sequential way, the results show that the additional impacts were of significant magnitude in the case of the June information, but were insignificant in the cases of August and November production information.

Uniqueness of the Study

The uniqueness of this study is in the fact that more than one report per single time period were analyzed in a framework where major agricultural commodities interact on both levels of supply and demand through cross-price elasticities. In addition, the market reaction to a given report is not limited to the time period in which it is released, impacts in succeeding years are captured, discounted at 10 percent, summed and added to current year impacts over all commodities. The results suggest that in magnitude, both cross-commodity and dynamic impacts are important. However, because they exhibit a near symmetry, on an expected value basis, they tend to be small, but positive; thus adding to the net primary impact of the information. Furthermore, all impacts are calculated on the assumption that only corn, soybeans, wheat, grain sorghum, oats, barley and cotton are interacting and six time periods are simulated with the lagged impacts discounted at 10 percent. With other commodities included in the model, more time periods simulated and lower discount rate impacts would probably be higher.

Policy Recommendations

One finding of this study is that public information is more potentially valuable the bigger the discrepancy between the current state of the world and previous market expectations. The magnitude of this discrepancy determines the overall value of information more than any other variable. Furthermore, the same information would be of greater potential value the earlier it is reported so that the market can adjust to it. Consequently, prospective plantings present the highest potential benefit followed by the June acreage information. Reports released close to the end of a production season generate small or no response and therefore the market derives a relatively low value from them.

If a public decision maker is faced with a choice between improving the accuracy or the timeliness of a report, the results suggest that the latter should receive higher priority. On the other hand, believability and accuracy improvements yield benefit to society that are of comparable magnitudes. More importantly, the results indicate that there are no sufficient grounds to be overly concerned about the potential contribution the publication of agricultural statistics has on society. The results suggest that the dissemination of only one corn prospective planting report, as an example, has a potential benefit to society that could exceed the total annual budget of SRS.

Limitations of the Study

A number of limitations characterize this study. First of all, the value of information was looked at from the point of view of aggregate market response only. If a particular report is expected to generate a limited response, it will have a low value. A case in point is the end-of-season production estimates, which the model suggests, have practically no impacts on producers and consumers in aggregate. These statistics serve as a basis for the computation of supply and utilization tables that are compiled over the years. Should one conclude that these statistics have no value to society? What about the various utilizations made of those data in research, extension and decision making, in general, that may potentially have significant impacts on society?

Second, it is to be emphasized, the study is aggregate in nature. Even though ending-year inventories adjust in each scenario considered, more timely market transactions by specific groups in the economy are only partially and/or indirectly captured by the model. Benefits of information to specific individuals or marketing firms cannot be seen directly from the results reported herein.

Third, the way production response is captured in the model may be simplistic. Further research is needed on this subject.

Fourth, the results are influenced by the parameters and baseline used in the simulation model.

Fifth, the study assumed the market reacts only to public information. The extent to which privately produced information plays a significant role in market decision making is yet to be studied.

Sixth, in a way, information is playing a stabilizing role in the market place. To a large extent, that is what U.S. Government programs are for, too. Hence, they probably supplement and accomplish similar functions. But could those programs achieve their goals if information was not available?

Many improvements are possible and desirable. This study nevertheless improved over existing partial equilibrium methodology that attempts to value information. Namely, information released for a given crop in year t affects not only that crop but also other related crops, immediately and in succeeding time periods. To capture all of those impacts a dynamic general equilibrium framework was needed. Such a framework was used to provide policy makers with quantitative answers regarding the potential benefit society could derive from having within-crop-year statistical information collected and published.

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APPENDIX

BASELINE DATA USED BY THE SIMULATOR

Code	Item	1984	1985	1986	1987	1988	1989
1.	Soybeans						
	Harvested Acres	69.02	70.31	73.79	75.37	75.02	75.28
	Yield	31.80	32.00	32.20	32.50	33.00	33.20
	Production	2194.84	2249.91	2375.27	2449.50	2475.64	2499.29
	Var. Exp. Per Acre	64.52	67.75	71.14	74.69	78.43	82.34
	Total Supply	2530.84	3585.91	2711.61	2785.60	2811.44	2835.51
	Dom. Demand	1174.87	1190.54	1305.55	1370.50	1385.06	1400.00
	Non-Mill Demand	90.00	90.00	90.00	90.00	90.00	90.00
	Total Dom. Demand	1264.87	1280.54	1395.55	1460.50	1475.06	1490.00
	Exports	929.97	970.03	979.96	989.29	1000.16	1009.76
	Total Use	2194.84	2250.57	2375.51	2449.79	2475.22	2499.75
	Ending Stocks	336.00	335.34	336.10	335.81	336.22	335.75
	Soy. Farm Price	6.25	6.51	6.74	7.00	7.25	7.25
2.	Corn						
	Harvested Acres	72.18	73.00	72.99	74.01	75.00	75.50
	Yield	107.10	110.18	110.80	112.30	112.56	113.00
	Production	7730.24	8043.14	8087.38	8311.31	8441.39	8531.78
	Var. Exp. Per Acre	146.14	153.45	161.12	169.18	177.63	186.52
	Total Supply	9612.32	9925.22	9969.45	10193.25	10323.49	10413.79
	Feed Demand	4449.37	4600.75	4706.04	4771.62	4804.16	4805.73
	Non-Feed Demand	850.00	900.00	950.00	1000.00	1050.00	1050.00
	Total Dom. Demand	5299.37	5500.75	5656.04	5771.62	5854.16	5855.73
	Exports	2431.87	2543.38	2432.50	2570.51	2588.33	2677.00
	Total Use	7731.24	8044.14	8088.54	8312.13	8442.49	8532.73
	Ending Stocks	1881.08	1881.08	1880.94	1881.10	1881.02	1881.06
	Soy. Farm Price	6.25	6.51	6.74	7.00	7.25	7.25
3.	Wheat						
	Harvested Acres	70.00	69.45	69.67	70.11	70.27	70.95
	Yield	36.43	36.50	36.60	36.80	37.00	37.00
	Production	2550.10	2534.92	2549.82	2580.13	1600.02	2625.02
	Var. Exp. Per Acre	61.17	64.23	67.44	70.81	74.35	78.07
	Total Supply	3285.10	3269.92	3284.82	3315.11	3335.02	3360.02
	Food Demand	629.98	640.00	650.00	660.07	671.10	679.99
	Feed Demand	124.99	124.98	124.88	124.62	125.03	124.85
	Non-Feed Demand	108.00	110.00	110.00	110.00	110.00	110.00
	Total Dom. Demand	862.97	874.99	884.88	894.69	905.13	914.85
	Exports	1689.13	1661.94	1666.96	1687.42	1696.89	1712.19
	Total Use	2552.10	2536.92	2551.84	2582.11	2602.01	2627.04
	Ending Stocks	733.00	733.00	732.98	733.00	733.00	732.98
	Wheat Farm Price	3.65	3.65	3.65	3.70	3.75	3.75

Code	Item	1984	1985	1986	1987	1988	1989
4.	Grain Sorghum						
	Harvested Acres	12.25	12.13	12.38	12.35	12.41	12.48
	Yield	61.21	61.25	62.38	63.17	63.91	64.72
	Production	749.97	742.96	772.21	780.19	793.10	807.73
	Var. Exp. Per Acre	74.80	78.54	82.47	86.59	90.92	95.47
	Total Supply	932.47	925.46	954.71	962.68	975.60	990.23
	Feed Demand	423.98	407.24	424.25	422.53	421.48	425.84
	Non-Feed Demand	11.00	11.00	11.00	11.00	11.00	11.00
	Total Dom. Demand	434.98	418.24	435.25	433.53	432 48	435.84
	Exports	314.98	324.72	336.97	346.65	360.63	370.85
	Total Use	749.96	742.96	772.22	780.18	793.10	807.70
	Ending Stocks	182.50	182.50	182.49	182.50	182.50	182.53
	G. S. Farm Price	2.45	2.40	2.45	2.45	2.50	2.50
5.	Oats						
	Harvested Acres	10.51	10.74	9.34	9.48	9.69	9.77
	Yield	53.78	52.84	52.69	54.05	54.97	54.93
	Production	565.38	567.49	492.12	512.39	532.65	536.67
	Var. Exp. Per Acre	46.54	48.87	51.31	53.88	56.57	59.40
	Total Supply	703.96	706.07	630.71	650.97	671.23	675.25
	Feed Demand	481.38	483.49	408.12	428.39	448.66	452.67
	Non-Feed Demand	75.00	75.00	75.00	75.00	75.00	75.00
	Total Dom. Demand	536.38	558.49	483.12	503.39	523.66	527.67
	Exports	10.00	10.00	10.00	10.00	10.00	10.00
	Total Use	566.38	568.49	493.12	513.39	533.66	537.67
	Ending Stocks	137.58	137.58	137.58	137.58	137.58	137.58
	Farm Price	1.50	1.40	1.40	1.40	1.45	1.45
6.	Barley						
	Harvested Acres	9.47	9.62	9.70	9.70	9.77	9.73
	Yield	52.81	53.00	53.60	54.34	54.75	55.00
	Production	500.11	509.86	519.92	529.80	534.93	535.13
	Var. Exp. Per Acre	62.97	66.12	69.42	72.90	76.54	80.35
	Total Supply	631.78	641.53	651.59	661.47	666.60	666.80
	Feed Demand	275.11	282.86	290.92	302.07	301.93	300.13
	Non-Feed Demand	180.00	182.00	184.00	186.00	188.00	190.00
	Total Dom. Demand	455.11	464.86	474.92	488.07	489.93	490.13
	Exports	55.00	55.00	55.00	51.73	55.00	55.00
	Total Use	510.11	519.85	529.92	539.80	544.93	545.13
	Ending Stocks	121.67	121.67	121.67	121.67	121.67	121.67
	Farm Price	2.20	2.10	2.15	2.15	2.20	2.20

Code	Item	1984	1985	1986	1987	1988	1989
7.	Cotton						
	Harvested Acres	10.45	11.08	10.64	10.60	10.67	10.78
	Yield	494.40	499.21	503.98	508.85	513.34	518.72
	Production	10.76	11.52	11.17	11.24	11.41	11.65
	Var. Exp. Per Acre	233.77	245.46	257.72	270.64	284.01	298.51
	Total Supply	15.39	15.49	14.79	14.77	14.90	15.20
	Domestic Demand	5.85	5.90	5.90	5.90	6.00	6.00
	Exports	5.59	5.97	5.37	5.39	5.36	5.56
	Total Use	11.44	11.87	11.27	11.29	11.35	11.57
	Ending Stocks	3.95	3.61	3.52	3.48	3.54	3.63
	Farm Price	0.65	0.67	0.68	0.70	0.71	0.71
8.	Livestock						
	Cattle						
	Production	22859.00	23780.31	24262.67	24846.12	25102.66	25470.99
	Price	0.65	0.68	0.70	0.72	0.70	0.70
	Cash Receipts	39184.50	41059.38	42073.11	38044.77	48175.76	52793.56
	Hogs						
	Production	15846.50	16572.03	16596.72	16390.18	16099.91	16299.98
	Price	0.43	0.40	0.39	0.40	0.42	0.44
	Cash Receipts	11782.89	13204.45	14112.62	15257.08	16948.38	18269.54
	Sheep						
	Production	370.00	370.00	370.00	370.00	370.00	370.00
	Price	0.63	0.65	0.65	0.64	0.65	0.65
	Cash Receipts	482.28	494.15	494.32	289.49	560.80	624.11
	Chickens						
	Production	13481.00	13540.86	13193.90	13058.39	13692.79	14324.71
	Prices	0.36	0.37	0.39	0.42	0.47	0.49
	Cash Receipts	6222.69	6414.88	6575.75	6986.57	8198.07	9025.00
	Turkeys						
	Production	2551.00	2635.31	2634.85	2636.71	2692.52	2896.63
	Prices	0.45	0.50	0.51	0.54	0.50	0.51
	Cash Receipts	1496.80	1716.44	1751.51	1852.83	2097.72	2421.43
	Eggs						
	Production	5800.00	5894.85	5859.45	4902.06	5900.44	5950.09
	Prices	0.75	0.68	0.69	0.70	0.70	0.70
	Cash Receipts	4711.13	4657.64	5082.18	5472.87	5978.46	6721.44

Code	Item	1984	1985	1986	1987	1988	1989
	Milk						
	Production	126906.00	126556.40	126194.00	125432.40	125998.60	126199.60
	Prices	0.15	0.17	0.17	0.16	0.17	0.17
	Cash Receipts	21717.00	24566.59	27312.52	29809.57	31571.30	38814.88
9.	Total Cash Receipts	126906.00	126556.40	126194.00	125432.40	125998.60	126199.60
	Crop Cash Receipts	85187.38	93381.31	103829.80	113103.00	120262.60	127819.20
	Livestock Cash Receipts	87474.69	94122.63	99515.50	103115.50	116017.80	131351.40
10.	Non-Money Income	20918.52	22197.56	23699.96	25097.93	26494.64	28003.58
11.	Realized Gross Income	193965.50	210101.50	227445.20	241716.50	263165.00	287574.20
12.	Total Production Expense	178010.40	191865.00	210363.80	226071.00	244576.30	268370.30
13.	Realized Net Income	15954.81	18236.50	17081.38	15645.50	18588.75	19203.94

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VITA

Boubaker Thabet

Candidate for the Degree of

Doctor of Philosophy

Thesis: EVALUATION OF POTENTIAL AGGREGATE ECONOMIC IMPACTS OF THE RELEASE OF PUBLIC PRODUCTION AND PRICE FORECASTS: A DETERMINISTIC SIMULATION APPROACH.

Major Field: Agricultural Economics

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