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GORDON C. RAUSSER, JAMES A. CHALFANT, AND KOSTAS
G. STAMOULIS

Instability in Agricultural Markets: The US Experience

INTRODUCTION

Governments continue to play a major role in agricultural markets throughout the world. As argued at some length in Rausser and Farrell (1984), the only market-failure justifications for governmental intervention are *excessive* uncertainty or unanticipated instability and an incomplete set of risk markets. In the United States prior to 1972, the common explanations for instability were the inelastic nature of aggregate food demand; the low-income elasticity of demand; and, on the supply side, weather patterns, rapid technological change, atomistic behaviour (and in some treatments naïve price expectations), and asset fixity. These characteristics were viewed as existing in a closed, insulated representation of the US agricultural sector. Without governmental intervention, the inherent and unanticipated instability resulting from these characteristics was regarded by many to be unacceptable to all actors in the food and agriculture system: input suppliers, producers, assemblers, processors, distributors, and consumers.

Keynes (1938), Houthakker (1967), and others have argued that, because inherent instability in storable commodity markets would lead to insufficient private stockholding, some government intervention is warranted. Since 1972, however, conventional wisdom has placed increasingly less emphasis on the inherent instability in commodity markets and more emphasis on instability due to external linkages with other markets. During this period, deregulation of the credit and banking system resulted in a greater exposure of agriculture to conditions in domestic money markets. Also, because international capital markets have become increasingly integrated, agricultural commodity markets are more sensitive to international monetary events, capital movements among countries, etc.

Government behaviour has also played an important role in commodity market instability. After the Soviet grain deal, the absence of government-held stocks contributed to large price increases. With the Food and Agriculture Act of 1977, changes in commodity programmes were introduced which permitted a wider fluctuation in prices. The

export embargo in 1980, variations in the rules of the Farmer-Owned Reserve Program since 1980, and the Payment-In-Kind (PIK) Program of 1983 suggest that policy uncertainty can be a major contributor to private commodity market instability.

Another source of instability is increased dependence on export markets. In the late 1970s, US agricultural exports accounted for almost 40 per cent of total output. This greater dependence on foreign trade has left US agriculture more vulnerable to shocks from foreign markets. In addition, the Soviet Union has emerged as a major importer, making the effects of its unstable agriculture felt in the United States.

The linkage of commodity markets with US money markets occurs through both demand and supply effects. Because farming in the United States is extremely capital intensive and debt-to-asset ratios have risen dramatically during the last ten years, movements in real interest rates have significant effects on the cost structure facing agricultural production. In addition, grain stocks held and the level of livestock breeding inventories are interest rate sensitive. Finally, the influence of interest rates on the value of the dollar can lead to reduced foreign demand for US grain. Thus, rising interest rates at once increase the cost of grain production and depress demand. Therefore, monetary and fiscal policy changes, through changes in real interest rates, also affect the stability of agricultural markets.

Along with these interest rate effects, there appear to be differential effects of monetary policy between agricultural and non-agricultural markets. If agricultural commodity markets behave as 'flex price' while other markets behave as 'fixed price', 'macroexternalities' will be imposed on the agricultural sector. Different speeds of adjustment in the two types of prices following changes in monetary policy mean that overshooting in agricultural prices will occur even if expectations are formed rationally. This overshooting is analogous to the exchange rate overshooting, first studied by Dornbusch (1976), and amounts to either a tax or a subsidy for agriculture through relative price changes. Thus, overshooting can introduce further instabilities into a sector that is already inherently unstable.

RECENT US MONETARY EFFECTS

The combination of US fiscal and monetary policies has driven real interest rates to all-time highs. The management of money supply in the United States and the relatively high interest rates in this country have reversed the decline of the US dollar that occurred throughout the 1970s. Possibly because of the dominant role of the Federal Reserve in world money markets and the rapid appreciation in the value of the dollar, other central banks also maintained a tight rein on their money supply in an attempt to manage the value of their currency. This has led to a decline in foreign demand for US agricultural exports.

The deflation in agricultural commodity markets over the 1980s, along

with the increasing attractiveness of financial assets, has resulted in some rather dramatic decreases in agricultural asset values, particularly land prices. Due to the role of land resources as collateral for agricultural loans and credit lines, the debt-absorption capacity of US agriculture has fallen markedly. This is evidenced by the increased frequency of bankruptcies in the agricultural production sector and by what has come to be called the agricultural financial crisis of 1984.

In the decade of the 1970s, conditions in the US general economy and the international economy were almost the exact opposite of the conditions that exist in much of the 1980s. In 1972–3, the magnitude of increases in farm product and food prices surprised even the most informed people within the public and private sectors. The move to flexible exchange rates, the rapid expansion of international markets, the emergence of a well integrated international capital market, and the decreasing barriers between the agricultural economy and other domestic economic sectors all resulted in significant changes in the agricultural sector. During this period, the Federal Reserve expanded the US money supply with the effective objective of holding the real price of energy at basically the same level; other countries attempted to ‘inflate their way out’ of the energy price shocks by increasing their money supplies. They also attempted to manage their exchange rates with the US dollar by selling their currencies and buying dollars and, thus, indirectly increasing their money supplies even more.

The increases in relative commodity prices which resulted along with the rapid rate of inflation experienced in 1972–4 and again in 1978–80 resulted in a dramatic increase in the valuation of the major resource input in agricultural production, namely, land. US agricultural land prices increased at a more rapid rate than the rate of inflation during much of the 1970s. Once again, due to the role of this resource input in agricultural credit markets, viz., its use as collateral for agricultural loans and credit lines, the total absorption capacity of the US agriculture for debt appeared to be augmented by leaps and bounds during the decade of the 1970s.

Thus, since the early 1970s, the US agricultural sector has been subjected to a vicious roller coaster ride, the valleys and peaks of which have been defined in part by the external linkages to the US macroeconomy and the international economy. These external linkages have made it crystal clear that timing, in terms of entry and exit from US agricultural production, is indeed critical. More important, they show that, in large part, the inherent instability in the agricultural sector has been augmented by instability caused by factors outside that sector.

DYNAMIC MARKET ANALYSIS

The experience in the United States, as well as in numerous other countries, makes it clear that the conventional microeconomic analysis of commodity markets is inadequate. The dynamic path of agricultural

commodity markets cannot be explained on the basis of private market demand and supply functions alone. In fact, the appropriate characterisations of such dynamics can only be obtained by specifying (1) the real supply and demand forces for a particular market; (2) the influence of governmental intervention; and (3) the linkages between domestic agricultural markets, exchange rates, and domestic as well as international money markets. Most observers would agree with the need for (1) and (2), but few have explicitly recognised the importance of (3).

Any attempt to characterise the dynamic instability of agricultural markets should address itself to at least three major sources of instability: inherent instability emanating from natural supply and demand forces, uncertainties and risk emanating from political or governmental failure (Rausser and Foster 1984), and overshooting of storable commodity prices resulting from linkages with financial markets. The first two sources of instability are reasonably well known and need not be addressed here. The new source of instability, namely, overshooting, is not widely known by agricultural economists and is generally neglected in agricultural price analysis.

As shown in the Appendix, overshooting of flexible prices, such as exchange rates or storable prices, arises because some markets in the general economy are fixed-price markets. This results in short-run non-neutrality of money because relative prices are affected (Stamoulis, Chalfant and Rausser 1985). Over time, as fixed prices adjust, relative prices are assumed to return to long-run equilibrium levels; but the interim effects can be thought of as macroexternalities.

As shown in the Appendix, as the share of flex-price markets rises, the extent of overshooting falls. This suggests, of course, that, *ceteris paribus*, the larger the number of flex-price markets, the less instability in storable commodity markets resulting from overshooting. In the case of the US agricultural sector, the introduction of flexible exchange rates in 1973 and, more recently, the introduction of flexible interest rates in late 1979 imply less overshooting for a given shock. Of course, the amount of observed instability may be greater, even though more markets become flex price, if the shocks in money markets are larger.

In the case of storable commodity markets, the overshooting phenomenon requires that the economy be a mixture of fixed and flex-price markets. Without this specification, money will not assume non-neutral effects over the short run. In the following section, we present a formal test for the fixed price, flex-price specification of the US economy.

FIXED/FLEX PRICE SPECIFICATION

We conducted a simple test for the presence of overshooting by examining the sensitivity of prices to anticipated money growth. We estimated money growth using a fairly *ad hoc* mechanism which we treat

as the reaction function of monetary authorities. As in the series of studies by Barro (1977, 1978) and the recent paper by Enders and Falk (1984), predicted values from this regression (MFIT) are treated as anticipated money growth. Fitted residuals are thought of as unanticipated money growth.

The anticipated money growth rate was used to explain the price level response in the fixed and flex-price sectors of the economy. The rate of change of the non-food Consumer Price Index (CPINF) is taken as the growth rate of prices in the fixed-price markets, while a calculated growth rate of the US Department of Agriculture Index of Prices Received by Farmers (FOODINF) was used to measure growth in flex prices. An equation is also estimated for the percentage change in the Consumer Price Index for food and beverages (CPIF).

To explain variation in these rates of change, we used as independent variables our anticipated money growth variable, distributed lags of the gap between potential and actual income (INCGAP), oil price inflation (OILINFL), the differential of wage and productivity growth rates (WPRODIF), and a lagged dependent variable. The following equations were estimated using instrumental variables (standard errors are given in parentheses, and we report only the sums of lag coefficients):

$$\begin{aligned}
 \text{FOODINF} &= 1.891 + 0.0319 \text{ FOODINF} - 0.188 \text{ WPRODIF} \\
 &\quad (2.608) \quad (0.128) \quad (0.380) \\
 &+ 0.00003 \text{ OILINFL} + 0.0286 \text{ INCGAP} + 1.641 \text{ MFIT} \\
 &\quad (0.0238) \quad (0.0113) \quad (1.319) \\
 \text{CPINF} &= 0.0117 + 0.366 \text{ CPINF} + 0.070 \text{ WPRODIF} \\
 &\quad (0.321) \quad (0.144) \quad (0.044) \\
 &+ 0.0115 \text{ OILINFL} + 0.003 \text{ INCGAP} + 0.329 \text{ MFIT} \\
 &\quad (0.0039) \quad (0.0014) \quad (0.169) \\
 \text{CPIF} &= 0.9826 + 0.3778 * \text{CPIF}_{t-1} + 0.0018 * \text{WPRODIF} \\
 &\quad (0.588) \quad (0.127) \quad (0.074) \\
 &+ 0.0052 * \text{OILINFL} + 0.0067 * \text{INCGAP} + 0.2144 * \text{MFIT} \\
 &\quad (0.00597) \quad (0.0028) \quad (0.250)
 \end{aligned}$$

$$\begin{aligned}
 \bar{R}^2 &= 0.242 \\
 \text{DW} &= 1.91
 \end{aligned}$$

Comparing the coefficients across the equations for FOODINF and CPINF, we see that the lagged dependent variable has a large and significant coefficient in the non-food inflation equation compared to the food equation. In addition, anticipated money growth causes a much

greater response in food inflation than for non-agricultural goods. In fact, the estimated coefficient exceeds one – corresponding to overshooting of food prices following money growth. By contrast, the coefficient in the CPINF equation is significantly less than one, indicating sluggish response to anticipated money growth. Presumably, this is because some of the factors causing stickiness of non-food prices, say, contracts, were already in place in the preceding quarter. These results support the assumption that prices in the non-food sectors adjust more sluggishly than food prices to changes in money growth. Coupled with the theoretical model presented in the Appendix, this provides a basis for assuming that there are spillover effects from monetary changes in US agriculture.

The results from the CPIX equation strongly indicate that the use of a Consumer Price Index for food is an inappropriate way to represent commodity prices, especially in the context of an asset-market equilibrium. The significance and magnitude of the coefficients of the lagged dependent variable and the income gap suggest an adjustment pattern that strongly resembles the industrial (non-food) price index adjustment. This is not surprising once we recognize that, from the farm gate to the food store, a lot of ‘industrial contamination’ occurs that increases the degree of ‘stickiness’ of the farm prices.

The test presented above for the fixed/flex-price specification of the US economy will be investigated for a number of other countries as well as worldwide agricultural markets. We are in the process of collecting the data for the three equations presented here for major exporting countries of food and feedgrains. We also propose to make the same sorts of tests for world-wide food and non-food prices. Ultimately, the latter empirical investigation will admit currency substitution; reaction functions on the part of central banks; and, indirectly, the influence of international monetary linkages on storable commodity market prices.

CONCLUSION

To the extent that money is non-neutral in the short run, analysis of agricultural market dynamics must take into account not only real demand and supply forces and the effects of sectoral governmental intervention but also the macroeconomic policies of the federal government. The fixed/flex price dichotomy of the US economy implies that money is, in fact, non-neutral. Because some goods and services do not respond to changes in demand in the short run, namely, the ‘customer’ goods defined by Okun (1975) or the fixed-price goods defined by Hicks (1974), analysis of commodity markets requires an explicit treatment of monetary factors and the linkages with the macroeconomy. The prices of most other goods are sticky while the prices of agricultural commodities, in the absence of governmental intervention, are free to respond to fluctuations in demand and supply.

Since the general price level is not free to respond fully in the short run,

changes in nominal money supply are also changes in the real money supply and, therefore, induce changes in the interest rate which, in turn, induce changes in relative prices. As a result, changes in the money supply will lead to overshooting in flex-price markets. Through much of the 1970s and 1980s, exchange rates have been flexible; hence, changes in the money supply will lead to changes in the value of the dollar that are more than proportionate to the change in money supply. Only when the dollar is 'overvalued' ('undervalued') will investors rationally expect a future rate of depreciation (appreciation) that is sufficient to offset the interest rate differential so that the interest rate parity condition holds and investors are willing to hold foreign currency. In the short run, the exchange rate overshoots its long-run equilibrium. This quite obviously happened from 1980 to 1982 when the Federal Reserve adopted a stringent monetary policy. Unlike the 1970s, the resulting higher nominal interest rates did not reflect higher expected inflation but, rather, represented higher real interest rates. As a consequence, the dollar appreciated sharply.

The overshooting is a direct implication of the fixed/flex price framework. This framework was formally tested and the empirical results corroborate the differential response of nonfood market prices and food market prices to changes in anticipated money growth. Factors affecting commodity price overshooting are shown in the Appendix to be the number of fixed-price markets, the speed of adjustment of those prices, and the interest rate elasticity of money demand.

Non-monetisation of large federal government deficits can be interpreted as a restrictive monetary policy. Such a restrictive monetary policy leads to increases in the real rate of interest and the exchange value of the dollar and to decreases in the long-run equilibrium feedgrain and wheat commodity price path. Because of slower adjustment in other segments of the macroeconomy, commodity prices in the short run also overshoot the new long-run equilibrium commodity price. With an expansionary monetary policy, all of these factors run in the opposite direction.

Results reported in Rausser (1985) demonstrate that macroeconomic policies can easily dominate the short-run effects of agricultural policies on the price and income paths for US agriculture. The implicit taxes resulting from overshooting that are imposed on US agriculture are modified by the current form and shape of US agricultural policy. In particular, price supports imply downward inflexibility of some commodity prices which, in turn, cause the incidence of the macroeconomic policy tax on agriculture to show up as an unexpected increase in the cost of maintaining price supports and the various forms of government stockholding. Overshooting of agricultural commodity prices in the downward direction places some of the implicit tax on the private sector and some on the public sector. Due to the form and shape of current US agricultural policies, the overshooting effects of expansionary monetary policies are asymmetric. Much, if not all, of the subsidy accrues to the private sector.

In the long run, because money is neutral, agricultural sector policies have a more significant influence on resource allocation to the US agricultural sector than do macroeconomic policies. The sector policies that provide incentives for overallocation of resources to agricultural production quite obviously make the sector especially vulnerable to macroeconomic policies that impose implicit taxes via overshooting. Such sector policies, when combined with macroeconomic policies that 'subsidise' US agriculture, must, by definition, lead to a financial crisis for both private and public sectors if and when macroeconomic policies begin to impose 'taxes' via overshooting on agriculture. The dynamic path composed of a subsidy period followed by a tax period during which sector policies provide incentives for overallocation of resources to agricultural production can be expected to create crises.

APPENDIX

Overshooting in commodity and exchange rate markets

Assume that uncovered interest parity holds which require that

$$i - i^* = x,$$

where i and i^* are domestic and foreign nominal interest rates, respectively, and x is the expected depreciation of the domestic currency. This expectation, in turn, is assumed to be a function of the extent to which the exchange rate (domestic currency per foreign currency units) deviates from its long-run equilibrium level,

$$x = \theta(\bar{e} - e),$$

where θ is directly related to the flexibility of non-agricultural prices. It ranges from zero (fixed prices) to one (perfectly flexible prices).

An equilibrium condition in the money market is expressed in natural logarithms:

$$m - q = \phi y - \lambda i,$$

where m denotes the nominal money supply, q the price level, y income, and i the interest rate. All are measured in logarithms except the interest rate. Purchasing power parity is assumed to hold for the agricultural commodity,

$$e = P_a - P_a^*.$$

If each price P_a is expressed in logarithms, the assumption that the foreign price is one allows this expression to be rewritten as

$$e = P_a.$$

Note that this is simply a choice about the units in which to express the price of the agricultural commodity.

The domestic price level is Q , and its natural logarithm q appears in the money market equilibrium condition. Initially, let Q be a Cobb-Douglas price index so that

$$q = \alpha P_n + (1 - \alpha) P_a$$

or

$$q = \alpha P_n + (1 - \alpha) e,$$

where P_n is the natural logarithm of the fixed-price good. The money market equilibrium condition can therefore be expressed as

$$m - \alpha P_n - (1 - \alpha) e = \phi y - \lambda i.$$

Combining the uncovered interest parity assumption and the expected depreciation of the currency, the money market equilibrium condition becomes

$$m - \alpha P_n - (1 - \alpha) e = \phi y - \lambda[\theta(\bar{e} - e) + i^*].$$

This expression summarises equilibrium in financial asset markets.

A long-run version of the expression for asset market equilibrium, one in which money supply is taken to be at its long-run equilibrium level, is

$$\bar{m} - \alpha \bar{P}_n - (1 - \alpha) \bar{e} = \phi y - \lambda i^*.$$

Note that the expected depreciation of the currency is now zero.

Combining the last two expressions and expressing the nominal interest rate differential ($i - i^*$) as expected depreciation or appreciation of the home currency,

$$m - \alpha P_n - (1 - \alpha) e = -\lambda \theta(\bar{e} - e) + \bar{m} - \alpha \bar{P}_n - (1 - \alpha) \bar{e},$$

where $y = \bar{y}$ is assumed for convenience. By taking $m = \bar{m}$ as well, we find that

$$e - \bar{e} = -\alpha[(1 - \alpha) + \lambda \theta]^{-1} (P_n - \bar{P}_n).$$

The equilibrium exchange rate deviates from its long-run equilibrium rate (\bar{e}) by an amount proportional to the deviation of the price in the fixed-price sector from its long-run equilibrium level. The proportion is increasing in α and decreasing in λ and θ .

The persistence of expected appreciation or depreciation does not mean that unexploited profits exist. The expected capital gain or loss on bonds denominated in the home currency will be consistent with both the uncovered interest parity assumption and the rate of return available through storing commodities. For instance, when the domestic interest rate falls below the foreign rate following an increase in money growth, the currency depreciates instantly as the prices of foreign assets are bid up. The more the interest rate falls, the greater this immediate overshooting response of the exchange rate must be. Depreciation continues until the expected revaluation plus the (lower) nominal interest rate just equals i^* , the rest-of-world interest rate. Then expected depreciation falls over time as the fixed-price P_n moves towards its long-run equilibrium and i returns to i^* .

In addition, there is no advantage to holding commodities instead of currencies. Frankel and Frankel and Hardouvelis (1983) develop this latter point in more detail, but a brief summary is in order. To compensate the holders of grain inventories for foregoing present consumption, the grain price must rise at the interest rate in between harvests once convenience yields, storage costs, and a risk premium are taken into account. If an unanticipated growth in the money supply occurs so that the liquidity effect causes a fall in the interest rate, a better return is available for storing grain than dollars and investors compete to hold grain inventories. This causes an immediate jump in the price of grain so that an asset market equilibrium of equal rates of return is restored. All commodity prices are, therefore, expected to rise at the now lower interest rate.

Recall that we took P_a to be equal to the exchange rate by normalising the rest-of-the-world price of agricultural output. This means that there is an equivalent amount of overshooting in the agricultural goods markets. Also, note that the proportion by which e deviates from \bar{e} is increasing in α or decreasing in $(1 - \alpha)$, so this illustrates the importance of the number of fixed-price markets. As the share of fixed-price markets rises, the extent of deviation of e from \bar{e} is greater; and, as that share falls, it is less.

Both e and P_a overshoot their long-run equilibrium levels in the manner directly related to deviation of P_n from its long-run equilibrium level. The upshot is that there are relative

price changes during the adjustment period. This is a source of macroexternalities. In the short run, relative price changes occur so that, after monetary growth, there is a period in which agriculture is subsidised; conversely, after a contraction, the change in relative prices acts as a tax on agriculture until the fixed-price has fully adjusted.

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DISCUSSION OPENING I – H. E. BUCHHOLZ

Two quite different papers have been presented. The first is a review of problems connected with uncertainty in market analysis. The second paper deals with a specific approach to analyse the increased instability which results from the linkage of commodity markets with other markets in the economy at large. I will comment on these papers in the order in which they have been presented.

The paper by Sarris contains a rather extensive review of literature

which shows on the one hand the importance that the notion of uncertainty has for many aspects of market analysis and, on the other hand, indicates some of the methodological concepts and approaches to deal with uncertainty in market analysis. Among the topics discussed are uncertainty with respect to supply and demand, stabilization problems, market imperfection and uncertainty, the role of expectations and of information and market institutions to deal with market uncertainty. This presentation concentrates on problems of empirical investigation. The methodological foundations and theoretical framework are touched upon only briefly. With this the paper conveys, in my view, an unnecessarily cloudy picture of the state of the art. This impression is emphasised by the concluding remarks which leave the impression that not very much has been achieved yet by way of analyses and, more importantly, that whatever has come out of such research has had even less of an impact on policy recommendations. In what follows I want to state briefly why I do not share this view. First of all, I think it is the *theoretical foundations* that should be stressed more than has been done. It is to be remembered, therefore, that there are at least three areas of basic research where solid progress has been achieved and is established firmly. These are:

- probability theory as a base of statistical inference;
- decision theory which is concerned with the optimisation of decisions under uncertainty;
- the use of stochastic simulations in econometric model building and testing.

It is wellknown that minimising uncertainty is the central research objective of analytical statistics. Statistical sampling requires a measure of probability and inferences from sample results are valid only within certain bounds. Methods of statistical inference are standard knowledge. Also, it became evident that economic uncertainty is closely related to the statistical uncertainty problem. The combination of both has nowadays resulted in a number of different concepts and methods that allow the analysis of economic decision-making when it is known that the objective variables are subject to probability distributions. In this respect such analyses go beyond the scope of deterministic models. They do not lead, however, to easy and unique results. The answers are more complex and not easily, if at all, to be generalised. They require on the one hand more empirical effort and emphasis, on the other, the conditional character of policy recommendations. So far they correspond closely to reality, since in the real world, too, there are no easy answers to complex problems. I would like to point out two recent studies where research along these lines has been applied to analyses of price uncertainty in the wheat market and the coffee market, respectively, by Kirschke (1985) and Hermann and Kirschke (1985), both at the University of Kiel.

The Rausser et al. paper deals with the increasing complexity of agricultural market analysis in a highly industrialised open economy. The specific problem is the increased importance of money markets for the

farm sector and the additional source of instability that opens up thereby. The authors succeeded in identifying and providing quantitative estimates for an overshooting of storable commodity prices resulting from linkages with financial markets. This analysis takes into account the traditional two other sources of instability: natural supply and demand forces and government intervention.

To appreciate fully the originality and I may even say ingenuity of their approach would require one to go rather deeply into the details of the model and also into the literature cited. This is not possible here. Therefore it may only be said that the arguments developed are of a convincing logic and the estimated values of the model parameters show plausible magnitudes. An open question still is how far the results of the analysis are actually suited to reduce instability and how they can be incorporated in real world decision processes. In these respects some doubts may be expressed because evidently only a small proportion of total variance of the dependent variables seems to be explained by the model variables. In the paper that was available to me, R^2 was given only for one of the equations. This one was very low (0.25) and it seems likely that the other equations fared no better. With about three-quarters of total variance unexplained the degree of uncertainty naturally remains high. Also the model presented so far is a deterministic analysis. Probably some work should be done to exploit the stochastic properties of the approach. Perhaps the authors could comment on their intentions in these respects.

Finally, it may be a question how successfully this approach can be applied to the situation in other countries or regions, as the authors intend. It may well be that the flex-price behaviour of storable commodity prices is rather an exception and restricted largely to the US markets. Elsewhere such prices are probably more of a fixed-price quality. What comes to mind here are the low price policies of developing countries, price setting procedures of centrally planned economies as well as the price stabilization policies of the EC. The EC in this regard is a special case since even the consequences of currency revaluations among member states are smoothed out by monetary compensation amounts (MCAs). The EC on the other hand is a good example of the fact that despite all stabilization efforts farmers cannot indefinitely be protected from market uncertainty. Recently the risk of policy changes has been greatly enhanced. But this is a different story.

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DISCUSSION OPENING II – BRIAN S. FISHER

Professor Sarris has outlined a number of important areas where he believes that there are gaps in our current knowledge of the impact of

uncertainty in agricultural commodity markets. I have made some similar observations elsewhere (Fisher 1985) and I am in strong agreement with many of Professor Sarris's points. There is much research yet to be done in the area of commodity market uncertainty.

Perhaps more important from an empirical point of view than the distinction drawn by Professor Sarris between analysable and non-analysable uncertainty is the notion that the level of uncertainty in agricultural commodity markets is subject to significant change. There is strong evidence that the level of uncertainty has increased over the past decade. This observation was made earlier at this conference by Ed Schuh and is consistent with that made by Professor Rausser and his colleagues. At this stage there appears to be no satisfactory way of modelling such changes. Although, as Professor Rausser has observed, we now have a better understanding of the importance of linkages between the agricultural sector and the rest of the economy and of international linkages.

As Professor Sarris has pointed out, perhaps one of the most difficult things to accomplish in research in the area of stabilization policy will be to properly account for the effect of any scheme on existing market institutions and *vice versa*. For example, the existence of an active futures market for a commodity for which prices are stabilized is likely to seriously complicate the analysis. Newbery and Stiglitz (1981), pp. 190–1, show that under some conditions farmers may prefer to use futures markets rather than to participate in a price stabilization scheme. An additional complication is that the existence of a buffer stock scheme will almost certainly lead to the substitution of institutional stocks for private stocks. Assuming that both groups are equally efficient in the storage operation, this is likely to have little consequence for the global expected gains from a given level of stabilization. However, if this effect is ignored, there is a danger of underestimating the levels of stocks required by the buffer authority, for a given reduction in price variability.

As Professor Sarris has noted, to model the effects of a stabilization scheme properly, it is necessary to recognise that producers are likely to respond to the scheme by changing supply. In contrast to Professor Sarris I believe that most of the econometric models of supply response which include risk variables are *ad hoc* in nature (see, for example, Just 1974; Traill 1978; Brennan 1982). There is a need for such models to be derived from first principles using the theory of decision-making under risk. A useful starting point may be to attempt to integrate the mathematical programming and econometric literature on the subject. In addition to the problem of accounting for the effects of a reduction in risk, it is also necessary to model expectations.

Uncertainty about the way expectations are formed has important implications for policy and policy research. In the case of stabilization policy, Scandizzo, Hazell and Anderson (1983) show that the estimated gains from stabilization are sensitive to assumptions about the way in which expectations are formed. Professor Sarris has called for more

research into the way in which expectations are formed. There is a limited agricultural economics literature on this subject. I suspect the reason for this is that research in this area is notoriously difficult. It is important to distinguish between the gains from reducing the losses due to incorrect forecasting and other benefits from stabilization, such as its effects on risk reduction.

Professor Sarris has asked the question whether it is more cost-effective for a government to provide better information to stabilise a market rather than to intervene directly. If there are large gains arising from the use of improved information then it may be more efficient to provide the information rather than attempt to compensate for bad forecasting by agents by the establishment of a stabilization scheme. As pointed out by Newbery and Stiglitz (1981) the market will not supply the optimal amount of information if information has a public-good element. There may therefore be a case for governments to supply additional information or to ensure that futures markets, for example, operate effectively. However, care should be taken to assess whether the benefits from an attempt to improve market information outweighs the costs. Newbery and Stiglitz (1981, pp. 144–8) present an example in which the gains from improved information make producers better off, consumers worse off and there is little net gain in welfare. In other words, there may be strong distributional effects from such policies. The nature of such distributional effects will depend, among other things, on assumptions about how expectations are formed.

Professor Rausser's thesis that overshooting in agricultural commodity prices will occur as a result of the different characteristics of agricultural and non-agricultural markets, even if expectations are formed rationally, is an important one. To date, much emphasis in research into agricultural commodity markets has been placed on traditional demand and supply forces and on trade linkages. Linkages with financial markets are less well understood. However, there is a vast literature on commodity futures markets.

Most economies can be characterised as having a mixture of 'fixed' and 'flex' price markets and it may therefore be reasonable to presume that money will be non-neutral in the short run. However, fixed price markets do not only occur in the non-agricultural sectors of economies. In many countries there is also extensive government intervention in agriculture. Such intervention may restrict the movement of farm prices. As Professor Rausser points out, the result may be unexpected increases in the cost of maintaining price supports. However, the effects may be more far-reaching if stocks are accumulated in an attempt to offset the effects of price overshooting. The existence of such stocks is likely to have an impact on future prices. The dynamics of models of this type are therefore well worth studying.

The two papers presented this morning have highlighted a number of important challenges in modelling agricultural commodity markets. Models in which full account is taken of uncertainty, future expectations

and government intervention are likely to be highly non-linear and to present major computational problems. As a result, relatively simple analytical models of commodity markets will continue to be used in policy analysis for some time to come. It is therefore important to determine just how robust such models are.

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GENERAL DISCUSSION – RAPPORTEUR: EWA RABINOWICZ

In the discussion from the floor of A. H. Sarris's paper the question was asked, who pays the costs of turbulence, claiming that traditionally shocks have been absorbed by farm families. Another issue raised was that differences between analysable and non-analysable uncertainty are of degree rather than of kind. Furthermore, it was suggested that the 'electoral/political cycle' was another uncertainty related subject for research in agricultural economics. A question about the possibility of endogenising policy behaviour was also asked. Finally, a point was made about using general equilibrium models in the uncertainty analysis.

In reply to Dr Buchholz, Professor Sarris disagreed that his paper should have been more theoretically oriented. He claimed that the stated purpose of the paper was to see how much theoretical developments in probability theory, optimisation theory etc. have influenced policy analysis and/or recommendations. Furthermore he stated that statistical uncertainty is different from economic uncertainty. On the issue of who pays the risk, he mentioned that distributional implications of risk are not well researched and deserve further study.

On the issue of the difference between analysable and non-analysable uncertainty Sarris stated that those are of different kind, non-analysable uncertainty not being included in the state space.

Commenting on endogenising of policy behaviour Sarris pointed out that attempts have been made by some authors with mixed success because it is quite difficult to describe the policy process. The political cycle is and has been analysed in the general economic literature. Related to it is a question of administering the policy.

Ending his remarks Professor Sarris pointed out that many recent contributions in uncertainty analysis have been made in the context of general equilibrium theory and many interesting cases from our world of incomplete markets and imperfect information can be analysed in this context.

In the discussion from the floor on the paper by G. C. Rausser et al. the point was made that the instability can be created not only by an inappropriate economic policy but also by the inefficient administration of a 'right' policy. The role of expectations for economic model building and forecasting and the possibility of endogenising policy behaviour in models were discussed as well. Scepticism was expressed about the applicability of the model for LDCs with badly developed credit markets. Furthermore it was pointed out that the risk premium in financial markets had effects on agricultural markets. Finally the question was asked in which way overshooting was non-optimal.

In reply to the remarks of Dr Buchholz on goodness of fit of the equations, Professor Rausser stated that the equations reproduced were a part of a large system, which has been estimated simultaneously. Furthermore, *ex ante* forecasting and *ex post* comparison with the data showed a high degree of correspondence. However the main point in the paper was to test if the coefficient (of anticipated money growth) was significant, i.e. to test the theory.

Commenting on the applicability of the model to other countries (Western Europe, LDCs) Rausser pointed out that the approach could be used for other countries as well. On the issue of the role of expectations in modelling, he stated that in large-scale models we had to be cautious and that policy variables had been separated in the model. For policy modelling we were still looking for evidence.

Commenting on the risk premium Rausser agreed that it was an important factor which was not included in the model. He believed, however, that overshooting would still be present, even if risk premium was included.

In reply to the issue of non-optimality, Rausser stated that if people did not adjust to the overshoot prices, non-optimality would be present. Since not everyone, however, would realise that prices were overshoot, the resource allocation would be affected causing non-optimality.

Participants in the discussion included G. Jones, F. Soares, H. Breimyer, J. Viaene, I. Elbadawa, A. Salazar, J. Kitchen and H. Mahran.