PRICE FORMATION, PRICE PROJECTIONS AND COMMODITY MARKETING RESEARCH

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The market is the place where resources committed to the production of goods and services some time earlier, are finally valued. In the traditional theory of the competitive firm in equilibrium — a theory that forms the foundation of many of our techniques of farm planning — it is assumed that planned resource valuations and final valuations coincide.

As recent experience in the wool market clearly demonstrates, the real world is a different place. However while developments in the wool market have resulted in increased emphasis on the effects of unexpected price fluctuations, the phenomenon of price instability itself is not new. Perhaps the most outstanding example of the apparent instability of commodity market prices is to be found in the world sugar market, although the cocoa market has an equally volatile history. Indeed, prices of all major internationally traded commodities are subject to wide fluctuations.

Such fluctuations, along with yield variability brought about by the weather, make effective farm planning difficult. Nevertheless the superficial association between yield variations and price variability as components of uncertainty, should not be misconstrued. There is an essential difference between forecasting the weather and projecting the market price. The weather man's prediction can have no influence on the outcome. In a technically efficient commodity market, any credible projection must influence the course of events.
In a loose sense, most economists probably regard it as self-evident that projections might influence the price, although they would have little confidence in their ability to accurately predict the magnitude of the effect. In fact, in a market that is technically efficient at price formation, the final price cannot itself be accurately predicted. In contrast, the effect on the price of the information provided by a credible short run projection of the price can be predicted with some accuracy. It is because of this fact, rather than because of any possible ex post realisation of the projected price, that research in commodity marketing economics is productive. At the same time, knowledge of the effects of a projection on the market can help indicate some of the pitfalls of price analysis.

In seeking to establish these points, the present paper begins with a brief discussion of the nature and operations of a technically efficient commodity market, drawing upon some of the results of the considerable volume of empirical economics research that has been conducted in this area. The main points are then illustrated with reference to some recent BAE work on wool prices. Finally, the implications of the influence of projections on prices are discussed in relation to research and research needs in the commodity analysis area.
The body of knowledge derived from research on futures markets is one of the few in economics that is based on the systematic empirical testing of relevant real-world hypotheses. Without going into detail concerning the modus operandi of futures markets, in this section some of the knowledge so developed is drawn upon by way of background, and the nature of the process of price projection is discussed.

Preoccupation with the hedging role of futures in Australia has, until recently, distracted some from their most important economic function, namely the formation of prices. Futures markets simultaneously price three activities: the production of the commodity; the production of storage services; and the production of market information.

Among the contributions useful to an overall understanding of commodity markets, made in the futures market literature, are the following:

(a) The difference between the "spot" or "actual" price of a commodity (or the price of the nearby future) and the price of a distant future represents the market's collective assessment of the relationship between today's supplies (in relation to today's demand) and expected supplies (in relation to expected demand). Consequently, this price difference
represents the market determined (shadow) price of storage $L^4T$. Simultaneously, as the spot price represents the market's determination of today's price, so the futures price represents the market's best estimate of the price at a point in the future.

(b) In arriving at these prices, market participants have brought to bear all available information, and all existing analyses of that information. If any participant obtains genuinely new information, or conducts a genuinely new analysis of available data, he is free to obtain a price for this information by buying (selling) the future, or by engaging in equivalent spot transactions. If he buys the future (because his new information indicates an increase in expected demand or a fall in expected supplies), the price of the future will rise. This temporarily results in an increase in the shadow price of storage, and encourages the withdrawal of supplies from the spot market, and the sale of a future. Eventually, when prices stabilise, both the spot and the future price have risen.

(c) Futures markets are reliably anticipatory, at least insofar as they take account of events with a high probability of recurrence, such as within-season factors, in determining both spot and futures prices $L^4T$, $\sqrt{2}$ /}. Although not documented in the
literature, it seems reasonable to expect that they would also take account of participants' (subjectively assigned) probabilities of the occurrence of episodic events (droughts, floods, bumper crops, wars, floods, strikes etc.).

(d) The pattern of price movement in an efficient futures market normally exhibits random walk. \[ T \] In other words, the price at any point in time is the cumulation of random movements, and knowledge of past prices is of no value in predicting future prices. This is because price changes only occur as a response to genuinely new information. The direction, timing, and extent of price changes that will be induced by new information is totally unpredictable until the information is known.

The essential point is that in an efficient market, final prices cannot be forecast. Recent unpublished work by Tier in BAE found that knowledge of the distant (12 month) futures price provided no information useful for predicting the final wool price. (Earlier work had shown that knowledge of past wool prices was of no predictive value) \[ T \] The London market failed to predict the current rise in sugar prices until information on the shortfall in the Cuban crop, and the U.S.S.R. purchases on the world market, became available. The Chicago market failed to predict the present shortage of fodder and forage crops in Europe, and the U.S.S.R. purchase of feedgrains, and consequently, on information that was available to it, projected much lower prices for January than have occurred.
Where well functioning commodity markets do not exist, the task of the research economist in short term price analysis is to attempt to simulate such a market, by (implicitly or explicitly) building models which take account of all available information, and which do the best possible job of analysing it. However, the economist starts from behind scratch for several reasons:

(a) No matter how good his intelligence network, he could never assemble and utilise all the information used by participants in well functioning commodity markets.

(b) The number of variables he may use in any model is limited by the number of past observations he has on the dependent variable - the degrees of freedom problem.

(c) Relevant information does not always come in quantifiable form, and even when it does the series may be short lived.

(d) He must rely on past data, and relationships change through time.

(e) Various econometric problems present themselves - multicollinearity (which is really a problem of insufficient data), identification and autocorrelation (problems of data and/or model specification).
In cases where a commodity market which is technically efficient at price formation is in operation, the research economist has to "beat the market" if he is to more efficiently project the price. In other words he has to discover some new source of information, or some previously unknown relationships between the price and sets of known information.

II.

Successful Projections and Their Effects

Despite the difficulty of the task confronting the economist in technically efficient markets, the systematic testing of alternative hypotheses can, of course, yield results. In addition, close observation of the performance of such a market, or even methodical "data mining," can result in the development of meaningful projections models. An example of success achieved by the latter means was the FAO model of the world cocoa market (outlined in [13]), but it was left to Weymar to establish the full meaning and rationale behind the FAO model. By systematically exploring the accumulated knowledge of commodity price behaviour (some elements of which were outlined above), Weymar was able to significantly improve the predictive power of the model and, more importantly, to explain why it worked.
On a considerably more modest scale, a recent exploratory BAE study achieved some success in predicting past wool prices \( \square 21 \). This model, which for various reasons did not take full advantage of the relationships used in the Weymar model, was of the following functional form:

\[
P_t = f(I_{t-4}, MC_{t-4} \text{ or } \frac{WF}{AF}_{t-4}, t)
\]

Where \( P_t \) = \( BAE \) index of clean wool prices at Australian auctions.

\( I_{t-4} \) = An aggregate index of interest rates in seven major wool consuming countries, lagged four quarters.

\( MC_{t-4} \) = A centred four-quarter moving average of mill consumption of virgin wool at the carding stage in the U.S., lagged four quarters.

\( \frac{WF}{AF}_{t-4} \) = The ratio of mill consumption of virgin wool to consumption of all fibres at the carding stage in selected countries, lagged four quarters.

\( t \) = Time

Two equations in these variables, one using the mill consumption variable as a ratio, the other using it in the alternative form, and with all variables except time transformed to logarithms, explained 93\% of the quarterly variability in the wool price index over the past nine years. The actual and estimated price series from one of those equations is shown in Figure 1.
FIGURE I

ACTUAL AND ESTIMATED WOOL PRICES
In passing it might be noted that the interest rate variable is responsible for almost all of the explanatory power of this model. Although this variable has been interpreted as an absolute "level of demand" variable, both it and the mill consumption variables could be interpreted, within an inventory adjustment model, as proxies for expected future inventory levels. For a number of reasons the model is at present exploratory, and it is interesting to note that some benefit may be obtained in further analysis by (among other things) explicitly relating expected inventories to existing or normal inventory levels, provided appropriate proxies are available. The picture is, of course, considerably complicated by the operations of the Australian Wool Commission, involving a transfer of (and perhaps a structural change in) the stockholding function.

The performance of the wool model and that of Weymar, may superficially appear to be at loggerheads with the earlier assertion that in an efficient market, final prices cannot be forecast. This is not, in fact, the case. Publication of these analyses constitutes new information, which will then be taken into account (if regarded by market participants as credible) in determining both the spot and the future price.
In Figure II, a schematic representation is given of the likely effect on market prices of new information of the type provided in Figure I. It must be borne in mind that the time period of the model is such that aggregate supplies (including those held as stocks) cannot be changed. This schema is based on two assumptions: that the credibility of the information is accepted by some market participants and that no other new information is simultaneously made available during the adjustment period.

Looking at Figure II, the spot price $S_1$ at time $t_1$ is the price prior to the projections information being made available. The line $S_1 F_1$ shows the structure of futures prices at time $t_1$.

The effect of the information projecting a price rise would be to bring about an immediate rise in the spot price. Mechanically, this could come about in a number of ways, but for illustrative purposes one is selected. A speculator who, on the basis of the information made available, decides that the quoted price for the distant future is too low, buys the future (expecting to profit by its subsequent sale). Stockholders, seeing the price of the future rise in relation to the spot price, (i.e. seeing the shadow price of storage rise) purchase wool, and simultaneously cover their spot purchase by selling a futures contract (or by signing a forward delivery contract), thus assuring themselves of a profit on the storage operation. When the market re-establishes equilibrium there will have been an equivalent rise in both spot and futures prices. The new
FIGURE II SCHEMATIC REPRESENTATION OF EFFECT OF A PROJECTION ON THE MARKET PRICE

- Actual price index
- Estimated price index (from projections model)
- Futures before projection information available
- Movement in spot price after projection available
- New Futures Price
equilibrium is shown in the diagram at time $t_2$. The actual spot price has followed the path $S_1S_2$, and the new structure of futures prices is shown as $S_2F_2$.

In the event, the realised spot price would only follow the line $S_2F_2$ if no new information with a bearing on the price became available between time $t_2$ and time $t_p$ (the end of the projection period).

The new spot and futures prices will be less than the projected price $P_p$, because the relative scarcity of supplies in relation to demand which the model had projected (when it projected a price rise) is no longer in prospect. Sufficient supplies have been carried forward in the hands of the trade to meet the expected rise in relative demand.

Of course in the real market, the two basic assumptions made may not hold. On the one hand the trade may not regard the projections model as completely credible (after all, the "explanatory" performance of the model in the past could possibly have been due to chance!) and, certainly, other relevant new information — in the wool market, currency revaluations and the possibility of industrial holdups in selling and shipping, to mention just two new factors — may have affected the structure of the market in the projection period. However the two points to carry out of this discussion are:
New information, including that related to expected future price levels, is as relevant to the accurate determination of the spot price as to the future price.

A price projection is, and indeed should be, by its very nature, "self defeating". After the information is made available to the market, we are in no better position to predict the final price than we were before we started to build the model, insofar as further new information, not yet available, will cause the price to move randomly from that point onwards. However although prices will still display random walk, one source of random fluctuation (that included in the projections model) will have been eliminated. Consequently the ex post variance of prices, given the projections information, will normally be lower than it would otherwise have been.

The effect of the price projection, then, is not to tell us what the price will be. Rather, it has helped the market to improve the efficiency of price formation, allowed it to more efficiently allocate supplies through time, and ultimately (if continuous revisions of the projection are made) helped to dampen down price fluctuations.
It has sometimes been suggested that statements should not be made about prospective market prices because they are likely to influence the price for the commodity. It has been demonstrated above that it is precisely because projections influence prices that well conducted research in this area is productive. At the same time it can readily be seen that inaccurate projections, if (for whatever reason) the market regards them as credible, can promote considerable inefficiency in price determination.

III

Implications for Research

In order to draw out the implications of the preceding section of the paper for commodity marketing research generally, it may be useful to reflect on the reasons why, in a market which is technically efficient at price formation, accurate projections information is price stabilising rather than destabilising. Basically, there are two reasons for this:

- [Redacted text]
- [Redacted text]
(a) The reallocation of storage resources in response to a change in the shadow price of storage can take place instantaneously on a centralised market which has facilities for both spot and futures transactions; and

(b) While the process of adjustment is taking place, new information concerning competitors' reactions to the projections: information is continually being made available in the form of statistics relating to the volume of open interest and the levels of spot and futures prices.

Obviously these two conditions do not apply in many commodity markets, when the projections period is of a long term rather than a short term nature. In fact some commodity markets are not efficient at price formation; many are not developed to the stage where new information can be quickly brought to bear on the market price; and there are often imperfections in the flow of information and errors in judgement in applying it.

However the basic principles of the model are still applicable, with some changes in the variables. In the long term, supplies can change not only because of decisions to store or not to store, but also because of decisions relating to production. For example, in the case of the meat industries, the short run function of storage is replaced in the medium term by decisions relating to time of slaughter and/or the amount of feed to utilise. Over a still longer period, breeding decisions are important. A recent study of the EEC beef market published by the BAE, although not unqualified in its conclusions,
projected a substantial shortfall in EEC domestic beef supplies in the first half of the present decade. It is possible, though in the judgement of the authors unlikely, that the information provided in that projection, if it is indeed accurate, could result in:

(a) a slowdown in the rate of "liquidation" of dairy cows in the EEC;

(b) a decision by the EEC to increase the price of beef now, and thus both reallocate expected supplies through time and increase supplies, so as to prevent the expected shortfall emerging; or

(c) a decision by the EEC to lower the price of grains and thus encourage fattening more quickly or to heavier weights.

In making long term projections, it is normal to assume that new information which becomes available in the interim will cancel itself out, and that the usual equilibrating forces of economics will prevail. There is normally no expectation on the part of the analyst that the projections will be realised. They are in fact made as convenient summaries of all currently available information, and their main purpose is to aid current planning.
However as planning devices they have a major weakness. The new information which will become available after their publication will not in fact cancel itself out as far as the eventual price is concerned; an important component of the new information will consist of reactions to the projections information. A moment's reflection will reveal that even if producers were provided with an expected price, and a price elasticity of supply (based on past supply responses), the elasticity would constitute new information, and would result in a different supply reaction.

Thus, for example, the FAO projections could conceivably result in perverse planning, on a world basis, if all countries used them as a basis for production planning, and took no account of the fact that other countries might be basing their plans on the same information. Of course, this possibility has been lessened by frequent updating of the projections.

While the danger of polarising expectations is a real one, the leads, lags and technical imperfections in the supply of information and in response to it undoubtedly increase the potential productivity of commodities research. For example, in a recent Outlook Conference paper, we were able to show that the high prices for oilseeds on world markets were due, not to "a shortfall of supplies in a number of countries" but to a coincidental slowing down in the rate of increase in supplies from the U.S. and the rest of the world. During the previous decade,
fluctuations in the rate of growth of U.S. supplies have acted to dampen down fluctuations in the rest of the world. Consequently current exceptionally high prices are an event with low probability of recurrence. Similarly the results of a recent study of the relative preference for maize and sorghum on the Japanese market suggests we should be cautious about using past quantity and price ratios in that market as a basis for determining the optimum combination of maize and sorghum production in Australia.\textsuperscript{29} In recent unpublished work, we attempted to find predictors of the quantity of wheat imported by China. Other recent studies have attempted to analyse export market prospects for beef\textsuperscript{30} and canned fruit.\textsuperscript{31} The many studies of this type conducted in the BAE and elsewhere have more or less direct implications for Australian agriculture.

Because of imperfections in the flow of information, because of the continual changes taking place in the structures underlying agricultural markets, and because of the need to derive secondary information from primary information (i.e. to analyse data) in order to recognise its full implications, we have of course the usual economic problem of allocating research resources to their most useful end-uses. In this connection we have been doing some rethinking on our Situation reports.
These are basically aimed at providing a balanced overall picture of current market developments and to counteract bias which might be caused by perception of only part of the total picture, such as, for example when headlines are awarded to eminent people who claim that farmers should expand output "to feed the world's starving millions". In a recent issue of the Coarse Grains Situation efforts were made to analyse specific aspects of the market in more detail while still providing an overall summary of the short term situation. In Outlook Conference papers, the aim has been to impart a little more understanding of the overall influences at work in the market, insofar as we understand them ourselves, and thus provide a better basis for formation of price expectations over a longer period. No attempt is made to actually project the price (unless such a projection is based on concrete research results and on knowledge of the possible market effects of the projection) for reasons which should by now be obvious.

Other work, reviewed in a recent paper has been based more explicitly on detecting imperfections in the structure, conduct, and performance of the market. Research of this type, although with a somewhat different
complexion from that done on the wool market and on a more limited scale, has recently been embarked upon in the meat industries. This work has not been covered in the present paper, but must obviously be considered in allocating agricultural marketing research resources.

Finally, it may be worth reiterating that the overall aim of analyses of demand, supply, and prices is not, in fact, to predict the eventual market price. It is actually aimed at improving our understanding of how markets work. By pursuing this type of research we should, hopefully, be in a better position to quickly interpret the meaning and implications of new information for the market price, to assist the market in efficiently performing its functions, and to ensure that any action taken to influence the operation of market forces will contribute to improved resource allocation in the production and marketing of agricultural products.
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- 22 -


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