REVIEW OF MARKETING AND AGRICULTURAL ECONOMICS
VOL. 46, NO. 3 (December 1978)

An Evaluation of Outlook Information for Australian Agricultural Commodities

J. W. Freebairn†*

This paper reviews the literature on the production, dissemination and use made of market outlook information for agricultural commodities. It focuses on the requirements and demand for market outlook information, the level of accuracy of information currently available, of future prospective gains in accuracy, some estimates of the value of outlook information, and government participation in the supply of outlook information.

1 Introduction

Most decisions about the production, trade and consumption of agricultural commodities take place in a state of uncertainty about future prices and quantities. Because of time-consuming biological and other product transformation constraints there are lags of months and sometimes years from the time when resources are committed to production and the time when output reaches the market. Investment decisions on assets such as machinery, buildings and breeding livestock effectively constrain production and consumption decisions during the life of the asset. Such investment decisions are costly to alter or reverse. During these periods changes in a number of factors including seasonal conditions, general economic conditions, technology and government policy can cause substantial changes in realised market prices and quantities.

The principal role of commodity outlook information is to facilitate decision making in an environment of uncertainty about future commodity prices and quantities.[1] Its immediate objective is to provide decision makers with information to assist them form estimates of future market outcomes. In general the choice of production, trade and consumption

† La Trobe University

* The paper is a revised version of a paper presented to the Victorian branch of the Australian Agricultural Economics Society in December, 1977. I am grateful for comments received at that meeting. Also, I wish to thank an anonymous referee and the Editors for their suggestions. Responsibility for the final version rests with the author.

[1] The paper is restricted to the use of and value of outlook information as an input into decision making. No consideration is given to it as a consumption good, for example, as a source of personal interest and the need to satisfy curiosity. While the consumption good component of outlook information may be important it is beyond the interest of this paper.

strategies will be assessed by decision makers with reference to estimates of future prices and quantities.[2] This is because the relative attractiveness of alternative decision actions often will vary with different estimates of future market outcomes. The ultimate objective of outlook information is to facilitate more effective decision making. The latter is specified in terms of selecting decision actions which result in higher levels of realised profits, utility and social welfare than would otherwise occur.

There is an extensive investment of resources by both the private sector and the public sector in Australia in the production, dissemination and analysis of agricultural commodity outlook information. Williams [51] provides a survey of principal Australian organisations involved in providing marketing information. Government involvement stems from the need for information for its own policy making needs and from alleged deficiencies in leaving the private sector to provide a socially desirable level of outlook information. There are no estimates of the value of resources currently used in agricultural commodity market outlook activities, but it is likely that it exceeds some millions and perhaps tens of millions of dollars per annum.

This paper reviews the literature concerning the demand for and supply of commodity outlook information. It considers the types of information required for effective decision making, the order of accuracy of estimates of future agricultural prices and quantities, the prospects for increasing the accuracy and usefulness of outlook information, some estimates of the benefits of the use of more accurate outlook information by decision makers, arguments for government intervention in the supply and dissemination of outlook information, and methods of government intervention. The paper aims to provide a framework for evaluating the role of and methods to be adopted by government in the production and dissemination of information about future prices and quantities of Australian agricultural commodities.

2 Outlook Information Requirements

Commodity outlook information is used as an input by individuals, organisations and governments in making decisions about the production, trade and consumption of commodities.[3] The requirements for useful outlook information must be assessed with reference to the decision problems, decision procedures and skills of producers, traders and consumers of commodities and of policy makers and administrators.

The needs of decision makers for commodity outlook information refer primarily to estimates of future prices and quantities rather than to past and current prices and quantities. For example, a farmer choosing between growing alternative crops or running different livestock activities wants to

---

[2] Such estimates are often referred to as forecasts, predictions and projections. All the terms are used inter-changeably in this paper. Arguments about differences between the terms are considered to be diversionary and sterile. In essence they are a convenient summary of available information about future outcomes. Each is conditional on a number of assumptions and the available information.

[3] If we see the decision process as involving the four steps of problem recognition, problem formulation, choice and implementation, the principal role of outlook information is as an input into the choice step. It may contribute also to the steps of problem recognition and problem formulation.

know the relative returns he will receive from the alternative activities at the time outputs from current decisions reach the market place rather than current returns. A processor in deciding on investment into equipment and buildings requires estimates of future flows of the commodity to be processed over the lifetime of the equipment and buildings. Suppliers of inputs, including machinery and finance, require estimates of future levels of input demand in planning production and marketing strategies. There are lags in responses to government policy changes. Policy makers require estimates of the future state of the sector associated with different policy actions. Many of the decisions effectively commit resources and production plans for five, ten and even more years into the future. If it is to assist decision making and to facilitate more effective decision making, useful outlook information must aid decision makers in making estimates of future prices and quantities.

The foregoing emphasis on the requirements of market outlook information for longer term forecasts does not, however, deny the importance of data on historical market outcomes. In some cases, such as in the theory of perfect markets, current prices are the "best" available forecast of future prices (for a review of the relevant literature see Fama [21]). But, making allowance for arbitrage costs and the long decision horizons encountered with agricultural commodities this model is likely to have limited applicability. More importantly, to a large extent forecasts are based on an understanding of and extrapolation of historical relationships. Whether formal and quantitative models or less formal models are used, historical data will be required on all prices, quantities and other important causal factors influencing the demand for and supply of commodities. Even so, the point remains that the recording of historical market outcomes is only a first step towards the preparation of outlook information useful as an input for effective decision making.

With longer term forecasts it is important to consider two types of forecasts. The first refers to estimates of market outcomes at particular times, *e.g.* price in ten years time. The second refers to estimates of the average market outcomes over the decision horizon, *e.g.* the average price over the next ten years. For many decisions the latter may be all that is required.

The forecast needs of market participants and policy makers include forecasts of prices and quantities. Given the atomistic structure of the agricultural sector producers are interested primarily in forecasts of prices. To these individuals, quantity forecasts are of indirect interest only, and then only if they have in mind a demand relationship for transferring quantity to price. Quantity forecasts are of direct interest to those involved in the transport, storage and processing of commodities, to marketing authorities and to policy makers. Forecasts of prices and quantities are readily combined into forecasts of income, resource efficiency measures, distribution measures, and other criteria of interest to policy makers and administrators.

For many decisions outlook information will be required to make estimates of the probability distribution function or likely range of future prices and quantities as well as point estimates. As argued in more detail below, forecasts of future commodity prices and quantities will be subject

to errors. Many decision makers will have non-neutral attitudes towards risk. They will need information on both the variability of individual future prices and quantities and on the correlations between different prices and quantities to effectively choose enterprise combinations and to plan contingency strategies. Useful outlook information will need to assess the order of reliability and magnitude of errors of estimates of future market outcomes.

There is a great diversity in the requirements of decision makers in the agricultural sector for outlook information. This diversity stems from the atomistic structure of most of the industry. Different producers have different objective functions, differences in decision procedures and particularly the time at which decisions are made, and differences in decision alternatives and associated pay-offs available to them. For example, different wheat farmers have different attitudes to risk, different alternative enterprises to consider, different age structures and composition of machinery, and they make their decisions on how much wheat to grow at quite different times. Such diversity, together with the almost continuous inflow of new information about seasonal conditions, policy changes and other factors, mean that the content and time of release of outlook information which best meets the requirements of one set of decision makers will not be entirely satisfactory for the requirements of others.

Since outlook information is an input rather than a final product it becomes valuable only if it is used by decision makers in revising decisions which, in turn, result in higher levels of realised welfare. If the information is to be helpful to decision makers it must be in a form which they can understand and readily interpret in the context of their own decision problems and options.

3 Current Usage of Outlook Information

This section considers what forecasts of future commodity prices and quantities are used by producers and government in decision making. It provides a background for assessing the use made of available outlook information. It provides a basis for assessing the potential economic benefits associated with an increase in the accuracy of forecasts which might follow from further investments in the production and dissemination of outlook information.

Considering the importance of knowing how producers, traders and consumers form estimates of future prices and quantities in making decisions it is surprising how little data of this type has been reported in the literature. Information is required on how decision makers perceive market information, how this information is used in decision making and in particular in what way does outlook information influence their perceptions.[4]

Data about the forecasts used by farmers in decision making is of three types: direct surveys, experimental, and positive econometric supply

[4] A number of approaches to these broad questions were canvassed in two sets of papers published in the *Quarterly Journal of Economics*, Vol. 90 (November, 1976) and *Review of Economic Studies*, Vol. 44 (October, 1977).

response studies. Surveys of US farmers in the 1940's and 1950's by Williams [49], Heady and Kaldor [30], and others found that a variety of procedures for estimating future commodity prices were used by different farmers. A common procedure was to adjust the current price for expected changes in demand for and supply of the commodity. More recent analyses of businessmen's price expectations by Turnovsky [47], Jonson and Mahoney [33], and others, also indicate that information on both current and past prices and anticipated changes in key causal variables is used. Bock [3] found that beef producers used information from a number of sources in making decisions; the most important sources of information contacted for long-term production decisions were family (60 per cent), stock agents (44 per cent), newspapers (38 per cent), Department of Agriculture (33 per cent), field day (28 per cent), farmer meeting (27 per cent) and radio (24 per cent). Similar findings have been reported by Eisgruber [19] and others. Another interesting result of the Bock [3] study and of observations by the authors of the Green Paper on Rural Policy in Australia [39] was that many farmers found much of government sponsored outlook information to be unintelligible or not directly relevant to what they saw to be the information needs of their decision problems.

Most econometric studies have taken a simplified view of how producers form price expectations. Typically expected price is specified as a distributed lag of past prices with the geometric lag being popular. In most applications the distributed lag model has been assessed as giving satisfactory results in terms of economic sense and statistical criteria. Smith and Smith [42] also include grain stocks as an indicator of future price movements and find that including the additional outlook information improved the ability of the model to explain changes in wheat acreage.

It seems reasonable to conjecture that farmers' forecasts of prices are influenced in part by past values of prices and in part by more recent outlook information. The relative importance of the two categories of information is not known. It may in fact change over time and between prices and it certainly varies between different producers. The different sets of information are combined in a variety of informal and perhaps formal frameworks of market outcome determination in arriving at estimates of future returns.

A similar description can be drawn for commodity forecasts used for decision making by agribusiness firms supplying inputs to and purchasing outputs from the farm sector. As the larger firms often employ personnel with specific functions of evaluating and providing market outlook information it is likely that they incorporate a high proportion of available outlook information in their forecasts. Evidence by Crowder [13] and others indicates that some firms use highly sophisticated statistical and economic models in formulating forecasts.

There is an extensive investment by government in the provision and dissemination of outlook information for agricultural commodities. In Australia the Bureau of Agricultural Economics (BAE) is the most important provider of agricultural outlook information.[5] While much of

[5] The BAE employs almost 200 people with special qualifications in economics. About 40 of these are involved full-time in the preparation of outlook papers. Many others spend much of their time in preparing outlook data. An important output of research by others is of direct value and contribution to the BAE's commodity outlook work and to the provision of background information for policy decision making.

the information is used by the government for its own decision making also much of its is made available for use by State Departments of Agriculture, agribusiness, marketing boards and farmers. Again, the BAE draws on outlook information provided by other government agencies, by the private sector, and by multinational agencies such as OECD and FAO. While some international organisations consider long term trend changes, the greater part of Australian government sponsored outlook information is restricted to prospective changes, and usually in very general terms, of prices and quantities in the short term of a year or less.

Government sponsored outlook information is used as a component of information in the formulation and administration of agricultural policy. For example, the BAE provides market outlook advice to the Australian Agricultural Council, and many aspects of commodity policy, such as the reserve price for wool, are based to a large extent on outlook information.

In addition, many of the results of government outlook information activities are disseminated to the public. Particular examples include the National Agricultural Outlook Conference, and state Department of Agriculture publications. It is not uncommon for official reports to be used in part or as a basis for media programs, for trade publications and circulars and by agribusiness in providing market outlook information to producers, traders and consumers of agricultural commodities.

A number of procedures are used by government for generating outlook information and forecasts of specific prices and quantities.[6] They include time series models, such as extrapolation of past trends and recent developments in the area of autoregressive and moving average models. The use of economic market models in producing outlook information involve consideration of factors causing shifts of the demand for and supply of commodities and the interaction of these shifts in determining future prices and quantities. They include descriptive models, balance sheet models and formal econometric models.

4 Accuracy of Forecasts

An idea of the order of magnitude of accuracy of available forecasts of commodity prices and quantities can be obtained from published studies.

Freebairn [25] evaluated forecasts of average annual farm prices and of annual production for some Australian agricultural commodities for the late 1960's and early 1970's. Forecasts of prices and quantities one year ahead by the BAE had, in most cases, average (absolute) percentage forecast errors between 10 and 20 per cent. The BAE forecasts were found to be significantly more accurate than naive no change, naive same rate of change and autoregressive model time series forecasts. Longer run forecasts of five and ten years ahead by the Monash team were found to have larger forecast errors than the one year ahead forecasts.

A similar pattern of forecast errors has been observed for agricultural commodity price and quantity forecasts released by the USDA. Gunnelson, *et al.* [26] found USDA estimates of annual production one

[6] More details on the procedures used may be found in Tomek and Robinson [45] and Freebairn [25].

year ahead over the period 1937 to 1970 to have an average (absolute) error of 7.4 per cent. Also of interest is that the forecast error had tended to decline over time with the use of more elaborate and more expensive forecast techniques. Other studies of USDA forecasts of prices and quantities one year ahead by Fox *et al.* [23] and Baker and Paarlberg [2] report average forecast errors of around ten per cent.

The results of these studies are indicative only. For the reasons noted in the previous section it is unlikely that the forecasts considered here were actually used by many let alone all decision makers. The results are historical and peculiar to the time periods and commodities covered. Even so, they provide a guide to the order of accuracy of forecasts of average annual prices and quantities used by producers and government in decision making.

5 Future Prospects

There are a number of reasons for being optimistic that there will be increases in the usefulness of outlook information and of the subsequent accuracy of commodity forecasts used by decision makers. However, there can be little doubt that significant errors will still occur. Here some of the reasons for optimism are noted.[7]

As noted by Bonnen [4], the usefulness of outlook information depends jointly on the production and collection of data, the analysis and interpretation of this data in purposeful decision problem contexts, and the dissemination of the information to decision makers. All steps must be considered. Further, failure to attend to any one component of the information process will adversely hinder the effectiveness of other components.

The data base for understanding how commodity outcomes are determined and for using this knowledge to estimate future outcomes is deficient in many ways. Often data is not available on key variables, *e.g.* on commodity stock levels and in some cases even on prices and quantities. Potential benefits could come from having more disaggregated data by time, by location and by product form. There is a need to bring together the definitional concepts assumed by theoretical models and actual data recordings. More accurate and more timely data on current market outcomes will facilitate improvements in commodity outlook information. Developments in sample survey techniques and more particularly in their application have enabled the USDA to increase both the accuracy and timeliness of estimates of future levels of production.

The development and use of more appropriate analytical techniques should lead to an increased understanding of how market outcomes are determined and, in turn, to a better framework for preparing forecasts. Consider three illustrative examples. The underlying models used by the BAE in its wool situation analysis have evolved from trends, to judgemental market models, to formal models beginning with Hussey [31],

[7] The discussion builds on and extends the symposium of a similar topic conducted by the American Agricultural Economics Society Meeting in 1966 and particularly the comments by Bottum [5].

then Dalton [15] and Dalton and Taylor [16]. Recent developments in time series and econometric methods have resulted in forecasting procedures with smaller expected forecast errors. Inclusion of allowance for price-substitution effects and commodity interaction effects in balance sheet models represent moves towards a more realistic and, one would expect, more accurate framework for preparing forecasts.

Perhaps very importantly, the usefulness of market outlook information to decision makers can be increased. A number of people including authors of the Green Paper on Rural Policy [39], Williams [51] and Bock [3] have observed that many farmers and others find much of the existing body of outlook information to be unintelligible or irrelevant to their decision problems. Bock suggests a greater need for presenting outlook information in the context of producers' production decisions. There is a need to reconsider from the user's viewpoint the appropriate forecast horizon, the time of release and method of presentation of outlook information, and there is a need to educate decision makers in the use of public outlook information.

In evaluating potential increases in the accuracy of commodity price and quantity forecasts it is necessary to consider an argument advanced by Miller and Harris [37] and others that a forecast by its very nature should be "self defeating". The argument is based on the premise that producers reacting to the forecast of a price increase will increase production resulting in a lower price than the forecast price; the converse holds for the forecast of a price fall. This argument is of no consequence if demand for the product is highly elastic, an assumption consistent with Australia being a relatively small contributor to total world trade, and if only a small proportion of producers react to the outlook information. More generally, the "self defeating" argument is based on the assumption that the forecaster ignores any producer reactions to his forecast. This restrictive assumption can and should be relaxed, for example, along the lines suggested by Smyth [43] and others. Admittedly it adds another element to the forecasting problem, namely producers' reactions to forecasts. Nevertheless, at least in principle and in many cases in practice, forecasts can be made so as to closely coincide with actual market outcomes.

Granting that the investment of additional resources into market outlook activities will lead to increases in the accuracy of forecasts used by decision makers it is critical to recognise that there will be forecast errors and in some cases very large errors. It is inevitable that outlook information will be based on models and procedures which simplify the complexity of the real world. Because of the need for simplicity or the lack of alternative information many factors which might change, and in some occasions do change, will have been assumed constant. Forecasts are based to a large extent on historical relationships which may change in the forecast period relative to the past. There will be unpredicted or unpredictable changes in future values of some of the critical causal variables. The variables include seasonal conditions both in Australia and in the principal importing and export-competing countries, changes in general economic conditions and changes in government policies. Errors in anticipating levels of these variables are a basic cause of forecast errors for Australian agricultural prices and quantities.

6 Some Economic Benefits of Outlook Information

Commodity outlook information has economic benefits as an input to more effective decision making under conditions of imperfect knowledge. It has value in the sense that it enables decision makers to realise higher profits and utility and for society to realise greater welfare than would otherwise be the case. In the literature three types of models have been suggested for quantifying the benefits of additional outlook information. They are decision theory models, information theory measures, and market models using changes in the area of economic surplus.[8] This section sketches details of the models, references some applications, and considers some estimates of the order of magnitude of benefits of additional market outlook information.

Decision theory models offer both an intuitively appealing and a practical framework for estimating the value of additional information to individual decision makers whether they be producers, consumers or policy makers. Given a set of alternative decision actions, a set of possible state outcomes, a pay-off matrix of actions by outcomes and a probability distribution function of outcomes, decision theory methods are used to choose the action which maximises expected utility of which profit is a special case. The probabilities may be conditional on the decision action and they may be formed subjectively, *i.e.* on the basis of beliefs, or objectively, *i.e.* on the basis of historical recordings. For the analysis of the benefits of market outlook information the decision actions might refer to choice of enterprise mix, level of investment and the form and level of government assistance. The possible state outcomes would be expressed in terms of different levels of future prices and quantities. Procedures used in setting-up and solving decision problems are reported in numerous articles and books including Raiffa [38], Dillon [17], and Halter and Dean [27].

The value of commodity outlook information can be assessed in two related ways. First, the expected value of perfect information, that is, information stating precisely which market outcome will occur, can be determined. While such an Utopian prospect is unlikely, the calculations are readily performed and the estimate provides an upper bound for the expected value of additional information.

Second, using Bayes' rule to combine prior and additional market outlook information to compute a posterior probability distribution function, the expected value of additional but less than perfect information can be assessed. The value of additional information is given by the difference between the expected utility using the posterior distribution function and using the prior distribution function. Details and worked examples are reported in Dillon [17] and Winkler [52]. This procedure requires more data and involves many more calculations than those required in evaluating the value of perfect information.

At the quantitative level several implications of the application of decision theory models to estimate the benefits of additional outlook information

[8] While product and job search models developed by Stigler [44] and others are useful for describing the behaviour of decision makers in seeking information in a world of imperfect knowledge, it is difficult to use search models for estimating the value of information at an aggregate level other than by using the procedures described in the text.

are of interest. Beneficial information is described in terms of signals which give a more precise picture of future market outcomes. This then is used in a more selective choice of actions yielding higher levels of realised pay-offs. The benefits are positively related to both the degree of accuracy of new market outlook information,[9] and particularly to that which indicates substantial market changes, and the scope for choosing alternative actions which have different relative pay-offs for different state outcomes.

At the empirical level a surprisingly small number of studies using decision theory models to estimate the value of more accurate market outlook information have been reported.[10] Eidman, Dean and Carter [18] estimate the benefits of more accurate price forecasts to a turkey farmer in choosing between contracting arrangements. The estimates are said to be "substantial" with the expected benefits being about five percent of the gross value of the farmers' production. Bullock and Logan [7] and Williams [50] provide estimates of the value of more accurate cattle price forecasts to feedlot operators and find the expected benefits to be less than two per cent of the gross value of cattle sold. Numerous other decision problems encountered by producers, consumers and policy makers could be evaluated along the lines of the turkey farm and feedlot operator examples.

Information theory has been suggested as a procedure for evaluating the information content of additional data such as market outlook information. Originally developed in the context of electrical communications and control it has been considered in a number of economic applications by Theil [46]. Leuthold [34] considers a specific application to commodity price forecasting. Information theory measures the information content of a message of an event occurring as minus the log (to base 2) of the probability of occurrence of the event. The information scale, with units being called bits, is based on the number of required binary choices.

Using information theory the information content of additional market outlook information is given by the difference between the expected information content of a message using the prior distribution function and the posterior distribution function (based on the prior plus additional market outlook data). Formally, the expected information value in bits is given by the expected value of the log of the ratio of the probabilities of state occurrence using the two distribution functions. There remains the problem of transferring the expected information gain measure to a measure of economic benefits. Without this additional function the usefulness of information theory as a method for estimating economic benefits of market outlook information is limited.

Several authors have used market models in conjunction with measures of changes in economic surplus to estimate the value of additional commodity outlook information. Because of forecast errors, production and

---

[9] Kihlstrom [34] presents a general theorem showing that, for profit maximisers, the demand for information is a non-negative function of the accuracy of information and is a non-positive function of the price of information.

[10] There have been, however, a number of studies evaluating the benefits of other types of information, *e.g.* Byerlee and Anderson [9] on rainfall data, Carlson [11] on data on fruit tree pests and Ryan and Perrin [40] on soil test data.

consumption decisions result in market outcomes different from those which would have occurred if there had been no forecast errors. The actual market outcome results in different levels of consumers' surplus and producers' quasi-rents as compared to the perfect foresight market outcome. The use of more accurate forecasts, that is forecasts which are closer to both the perfect foresight and realised market outcomes, result in an increase in aggregate economic surplus and this increase is used as a measure of the value of more accurate forecasts.[11] The marginal benefits of more accurate forecasts are found to decrease with the magnitude of the present forecast error.

Distribution of the aggregate benefits between producers and consumers differ between models and situations. Important considerations include the elasticities of supply and demand, the source of the forecast error, and decision procedures adopted. While there is always a net aggregate gain, in some cases either producers or consumers may lose from more accurate forecasts.

Several specific models have been developed and applied. Hayami and Peterson [29] formulated two models to estimate the value of more accurate production forecasts. An inventory adjustment model was used to estimate the aggregate benefits of more accurate crop commodity forecasts. A production adjustment model was applied for the case of livestock commodities. Assuming decision makers adopted USDA production forecasts it was estimated that a reduction in the average (absolute) forecast error from three to one per cent would increase aggregate economic surplus by about six per cent of the gross value of the crop commodities traded and by about one per cent of the gross value of the livestock commodities traded. Further analysis of the Hayami and Peterson model by Bullock [8] indicates that the benefits of more accurate production forecasts may not be symmetrical with respect to under and over estimates of future quantities. Bradford and Kelejian [6] have extended the theoretical analysis of the inventory model. They evaluate the distribution of benefits between buyers, farmers, speculators and storage providers and they consider the cases in which speculators adopt naive and rational price forecasts.

Freebairn [24] developed two models to estimate the value of more accurate price forecasts for horizons of one and five years to assist producer decision making. They were applied to some Australian agricultural commodities. Assuming that existing price forecasts were given by the adaptive expectations model it was found that a fifty percent reduction in the forecast error would increase economic surplus by less than one percent of the gross value of the commodities produced and that most of the gains would have gone to producers.

On a number of counts estimates of the benefits of outlook information using the market models are biased downwards. For example, they ignore the benefits of greater market stability that may result from decision makers using more accurate forecasts, they assume risk neutrality of

[11] The surplus measures are interpreted as the money sums which buyers and sellers would exchange for a shift in market outcomes from that occurring without the market outlook information to that occurring with the market outlook information. The use of this measure together with a discussion of some of the limitations may be found in Currie *et al.* [14].

objective functions, and benefits associated with better policy decisions are ignored. The first two are explored below.

Market outlook information may stabilise realised market prices and quantities relative to a situation without such information. Using a cobweb model, and building on the work of others, this is shown formally by Smyth [43] and Turnovsky [48]. The latter shows that the use of more accurate forecasts also increase aggregate economic surplus in a similar way as would a buffer stock stabilisation scheme that stabilises price. That is, announcement of rational forecast prices for use by private decision makers can be used as an alternative stabilisation instrument to public use of the information in a buffer stock scheme. Miller and Harris [37] present the argument in a less formal but more general context. For risk averse decision makers choosing portfolios of activities, less variability will enable them to choose portfolios with a higher expected pay-off. Greater stability of quantities over time reduces the need for some expensive capital equipment and storage facilities required to cope with uneven supplies. In general the costs of decision making are reduced by having a pattern of market outcomes with smaller random fluctuations.

If risk aversion is an important characteristic of the behaviour of decision makers, and there is considerable evidence to this effect, then outlook information will provide additional benefits to those noted so far. Additional outlook information will reduce the uncertainty confronting decision makers in two ways. First, the degree of variability of realised market outcomes is likely to be reduced. Second, the additional information provides decision makers with a more accurate picture of future movements in prices and quantities so that while variability remains there will be more knowledge about that variation. The reduction in uncertainty will itself increase the perceived welfare of many individuals. For example, Cary and Weston [10] found with a sample of dairy farmers that reduction in uncertainty about future market prospects, even when the future was estimated to be gloomy, reduced the stress felt by decision makers and thus raised their perceived welfare.

This section has discussed some models which make explicit the ways in which commodity outlook information can convey benefits to individuals and to society. It summarised some estimates of benefits from using such models. Only if decisions are made in a situation where future outcomes are uncertain and in which outlook information can be used to revise decision actions will the information yield benefits. The benefits stem from the revised decisions yielding greater realised benefits. The benefits are a decreasing function of the gains in forecast accuracy. The potential benefits of further investments in market outlook activities are likely to be small rather than large amounting to no more than a few percent of the gross value of commodity trade.[12] Even so, in the Australian context these benefits would amount to some tens of millions of dollars per annum. The

[12] Since the benefits of market outlook information stem from a more efficient allocation of resources as seen *ex post* it is interesting to note that the estimated benefits of more accurate commodity forecasts surveyed in this paper as a percentage of the gross value of commodities traded are comparable to the benefits as a percentage of GDP of removing resource misallocations associated with monopoly, *e.g.* Harberger's classic study [28] of monopoly costs in the USA, and trade barriers, *e.g.* Evan's study [20] of the costs of tariffs to Australia.

benefits should be compared with the opportunity cost of resources required to obtain increases in forecast accuracy. In this context the favourable benefit to cost ratios reported by Hayami and Peterson [29] are encouraging. However each case should be evaluated on its own merits.

7 Reasons for Government Involvement

The extensive investment by the federal and state governments in market outlook information for agricultural commodities stems from at least two considerations; the need for information for the formulation and execution of policy, and alleged market imperfections. Arguments for government measures to augment the level of outlook information available to the private sector decision makers include the public good attribute of information, scale economies in its provision and dissemination, and the uncertainty of returns from outlook information. Equity and distributional reasons may also be advanced for government involvement. This section evaluates some of the reasons for government provision of outlook information for use by the private sector.

Outlook information is a public good. This can result in a divergence between the criteria used by individuals and by society in allocating resources to outlook activities. Information is a public good in the sense that one person's use of it does not affect its availability to other users. In addition, it is difficult and costly both to restrict others from having access to and to using outlook information produced by one individual and to detect from observed behaviour those who have used the information. This means that an individual's investment in outlook information activities is likely to return a lower value to him than the sum of the returns gained by all users of the information. With its atomistic structure the extent of divergence between social and private benefits of market outlook information is likely to be large for many agricultural commodities. While the public good argument does not mean that no private resources are devoted to outlook information activities, it does mean that the private sector will tend to devote too few resources to the activities.

A further problem is that, as argued in the previous section, the benefits of outlook information go to producers and to consumers. The proportionate breakdown of benefits is very sensitive to model assumptions. Unlike the case of research for which the Industries Assistance Commission [32] has argued that the distribution of the benefits are similar to the distribution of the cost of a tax on producers for using the research, it is not obvious what form of charging of producers for government produced outlook information would have a similar distributional incidence as the benefits. Further work at the theoretical level is required. Given our present level of knowledge, since consumers may take some of the gains of outlook information it can be argued as a tentative hypothesis that consumers should contribute some of the cost. Traditionally governments have been charged with this function.

The level of returns to an individual from resources devoted to the production of outlook information is uncertain. There is uncertainty about the level of increase in accuracy of forecasts that will result. Also, there is uncertainty about the value of more accurate forecasts. Because of uncertainty about returns from investment of resources in outlook

information, risk averse individuals will invest less resources in the activity than is indicated by a criterion of expected profit maximization. However, this argument is not by itself sufficient to conclude that not enough resources are devoted to market outlook since other investments also have uncertain returns.

Government participation in outlook information activities has been advocated as one way to reap the benefits of cost economies of size and specialisation in the collection, interpretation and dissemination of data, for example, by Green Paper on Rural Policy [39, paragraph 5.175]. No doubt there are cost economies, but there is no available data on when they begin and end. Also, there are conflicting arguments as to the relative cost effectiveness of a centralised versus a disaggregated structure of sources of outlook information. One area of concern with a centralised structure is the lack of competitive pressures to provide the types of outlook information required at least cost.

An important characteristic of useful outlook information is that it provides a complete and impartial picture of market prospects. This characteristic has to be believed by the users of information. Often direct government provided information is demanded as a source of reliable, unbiased and impartial assessment of both the current market situation and of likely future market outcomes.

The Green Paper on Rural Policy [39] and others have suggested the need for government provision of information to meet distribution objectives. It is argued that all market participants should be provided with equal access to information about future market prospects. Clearly such an effect will have distributional implications. But, it is useful to ask whether the redistribution is a more desirable one and if the provision of outlook information is a cost effective instrument for redistribution?

Thus, there are a number of logically valid arguments for some form of government provision of commodity outlook information to the private producers, traders and consumers of agricultural commodities. Assessment of what that level is, while straightforward conceptually, is bound to be difficult to determine in practice. It is likely however that an additional investment of resources above that required to provide information for its own policy needs will be justified by a social benefit cost assessment. This follows from differences in the information needs of private decision makers, a tendency for private decision makers to invest less in outlook activities than is socially desirable, and the demand for government supplied information to ensure in the minds of at least some private decision makers that it is impartial and reliable.

8 Some Government Strategies

Accepting the arguments that government should take an active role in producing and disseminating agricultural commodity outlook information to the private sector this section considers some issues affecting the type of information to supply, the means of producing the information, the ways of disseminating it, and the method of financing the activities.

The types of outlook information useful to decision makers have been discussed in an earlier section. A number of deficiencies in the current

output of agricultural commodity outlook information were noted. These include the need for more price outlook information for periods of one to five and more years ahead, greater attention to explaining the extent of and causes of forecast errors, and for information about interrelationships, including correlations, between market outcomes for different commodities. In all cases it is vital to assess what information is sought by and would be used by decision makers. A number of studies point to limited use being made of the present output of government commodity outlook information and to criticisms of that which is produced, for example, Green Paper on Rural Policy [39], Williams [51] and Bock [3].

In considering the methods of producing commodity outlook information, the general framework of Bonnen [4] is a useful starting point. For the specific Australian context, the ad hoc and uncoordinated manner in which information is collected, analysed and disseminated by a multitude of organisations is striking. Also, there are long time lags in information reaching producers. There would appear to be substantial gains from a greater level of co-ordination of activities of the various federal and state departments, particularly BAE and Departments of Agriculture, of the commodity marketing boards, and probably also private industry. Greater use of, a more consistent pattern of use of, and more explicit direct access to outlook information produced by other governments and multinational bodies seems desirable as an input in producing outlook information.

One would hope for development of standardised, consistently applied consensus frameworks of models for evaluating the determination of commodity outcomes and for combining information in the preparation of outlook information.[13] These models would be based on economic logic, details of institutional structures, technical relationships and statistical studies. Legitimate differences of opinion and the evolution of knowledge require that the consensus model be general and not too specific. Consensus models would facilitate the efficient collection of data, simplify and help speed its analysis, and facilitate the dissemination of outlook information.

In disseminating outlook information two extreme strategies might be considered. The first or specific strategy is one of producing specific forecasts of particular market outcomes and releasing it at a particular date. The second or educative strategy is one of educating decision makers in understanding how market outcomes are determined so that they can form forecasts to meet the particular needs of their own decision problems.[14]

The two strategies have a number of comparative advantages and disadvantages. The specific forecast strategy has the advantage that the information is explicit and can be readily interpreted by decision makers. The alternative strategy requires that decision makers be educated in the use of general principles and that they are prepared to devote time and

---

[13] A tentative move in this direction is appearing in recent work by the BAE, however there is a long way to go. Also, a greater degree of participation by State Departments of Agriculture, marketing boards and others is required.

[14] This strategy was advanced by Miller and Harris [37].

resources into compiling and revising forecasts. Advantages of the education strategy stem from its flexibility in meeting the diversity of forecast requirements of different decision makers and in permitting decision makers to incorporate the latest information in forecasts. By contrast, specific forecasts are of direct relevance only to a subset of decision makers. Also, they may leave decision makers in a quandary as to how to revise forecasts in the likely event of additional information coming available during the time between release of the forecast and the time the decision is taken. In a sense the choice of strategy becomes one of balancing the simplicity and reduced applicability of specific forecasts with the more general education strategy which offers more flexibility but requires a more sophisticated audience.

For the current Australian context a compromise is suggested. The longer term goal would be to educate decision makers in the operation of markets and in how forthcoming information can be used to revise forecasts. In the interim period, and as a component of the education phase, specific forecasts for key outcomes of general applicability would be presented together with a discussion of the underlying logic used in forming the forecast. The forecast might take the form of average annual prices and quantities for (stated) "normal" conditions over the next one and five years and sensitivity of the forecasts to (stated) plausible but "less likely" changes in some key causal variables.

A critical issue for government policy concerns who should pay for public provided outlook information. Several points of view can be found in the literature.

Arrow [1] and others suggest that government should provide the information to users free of charge and that lump sum taxes be used to finance the activities. The argument is built on the objective of an efficient allocation of resources and the public good property of outlook information. The cost of distributing outlook information once it is produced is minimal and further the marginal cost of distributing to one or many potential users is very low.

However, since outlook information is a public good the price placed on it will have no effect on its use by private decision makers. Once government determines the amount of information to produce, then that volume of information, no more and no less, is automatically available to private decision makers. Only if government could attribute a charge per unit of information used would the price set affect the level of information usage. But, the very nature of a public good rules out such an arrangement.

An alternative view based primarily on considerations of equity is that those who benefit should pay.[15] As noted in the previous section the welfare of both buyers and sellers may be affected by outlook information and the magnitude of benefits to individuals differ with their objective functions, decision alternatives and decision processes. It is unlikely that costing arrangements based on simple formulae such as "benefits are proportional

[15] The criteria of those who benefit should pay is widely advocated in the discussion of related issues concerning the payment of resources employed in public research of a technological nature, for example, by the Industries Assistance Commission [32]

to the quantity bought and sold" provide even a crude approximation to the distribution of benefits of market outlook information.

Thus, the choice of method of financing public provision of outlook information remains unresolved. Because of its public good nature many alternatives would have virtually no effect on private sector decisions affecting the use of available outlook information. The strict application of equity considerations as a basis for financing public expenditure on these activities is complicated by difficulties in assessing the magnitude of benefits going to different individuals.

9 Some Implications for the Future

Outlook information is used as an input in making decisions by producers, consumers, traders and government. It is a useful activity only if it results in decision makers choosing actions which realise greater levels of profits, utility and social welfare than would otherwise be the case.

An important area for future enquiry concerns assessing the information needs of decision makers and in particular the way in which they perceive and use government produced information. The limited evidence available suggests that many decision makers, and especially farmers, do not use much of the information produced and many regard that which is produced as not suitable for the needs of their decision problems.

Several suggestions follow from the results of this study. Required data for making decisions include estimates of future prices and quantities for several horizons including the next few weeks, next year, and the longer term. As well as point estimates there is a demand for estimates of favourable and unfavourable outcomes and for data about interrelationships between different prices and quantities. It is imperative that users be made aware of potential errors in estimates of future prices and quantities and that some measure of these errors be conveyed to them. To be useful, outlook information has to be integrated with production decisions and opportunities as seen by producers.

As well as improving the way in which outlook information is presented to decision makers there is a need to further the education of decision makers in making use of available data. Because of the great diversity of the form and timing of forecasts required by different decision makers and the continuous inflow of relevant information for updating forecasts it is apparent that private decision makers, rather than government, will have to themselves make the specific forecasts for most of the specific decision problems they face.

A number of options might be considered in improving the production and accuracy of commodity outlook information in a least cost manner. A number of gaps in available data series and particularly improvements in the timeliness of data should be reconsidered. Recent developments in methods of understanding and analysing the determination of current market outcomes and of forecasting should be pursued. More extensive and formal use of commodity analyses and outlook information prepared in other countries and overseas agencies is required. In Australia potential gains would flow from a more formal and explicit degree of co-ordination of outlook activities — both in production and dissemination — between

the federal and state government departments, marketing boards and private industry. Consideration could be given to the formulation of a consensus framework for analysing the determination of current and future prices and quantities. Such a framework would facilitate the collection of appropriate data, the analysis stage, the dissemination stage, and the stage of educating outlook information users.

Even with the foregoing improvements considerable errors will remain with forecasts of agricultural prices and quantities. Forecast models simplify reality and sometimes factors considered unimportant in the past will become important in the forecast period. In the context of agricultural commodities there are limits to the extent to which such important causal force as seasonal conditions and trade policies can be foreseen. With average annual prices and quantities produced, average forecast errors of ten per cent may well represent upper bounds for the accuracy of forecasts. In particular cases much larger forecast errors can be anticipated.

Estimates of the benefits that would arise from decision makers using more accurate price and quantity forecasts suggest that they will be small rather than large. Using decision theory models and market models, estimates of benefits of halving the errors of forecasts now assumed to be used by many decision makers would increase economic returns by no more than a few per cent of the gross value of commodity production. Marginal benefits are a decreasing function of increases in forecast accuracy. A benefit cost type analysis would be used to assess the desirable level of additional investment in outlook information activities.

Bibliography

[1] ARROW, K. J., "Economic Welfare and the Allocation of Resources for Invention" in *The Rate and Direction of Inventive Activity: Economic and Social Factors*, N.B.E.R., Princeton University Press, 1962.

[2] BAKER, J. D. AND D. PAARLBERG, "How Accurate is Outlook", *Journal of Farm Economics*, 34 (1962): 509-519.

[3] BOCK, I. M., "Market Information and Farm Management Decision Making", School of Agriculture and Forestry, University of Melbourne, 1976.

[4] BONNEN, J. T., "Improving Information on Agriculture and Rural Life", *American Journal of Agricultural Economics*, 57 (1975): 753-763.

[5] BOTTUM, J. C., "Changing Functions of Outlook in the U.S.", *Journal of Farm Economics*, 48 (1966): 1154-1159.

[6] BRADFORD, D. F. AND H. H. KELEJIAN, "The Value of Information for Crop Forecasting in a Market System: Some Theoretical Issues", *Review of Economic Studies.*, 44 (1977): 519-532.

[7] BULLOCK, J. B. AND S. H. LOGAN, "An Application of Statistical Decision Theory to Cattle Feedlot Marketing", *American Journal of Agricultural Economics*, 52 (1970): 234-241.

[8] BULLOCK, J. B., "Social Costs Caused by Errors in Agricultural Production Forecasts", *American Journal of Agricultural Economics*, 58 (1976): 76-80.

[9] BYERLEE, D. R. AND J. R. ANDERSON, "Value of Predictors of Uncontrolled Factors in Response Functions", *Australian Journal of Agricultural Economics*, 13 (1969): 118-127.

[10] CAREY, J. W. AND R. E. WESTON, "Social Stress in Agriculture", University of Melbourne, School of Agriculture and Forestry, 1978.

[11] CARLSON, G. A., "A Decision Theoretic Approach to Crop Disease Prediction and Control", *American Journal of Agricultural Economics*, 52 (1970): 216-223.

[12] CHRIST, C. F., "Judging the Performance of Econometric Models of the U.S. Economy", *International Economic Review*, 16 (1975): 54-74.

[13] CROWDER, R. T., "Statistical Vs. Judgement and Audience Consideration in the Formulation and Use of Econometric Models", *American Journal of Agricultural Economics*, 54 (1972): 779-783.

[14] CURRIE, J. M., MURPHY, J. A. AND A. SCHMITZ, "The Concept of Economic Surplus and Its Use in Economic Analysis", *Economic Journal*, 81 (1971): 741-799.

[15] DALTON, M. E., "Short-Term Wool Price Movements — A Projection Model", *Quarterly Review of Agricultural Economics*, 27 (1974): 195-209.

[16] DALTON, M. E. AND E. L. TAYLOR, "Further Developments in a Model Projecting Short-Term Wool Price Movements", *Quarterly Review of Agricultural Economics*, 28 (1975): 209-222.

[17] DILLON, J. L., "An Expository Review of Bernoullian Decision Theory in Agriculture: Is Utility Futility?" this *Review*, 39 (1971): 3-80.

[18] EIDMAN, V. R., G. W. DEAN AND H. O. CARTER, "An Application of Statistical Decision Theory to Commercial Turkey Production", *Journal of Farm Economics*, 49 (1967): 852-868.

[19] EISGRUBER, L. M., "Managerial Information and Decision Systems in the U.S.A.", *American Journal of Agricultural Economics*, 55 (1973): 930-936.

[20] EVANS, H. D., *A General Equilibrium Analysis of Protection*, Amsterdam, North-Holland, 1972.

[21] FAMA, E., "Efficient Capital Markets, A Review of Theoretical and Empirical Work", *Journal of Finance*, 25 (1970): 43-63.

[22] FISHER, B. S. AND C. TANNER, "The Formulation of Price Expectations: An Empirical Test of Theoretical Models", *American Journal of Agricultural Economics*, 60 (1978): 245-248.

[23] FOX, K. A., J. K. SENGUPTA AND E. THORBECKE, *The Theory of Quantitative Economic Policy*, North-Holland, Amsterdam, 1966.

[24] FREEBAIRN, J. W., "The Value and Distribution of the Benefits of Commodity Price Outlook Information", *Economic Record*, 52 (1976): 199-212.

[25] FREEBAIRN, J. W., "Forecasting for Australian Agriculture", *Australian Journal of Agricultural Economics*, 19 (1975): 154-174.

[26] GUNNELSON, G., W. D. DOBSON AND S. PAMPERIN, "Analysis of the Accuracy of U.S.D.A. Crop Forecasts", *American Journal of Agricultural Economics*, 54 (1972): 639-645.

[27] HALTER, A. N., AND G. W. DEAN, *Decisions Under Uncertainty*, Cincinnati: South-Western, 1971.

[28] HARBERGER, A. C., "Monopoly and Resource Allocation", *American Economic Review*, 44 (1954): 77-87.

[29] HAYAMI, Y., AND W. PETERSON, "Social Returns to Public Information Services: Statistical Reporting of U.S. Farm Commodities", *American Economic Review*, 62 (1972): 119-130.

[30] HEADY, E. O. AND D. R. KALDOR, "Expectations and Errors in Forecasting Agricultural Prices", *Journal of Political Economy*, 62 (1954): 34-47.

[31] HUSSEY, D. D., "A Short-Term Projection Model for Wool Prices — An Explanatory Analysis", Occasional Paper No. 7, B.A.E., Canberra, 1972.

[32] Industries Assistance Commission, *Financing Rural Research*, A.G.P.S., Canberra, 1976.

[33] JONSON, P. D. AND D. M. MAHONEY, "Price Expectations in Australia", *Economic Record*, 49 (1973): 50-61.

[34] KIHLSTROM, R. E., "Firm Demand for Information about Price and Technology", *Journal of Political Economy*, 84 (1976): 1335-1341.

[35] LEUTHOLD, R. M. *et al.*, "Forecasting Daily Hog Prices and Quantities: A Study of Alternative Forecasting Techniques", *Journal of the American Statistical Association*, 65 (1970): 90-107.

[36] LEUTHOLD, R. M. "On Combining Information Theory and Bayesian Analysis", *Canadian Journal of Agricultural Economics*, 19 (1971): 26-34.

[37] MILLER, G. L. AND S. F. HARRIS, "Price Formation, Price Projections and Commodity Marketing Research", Bureau of Agricultural Economics, Occasional Paper No. 13, 1972.

[38] RAIFFA, H., *Decision Analysis*, Reading, Addison-Wesley, 1968.

[39] Rural Policy in Australia, Report to the Prime Minister by a Working Group (Green Paper), A.G.P.S., 1974.

[40] RYAN, J. G. AND R. K. PERRIN, "Fertiliser Response Information and Income Gains: The Case of Potatoes in Peru", *American Journal of Agricultural Economics*, 56 (1974): 337-343.

[41] SANDERS, J. H. AND R. C HOYT, "The World Food Problem: Four Recent Empirical Studies", *American Journal of Agricultural Economics*, 52 (1970): 132-135.

[42] SMITH, A. W. AND R. L. SMITH, "A Model of the Australian Farm Sector: A Progress Report", *Economic Record*, 52 (1976): 462-482.

[43] SMYTH, D. J., "Effect of Public Price Forecasts on Market Price Variation: A Stochastic Cobweb Example", *American Journal of Agricultural Economics*, 55 (1973): 83-88.

[44] STIGLER, G. T., "The Economics of Information", *Journal of Political Economy*, 69 (1961): 213-225.

[45] TOMEK, W. G. AND K. L. ROBINSON, "Agricultural Price Analysis and Outlook" in Martin L. R. (Ed.) *A Survey of Agricultural Economics*, University of Minnesota Press, Minnesota, 1977.

[46] THEIL, H., *Economics and Information Theory*, Amsterdam: North-Holland, 1967.

[47] TURNOVSKY, S. J., "Empirical Evidence on the Formation of Price Expectations", *Journal of the American Statistical Association*, 65 (1970): 1441-1454.

[48] TURNOVSKY, S. J., "Stabilisation Rules and the Benefits from Price Stabilisation", *Journal of Public Economics*, Vol. 9. (1978): 37-58.

[49] WILLIAMS, W. F., "An Empirical Study of Price Expectations and Production Plans", *Journal of Farm Economics*, 35 (1953): 355-370.

[50] WILLIAMS, J. E., "Feed-Marketing Decisions and the Value of Price Forecast Information to the Cattle Feeder", Unpublished Ph.D. dissertation, Iowa State University, 1975.

[51] WILLIAMS, P., "Report on a Survey of Agricultural Marketing Information in Australia", Australian Broadcasting Commission, Rural Department, 1975.

[52] WINKLER, R. L., *Introduction to Bayesian Inference and Decision*, New York: Holt, Hinehart and Winston, 1972.