ANALYSIS OF THE TIMELINESS OF U.S.D.A. CROP FORECASTS FROM A PRODUCERS' PERSPECTIVE

By

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CHAPTER I

INTRODUCTION

General Problem

The United States Department of Agriculture was created on May 15, 1862. The Department of Agriculture was developed into nine agencies under the direction of the Secretary of Agriculture, which is a political appointment. The general objectives of these nine various agencies are those items dealing with the economic production and distribution of essential food and fiber, wise conservation of natural resources, development of rural areas, sound stabilization of farm prices and returns, scientific investigation of newer and better methods of agricultural production, regulation of markets and trade in farm products and facilities, development and expansion of foreign markets and providing information to farmers and the public on achievements and progress made.

The basic characteristics and needs of American agriculture have changed very little over time, and neither has the opinion or point of view by which the American public views agriculture. The critical role which the U.S.D.A. plays is unquestioned by the people it serves. There are, however, questions now being asked which deal with the manner in which the U.S.D.A. should achieve its general objectives. There is some question of whether the changing magnitude of American agriculture is in need of different kinds of information in order to strive for economic production of agricultural products. If this is the case, the public institution of the U.S.D.A. must be prepared to adequately meet the needs of American agriculture.

The usefulness and necessity of agricultural statistics to the agricultural producer has been recognized for years. This need became widely recognized during the 1920s. The decade of the 1920s was characterized by erratic movements in farm prices and incomes and the development of larger numbers of specialized farms; this in turn stimulated the farmer's interest in production information. These changes resulted in an expansion of the scope of the existing statistical programs and in the modification of the distribution system for this information.

Uses of statistical information are both broad and diverse. The chief user of this information is the agricultural producer. Just as there are various types and sizes of farms, so must the Statistical Reporting Service (SRS) provide various types of information. Agricultural producers are in agreement that information provided by the U.S.D.A. represents the most accurate and comprehensive agricultural data available (Jones, Sheatsly, and Stinchombe, 1979). With the Reagan Administration's Budget Cuts, there is renewed interest in determining programs which producers feel are important and eliminating those which are deemed expendable.

One of the major desires of farmers as determined by Jones, Sheatsly, and Stinchombe (1979) is that published forecasts be as accurate as possible. There is some evidence to suggest that for some of its forecasting the U.S.D.A. has been reasonably accurate

(Mlay and Tweeten, 1981). However, the time period required by the U.S.D.A. to construct an accurate report extends past the point at which producers desperately need this information so as to formulate their production plans. Whereas producers face stiff production penalties if they fail to comply with the growing season of their crops, any totally accurate forecast occurring nine months following the completion of their planting is of little use to them. This is where the trade-off between accuracy and timeliness occurs.

Specific Problem

At this time little, if any, research has been conducted to analyze this element of timeliness necessary in U.S.D.A. forecasts from a producer's perspective. As government places increased pressure upon balancing the budget emphasis will be placed on eliminating programs which do not meet the needs of the public and modifying those existing programs deemed necessary; crop forecasting most certainly falls in the latter category. Currently little is known about this element of timeliness as it coincides with producers' production schedules. The traditional thought has been to produce a forecast which is accurate and as comprehensive as possible. This situation has failed to place emphasis upon the period which is so critical to producers. The pre-planting period is of critical importance due to the simple fact that after planting his crop and realizing the bulk of his operating cost the producer's alternatives have been greatly reduced. Again there appears the trade-off between accuracy and timeliness. It is impossible for the U.S.D.A. to perfectly forecast production or prospective plantings prior to any planting actually occurring, and yet it is crucial if the U.S.D.A is to conform to its general objectives to provide producers with the necessary information such that "economic production and sound stabilization of farm prices and returns" might occur. In order to eliminate this confusion it is necessary that a clear understanding of this timeliness issue exist.

Purpose of the Study

The overall objective of this study is to determine if and when the element of timeliness is a critical issue from a producer's perspective. More specifically, the objectives are:

1. To determine if U.S.D.A. crop production forecasts are inherently problematic due to feedback effects.
2. Estimate when information provided by the U.S.D.A. is of value to agricultural producers (timeliness vs. accuracy).
3. Determine the point at which a forecast is no longer timely.

The first objective is accomplished by analyzing four of the most common situations which producers might be placed in.

The second objective is accomplished simultaneously with the third objective. Futures prices were gathered for a ten year period which corresponded to those dates upon which planting intention and production reports were released; from this elasticity estimates were derived.

Models were developed to include those elements affecting the three crops under analysis: corn, soybeans and spring wheat. Regression procedures were then applied to these models to analyze the various crops during the three planting periods: pre-planting, during planting and post-planting.

Organization of Study

The second chapter provides a discussion of various aspects of information and a brief review of articles pertaining to the subject.

Chapter III contains a discussion of the sources of information, including the government agencies which provide critical crop information to producers, and the frequency which this information is reported.

Chapter IV deals with analysis of the various models and methods of evaluation used upon the gathered data.

Chapter V contains the summary of results obtained from analysis of the various models and the concluding remarks.

CHAPTER II

THE INFORMATION PROBLEM

Only recently have the fields of economic and managerial science begun to place renewed interest in the body of theory concerning the economics of information. By assumptions made by Machlop (1962), knowledge, production and distribution in an industrialized society such as the United States of America, account for as much as 29 percent of the gross national product. Current changes in public and private expenditure patterns on such items as research and development, suggest that Machlop's estimations are not as radical as first believed. This trend leads us to believe that truth exists in the thought that investment in information and knowledge is the fundamental source of productivity growth (Denison, 1967). In order to understand the importance which the field of economics must place on this subject it is helpful to review the definition of economic activity. Economics encompasses those activities involved in the process of allocating scarce resources toward the end of satisfying those wants as fully as possible.

The lack of a proven and general methodology limits the obvious need for estimation of the value of information systems. The contributing factors to this methodological problem were accurately listed by Miller (1977).

> There is a general absence of a market system for information. Thus there is no 'market place' for many public information systems that would suggest their value. Secondly, information is not a physical good and therefore lacks the concreteness that provides a basis for valuing many items. Third, many information systems do not have an impact that is observable in secondary data. Therefore many econometric techniques are of little assistance in estimating information values. Fourth, the concept of information value itself is somewhat an abstraction. The peculiar properties of information as a commodity arise even more fundamentally in the characteristics of supply of and demand for information (p. 4).

As Arrow (1962) points out, information typically violates three classical properties of privately supplied goods: (A) Producers of information cannot normally charge for further uses fully appropriable; (B) since further users of information are able to employ or transmit information is subject to increasing returns in use; and (C) information is not an infinitely divisible commodity. These difficulties in the supply of information, especially (A), lead to the well-known proposition that information, as an imperfect private good will be underproductive relative to what it would obtain if it were a perfect private good (Samuelson, 1954).

The importance of information was initally revealed in the early work by Stigler (1961). Information is such a critical common ingredient in the decision making process that its position in economic investigation has most often gone unnoticed. The treatment of this subject is most aptly described by Stigler (1968).

> One should hardly have to tell academicians that information is a valuable resource: Knowledge is power. And yet it occupies a slum dwelling in the town of economics. Mostly it is ignored: The best technology is assumed to be known; the relationship of commodities to consumer preference is a datum. And one of information-producing industries, advertising, is treated with a hostility that economists normally reserve for tariffs or monopolies (p. 171).

Economics of Information

The economics of information and knowledge begins by recognizing that an economic system is activated by decisions which link information flows to objectives. Traditional analysts have assumed that the firm has had access to available information concerning the demand for its product, input inventory conditions, and technology. The consumer was assumed to have thorough knowledge of current prices, the characteristics of the goods, and their tastes and preferences. The underlying problem with this traditional approach was it assumed that the price of goods is determinable if information such as tastes, preferences and current supply levels for each person in the market is known. The problem with the neo-classical structure of static value theory was that is ignored the individuals information level (Shackle, 1957). While this issue has received more attention, many troublesome questions have yet to be answered. The consumer of firm requires information about a world which is clouded with many issues and alternatives; with such an environment, existing efforts will be made to produce knowledge. When knowledge production is begun in an economy (with appropriate 'classical' properties) then even with simple modifications of neo-classical theory the optimality or existence of equilibrium is not assured (Marschak, Glennan, and Summers, 1967). If there exists any merit to this thought, the question must be raised as to the usefulness of the criterion of perfect competition in relation to a world in which the production of information and knowledge is widespread. Increased information could permit oligopolists to coordinate their actions more effectively. The greater stability so achieved could produce greater departures from 'competitive' prices (Dolber et al., 1968). In analyzing the value of information it is critical that the market structure of those using and producing information be examined.

Exchange or potential of exchange or relevance to exchange is what makes things commodities. It is from this point of view which economists would likely view information. Uncertainty is the key element which especially places information in the category of a commodity. Prices change with varying degrees in all markets, and unless a market is completely centralized, no one will know all of the prices which various sellers or buyers quote at any one time. A buyer (or seller) who wishes to ascertain the most favorable price must canvass various sellers (or buyers)--a phenomenon termed search.

The amount of dispersion of asking prices of sellers is a problem discussed later, but it is important to emphasize initially the fact that dispersion is ambiguous even for homogeneous goods. Price dispersion is a manifestation and indeed a measure of ignorance in market participants. This is so because there is never absolute homogeneity in a commodity if the terms of sale are included within the concept of the commodity.

At any time, there will be a frequency distribution of prices quoted by sellers. If search costs are high, the buyer seeking the quoted sellers. If search costs are high, the buyer seeking the commodity purchases from the first seller he contacts. But if the dispersion of price quotations of sellers is at all large (relative to the cost of search), it will pay on the average to contact several sellers. The frequency distributions of asking (and offering) prices have not been studied sufficiently to support any hypothesis as to their nature. Asking prices are probably skewed to the right, as a rule, because the seller of reproducible goods will have some minimum but no maximum limit on the price he can accept (Stigler, 1968). The expected saving from a given search will be greater, the greater the dispersion of prices. The savings will obviously be greater, the greater the expenditure on the commodity. Those individuals who possess the ability to have this dispersion information collected, will benefit by obtaining the highest price obtainable in the case of the sellers or discovering the lowest price present in the market in the case of the buyers (Chamberlain, 1952). That competition exists only in a world of incomplete information, and where wants are known, uncertainty disappears and monopoly is possible due to the possibility that exists for economies of size in market information. Thus the reason for the role which the U.S. Government plays in U.S. agricultural commodities.

Necessary Qualities of Market Information

In order for market information to be of any value it must possess such essential characteristics as those discussed below.

Accuracy

If a market forecast is to be of any value to market participants, it must possess the obvious quality of accuracy. If a forecast is found to be inaccurate, it will be discovered very quickly by market analysts and quickly ignored. In agricultural commodity markets where the margin between profit and loss is often an extremely thin one, accurate market information is important. Measuring the accuracy of forecasts can be done by numerous measures, all of which have their advantages and disadvantages. One means by which accuracy might be analyzed is by analysis of the mean square error (MSE). The MSE can be defined as MSE = Variance + $(\text{Bias})^2$. One study that examined agricultural commodity forecasts from various sources using MSE to measure accuracy is by Just and Rausser (1981). However, an unbiased forecast is often considered to be an important factor for accuracy. In this study a forecast is considered unbiased if the expectation of the forecast $\hat{y}_t$ given the information set at time t-1 equals the actual amount of y_t.

It would be expected that as the marketing year developed, errors present in a forecast would be systematically reduced. This would occur for two reasons. First, increased fixidity of market participants to take advantage of alternative production plans. As the growing year develops the alternatives which producers might choose becomes greatly reduced and in turn the ability of his decision to effect the market is reduced. The second reason is that as the year develops, more and more information becomes known about current conditions. Thus the ability of forecasters to predict actual amounts increases.

An essential element of a market forecast is reliability. The time and place of release must be common knowledge. It is desirable that any changes in the construction or tabulation of data be announced beforehand. The reliable forecasts must be produced in such a manner that all market participants have equal opportunity to exposure of the data, such that no one individual gains an unfair advantage. A reliable forecast is one which is produced punctually and informs users prior to any changes.

A desired characteristic of market forecasts is randomness of error or lack of autocorrelation in forecasts. Randomness in this case would be an error in one year is not allowed systematically to be a related error in the following year. This would produce an inequity in the market because large producers will, due to their greater research facilities, take note of this error and adjust for it, while small producers will be damaged by this problem.

Generation of Pertinent Information

A desirable characteristic, which is so obvious that it deserves little mention, is that the forecast be, in some way, applicable or relevant. If a forecast lacks this necessary quality its existence benefits no one and, if publicly produced, is a nuisance to society from an economic viewpoint. Thus its existence should be terminated.

Timeliness

If the element of timeliness were lacking from the necessary elements of a forecast, regardless of its other qualities, the forecast would lack dependability, thus diminishing its value. In order for a forecast to be considered timely it is critical that it provide market participants with market information when and where it is needed. After planting has taken place, most fixed and variable cost decisions have taken place. Therefore, the need for market information prior to this phase is critical. After this initial set of decisions the need for information diminishes. As the growing season progresses various harvesting decisions begin to arise and the need for information again increases. In order for a forecast to possess the element of timeliness, the frequency is of little importance. What is important is that the forecast occur at the most suitable and opportune time in the eyes of the users.

The purpose of this paper is to focus on this particular characteristic, timeliness. The study of this timeliness issue is desirable because of the economic considerations from both an administrative and producer standpoint. The purpose of this study is to determine when forecasts are of use to producers and the point when they are no longer beneficial economically.

CHAPTER III

ANALYSIS OF THE SUPPLY OF INFORMATION

Public Information

Reasons for Existence

Farming has evolved from a way of life to a specialized business. The agricultural producers in the twentieth century must combine the skills of a technician with the expertise of a business executive. In order to operate efficiently, effectively and profitably, producers must have access to accurate, and timely information which enables them to make feasible managerial decisions concerning production. This information must cover such areas as production, supplies, marketings, prices, export, weather, and a vast array of other inputs.

The Statistical Reporting Service (SRS) of the U.S.D.A. and its predecessor organizations have been collecting and disseminating current primary data on agriculture for more than a century. The SRS provides the channel for the orderly flow of this information dealing with the agricultural economy of the country. This agency, the primary fact-collecting and reporting organization of the U.S. Department of Agriculture, is responsible for the national and state crop and livestock estimates and related statistical information, and the coordination and improvement of the U.S.D.A.'s statistical program. Although the task over time has increased, the major objective has remained unchanged--to report the basic statistical facts of the nation's agriculture.

Flourishing economic periods and stable market prices have been less conducive to the shaping of the current information supply system than have times of economic instability. This is apparent when analyzing the relationship between expansion of the statistical services and periods of droughts, plagues and depressions. There arises a distinct underlying trend toward demands for more detailed, reliable data during economic ups and downs. This relationship can be explained by the spread of farming across the continent, to the greater commercialization of farming and agriculturally oriented industries, and to the accelerating developments of mechanization, specialization, automation and integration which have led to the development of modern agriculture.

History of Agricultural Statistics

On July 1, 1862, Issac Newton, who had previously headed the agricultural work of the patent office, was appointed the first commissioner of the Department of Agriculture by President Lincoln. The commissioner adopted the following "objectives" for the department:

1. Collecting, arranging, publishing and disseminating, for the benefit of the nation, statistical and other useful information in regard to agriculture in its widest acception.

2. Collecting from different parts of our own and foreign lands, such valuable animals, cereals, seeds, plants, slips and cuttings as may be obtained by exchange, purchase or gift.

3. Answering the inquiries of farmers and others on all matter related to agriculture.

4. Testing, by experiment, the value of different agricultural implements and their adaptation to the purposes intended, as well as testing the value of cereals, seed and plants, and their adaptation to our soil and climate.

5. Analysis, by means of a chemical laboratory, of various soils, grains, fruits, plants, vegetables, and manures, and publishing the results.

6. Establishing a professorship of botany and entomology.

7. Establishing an agricultural library and museum.

Organization of Statistical Reporting Service

The Statistical Reporting Service, under various organizational titles, has served agriculture for well over a century. The tasks and procedures have changed continually during the span to accommodate the needs and alterations of the industry.

SRS is a broad-based, nonpolicymaking organization headquartered in Washington, D.C., with State Statistical Offices serving all states. Responsibilities for a viable program, directed by the administrator, are shared by the Research, Survey and Estimates Divisions, the Crop Reporting Board, and the State Statistical Offices (SSO's).

The main responsibilities of SRS center on collecting, preparing and publishing regular series of crop and livestock estimates and data on related elements of farming (Table 1). SRS is also concerned with statistical research and improved methods of gathering, evaluating and processing information.

The letter X in Table 1 is used to denote the months which the report is released to the public, not necessarily when the information was gathered. In the case of the Prospective Plantings report, which is the report used chiefly in this study, the January report is usually issued in the second and third weeks of the month. The information contained in this report is based upon conditions existing as of January 1. The months of release varied for many of these reports

Table 1. Calendar of CROP, LIVESTOCK and PRICE REPORTS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crop Production (includes Annual Summary on Small Grains in December)......................	X	X	X	X	X	X	X	X	X	X	X	X
Prospective Plantings..........	X	---	X	---	---	---	---	---	---	---	---	---
Annual Crop Summary............	X	---	---	---	---	---	---	---	---	---	---	---
Winter Wheat and Rye Plantings..	---	---	---	---	---	---	---	---	---	---	---	X
Crop Values....................	X	---	---	---	---	---	---	---	---	---	---	---
Other field and seed crops												
Seed Crops-Annual Summary.......	---	---	---	---	X	---	---	---	---	---	---	---
Field Crops Disposition-Annual Summary......................	---	---	---	---	X	---	---	---	---	---	---	---
Grains Stocks in all positions..	X	---	---	X	---	---	X	---	---	X	---	---
Naval Stores...................	X	X	X	X	X	X	X	X	X	X	X	X
Peanut Stocks and Processing....	X	X	X	X	X	X	X	X	X	X	X	X
Popcorn........................	X	---	---	---	---	---	X	---	---	---	---	---
Potatoes, and Sweet Potatoes-Annual Summary, including Potato Sales, and U.S. utilization of Crop................	---	---	---	---	---	---	---	X	---	---	---	---
Potato Stocks..................	X	X	X	X	---	---	---	---	---	---	---	X
Rice Stocks....................	X	---	---	X	---	---	---	X	---	X	---	---
Seed Crops, Forecasts and Other Reports......................	X	---	X	---	---	X	X	XX XX X	---	XX	---	---
Soybean Stocks in All Positions.	---	---	---	---	---	---	---	---	X	---	---	---
Stocks of Hops.................	---	---	X	---	---	---	---	---	X	---	---	---

Table 1 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fruits and Nuts												
Apples-Production by Varieties...	X	---	---	---	---	---	---	X	---	---	---	---
Fruits, Citrus-Annual Summary....	---	---	---	---	---	---	---	---	---	X	---	---
Fruits, noncitrus, Annual Summary	X	---	---	---	---	---	X	---	---	---	---	---
Cranberries-Indicated Production 1:00 p.m. Release Time.........	---	---	---	---	---	---	---	X	---	---	---	---
Cherry Report...................	---	---	---	---	---	X	---	---	---	X	---	---
Vegetables												
Onion Stocks in Storage..........	X	---	---	---	---	X	---	---	---	---	---	---
Vegetables-Fresh Market..........	X	---	X	X	X	X	X	X	X	X	X	X
Vegetables-Processing...........	---	---	X	---	---	X	X	X	X	---	X	X
Cucumbers for Pickles, Stocks....	---	---	---	---	---	---	---	---	---	---	X	---
Celery Report (Fla., Calif., Ohio, N.Y., and Mich.)........	X	X	X	X	X	X	X	X	X	X	X	X
Milk and Dairy Products												
Milk Production.................	X	X	X	X	X	X	X	X	X	X	X	X
Milk-Production, Disposition, and Income, by States.......	---	---	---	X	---	---	---	---	---	---	---	---
Production of Manufactured Dairy Products..............	---	---	---	---	---	X	---	---	---	---	---	---
Dairy Products: Production of butter, cheese, frozen products, evaporated, condensed, dry milk and prices...........	X	X	X	X	X	X	X	X	X	X	X	X
Weekly American Cheese Production-Released at Madison, Wis.	---	---	---	---	Every Wednesday of the year					---	---	---
Weekly Creamery Butter Production-Released at Madison, Wis.	---	---	---	---	Every Wednesday of the year					---	---	---

Table 1 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Livestock and Livestock Products												
Cattle........................	---	X	---	---	---	---	X	---	---	---	---	---
Sheep and Goats...............	X	---	---	---	---	---	---	---	---	---	---	---
Meat Animals-Disposition and Income......................	---	---	---	X	---	---	---	---	---	---	---	---
Livestock Slaughter and Meat Production..................	X	X	X	X	X	X	X	X	X	X	X	X
Annual Summary............	---	---	---	X	---	---	---	---	---	---	---	---
Cattle on Feed................	X	X	X	X	X	X	X	X	X	X	X	X
Hogs and Pigs.................	---	---	X	---	---	X	---	---	X	---	---	X
Sheep on Feed.................	X	---	X	---	---	---	---	---	---	---	X	---
Wool and Mohair Production and Value......................	---	---	---	X	---	---	---	---	---	---	---	---
Lamb Crop and Wool Production..	---	---	---	---	---	---	X	---	---	---	---	---
Wheat pasture (in Crop Production)..................	---	---	---	---	---	---	---	---	---	X	X	X
Honey reports.................	X	---	---	---	---	---	---	---	X	---	---	---
Mink, number pelted, females bred.......................	---	---	---	---	X	---	---	---	---	---	---	---
Poultry and eggs												
Chickens and Eggs and Commercial Broilers, Disposition	---	---	---	X	---	---	---	---	---	---	---	---
and Income..................	---	X	---	---	---	---	---	---	---	---	---	---
Commercial Broilers Produced and Broiler Chicks Placed in 21 States...................	---	X	---	---	---	---	---	---	---	---	---	---
Egg Products-Liquid, Frozen, Solids, Production..........	X	X	X	XX	X	X	X	X	X	X	X	X
Eggs, Chickens, and Turkeys....	X	X	X	X	X	X	X	X	X	X	X	X
Layers, and Egg Production.....	---	X	---	---	---	---	---	---	---	---	---	---

Table 1 (Continued)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hatchery production............	---	---	X	---	---	---	---	---	---	---	---	---
Poultry-Slaughter and Processing.........................	X	X	X	X	X	X	X	X	X	X	X	X
Chicken Inventory												
Eggs, Chickens and Turkeys	X	---	---	---	---	---	---	---	---	---	---	---
Turkeys........................	X	---	X	---	---	---	---	X	X	---	---	---
Weekly Turkey Hatchery Report-released in 9 States concerned..........................	---	---	---	---	Every Thursday of the year					---	---	---
Weekly Broiler Hatchery Report-released in 21 States concerned..........................	---	---	---	---	Every Thursday of the year					---	---	---
Other reports												
Agricultural Prices............	X	X	X	X	X	X	X	X	X	X	X	X
Prices Received by Farmers for Manufacturing-Grade Milk in Minnesota and Wisconsin......	---	---	---	---	---	---	X	---	---	---	---	---
Cold Storage..................	X	X	X	X	X	X	X	X	X	X	X	X
Commercial Fertilizers monthly.	X	X	X	X	X	X	X	X	X	X	X	X
Flowers and Foliage Plants, 22 States......................	---	---	X	---	---	---	---	---	---	---	---	---
Farm Labor.....................	X	X	---	---	X	---	---	X	---	---	X	---
Farm Numbers and Land in Farms.	X	---	---	---	---	---	---	---	---	---	---	X
Mushrooms.....................	---	---	---	---	---	---	---	X	---	---	---	---

over the time period of the study. The reporting month shown is that period used the majority of the time, during the time frame of the study. Table 1 easily shows the importance of analyzing the element of timeliness. One case is the report's dealing with winter wheat plantings.

Winter wheat planting occurs uniformly across the wheat producing states usually in the months of August and September, depending on weather conditions. Once the planting process has occurred producers have incurred the majority of their cost, with very few alternatives available to them at this point. It would be extremely helpful to producers if they had some idea of the intentions of their peers prior to planting. But the only forecast concerning this area occurs in December, far too late for it to be of any help to winter wheat produers.

The Statistical Reporting Service frequently performs technical assignments for other federal or state offices in addition to limited services for agriculturally related private industry on a reimbursable or advance-payment basis. These services consist primarily of surveys and related statistical data collection activities. SRS also participated in the Agency for International Development's foreign-visitor program, and provides technical consultation and support in developing countries for agricultural estimating programs.

The primary functions of the Research Division are to develop new and improved collecting, estimating, and forecasting methods for agricultural statistics and to encourage the use of sound statistical techniques through the U.S.D.A. The Division devises improved sampling techniques and methods of controlling sampling errors, constructs area and list sampling frames, and researches nonsampling errors stemming from questionnaire wording, enumerators' interviews, or other causes. New models for assessing the yield of field and crops and the application of remote sensing in identifying crops, land use and acreage measurements are investigated. The Division publishes the results of its research.

The Survey Division is responsible for preparing and establishing procedures used by the SSO's in collecting data by mail and enumerative surveys, and for the objective yield measurement program. The Division designs and tests survey techniques, including forms and questionnaires, writes data collection instructions, and conducts training schools for enumerators.

The Division also conducts data collection activities for other U.S.D.A. and federal or state agencies on a reimbursable basis.

The Estimates Division is the primary source in SRS for agricultural statistics, including their analysis and interpretation, for use by the Crop Reporting Board in making estimates and forecasts of the nation's agriculture. The Division evaluates commodity statistics, determines needs, and implements proper statistical plans in support of the crop and livestock reporting program, and ensures that appropriate methods and procedures are used in all phases of the program.

The Crop Reporting Board reviews and adopts official state and national estimates for crops and livestock as required by U.S.D.A. regulations. The Board includes a Chairman, the SRS Deputy Administrator; a Vice Chairman, the Estimates Division Director; a Secretary, and the Chief, Data Services Branch, Survey Division.

The State Statistical Offices are the primary data collecting, processing, evaluating, estimating and publishing units of SRS. Following prescribed procedures, they conduct surveys and recommend statistical estimates for their states and counties to the Crop Reporting Board. These estimates, after Board review and adoption, become part of the national, state and county data series.

Methods of Collecting and Processing Data

Introduction

The data collection program of the Statistical Reporting Service consists of a series of surveys designed to produce current agricultural statistics of acreages, yield and production of crops and other information pertaining to the agricultural economy. The majority of this information is collected from farmers through various sampling and surveying methods. Changes in the structure of American agriculture have necessitated significant changes in SRS survey methods. One of these was the shift from subjective nonprobability mailed questionnaires to an objective or enumerative data collection system to supplement the mail approach.

Data Sources

The most important source or survey data is the farm operator who voluntarily supplies information about his particular farming operation. The number of farmers involved in the measurement process depends on the sampling technique employed. If a preselected probability survey is employed, where responses are collected by personal interviews, telephone or mailed inquiry, only a small number of producers may be contacted. Surveys where the mailing technique is used, involve a large sample of producers. Surveys are often made of those businesses which supply and serve agriculture. These firms often provide valuable data on quantities marketed or processed, which may be used as a check against earlier estimates made from sample surveys. Important information is also provided by census, such as United States Census of Agriculture, State Farm Censuses, Producers Associations, railroads, irrigation projects, Financial Agencies Service Farmers and others.

Methods of Data Collection

Mail Survey

The principle advantage of mail surveys are their relatively low cost compared with other information collection methods such as interview and enumerative surveys. Besides the advantage of low cost the turnaround time between mail out and the availability of survey results is very attractive.

One limitation of the mailed response is the large percentage of nonresponse. As agriculture has developed and specialization of production has occurred the large-scale mail surveys are no longer a satisfactory means of obtaining data, for respondent and nonrespondent farms are more likely to be dissimilar. Years ago most neighboring farms grew similar produce and characteristics of respondent and nonrespondent farms did not differ greatly. For this reason emphasis has shifted from sole reliance on large-scale nonprobability mail surveys to greater dependence on more scientific procedures. The mail survey technique is still applicable in those areas where variability of the data to be reported is limited, and where the survey is restricted. Cases where this situation is present are crop surveys to measure prices received and paid by farmers. Mail surveys are basically concerned with two types of information: data relating to a specific farm and data relating to agricultural conditions in specific localities.

Enumerative Surveys

Enumerative surveys require the collection of survey data pertaining to specific land areas. Each year the SRS employs and trains about 1,500 individuals to carry out these enumerative surveys. At least 30 enumerators are usually employed in each state on a part-time basis. All enumerators are trained by statisticians prior to survey work so that consistency and accuracy in data collection may be maintained.

The June Enumerative Survey (JES) is conducted annually in the 48 conterminous states during the last week of May and the first week of June. The basic frame sample used by SRS includes about 16,300 area segments. The number varies by state according to land area, importance, and diversity of agriculture.

An annual July survey uses a subsample of 11,000 JES tracts to update planted and harvested acreage estimates based on the JES. This survey also serves as a quality check of information obtained in the JES. Data is collected by personal enumeration during July for use in publishing current acreage estimates with the August 1 crop production report.

December Enumerative Survey is conducted annually in 48 states during the last week of November and the first week of December.

Operators of 20,000 tracts are personally visited by enumerators who obtain information in the same manner as the June survey. This December survey emphasizes collecting information for estimating. Livestock and poultry inventories, pig and cattle births, death and number of head butchered for home consumption, and acreage of fall-seeded wheat and rye. The survey is also used to estimate incompleteness of farm operator lists in the 29 states with multiple-frame livestock surveys and in the 10 states with white corn acreage and production surveys.

Multiple-Frame Surveys

The SRS is finding many applications for multiple-frame techniques which follow principles of probability sampling. The use of a list frame which represents a significant portion of the universe of interest enables a great deal of the data to be collected inexpensively by mail. Telephone interviews are widely used to obtain data from nonrespondents and to clarify questionable data submitted by mail.

Multiple-frame methods were used in livestock surveys starting in 1967 to provide cattle and hog estimates with sampling errors of 1 percent or less at the U.S. level. Results included improved reliability of state estimates over those obtained from either area frame surveys or nonprobability mail surveys.

Objective Yield Survey

Although crop acreages for specific commodities change from year to year, some of the variations in crop production are caused by fluctuations in the yield per acre. For almost 100 years, yield forecasts were based on voluntary producer appraisals of expected yield. This survey technique generally produced satisfactory crop forecasts and continues to be used. Large yield variations, however, are many times not fully reflected in grower's subjective appraisals. This problem led to the development of objective methods to forecast and estimate yields of major crops in the national program. Objective procedures included actual counts and measurements of plant characteristics in sample fields by trained enumerators, and laboratory analysis of fruit from the crops.

For the national objective yield programs, a sample of fields enumerated in the June or December surveys is selected for making counts and observations. Theoretically all fields of crop have a probability of selection proportional to acreage. This provides a self-weighting sample which simplifies estimation and summerization. The location of plots within the fields is determined in a random manner before entering the field so that all areas of the field have equal probabilities of being selected and potential biases are minimized.

Preparing a Report

In December each year, the date and hour of the release of each SRS-Washington, D.C. report for the coming year is announced. With few exceptions reports are issued by a designated release officer at the specified time. The State Statistical Offices make the national and state information available immediately after the Washington release.

The major sources of reliable information for crop and livestock estimates are directly associated with agriculture-producers, hatcherymen, feeders, slaughterhouse managers, meat and poultry inspectors and grain elevator operators--the same people who are extensive users of SRS data.

Information is collected by various methods: mail surveys, telephone, personal interview and through observation in selected fields. Individual reports from respondents are held confidential by the agency and are used only to develop the estimates. Information for estimates represents the combined efforts of both State Statistical Offices and Washington, D.C. personnel.

Mail surveys based either on nonprobability or probability samples are widely used to provide statisticians with general information on an array of agricultural activities. Mail surveys with nonprobability samples are quick and economical but cannot, alone, provide all the information needed for accurate estimates. For example, not all farmers in the sample respond to the questionnaire; and those who do may not be representative of the full group because of differences between their farms and others not in the sample.

To overcome the weakness in this type of mail survey, SRS has increased its use of probability sampling techniques. Statistical theory provides a basis for selecting samples so that the chance, or probability, of each farm or farmer being in the sample can be computed. This offers two advantages. First, if data are collected from all farms in a probability sample that represents a true cross section of U.S. farms, the estimates are not biased as they may be when the sample is not representative; second, a probability sample provides information for computing sampling errors. Thus estimates can be made with a known degree of precision.

In the State Statistical Offices, data from the surveys are edited, summarized, and analyzed, and then expanded into state indications. State statisticians prepare initial forecasts or estimates and transmit them for review, with appropriate supporting material and comments, to the Crop Reporting Board.

Statistics prepared by SRS are based on sample surveys rather than on census counts (complete enumerations). While crops are still growing and before harvest, expected yield and production data are called "forecasts". After harvest is complete and end-of-season surveys have been made, these crop statistics are called "estimates".

Estimates of production of corn, wheat, cotton, soybeans and sweet oranges, and the supply of grain in storage are defined as "speculative". These commodities are heavily traded on commodity markets and anyone having early access to official estimates would have an obvious advantage in trading. Precautions are taken to prevent unauthorized access to such information before its official release. Reports from surveys on the speculative commodities from the major producing states go through the mails in distinctive envelopes and receive special handling. When they arrive at U.S.D.A. in Washington, they are placed in a special steel box secured by two locks. One key is held by the Office of the Secretary of Agriculture and the other by the Secretary of the Crop Reporting Board.

Early on the morning of crop report day, the Chairman and a representative of the Secretary, escorted by a U.S.D.A. guard, open the box, remove the reports, and take them to the Board rooms.

While the reports are being prepared, the area is isolated and guarded. Doors are locked, the window blinds closed and sealed, and all telephones disconnected. Food is sent in. Only authorized persons may enter, and no one leaves until the report is released.

Commodity indications from the State Statistical Offices are reviewed by the specialists in the Estimates Division and those serving on the Crop Reporting Board to arrive at official state estimates and a national total.

While certain reports are designated "nonspeculative"--livestock and poultry numbers, vegetables, potatoes, agricultural prices, cold storage holdings and others--strict security precautions are still imposed. Although not prepared behind locked doors, material for these reports is worked on in restricted areas and access by unauthorized persons is denied. These estimates, too, are reviewed by the Crop Reporting Board before release.

Shortly before the lockup report is to be released, the Secretary of Agriculture or his representative enters the Board room for his first look at the commodity estimates, and receives a briefing on the report, which has been printed inside the lockup. He then signs the report.

Minutes prior to release time, the Chairman, Secretary, and a limited number of Board members take copies of the report to the newsroom outside the locked area. No communication with anyone is permitted. Reporters from wire services, newspapers, radio, television and brokerage houses wait behind a restraining line for copies of the report. The reports are made available to all at the same time.

Crop Statistics Provided

The Department of Agriculture through the SRS produces more than 500 times a year various statistics covering a variety of commodities. More than 100 of these reports deal with crop information including acreage planted, crop production estimates for the current marketing year, revisions of past production estimates, current crop conditions, the effect of impending agricultural legislation and current import and export figures, and the status of factors which influence crop supply (Table 1). The Economics, Statistical and Cooperative Service produce more than 200 reports dealing with various aspects of the livestock industry. The frequency of these reports varies from weekly to monthly and even annually. As in the crop reports, these reports cover the livestock industry. The ESCS produces 271 various reports dealing with industries interrelated to the system and pertaining to the movement and distribution of agricultural produce from producer to consumer. These reports deal in such varied areas of interest as cold storage and to commercial fertilizer porduction levels. With the numerous and diverse number of forecasts published, there seems to be little validity to the argument that the government does not produce an adequate amount of pertinent information. These reports are not published solely for the purpose of increasing the productivity of farmers, although that is one of its duties. But it is generated to compensate an inequity in the information process which is inherent in the agriculture market structure.

Acreage, Yield and Production

Acreage and yield are the two components used in forecasting and estimating production and are significant to sound agricultural research, planning and program administration. Acreage reports help farmers plan and adjust their operations, serve as direct measures of land utilization and point out demand for various farm production supplies and labor.

Prospective Plantings

The SRS acreage series for spring-seeded crops begins with the prospective planting estimates. These estimates are based on mail surveys, with approximately 390,000 farmers receiving questionnaires regarding spring planting plans. Normally one-fourth of the questionnaires are returned; they are the basis for computing acreage indications.

Participating farmers in about two-thirds of the states receive a questionnaire asking for the number of acres planted the previous year and acreages they intend to plant in the coming season (historical/current questionnaire). Producers in the remaining states are asked to supply only current-year acreage plans. The state indications computed for each crop from the individually farm-reported data include (1) ratio to all land in farms, (2) ratio to cropland (in some western states), (3) percentage change from the previous year based on matched reports, and (4) percentage change from the previous year based on the current report of acres planted in the current year in states using the historical/current questionnaire.

The percentage change indication, based on matched reports, is computed in all states using the current-year questionnaires. The match with corresponding farm reports received from identical farmers the previous year is a major task without automated data processing systems. The task of computing the percentage change indications is simplified, however, when the historical/current questionnaires are used, because data for both years appear on the same questionnaire. One disadvantage of this type of questionnaire is that data reported by farmers for the preceding year are often subject to error because of memory bias or other reasons. The shift from the use of the historical/current questionnaire to the "current-year" questionnaire is being made in additional states as sampling and data processing capabilities permit. The change eliminates the memory bias problem and reduces respondent burden for reporting farmers.

The estimates are based on interpretations of the survey indications for each state. The national estimates are obtained by summing the individual state estimates. Differences between reported intended plantings and actual plantings can vary considerably, depending on changing circumstances. Changes in either economic or weather conditions can result in considerable shifts from early plans.

Both probability enumerative and nonprobability mail surveys are conducted to establish midyear planted acreage estimates, but only nonprobability mail surveys are carried out for the prospective planting acreage estimates. The advantage of the added precision possible with the more costly probability survey is negligible for estimating prospective plantings, because such precision would in many cases be nullified by the greater differences resulting from changes in producers' plans between survey time and actual planting.

Midyear Acreages

Major nationwide enumerative and mail surveys are conducted about June 1 to establish estimates of spring planted acreages and acreages for harvest. The results are released in the July Crop Production Report.

Acreage questionnaires are mailed to approximately 470,000 producers; about one-third of the questionnaires are returned and are used in computing the indications. Additional special questionnaires go to growers of certain crops (such as dry beans and peas) to assure an adequate sample size for crops with relatively few producers. The same kinds of indications are computed from this mail survey as for the prospective plantings surveys. Regression charts are used to evaluate the indications from the mailed surveys in setting the estimates.

The June enumerative survey includes acreage data on about 0.6 percent of the total U.S. land area. The primary indication from this survey is the direct expansion of reported acreages. Additional indications obtained from the June enumerative survey include a ratio of current year data to the previous year's data for those area segments that were enumerated both years, and a ratio-to-land indication.

The size of the area frame sample was established to obtain a relative standard error of 2 percent at the national level and about 6 percent at the state level for the direct expansion for major crop acreages. For corn, the most widely grown crop, the standard error is nearer 1 percent at the national level and less than 6 percent for major producing states. The standard errors for soybeans, winter wheat and oats are near 2 percent, and cotton near the 3 percent level for the nation. The relative standard errors for minor crops exceed those for the major commodities.

The Crop Reporting Board sets the national estimates for major crops, using the June enumerative survey expansions and the mail survey ratio-to-land and percentage change from the preceding year's indications. This procedure utilizes the enumerative survey expansions at their greatest level of precision. State estimates are reviewed by the Board and adjusted to add up to the national estimates.

Prior to the initiation of the enumerative survey in the mid-sixties, state estimates were established individually and added to obtain the national totals. Estimates of planted acreages and acreages for harvest for less widely grown crops are still established on an individual state basis and summed to the national total. The enumerative survey has expanded data for those crops having larger relative errors and limited the value of first establishing national levels. Special surveys of known growers of many of these crops supplement the general purpose surveys to provide the needed reliability at the state level.

The estimates of planted acreage published in the July Crop Production reports are normally not changed during the crop season. However, if planting is incomplete when the survey is taken in June, additional information is collected in July from a subsample of those reporting in June. A ratio indication of change from the June survey is computed and summarized at the state and national levels. Revised estimates of planted acreage are made and published in the August Crop Production report when the July survey shows that revision is needed.

Midyear estimates of harvested acreage are based on reported acres for the earliest harvested crops, such as the small grains. For the later harvested crops, such as corn and soybeans, normal allowances are made for abandonment and acres used for other purposes. The estimates of acreage for harvest are subject to revision monthly, although they usually remain unchanged through the season. Current monthly acreage indications are obtained from the objective yield measurement program for corn, cotton, wheat and soybeans, and for other crops from special surveys conducted when unusual weather or economic conditions occur that could result in changes in the acreage to be harvested.

Forecasts of Yield and Production

Forecasts of expected yield and production are issued during the growing season and estimates are issued at season's end. Forecasts and estimates are considered by SRS to be two distinct concepts. Forecasts relate to an expected future occurrence, such as crop yields expected from actual harvest of the crop. Estimates generally refer to an accomplished fact, such as crop yields, after the crop is harvested.

The first forecasts of yield and production are made in the December preceding harvest for winter wheat; in July for corn, flue-cured tobacco, spring and durum wheat, and other small grains; and in August for later harvested crops, such as cotton, hay, peanuts, rice, sorghum, soybeans and sugar. Winter wheat forecasts are made again in May and monthly thereafter through the season; forecasts for most other major crops are made monthly following the initial forecast.

The monthly forecasts are based on indications obtained from both probability surveys. Crop reporters provide subjective appraisals of local crop conditions and expected crop yields. General mail questionnaires are sent monthly to about 75,000 crop reporters and normally about one-third are received and summarized. In addition, to supplement the general surveys, special questionnaires are sent to known producers of some crops which are grown in limited areas. Enumerators make objective yield counts in sample fields of approximately 3,200 corn fields, 2,500 cotton fields, 1,700 soybeans fields, and 2,500 wheat fields.

The Crop Reporting Board adopts corn, cotton, soybean and wheat forecasts for major producing states by first establishing regional levels, utilizing indications from the probability objective yield measurements and from nonprobability mail surveys. The individual state forecasts within the region are then adjusted to add up to, within rounding limits, the regional levels on the basis of the individual state indication. The forecasts of these crops for the smaller producing states are established individually, based on their respective survey indications, as are all state forecasts for crops not in the objective yield measurement program.

State yield forecasts are adopted and multiplied by the current state acreages for harvest to establish the state production forecasts. The sum of the state production forecasts is then divided by the sum of the state harvested acreages to derive the U.S. yield forecast.

A "limited-forecast" program was initiated in 1971 for most crops to conserve resources. The states of least production for each crop--those which individually account for less than 1 percent and collectively account for less than 5 percent of the U.S. production--are designated "limited-forecast" states for the crop. The initial forecast of the season is made for a crop then carried forward unchanged in the succeeding monthly forecasts for these states. No new survey data are collected until the end-of-season surveys are made for the estimates published in the annual crop summary. This limited-forecast program was adopted only after study indicated that the program would not significantly affect the reliability of the national forecasts.

Reported Condition

One of the original statistical activities of the U.S.D.A. was the reporting of condition of crops during the growing season. Later, about 1880, the concept of normal condition was initiated, with "100" used to designate normal condition. The concept is still used for the early season forecasts when crop development has not advanced to the stage where farmers can reasonably evaluate their plantings and report expected yield.

Crop reporters are instructed to "Report the condition of crops now, as compared with the normal growth and vitality you would expect at this time, if there had been no damage from unfavorable weather, insects, pests, etc. Let 100 percent represent a normal condition for field crops." The "normal" condition of a crop varies from one locality to another with differences in soil and climate. It also changes slowly in the same locality because of changes in varieties, cultural practices and soil fertility.

Shifts in the reported condition alone do not fully explain trends in yields. Multiple-regression charts are used for some crops, with time as a separate variable to allow for trend. A simple regression of condition-versus-estimated yield is charted and deviations from the regression line are plotted against time on another graph. Chart readings of current condition indications combine the regression value with an increment for trend read from the deviations-against-time chart.

Reported Yields

As the crops near maturity, crop reporters are asked to report the probable average yield in their localities. Averages of crop reporters' expectations of yield are translated into yield forecasts by means of regression charts on which final yields are plotted against reported probable yields for a series of years.

The objective yield data collected for corn, cotton, soybeans and wheat include monthly plant and fruit counts.

The possibility of using weather data to forecast and estimate crop yields has been investigated on numerous occasions for most sections of the United States. The effects of weather and cultural factors are so complex that weather data alone do not provide a practical basis for estimating prospective crop yields per acre. Usually the effectiveness of rainfall is reflected in the reported condition or expected yield of a crop.

Rainfall data have, however, proved useful in estimating the winter wheat and soybean crops, especially in areas where precipitation is very influential in determining the final yield. The total rainfall during certain months has been used together with the reported condition or probable yield to reflect some measure of the ability of the crop either to respond to additional moisture or to withstand deficient rainfall. Multiple-regression equations are used with reported conditions or probable yield, rainfall during specific months, and time as separate variables in the equation, which is:

$$Y_c = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \qquad (3.1)$$

in which

Y_c = computed yield per acre,

x_1 = reported condition, or probable yield per acre,

x_2 = precipitation for specified months prior to the date of forecast,

x_3 = precipitation for specified months after date of forecast,

x_4 = time, and

b_i = multiple regression coefficients.

A forecast of prospective yield or production on a given date assumes that weather conditions and damage from insects or other causes will be about normal (or the same as the average of previous years) during the remainder of the growing season. Forecasts based on current conditions and objective counts may be appraised accurately. However, if weather, disease, insects or other conditions change, the final estimate may differ significantly from the earlier forecast. The corn crop forecasts of 1970 and 1972 are examples of such changes. In 1970 the corn blight appeared after the August crop survey and the final U.S. corn yield was 8.5 bushels below the August forecast. An opposite situation occurred after August 1, 1972 when nearly ideal moisture and temperature conditions improved prospects and the final U.S. corn yield was 10.5 bushels above the August 1 forecast. The difference between the August 1 forecasts and the final estimates would have been smaller in these years if normal conditions had prevailed after August 1.

End-of-Year Estimates

The harvested acreage, yield and production estimates are based on acreage and production (A&P) mail surveys and for wheat on final objective yield data. The mail surveys are conducted after most of the field crops have been harvested. Most states conduct two general A&P surveys, one in August or September for small grains and another in November or December for the later harvested crops. However, in a few states the crop harvest periods permit conducting only one A&P survey for all crops. Separate surveys of known producers are conducted for some crops not widely grown, or grown only in limited areas of a state, to supplement the data collected on the general surveys covering several crops.

The principal indications computed from the A&P survey for harvested acres are (1) ratio to land, (2) ratio to cropland (some states), (3) percentage of planted acres utilized for grain, silage (for crops), and abandoned. The A&P yield indications are derived by dividing the reported production by reported acres harvested. The final yields obtained from the objective yield surveys of corn, cotton, soybeans and wheat are based on production havested from the sample plots by enumerators, less harvesting losses (which are determined after farmer harvest of the crop by gleaning other nearby sample plots newly selected for that purpose).

Regression charts are used for interpreting the A&P mail survey indications to minimize the effect of biases that are present becuase of selectivity in the list and responses. The A&P survey indications and final objective yield data are the primary data sources considered in establishing the preliminary estimates. Consideration is given to prior survey results and other available data. Supplemental information is obtained for certain crops from dealers and factories that contract acreage or production. Sugar beet factories, for instance, provide useful data on planted and harvested acreage and production.

Estimates are established on an individual state basis. The national levels of harvested acreage and production are the sum of the individual state totals; the U.S. yield is derived by dividing the U.S. production by the U.S. acreage for harvest.

Revised Estimates of Acreage, Yield and Production

Estimates for all crops are subject to review and revision, if necessary, at the end of the crop marketing year. Revisions for the preceding year's crop are published for peanuts in the April Crop Production report, for cotton and tobacco in May, for sugar crops in June, and for dry edible beans, rice and small grains in December. Revisions for most other field crops are published the following January in the Crop Production Annual Summary.

The revisions, when made, are based on data that become available after the preliminary crop estimates. Such check data may include reports on cotton ginnings, soybean and flaxseed crushings, tobacco marketings and peanut inspection. Some state assessors' reports provide check data on acreage. The preliminary estimates are viewed in the light of such check data and revised when necessary. A reevaluation of the earlier indications is performed and revisions are made in acreage and/or yield, when appropriate, to harmonize production levels with check data and original survey indications. Further review and revision are not considered until the next census of agriculture.

Corn

The corn estimating program includes indications of the crop planted for all purposes; harvest acres, yield and production for grain and silage; and acres harvested as forage (Table 2). Corn forage includes acreage hogged, grazed or cut dry and fed without removing the ears from the stalk.

Estimates of acreage for harvest as grain are made for July and August. Corn-for-grain forecasts of yield per acre and production are made initially in August in 41 states. New forecasts are made in September, October, and November for 19 states that account for

Table 2. Calendar of CORN CROP REPORTS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Corn, all												
Planting intentions.........	X[a]	---	---	X	---	---	---	---	---	---	---	---
Annual Summary (Acreage, yield, production)........	X	---	---	---	---	---	---	---	---	---	---	---
Indication Area (harvest, yield, production)........	---	---	---	---	---	---	X	X	X	X	X	---
Plant Production............	---	---	---	---	---	---	---	---	---	---	X	---
Monthly Marketing...........	---	---	---	---	---	---	---	---	---	---	---	X
Planting Information (Row, width and variation)	---	---	---	---	---	---	---	---	---	---	X	---
Grain Stocks...............	X	---	---	X	---	X	---	---	---	X	---	---

a/ As of June 1.

approximately 95 percent of the U.S. crop. The August forecast is carried forward unchanged in succeeding forecasts for the 22 limited-forecast states.

Objective Yield Measurement of Corn

Corn objective yield surveys are conducted monthly during the growing season for 19 major states. Sample plots are carefully located and marked in each sample field. Stalk and ear counts and measurements are made monthly in the plots.

The two components used in forecasting yield from objective measurements are number of ears and weight per ear. Early in the growing season it is necessary to forecast each of these components. Two models are used to forecast number of ears. Both use linear-regression equations relating three years of historical data of early counts to number of ears finally harvested. One model forecasts number of ears, based on stalk counts; the other uses the ratio of stalks with ears to total stalks for predicting the ratio of ears and ear shoots present to the expected number of ears at harvest.

The models, developed state by state, depend on maturity of the corn at the time the sample is visited. For samples in the earliest stages of development, only the model using stalk count is used; both models are used for fields in a more advanced stage. One model is based on average lengths of kernel row in five sample ears. The other model uses the average length measurements made over the husks for ears in one row of the plot. The two predictions of ear weight are then weighted together, using weights based on their respective coefficients of determination, R^2, which reflect the precision expected for each of the two models. For samples in the early stages of development, the 3-year historical average ear weight for the state is used instead of the forecasted ear weight.

At maturity, the corn in the sample plots is harvested, counted and weighed to determine the yield of the sample. Two of the harvested ears are selected at random to determine moisture content and shelling percentage. After harvest, separate sample plots in the same sample fields are gleaned to indicate harvesting loss. Estimates of these losses are computed and subtracted from the biological (gross) yield determined from the harvested plots to determine net yield per acre. A bushel of corn is defined as 56 pounds of shelled grain with 15.5 percent moisture content.

Indications for forecasting corn yield are also obtained on the monthly general mail surveys of volunteer crop reporters in all states. Condition of the crop or probable-yield data are collected, depending on the maturity of the crop. The initial forecast made for limited-forecast states is based solely on these mail survey indications.

Winter Wheat

About three-quarters of all wheat produced in the United States is the winter wheat type. Of the 42 states included in the winter wheat program, 24 states accounting for about 97 percent of the crop make forecasts in December and from May through August. A September forecast also is issued for Montana, Idaho, Washington and Oregon, with the August forecast carried forward for other states. For the 18 limited-forecast states, forecasts are made in December, May and July.

Table 3. Calendar of WHEAT CROP REPORTS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Field Crops:												
Wheat, all												
Planting intention......	X[a]	---	---	X	---	---	---	---	---	---	---	---
Annual Summary (acreage, yield, products)[b]...............	X	---	---	---	---	---	---	---	---	---	---	---
Indicated area (harvest, yield, production)....	---	---	---	---	X	---	X	X	X	X	---	---
Products by classes (U.S.)................	---	---	---	---	---	---	X	X	X	X	---	---
Seeded Wheat Available for Grazing..........	---	---	---	---	---	---	---	---	---	---	X	X
Monthly Marketing.......	---	---	---	---	---	---	---	---	---	---	---	X
Seeded Acreage (Current Year)[c]................	---	---	---	---	---	---	---	---	---	---	---	X
Indicated and by classes (U.S.)................	---	---	---	---	---	---	---	---	---	---	---	X
Grain Stocks............	X	---	---	X	---	X	---	---	---	X	---	---

a/ As of June 1.

b/ For the two previous years.

c/ For following year.

Production forecasts are first published in December for winter wheat, in July for spring wheat and rye, and in August for rice. The end-of-season estimates for these crops are published in the December Crop Production report and the Crop Production Annual Summary.

Winter wheat objective yield surveys are conducted in 15 states that account for 90 percent of the total crop. The mail surveys provide the sole basis for the forecasts in 27 states with lower production.

Objective yield surveys begin May 1 in 11 states and June 1 in Idaho, Michigan, Montana and South Dakota. The monthly surveys are continued through the season until the sample fields are harvested.

Sample fields are selected from the December and June enumerative surveys, except in Texas, where the sample is selected from a fall probability acreage and production survey. Two sample plots are laid out in each selected field. Each plot includes three rows 21.6 inches long. Field enumerators use U-shaped frames measuring 21.6 inches between 4-inch arms to lay out the plots. Stalk and head counts are made monthly throughout the season and samples of heads are clipped and sent to state laboratories for analysis as the crop nears maturity.

Two statistical models are used for forecasting each of the yield components (head weight and number of heads). These regression models are based on the relation between counts and measurements of plant characteristics made at selected times during the growing season and actual counts, measurements or weights made for identical sample plots at harvest.

Early in the season, the major independent variable used to forecast expected number of heads is the stalk count. Later, the count of stalks 10 inches tall or taller and the number of heads emerged or in the boot stage of development provide independent variables for predicting the number of heads expected at harvest. A count of spikelets provides the first indication of head weight. Prior to the formation of the heads in the boot, historical 3-year averages are used for head weights. When the wheat plant reaches the late stage of development, the actual count of kernels is used for predicting final head weights. The coefficient of determination is computed for each regression model and is used to weight the two forecasts together for each component.

The same plots are harvested when the field reaches the hard dough or ripe state, the number of heads is counted, and average grain weight per head and moisture content are determined for each sample. The number of heads is expanded to heads per acre, and grain weight per head is adjusted for moisture content. These actual yield components are then expanded by the model to determine final biological (gross) yield per acre. Harvesting losses determined by sample gleanings are then subtracted to arrive at net harvested yield. A bushel of wheat for yield forecasts and estimates weighs 60 pounds at 12 percent moisture content.

Durum and Other Spring Wheat

About one-quarter of all wheat produced in the country is planted in the spring, mostly in the West, North Central and Northwestern states. Durum wheat represents about one-fifth of the total spring crop and estimates are made for five states, including one limited-forecast state. Estimates for other spring wheat are made for 12 states, 6 of which account for 99 percent of the crop. The remaining are limited-forecast states.

Monthly production forecasts are published in the July, August, September and October Crop Production reports. The July forecasts for seven limited-forecast states are carried forward without change in the succeeding forecast reports.

The spring wheat objective yield procedures are similar to those discussed earlier under winter wheat.

Soybeans

Soybeans estimates relating to acreage planted for all purposes, harvested acres, yield and production are normally made for 30 states that account for virtually all the U.S. crop. Production forecasts are made monthly from August through November for 18 major states. For 12 states, a limited forecast of production is made in August and carried forward in the succeeding months (Table 4).

Currently, 14 states producing over 90 percent of the U.S. crop are in the soybean objective yield measurement program. Sample fields are visited for the first time for the August 1 forecast in six North Central states that account for about two-thirds of total production. All 14 states are visited for the September 1 forecasts. Sample plots consisting of two rows 3 feet long are carefully located in each field selected. Counts of plants blooms, pods and lateral branches are made in the plots monthly thereafter.

The gross yield is forecast for each sample on the basis of plants per unit area; pods with beans per plant; and weight of beans per pod with beans. Harvesting loss is subtracted from gross yield to arrive at the net yield.

Table 4. Calendar of SOYBEAN CROP REPORT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Field Crops												
Soybeans												
Planting intention......	X[a]	---	---	X	---	---	---	---	---	---	---	---
Annual Summary (Acreage, yield, production)....	X	---	---	---	---	---	---	---	---	---	---	---
Indicated Area (harvest, yield, production)................	---	---	---	---	---	---	---	X	X	X	X	---
Plant Production..........	---	---	--	---	---	---	---	---	---	---	---	---
Monthly Marketing.........	---	---	---	---	---	---	---	---	---	---	---	---
Revised (Acreage, yield predicted for previous year)..................	---	---	---	---	---	---	---	---	---	X	---	---
Planters Information (Row, width and varieties)..................	---	---	---	---	---	---	---	---	---	---	X	---
Stock Reports.............	X	---	---	X	---	X	---	---	---	---	---	---

a/ As of June 1.

The plants per unit are counted, but pods with beans and weight per pod must be forecast during the growing season. The number of pods per plant is forecast by using one or more of the following counts, depending on plant maturity: (1) main stem nodes, (2) total fruit (blooms and pods), (3) pods only, (4) main stem nodes with fruit, (5) lateral branches with fruit, and (6) pods with beans per plant. Prior to harvest, the average weight per pod is forecast, based on historical pod weights. At maturity the pods are actually stripped from the plants in the units and weighed to determine final output. Gleanings of sample plots following farmer harvest are made to determine harvesting losses, which are subtracted from the biological (gross) yield to determine net yield. Soybean yield is estimated from yield data in bushels equivalent to 60 pounds of beans at 12.5 percent moisture content. Forecasts for states not having data derived from objective measurement of yield are based on the monthly general mail surveys.

Dissemination of Private Information

It is generally accepted that due to reasons mentioned above there exists no source of crop information as concise as that issued by the government. As the object of these reports is to provide as much and as accurate market information as feasible, it is only possible, for economic reasons, that this information be issued on a quarterly basis. Due to the requirements necessary to provide accurate crop forecasts it is virtually impossible for private sources to compete with public sources of commodity information. Evaluating the frequency of government reports and the volatility of commodity markets, these conditions necessitate the existence of additional market information for those individuals who have some stake or are financially affected in some manner by movements in the market. Thus the private sector must tend to complement rather than substitute for the public sector. In the private sector it is necessary to distinguish between the aspects of types of information that market participants generate for sale to others in the market. Some firms generate information in the form of market letters and market information services, but others--such as large companies, food processing firms and food-brokerage firms--generate substantial amounts of internal information as a means of identifying emerging market opportunities as quickly as possible.

Private-sector firms, again may complement the U.S.D.A. both in the collection and the analysis of raw data. There might appear to be little opportunity for private firms to compete in the area of data collections with such an adversary as the U.S.D.A. reports. U.S.D.A. information is published at intervals--weekly, monthly, quarterly, or annually--but important changes in market equilibrium positions occur between reporting dates and thereby affect the profit prospects of market participants. Some firms develop interim estimates by conducting limited field surveys, but most develop these estimates by evaluating the effects of weather, disease or pest developments on the most recent U.S.D.A. estimates of crop production.

Private firms similarly play an important role by filling an analysis gap. While the U.S.D.A. provides useful analysis in its situation reports, it does not usually predict price movements, nor does it provide market participants information on the positions they should take in the market. This type of analysis gap is filled by a number of market letters and services each of which is generally aimed at a different audience of farmers, merchants or speculators. An analysis of the job which the private sector does in filling this information gap is an area too expansive to be correctly carried out in this paper. The concerns voiced by Gorham (1978) in anticipation of the loss of private sector information is unfounded for a simple reason.

> Although public information as to which state will occur is indeed of social value to producers in the area of market exchange, the individuals possessing private foreknowledge possess enormously greater potential wealth than those individuals possessing public foreknowledge (Stigler, 1961, p. 214).

As long as this potential wealth is associated with foreknowledge there will be those individuals willing to support the private sectors existence.

Sources of Private Information

Information provided by national publications falls into two categories: information concerning farmers as a whole, and information which is targeted at specific crop producers.

Publications targeted at farmers as a whole are the most common type of farm publication. The information provided by these publications generally deals with subjects of common concern to agricultural producers. Such subjects are land, marketing, money management, machinery, chemicals, laws, taxes and technology. There usually appears short articles on each of the major categories in agriculture, beef, hogs and crops.

Publications marketed towards specific groups of producers in agriculture concentrate on such areas as soybean, corn, tobacco, wheat, swine and cattle producers, etc. These publications provide greater technical, in-depth articles and interviews concerning new developments in their various areas. Articles concentrate on markets in these areas, providing graphs of current market behaviors, technical trading tips and outlook for the current market year. These publications parallel the format of the more general publications but are able to provide much greater analysis of the issues since they are able to target the interest of the sector of the public which they serve.

Another form of specialized publication is that publication which is developed to appeal or serve a specific region of the country. Since the area which the publication serves is known, this enables publishers to concentrate on problems which are critical to producers in a specific area. Such issues might be weather conditions, impact of state and federal legislation, new crop varieties, transportation issues and local markets, etc. Since the area which they serve is limited, this enables these publications to investigate problems which may be of critical importance in a specific region but of little interest on the national level.

Newpapers

Newspapers almost always provide some type of market information, the quantity of information generally differs between papers, but most include the previous days commodity market activity. This information generally includes the high, low, open and close price of the most current contract and will sometimes provide some historical information on the contracts. Often there appears a short article analyzing those markets of interest for that particular area. The region which the paper serves, be it rural or urban, will be a deciding factor upon the level of agricultural market information it provides.

Radio-TV

Again the quantity and quality of information provided by these sources will depend upon the audience and region of the country they serve. In most cases these services provide a highlight of current market levels and news of anything which might effect the commodity market.

Producer Organizations

These organizations are concerned chiefly with keeping members informed about current happenings within the industry. They are concerned with promoting market image, making the public aware of their product, and insuring that the image the public has of their product is a favorable one.

Private Consulting Services

Private consulting services can be divided into two distinct groups. Those providing monthly and quarterly data and those providing data on a more frequent schedule. This type of service is catered to individuals in the processing and manufacturing fields, whose need for information stems from the necessity of formulating short term plans at the present. Their services usually include access to the firms software on time sharing options.

Producers, on the other hand, who are concerned with making day to day decisions desire more timely information. Currently several farm publications are in the process of instituting a method by which producers may call up certain numbers on their telephones and the information requested will appear on their television sets. The lack of the ability to interact and several other problems still exist in the proposed system, but the overall idea possesses a great deal of potential.

CHAPTER IV

THEORETICAL AND EMPIRICAL ANALYSIS

Chapter IV begins with a simple conceptual model that examines the feedback effect and timeliness of U.S.D.A. crop production forecasts. By feedback effect we mean adjustments made by producers due to U.S.D.A. forecasts. Timely forecasts are forecasts which allow for adjustments by producers, however, U.S.D.A. crop forecasts fail to account for possible adjustments. Given the information set at the time the forecasts are made, without considering feedback due to the forecasts, U.S.D.A. may be providing good forecasts. Nevertheless, if the feedback is substantial U.S.D.A. may have some credibility problems with their forecasts. Also, in this chapter is an evaluation of several critical decision making time periods in order to determine when information provided by the U.S.D.A. is of greatest value to agricultural producers. This chapter is concluded with an investigation to determine that point at which timeliness is no longer an issue.

Crop production forecasts by the Statistical Reporting Service (SRS) of the U.S. Department of Agriculture (U.S.D.A.) have been a source of scrutiny and irritation by academicians and decision makers in agricultural markets. Academicians have analyzed the accuracy (Houck and Pearson, 1978; Mlay and Tweeten, 1981; Gorham, 1978; Gunnelson, 1972) and social costs of crop forecasts (Hayami and Peterson, 1972; Bullock, 1976) while farmers have been very critical of the usefulness of these forecasts for them (Jones, Sheatsly, and Stinchombe, 1979). A major goal or desirable characteristic of crop forecasts is that they be accurate. One definition of accuracy is that the forecast be unbiased and possess low variance. However, timeliness of the forecast[1] is also a major concern to market participants who use these forecasts in making decisions. A forecast that is timely allows decision makers to make adjustments in their operations, be it production, marketing, or inventory decisions. A forecast right after harvest will be useful for marketing decisions. However, there is a trade-off between timeliness and accuracy. A timely forecast of production is likely to be associated with a higher variance than a less timely forecast. Moreover, a timely forecast is one that will allow farmers consideration of alternative production plans. Unfortunately, supply adjustments are not taken into account when timely production forecasts are made. The result is that timely forecasts will be subject to feedback effects.

This does not imply, though, that this information is now useful (see Bullock, Ray and Thabet, 1982). This information is probably better than no information at all. At issue is whether information on feedback effects is also useful. Would the adjustments producers make be different if they knew how others in the market may react to crop production forecasts? Should U.S.D.A. be providing this information on feedback effects or taking them into account in their forecasts? Some insight into these issues will be discussed in this chapter.

The Statistical Reporting Service (SRS) is the principal data accumulation and dissemination branch of the U.S. Department of Agriculture. At the current time, the SRS agency contains a Research, Survey and Estimates Division, 44 State Statistical Offices (SSOs) and the Crop Reporting Board which is not a permanent organizational unit. One of the many duties of the SRS is the preparation and printing of official U.S. Crop Forecasts. These forecasts are based upon a national survey of producers. This information is summarized, analyzed and sent to the Crop Reporting Board for final analysis and approval for public release. Once harvest has occurred, estimates, not forecasts, are issued. Information relevant to production includes acres harvested and planted, yield and production. The SRS forecasts are, due to sample size and intensity, considered the most reliable source of production information available (Gorham, 1978). Forecast errors are a result of sampling errors, producers falsely reporting production plans, and uncertainties in the physical environment. For the most part, the above errors may have an expected value of zero except the latter. Since supply is upward sloping, forecasts that change producers' price expectations will impact their production in one direction or the other with a nonzero expected change.

The Model

The feedback effect of production forecasts casts a shadow on statistical tests that examine accuracy of forecasts since the ability to adjust to the information provided by the forecasts changes the information set upon which the forecast was made (i.e., the forecasts become a component in the new information set). Our purpose initially is to examine qualitatively the effects of this adjustment. We will follow a model by Bullock, Ray and Thabet to which, while retaining some of their assumptions, we add some slightly different assumptions.

1. There are no carry over stocks.

2. Producers' price expectations and current resource allocations are based upon futures market prices.

3. U.S.D.A. forecasts are perfectly accurate given their survey data but do not take into account supply adjustments.

4. The market demand curve at harvest is known with certainty at the time farmers are formulating their current production decisions.

5. We will look at two cases where the market anticipates supply adjustments and where it does not, the latter being a cobweb-like model.

The first assumption is made to keep the model simple, although the results are not substantially changed when considering carry over stocks. The second assumption, while not entirely realistic, is made, since futures market prices are observable, to allow us to say something about the direction and possibly the magnitude of the feedback effect. The third assumption is made to assume that there is no uncertainty as to the accuracy of the forecast. The fourth assumption is again made for simplicity while the last assumption shows the consequences of the feedback effect under different scenarios.

Throughout this discussion of the timeliness and accuracy it is important to remember that one of the crucial periods of analysis is that one prior to planting. For it is in this time frame that the greatest potential for study of the timeliness and accuracy trade-off occurs. While production forecasts are not made prior to planting, prospective planting reports do have an impact on expectations. The more timely the report is the more producers are able to adjust. In order to analyze this feedback effect with greater scrutiny, this study will direct its attention to two market situations, although other market situations are readily apparent. The first situation is when producers' expectations and producers' adjustment alternatives are restricted to an area above the demand curve, and the second is when producers' expectations are above the demand curve and the production adjustment path or the supply curve passes through the demand curve.

The model here considers a kinked adjustment curve essentially identical to the supply response curve considered by Bullock (1981). However, we claim that this phenomenon is relevant prior to planting. At the time of the release of the prospective planting reports, though a production forecast is not given, if forecasts are made available earlier, producers would have more flexibility than with the production forecast made during the growing season. A lower bound is established due to the growing season of certain crops. Upper bounds on some crops are also a result of lower bounds on alternative crops.

In Figures 1, 2, 3, and 4, only the supply adjustment curve at the time the forecast is made is drawn with the demand curve. In Figure 1 it is assumed that producers' supply adjustment curve lies entirely above the demand curve. Expected price at harvest is P_{t-1}. SRS forecasts crop production to be Q_f (or we may consider a prospective planting forecast with production implied to be Q_f). If decision makers in the market are naive about the existence of the supply adjustment curve, but demand is known, expected harvest price should fall to P_{t+1} after the forecast is released. This assumes, of course, that the forecast is not anticipated prior to its release. At any expected price below P_c farmers will adjust their production to the lower bound, Q_1, where $Q_1 < Q_f$. Even if higher than expected yields are obtained at harvest, the forecast, at the time it is released will overstate the expected production after producers have adjusted

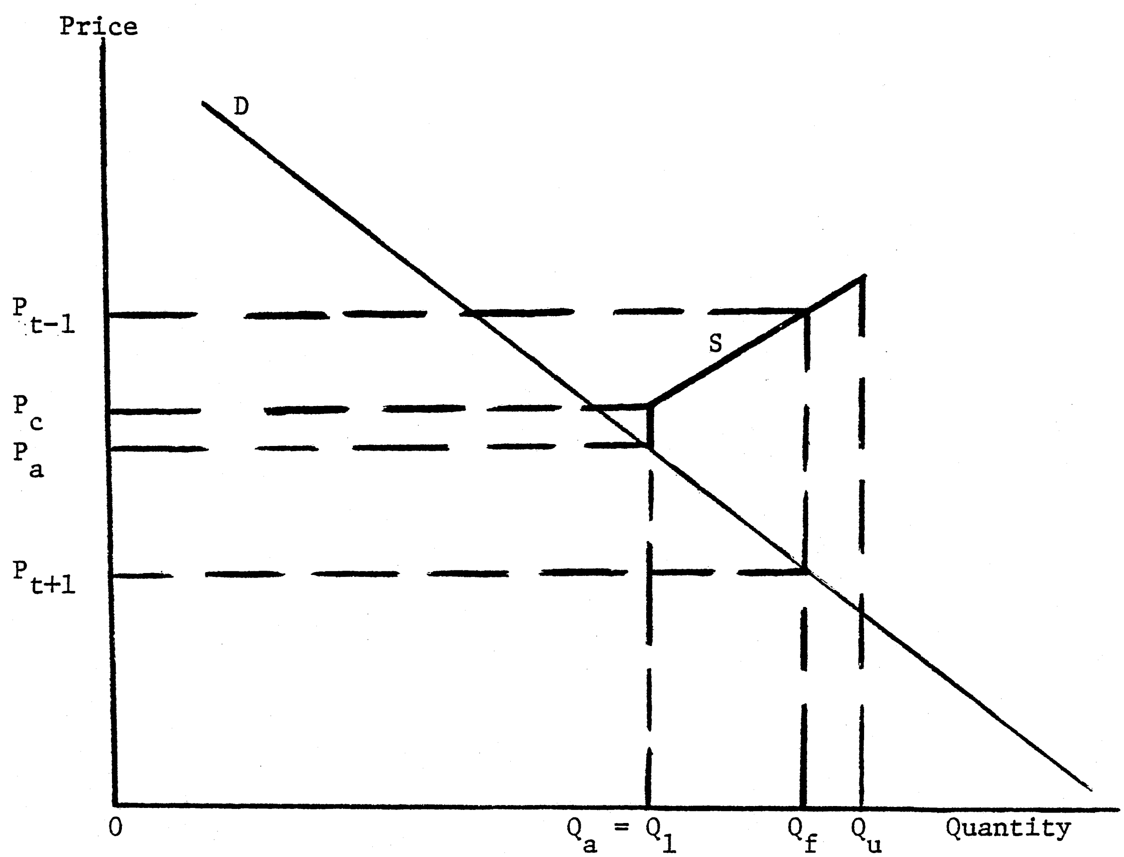

Figure 1. Supply Adjustment Curve Lies Above the Demand Curve and is Not Accounted for in the Forecast

to the information provided by the forecast. Once actual production is known, the price, as depicted in Figure 1, will rise to P_a.

In Figure 2, the situation that is depicted represents the case where the supply adjustment curve is taken into account by market participants. In this case price falls to P_{t+1} which will be equal to P_a. Quantity produced falls again to the lower bound. Again the SRS forecast overstates production. In both cases 1 and 2, the actual production will be the same, Q_a. However, initial price adjustments to the forecast will not be the same. In this model where no carry over stocks are assumed the importance of this is not readily apparent. However, once storage is introduced, while there is no impact on production, inventory adjustments will be made (Bullock, 1961).

In Figures 3 and 4 the scenario is changed by allowing the supply adjustment curve to cut through the demand curve. In Figure 3, the illustration is similar to Figure 1 where price expectations do not take into account supply adjustments. In this case prices are more volatile because the upper and lower bounds are extended out from the previous case. After the forecast expected harvest price falls to P_{t-1} and production falls to Q_a. Once production is known price rises to P_a. In Figure 4, supply adjustments are known and are used in price expectations. In this case production falls to Q_a and expected price falls to $P_{t+1} = P_a$.

Assuming as we have that producers' price expectations are identical with future market prices, then the direction of change in the futures price tells us something of the direction of the production adjustment. If after a forecast announcement, the price falls then the production forecast will overstate actual production when supply

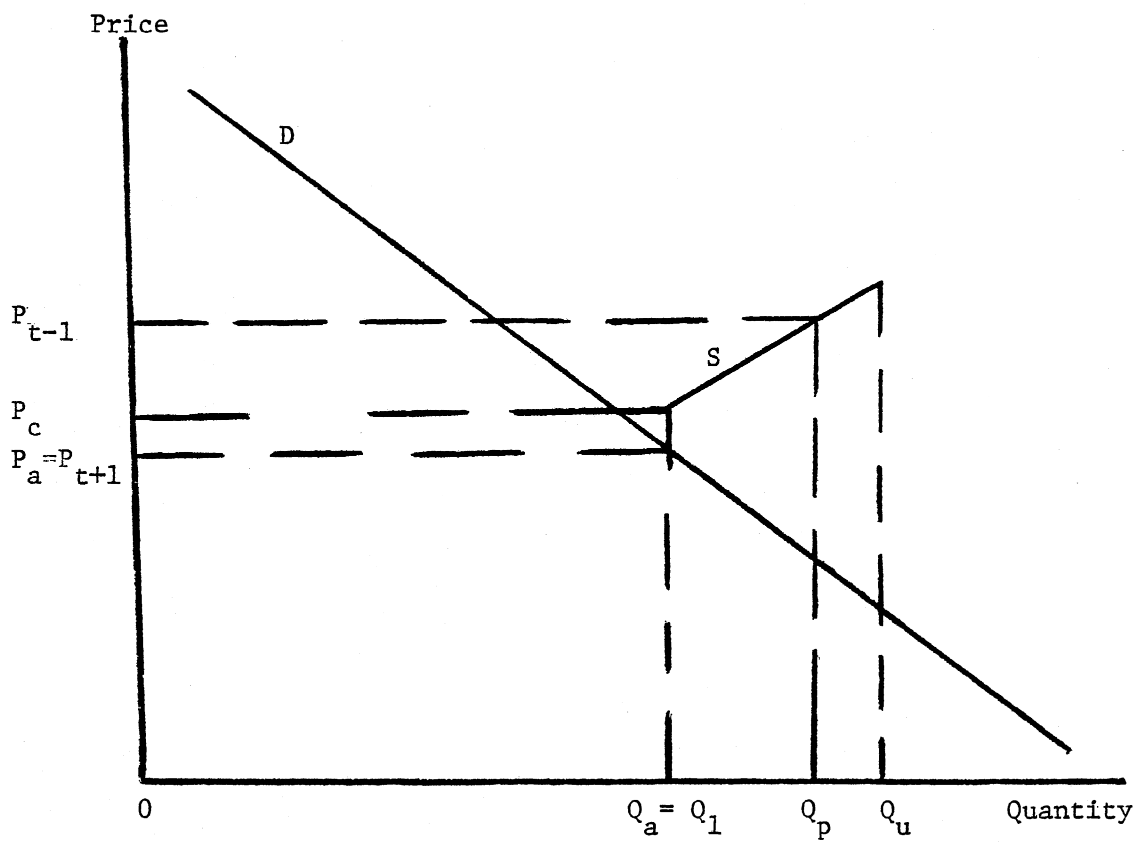

Figure 2. Supply Adjustment Curve Lies Above the Demand Curve and is Accounted for in the Forecast

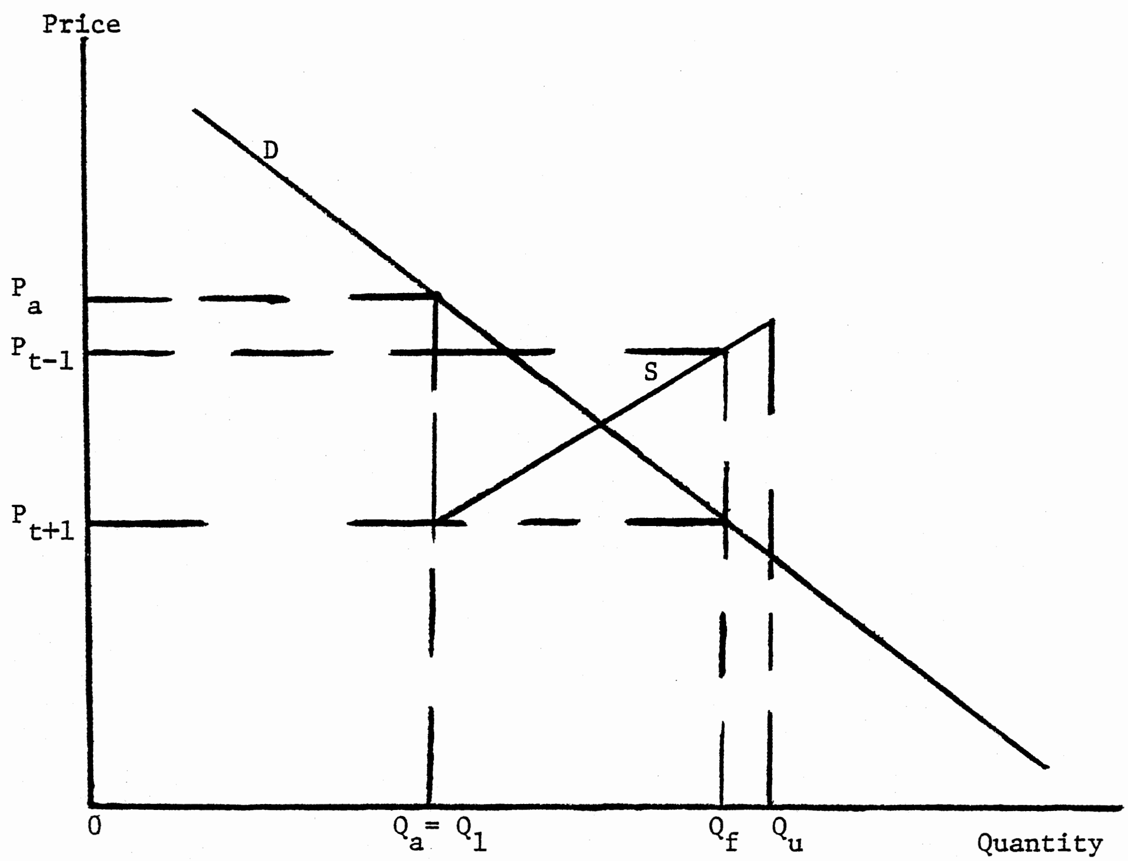

Figure 3. Effect When Price Expectations Do Not Take Into Account Supply Adjustments

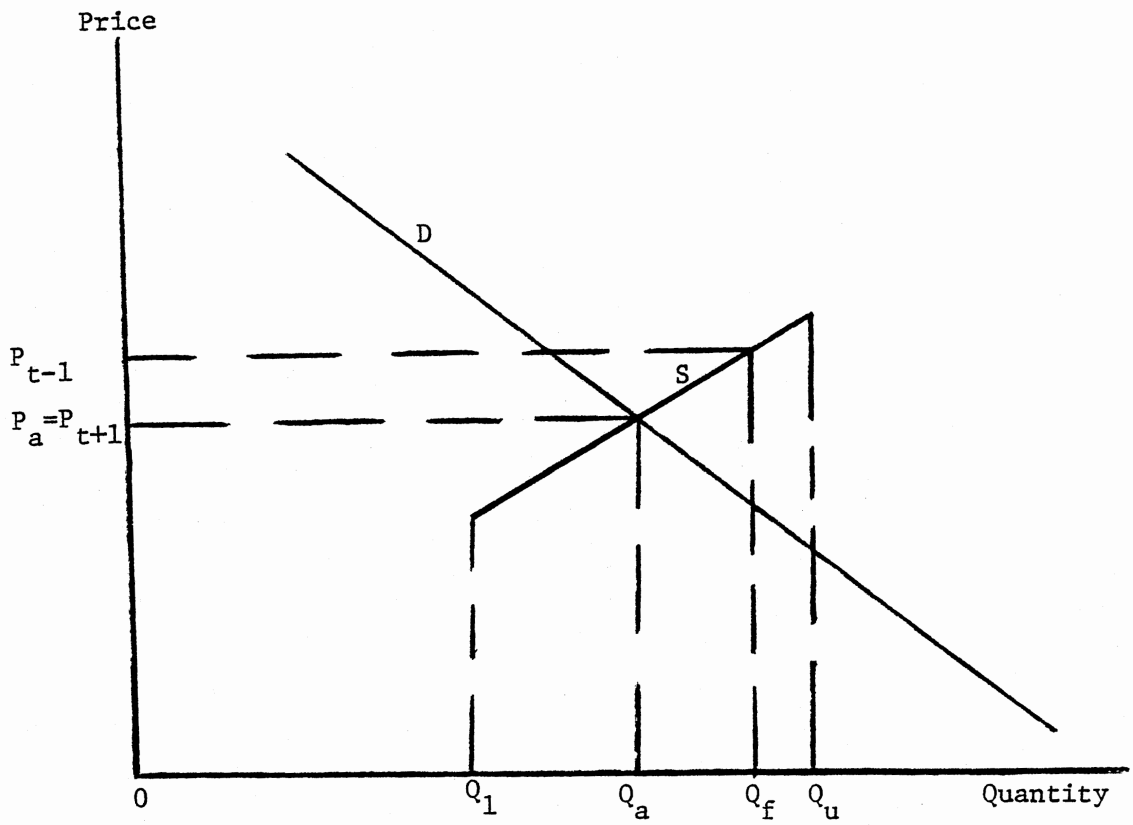

Figure 4. Price and Quantities are Accurately Forecasted When Supply Adjustments are Known and Taken Into Account in the Forecast

adjustments are not taken into account. The opposite occurs when price rises. If supply adjustments are taken into account and assuming an accurate forecast, in case 1 no change in production would occur, but there should be less price volatility depending on how price expectations are formed. This occurs due to the narrow range of adjustment. The future price should move to the actual harvest price (assuming no new information or unexpected shocks). If either the market or U.S.D.A. is aware of supply adjustments then the expected futures price is the harvest price.

In case 4, where the supply adjustment curve cuts through the demand curve, the qualitative results are the same but the magnitude is larger. Prices and quantities are accurately forecasted when supply adjustments are known and taken into account. Actual prices and quantities are the same regardless of whether U.S.D.A. forecasts with adjustments by producers taken into account or forecasts without knowledge of adjustments but the private market is aware of supply adjustments.

The interrelationship between timeliness and accuracy is a situation which occurs due to the type of irreversible decision situation which agricultural producers face. Once the crop is planted, although there exists in some cases alternatives to grain harvesting the crop, the producer has entered into a nonrecourse situation. The need to know precisely the market outlook for the coming year is critical to a producer who is risking thousands of dollars of operating capital in one production decision. In order to thoroughly analyze this situation, and to be able to evaluate as many major crops as possible, the spring planting period was chosen. This enabled us to analyze this issue as it concerns corn, soybeans and spring wheat (which makes up for one-fourth of the wheat produced in the U.S.). The spring planting period was then divided into three parts, pre-planting, planting and post-planting. The pre-planting period was considered that time period between the months of January and April (although some might argue that pre-planting work or decisions are carried out previous to this period, this is the time frame in which the bulk of planting preparation is carried out thus the reason it was selected). The planting period was considered those days falling between the first of April and the first of July. It may be argued that the latter time period is much too late to plant, but as there may be exceptionally wet years which delay planting, and whereas the practice of double cropping (winter wheat followed by soybeans) is increasing in popularity, and the crop has yet to reach a stage which alternative production plans might be implemented, this time frame was considered adequate. The post-planting period was considered the months from July to August. This period would be the third and final opportunity for producers to make use of alternative means of harvesting their crop (i.e., silage, bailing, grazing) based upon market information provided by the government.

Model Development

In this section of Chapter IV, a general model is developed to analyze when the most desirable time period is, from a producers' prospective, for the U.S.D.A. to provide production information to the producer. Producers' need for information would obviously fall in that time period prior to planting and prior to incurring the majority of their fixed costs. In order to analyze this accurately and thoroughly as mentioned previously in this chapter, this study looks at a pre-, post- and during planting period. The idea was to analyze the impact upon production during these various time periods as the U.S.D.A. released monthly production reports. The assumptions made in order to more easily analyze the critical aspect were:

1. That the U.S.D.A. forecasts at release are an accurate reflection of current crop conditions, with a small amount of measurement error present (Mlay and Tweeten, forthcoming report).

2. That producers' price expectations and current resource allocations are based upon Futures Market Prices.

3. That the market demand curve at harvest is known with certainty at the time farmers are formulating their current production decisions.

4. The model assumes that farmers only respond to price and not to weather.

The time period for this study is from 1970-81. Although a larger time frame for the study was first desired, it was discovered that information necessary for the desired study was not to be found available in a regular fashion.

The Prospective Planting Report is published biannually[2] with the first report being released during the last two weeks of January. This report is based upon information gathered in surveys (Method of Collection explained in Chapter III) upon crop conditions as of January 1. The second report was varied between releases in April and in May. The information obtained in this report is based upon crop conditions up to the first of the month in which the report is released.

The Crop Production Report is released monthly, commonly in the second week. This report unlike the Prospective Planting Report deals with anticipated production figures, whereas the Prospective Planting Report deals chiefly with anticipated planted acres. The July and

August Crop Production Reports were used to provide necessary information such as anticipated production levels for the analysis.

In initial development of the model it was recognized that with the assumptions above in mind that:

Production = Acreage X Yield

Consider production for crop i as:

$$Q_i = A_i Y_i$$

where Q_i = production for crop i,

A_i = harvested acreage for crop i, and

Y_i = yield for crop i.

From a standard supply model where acreage is the decision variable, it was considered that harvested acreage will be a function of own output price and prices of substitute crops. If we consider two alternative crops we have:

$$Q_i = A_i(P_i P_j P_k) Y_i$$

Now consider changes in production due to changes in output prices, this was done by taking the total derivative.

$$dQ_i = \left[\frac{\partial A_i}{\partial P_i} dP_i + \frac{\partial A_i}{\partial P_j} dP_j + \frac{\partial A_i}{\partial P_k} dP_k \right] Y_i + A_i dY_i$$

Dividing both sides by Q_i on the left and $A_i Y_i$ on the right we have:

$$\frac{dQ_i}{Q_i} = \left(\frac{\partial A_i}{\partial P_i} \frac{P_i}{A_i} \right) \frac{dP_i}{P_i} + \left(\frac{\partial A_i}{\partial P_j} \frac{P_j}{A_i} \right) \frac{dP_j}{P_j} + \left(\frac{\partial A_i}{\partial P_k} \frac{P_k}{A_i} \right) \frac{dP_k}{P_k} + \frac{dY_i}{Y_i}$$

$$\frac{dQ_i}{Q_i} - \frac{Y_i}{Y_i} = \varepsilon_{ii}\frac{P_i}{P_i} + \varepsilon_{ij}\frac{P_j}{P_j} + \varepsilon_{ik}\frac{P_k}{P_k}$$

where ε_{ii} is own price elasticity and ε_{ij}, ε_{ik}, are cross price elasticities.

From this equation the following regression is run.

$$\left(\frac{\Delta Q_i}{Q_i} - \frac{\Delta Y_i}{Q_i}\right) = B_i\frac{\Delta P_i}{P_i} + B_j\frac{\Delta P_j}{P_j} + B_k\frac{\Delta P_k}{P_k}$$

The regression coefficients are interpretable as elasticities.

In the above equation $\frac{\Delta Q_i}{Q_i}$ was arrived at in the following manner: $\frac{Q_a - Q_j}{Q_j}$ where Q_a represents production in April minus production in January divided by production in January. This same format was used in arriving at ΔP_i and the ΔY_i.

Chicago Board of Trade prices used in this study were obtained from the Wall Street Journal. As discussed previously, forecasts were based upon surveyed conditions as of the first of the month upon which the forecast was released. Prices were then obtained for the time period of the survey and averaged to obtain the prices which producers were basing production decisions upon.

Dummy variables were applied to the models to those years in which an effective support price or an effective diversion program was present. In this study only wheat and corn had programs which were in effect during the 1970-81 period. Due to the substitution possibilities between soybeans and corn, the corn policy variables were also used in the soybean model. Runs were made with and without policy variables, as shown in Tables 5 and 6. It is apparent from the results that

Table 5. Evaluation of Results with Policy Variables

	Bean	Wheat	Corn	Policy Variable[a/]	Intercept	R^2
January - April						
Bean	0.277003	-0.299627	-0.035492	0.037525[b/]	-0.015682	.89
	(3.778)[c/]	(-4.2872)	(-0.2720)	(3.4448)	(-2.1559)	
Wheat	-0.05603	0.515915	0.39778	-0.039123	0.01700	.44
	(-0.169)	(1.89)	(0.777)	(-0.864)	(0.59)	
Corn	-0.05656	-0.039867	0.164488	-0.001511	0.004396	.18
	(-0.547)	(-0.698)	(1.14)	(-0.1258)	(0.547)	
April - July						
Bean	-0.152363	0.151604	0.091052	-0.046635	0.042744	.26
	(-1.0618)	(0.4918)	(0.2282)	(-1.065)	(1.435)	
Wheat	0.058337	0.45057	-0.684668	-0.016817	0.036141	.37
	(0.4045)	(1.552)	(-1.72)	(-0.4347)	(1.1569)	
Corn	0.173315	0.738341	-0.848199	-0.124616	0.01737	.39
	(0.775)	(1.5369)	(-1.3639)	(-1.8273)	(0.296)	
July - August						
Bean	-0.44789	-0.30067	0.28475	-0.021637	0.25260	.51
	(0.9302)	(-0.9642)	(0.6198)	(-0.3540)	(0.7054)	
Wheat	0.244136	-0.279646	0.413566	-0.088237	-0.043781	.33
	(0.768)	(-1.1368)	(1.2059)	(1.80)	(-1.5137)	
Corn	0.46563	-0.31462	0.64042	0.07361	-0.02082	.29
	(1.039)	(-1.084)	(1.498)	(1.2959)	(-0.6253)	

a/ Policy variables used to reflect the use of support prices and diversion programs for those years when in effect.

b/ Policy variables applied to the bean model were used to reflect those years when corn policies where in effect to show the cross effect which might be present.

c/ Values appearing in parenthesis are t-values.

Table 6. Evaluation Results Without Policy Variables[a]

	Bean	Wheat	Corn	Intercept	R^2
January - April					
Bean	0.316045 (2.7291)	-0.241431 (-2.22261)	0.057802 (0.2832)	0.0003114 (0.0348)	.69
Wheat	-0.193459 (-0.6788)	-0.498715 (-1.8689)	0.395433 (0.7873)	0.001467 (0.0665)	.32
Corn	-0.058133 (1.2297)	-0.042212 (-0.6078)	0.160729 (-0.783)	0.003752 (0.6539)	.18
April - July					
Bean	-0.158017 (-1.0927)	0.025553 (0.0890)	0.154364 (0.3879)	0.020476 (0.9570)	.14
Wheat	0.5931 (0.4325)	0.471382 (1.7368)	-0.695982 (-1.85)	0.02622 (1.2964)	.36
Corn	0.158208 (0.6227)	0.401512 (0.7961)	-0.679019 (-0.9713)	-0.045768 (-1.2176)	.10
July - August					
Bean	-0.394748 (-0.9143)	-0.373103 (0.6858)	0.380550 (1.0862)	0.016186 (0.6858)	.5076
Wheat	0.103608 (0.2971)	0.059752 (-0.0712)	-0.010024 (-0.0354)	-0.00135737 (0.333)	.0296
Corn	0.284672 (0.6423)	-0.067948 (-0.2980)	0.31424 (0.8737	0.010074 (0.4158)	.1236

a/ Parenthesized figures denote t-values.

acreage policies have a definite effect upon producers' production decisions. Table 7 was constructed of coefficients derived over various time periods for comparison purposes.

Since the purpose of this study was to analyze the level of adjustments occurring in each of the three time periods, certain information were necessary. To obtain the price elasticities of corn, spring wheat, and soybeans, which were independent variables in the model, it was necessary to gather price and production information over the ten year period used in the study.

Production information for the January and April time periods were obtained from Prospective Plantings Report which is published twice annually. The production information for the July and August periods were obtained from the Crop Production Reports. In the case of the January Prospective Plantings Report, and in some instances due to changes in the U.S.D.A.'s reporting format, the necessary information for the study was unavailable. To obtain this information a sequential regression was run on yield and harvested acres. The following equations were used to determine the necessary numbers.

$$\text{Actual yield} = \alpha_0 + \alpha_1(\text{year})$$

$$\text{Actual harvested acres} = \beta_0 + \beta_1 \text{ (actual planted acres)}$$

In the yield equation α_0 represents the intercept coefficient, α_1 represents the derived slope coefficient which shows the amount which yield has changed each year. The use of these coefficients with the year in the equation allowed the time trend yield for that particular year to be calculated. For example, using spring wheat, 1980 expected yield would be calculated as follows:

Table 7. Supply Elasticities as Calculated by Previous Studies[a]

	Wheat	Soybeans	Corn
Richardson's (Direct & Cross Acreage)			
Wheat	.10 (.20)	-.02 (-.04)	
Soybean	-.20 (.024)	.25 (.312)	
Hossen Askin & John T. Conners			
Fisher & Tempin (1967-1914)	.11 (.80)		
Colley & De Canio (1874)	.12 (.18)		
Nerlove (1909-1932)			
Wheat	.47-.93		
Corn			.09-1.02
Houck & Subotnik (1946-1966)			
Soybean	-.04	.84	-.65
Trapp			
Corn	-.157	-.050	.037
Soybeans	-.087 (.293)	.260 (.877)	
Wheat	.472		-.052

a/ Values in parenthesis are long run elasticities.

Expected yield = $\hat{\alpha} + \hat{\alpha}$ (year)

Expected yield = -19.18 + .6563(70)

Expected yield = 26.76

The intercept as found in Table 8 would be -19.18, the slope coefficient would be .6563 which would say that in 1970 the yield would be expected to increase by .656 of a bushel.

The equation used to obtain actual harvested acres would work in a similar manner. β_0 in Table 8 would then represent intercept coefficients, β_1 would then represent the amount of change occurring between what was planted and what actually was harvested for that particular year, this coefficient also helps show the amount of variability occurring between the various crops.

The coefficients shown in Tables 8, 9, and 10, derived by the equation discussed above, appear as expected. The yield coefficients exhibit a lower R^2 value than found in the harvested acre coefficients. The chief reason for this occurence is that as soon as planting occurs an upper bound is placed upon the number of acres available to harvest. In the yield equation a lot of variability around the time trend would be expected due to the nature of yield. Time is not a very good independent variable since there are many more important variables, such as weather, etc. However, these variables are difficult to forecast.

It is immediately apparent that the January-April time period demonstrates a period when information appears to be of most use to agricultural producers. The soybean model appeared to exhibit the strongest support for this theory, with elasticities very similar to results found in previous studies (Table 5). The soybean model showed

Table 8. Spring Wheat Estimated Coefficients

	$\hat{\alpha}_0$	$\hat{\alpha}_1$	R^2	$\hat{\beta}_0$	$\hat{\beta}_1$	R^2
1970	-19.18 (0.3663)[a/]	.6563 (0.0632)	.33275	-60.032 (0.9646)	.9689 (0.0001)	.895269
1971	-27.658 (0.1482)	.7902 (0.0149)	.462998	-260.498 (0.7604)	.98617 (0.0001)	.955028
1972	-26.952 (0.1007)	.779 (0.0057)	.51595	-286.717 (0.7262)	.9892 (0.0001)	.954944
1973	-23.619 (0.0973)	.727 (0.0031)	.531219	-399.656 (0.5463)	.9988 (0.0001)	.969541
1974	-10.30 (0.4748)	.52 (0.0268)	.323782	-389.54 (0.3935)	.9980 (0.0001)	.985447
1975	-7.44 (0.5593)	.475 (0.0216)	.323235	-142.82 (0.7138)	.977 (0.0001)	.988522
1976	-5.63 (0.6195)	.448 (0.0150)	.334768	191.085 (0.5530)	.951 (0.0001)	.991959
1977	-4.649 (0.6474)	.4329 (0.0088)	.357234	260.72 (0.3978)	.945 (0.0001)	.992419
1978	-6.289 (0.4961)	.457 (0.0027)	.419468	210.50 (0.4772)	.949 (0.0001)	.992793
1979	-4.51 (0.5919	.430 (0.0019)	.423286	168.29 (0.546)	.953 (0.0001)	.993459
1980	.109 (0.989)	.360 (0.0052)	.343659	1040.13 (0.0615)	.886 (0.0001)	.973203
1981	-4.812 (0.5524)	.435 (0.0010)	.427913	864.91 (0.0945)	.899 (0.0001)	.976903

[a/] Values in parenthesis are t-values.

Table 9. Bean Estimated Coefficients

	$\hat{\alpha}_0$	$\hat{\alpha}_1$	R^2	$\hat{\beta}_0$	$\hat{\beta}_1$	R^2
1970	4.01 (0.54)[a/]	.323 (0.0092)	.547929	-514.53 (0.0306)	.989 (0.0001)	.999703
1971	2.79 (0.616)	.343 (0.0019)	.634667	-605.19 (0.0132)	.992 (0.0001)	.999684
1972	2.136 (0.6524)	.352 (0.0004)	.699580	-483.95 (0.332)	.988 (0.0001)	.999676
1973	2.55 (0.5346)	.346 (0.0001)	.736428	-635.43 (0.0029)	.993 (0.0001)	.999765
1974	10.61 (0.0992)	.22 (0.0273)	.322287	-967.95 (0.0042)	1.00 (0.0001)	.999366
1975	8.22 (0.1543)	.25 (0.0004)	.422428	-908.23 (0.0034)	1.00 (0.0001)	.999445
1976	10.47 (0.0553)	.22 (0.0085)	.378980	-901.92 (0.0022)	1.00 (0.0001)	.999480
1977	7.162 (0.1666)	.27 (0.0015)	.476381	-799.19 (0.0035)	.998 (0.0001)	.999521
1978	6.20 (0.1852)	.289 (0.0003)	.538588	-754.32 (0.0022)	.997 (0.0001)	.999614
1979	3.22 (0.4785)	.334 (0.0001)	.602862	-720.57 (0.0010)	.996 (0.0001)	.999707
1980	6.29 (0.1756)	.287 (0.0002)	.518067	-415.24 (0.1238)	.998 (0.0001)	.999423
1981	3.13 (0.4445)	.33 (0.0001)	.045447	-396.03 (0.1186)	.987 (0.0001)	.999485

[a/] Values in parenthesis are t-values.

Table 10. Corn Estimated Coefficients

	$\hat{\alpha}_0$	$\hat{\alpha}_1$	R^2	$\hat{\beta}_0$	$\hat{\beta}_1$	R^2
1970	-76.90 (0.285)[a]	2.26 (0.0008)	.734044	-6928.87 (0.0281)	.9589 (0.0001)	.9865432
1971	-87.94 (0.0064)	2.43 (0.0001)	.795348	-6873.79 (0.0159)	.9581 (0.0001)	.987176
1972	-108.43 (0.0012)	2.756 (0.0001)	.828018	-6839.75 (0.0113)	.9577 (0.0001)	.987243
1973	-105.55 (0.0004)	2.71 (0.0001)	.852637	-6753.97 (0.0079)	.9563 (0.0001)	.987661
1974	-67.468 (0.041)	2.11 (0.0004)	.63773	-3230.90 (0.2477)	.90 (0.0001)	.977003
1975	-59.938 (0.0408)	2.00 (0.0002)	.649545	-2964.30 (0.2309)	.8993 (0.0001)	.980605
1976	-54.359 (0.0379)	1.91 (0.0001)	.666306	-841.26 (0.6956)	.868 (0.0001)	.982703
1977	-51.4353 (0.0291)	1.8722 (0.0001)	.691953	28.36 (0.9883)	.8552 (0.0001)	.984829
1978	-57.86 (0.0093)	1.97 (0.0001)	.737611	-1095.56 (0.5967)	.8721 (0.0001)	.9825
1979	-69.10 (0.002)	2.14 (0.0001)	.7714	-2702.45 (0.2541)	.896 (0.0001)	.97814
1980	-75.62 (0.0005)	2.238 (0.0001)	.8024	-3013.73 (0.1711)	.90 (0.0001)	.980781
1981	-78.93 (0.0001)	2.28 (0.0001)	.827829	-4104.93	.91	.980703

[a] Values in parenthesis are t-values.

coefficients with signs as could be anticipated from a theoretical standpoint. An increase in the price of wheat and corn results in the reduced production of soybeans. The corn policy variable was applied to the soybean model due to the interrelatedness of soybeans and corn production. The policy variable came in positive which would signify that those years in which a government program, such as set-aside or diversion was in effect for corn, would result in a transfer of production acreage from corn to soybeans. All t-values came in at a statistically significant level except for the corn price. The other models in the first period, that of corn and wheat, have the correct sign for the cross elasticities but low t-values. One item turned up that is opposite from a theoretical standpoint in the wheat model. It showed that an increase in the price of corn would result in an increased quantity of wheat produced. All t-values in the wheat model came in a level not statistically different from zero, thus not raising much concern over the positive sign which the cross elasticity of corn had in the wheat model. The R^2 value came in at 44 percent suggesting that a substantial amount of variance in the data was unexplained by the model. The final model in the first period, that of corn, came in similar to the wheat model. Although the signs on the coefficients came in with the correct manner, the t-values failed to show that the coefficients were statistically different from zero.

Analysis of periods 2 and 3 show no coefficients with t-values which are statistically different from zero, and none of the models reveal signs upon the coefficient which support or follow conventional theory where these crops are concerned. For example, in the second period the cross elasticities in the soybean model suggest that an increase in the price of soybeans results in an increase in the production of corn and wheat and a decrease in the quantity of soybeans produced. The dummy variable in this model indicated that acreage reducing policies applied to corn would result in reduced soybean acreage, which would be contrary to conventional economic theory.

Analysis of periods 2 and 3 seems to support the argument that producers need information prior to planting. The fact that the coefficients in the first period for spring wheat were found to not be statistically different from zero at the 5 percent level (although it is significant at something less than the 10 percent level) may be due to the fact that the major crop producing area for this crop may be unsuitable for a diversity of crop production. This is expecially true for spring wheat, the majority of which is produced in Montana, Wyoming, North and South Dakota, and Washington. A more likely reason was that there were many more variables other than those in the model which effect wheat and corn production. While the results are less than ideal, the model appears to be reasonable.

Table 5 results do not conclusively prove that earlier forecasts allow producers an increased amount of adjustment over later forecasts. This table does indicate, especially when combined with conventional economic theory, that earlier forecasts allow producers time to adjust their production decisions. This suggests that information is of much greater value if it is made available prior to planting, as shown by the differences in results between the January-April period and the April-July, July-August time periods.

In comparing the derived elasticities in Table 5 (for the January-April equations) to elasticities derived in other studies (Table 7), it was found that the results matched up favorably with past studies, lending support to the variables present in the models. The spring wheats own price elasticity of .51 was substantially larger than Richardson's elasticity calculation of .472 (1978), but was within the range calculated in Nerlove's study .47-.93 (1956). The soybeans own price elasticity of .27 compared favorably with studies conducted over recent time periods but was quite different from studies dealing with data gathered, say, 40 years ago. There was an inadequate number of previous studies by which to compare corn estimates. Those which were available varied substantially from previous studies, but here again, this is most likely due to the differences between time periods considered.

For the most part, own price elasticities were at the lower end of the range in comparison with other studies; in particular Nerlove's (1956) wheat and corn estimate, and also soybeans considering Houck's estimate (1972). This is to be expected since the shorter the run the more inelastic the supply curve should be. The cross elasticity of wheat derived in the soybean model was found to be generally higher than estimates found in other studies; while the cross elasticity of corn as a whole tended to be of lower size than those calculations made in comparable studies. The cross elasticity of soybeans in the wheat and corn equations was found to be generally comparable to previous studies. Multicollinearity is a potential problem with the estimated equations, since data was from 1970 on, resulting in low degrees of freedom. This will have some impact on the estimates, but given comparability with other studies the situation is not too serious.

FOOTNOTES

[1]Information relating to crop production is released by the U.S.D.A. throughout the year. Formal estiamtes are first issued during the growing season. Usually the first estimates for the feed grains and the fats and oils are issued in July or August. However, in some years a forecast on crop production is issued in May in situation reports, usually with a range depending on production conditions. In addition, earlier in the year, there is the Prospective Planting report in January and again in March. This information is used by decision makers in forming their expectations on production and price, so it is relevant for the discussion in this paper. The essential point is that forecasts that do not consider production adjustments by decision makers, when adjustments are possible and are made as a result of the forecast, are inherently biased.

[2]The Prospective Planting report was published annually up to 1971, at which time it began appearing semi-annually. In 1982, due to the Reagan Administration Budget Reductions, the Prospective Planting report assumed an annual publication which is released in February, where previously when appearing annually it was released in January.

CHAPTER V

SUMMARY AND IDEAS FOR FUTURE RESEARCH

The overall objective of this study was to determine if and when the element of timeliness is a critical issue from a producers' perspective. In order to more clearly discuss the manner in which this objective was analyzed, it is helpful to view the general objective by looking at the individual objectives.

The first objective was to determine if forecasts were inherently problematic due to feedback effects. This question was analyzed theoretically based upon the following assumptions:

1. There are no carry over stocks.
2. Producers' price expectations and current resource allocations are based upon Futures Market prices.
3. U.S.D.A. forecasts are perfectly accurate given their survey data but do not take into account supply adjustments.
4. The market demand curve at harvest is known with certainty at the time farmers are formulating their current production decisions.
5. Two cases will be analyzed; one where the market anticipates supply adjustments and one where it does not, the latter being a cobweb-like model.

It was determined that the feedback effect would be problematic only if:

1. Producers' price expectations are affected by the information released by the U.S.D.A. in the form of prospective plantings and production forecasts.

2. The adjustment curve has nonzero elasticity and bounds that are not too restrictive or narrow.

3. Feedback effect is problematic if, and only if, forecasts are timely.

4. Finally, whether or not the U.S.D.A. should seek to take feedback effects into account in their forecasting is an important issue that needs further research.

The second and third objectives, which were to determine when information provided by the U.S.D.A. is of value to agricultural producers and at which point the timeliness of these forecasts is no longer an issue, were determined simultaneously in Chapter IV. Timeliness was determined by estimating elasticities for the three crops: spring wheat, corn, and soybeans. The elasticities were determined by analyzing production and price information in the three time periods: pre-planting, post-planting, and during planting. The necessity for earlier reports could not be proven conclusively but results found in the study suggested that information provided prior to planting was of much greater use to producers than information released after planting.

It appeared that producers' ability to make production adjustments after January 1 release of the Prospective Plantings report was significant; elasticities in this time period were found to be statistically different from zero, thus supporting this theory. A part of producers' adjustments may be due to the U.S.D.A. forecast, which would be considered a feedback effect. Consequently, some U.S.D.A. forecasts may not appear to be as bad in hindsight when feedback effects may be operating. In addition, other shocks in the market which could not be attributed to forecasts will have affects upon producers' decisions.

It must be emphasized that this study was analyzing this question of timeliness from a producers' perspective. Comments in this study were not intended to insinuate that information that is not timely for production decisions is of no use. This information is still invaluable for marketing or storage decisions.

Future Research

One area in which future research is needed is in the area of production adjustments associated with the release of pertinent market information. In particular, U.S.D.A. information, since it represents a major source of information for agriculture markets. This might be accomplished by analyzing various crops' specific growing characteristics in their major producing states. It might be desirable to review producers' pre-planting production habits, as these most certainly dictate the degree which producers are able to adjust.

This study points out the need for closer examination of prices as they relate to production forecasts. As this study analyzed prices during the period which the forecast data was gathered, it might be beneficial from an accuracy standpoint to discount extraordinary information which occurs during the various stages of the study.

The study also reveals the lack of information released by the U.S.D.A. concerning winter wheat. It was observed that what information was released did not appear to be timely, nor was it released with any frequency. At the initial stages of this study some consideration was given to analyzing adjustments in the production of winter wheat, but this idea was dropped because of the points previously mentioned.

Further research may help determine pertinent and timely information for winter wheat and other crops, as well as livestock.

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