

EUROPEAN UNIVERSITY INSTITUTE
DEPARTMENT OF ECONOMICS

EUI WORKING PAPER N° 9

INFORMATION PROCESSING
IN FUTURES MARKETS -
AN ESSAY ON THE ADEQUACY
OF AN ABSTRACTION

by
M a n f r e d E . S t r e i t

M a r c h 1 9 8 2

The author is indebted to the participants of a workshop on theoretical and empirical issues of futures trading held at the Institute on January 21-23, 1982 and to his colleague K. Velupillai for valuable criticisms and suggestions. However, he retains responsibility for any remaining shortcomings.



BADIA FIESOLANA, SAN DOMENICO (FI)

All rights reserved.
No part of this paper may be
reproduced in any form without
permission of the author.

(C) Manfred Streit 1982
Printed in Florence in March 1982
European University Institute
Badia Fiesolana
- 50016 San Domenico (FI)
Italy

Abstraction is the most valuable ladder of any science ... However, the task of science is not to climb up the easiest ladder and remain there forever distilling and redistilling the same pure stuff. Standard economics, by opposing any suggestion that the economic process may consist of something more than a jigsaw puzzle with all its elements, given, has identified itself with dogmatism.

(Nicholas Georgescu-Roegen, 1971)

1. Introduction : the points to be argued

The present paper is an attempt to show that a considerable part of the discussion of information processing on speculative markets in general and futures markets in particular is not very conducive to a better understanding of the market process. The theoretical impasse seems to be the consequence of a number of traditional and convenient abstractions. It will be argued

- that the abstraction from the possible complexity of motives for futures trading allows one to dichotomize market participants into (routine) hedgers and speculators but is an inadequate abstraction as far as it is conducive to the interpretation of trading on these markets as pure risk-shifting operations ;
- that an abstraction from the multitude of observable types of transactions involving futures markets in favour of hedging and speculation only impedes rather than assists the analysis of these markets as public goods, allowing a division of labour in procuring, evaluating, and processing information potentially relevant for the future ;
- that the abstraction from time, in order to allow a comparative static equilibrium analysis, and the use of a specific class of rational expectations makes it

possible to construct an artificial paradox of information which can be thoroughly misleading with respect to a proper understanding of competitive information activities and of information clearing via markets, if taken seriously ;

- that the abstraction from uncertainty by introducing Muth-rational expectations as a de facto surrogate for certainty helps to save equilibrium analysis and is econometrically convenient but it represents a misconception of markets as information systems and does not explain in terms of testable propositions the information-cum-trading process which may lead to a temporary equilibrium.

Some observable exceptions and partially plausible deviations have to be set up against these theoretical developments. In addition, it seems to be necessary to point at well-published warnings against applying concepts like rational expectations which are, however, frequently by-passed without any comment. Finally, it will be argued that, particularly in the field of futures markets, more convincing theoretical concepts seem to have emerged from a scientific process in which theoretical reasoning and empirical analysis of these markets as well as of their institutional arrangements are closely interrelated. The results achieved in this way may not always have the formal elegance of "pure" economics but seem to be more adequate in a field where it is necessary "to describe a process of groping experiment and gambling for knowledge, of being wrong many times in order to be ultimately right" and not "what things will be like when, if ever, they have attained rightness"¹.

1. G.L.S. Shackle (1972), p. 53.

2. Information clearing versus risk shifting

A deceiving hypothesis

An important barrier towards the understanding of forward and futures markets proved to be Keynes' "theory of normal backwardation"¹ which reduced the explanation of futures trading to a pure risk-shifting operation. Using some unrevealed statistics on seasonal price variations in organized markets as a base, he suggested that there exists a general, and sizeable bias in futures prices from which those -- who take "long" positions tend to benefit. Since hedgers, conventionally defined, tend to be (net) short in futures, the bias could be interpreted as a premium paid by them as the more risk-averse to the less risk-averse speculators who tend to be (net) long.

The theory was subsequently refined² but without taking much notice of two challenges on factual grounds : First, it proved to be difficult to muster sufficient evidence to support the existence of a general and sizeable bias despite the improvement of statistical methods and records. The comparatively few pieces of positive evidence can be more convincingly explained by market imperfections. A bias tends to be observable on thin futures markets with too little speculation compared to hedging demand³. But in general, speculators do not seem to be able to earn a scarcity rent on futures markets which would lend itself to interpretation as a risk premium. Hence their presence requires a more satisfactory explanation. Second, the business practice of hedgers which would be in line with the theory of normal backwardation does not seem to coincide with their observable behaviour. If it

1. J.M. Keynes (1930), pp. 137 f, 143 f. For a brief discussion of the development of the theory of normal backwardation see, for example, R.W. Gray and D.J.S. Rutledge (1971), pp. 65 ff.

2. E.g. J.R. Hicks (1939), pp. 137 ff.

3. Corresponding evidence has been initially provided by R.W. Gray (1960). For more recent evidence see D.E.A. Giles and B.A. Goss (1980), who found that for the Sydney Wool Futures Market a bias can be observed during its initial period (1963-1967). It disappeared, however, thereafter with the widening of the market.

were in general purely a matter of risk shifting against a premium, routine hedging would be the normal case. But compared to the wide range of discretionary forms of hedging actually used, this seems to be the exception rather than the rule. Obviously, hedgers take a much more active part in futures trading than just trying to avoid risks¹.

A possible explanation for the presence of speculators not in receipt of a significant risk premium would be that they are not risk-averse on balance². However, they also do not seem to gamble because there is sufficient evidence that some of them systematically earn profits whereas others do not³. Even if this were be disregarded, the attitude towards risk remains an unsatisfactory criterion of abstraction in view of the existence of discretionary hedging. However, it would be equally one-sided to question risk reduction as a central motive for hedging. The relevant point is that the price for being able to unload risk onto the futures markets can be reduced by information activities. Thereby the minimum a potential hedger can do is to use the information he acquires via his business in actuals as a basis for forming his own expectations. Routine hedging, on the other hand, would mean that either no price-expectations or beliefs are formed at all or that a hedger never trusts his own beliefs. He would always be satisfied with locking in a futures price.

Information, divergent beliefs and futures pricing

Much more compatible with the evidence seems to be the

-
1. This has already been suggested by G.W. Hoffman (1932), pp. 409, 418. Later on it was primarily H. Working (1953), who forcefully argued in favour of a revision of the then still dominant concept of hedging. However, outside the analysis of futures markets, the theoretical reasoning on hedging remained comparatively unaffected.
 2. M. Friedman (1969), p. 286.
 3. See, for example, the analysis of returns to futures traders by Ch. S. Rockwell (1967).

contention that most market participants speculate in the sense that each of them "hopes to exploit the general insufficiency of knowledge and hopes to do so despite the recognized insufficiency of his own"¹. Access to this information concept of futures trading may be gained by considering, for example, a short hedge which proves to be profitable when compared with holding a long position in unhedged actuals, i.e. speculating in actuals. Subject to the transaction costs incurred, this is the the case if (1) the difference between futures and actuals' price (the basis) changes in favour of a trader which (2) also requires a change in the futures price. Even the borderline-case of a perfect hedge (a constant basis) only provides (non-money) profits in terms of effective risk-shifting if the futures price changes. This, however, has interesting implications with respect to the predictive quality of a futures price from the point of view of an individual trader.

Consider the trader who engages in discretionary hedging². If his participation in futures trading is not governed by chance he must have beliefs as to the actuals' price at the expiry date of the contract differing from the de-facto forecast provided by the futures price. His beliefs could be founded (1) on intuition but also (2) on a different evaluation of generally available information of predictive value or (3) on information so far inaccessible to many or all other market participants. If he is able to establish his position at a futures price he considers to be a wrong forecast, those who are prepared to hold the opposite position, in general, must have opposing beliefs.

In order to conceptualize the process of adjustment of prices to different informative situations of traders, it is

1. G.L.S. Shackle (1972), p. 158.

2. The discretion goes further than the one implied in the following reasoning. It also includes conscious mismatching of the volume of hedging transactions and the quantities in actuals (either over- or underhedging) as well as mismatching of the time structures (delayed hedging, premature lifting of the hedge).

useful to consider the time-structure of trading and the likely underlying beliefs. Two different trading rounds can be distinguished, one prior and one posterior to a new informative situation of the market as a whole¹. In the prior round, a trader establishes a portfolio position which he hopes to revise at a profit via re-trading in a posterior round. This would be the case if the uncertainty concerning the future actuals' price is partly or totally removed in a way, consistent with his intuition or the state of information on which he based his belief. Total removal corresponds to the situation at the close of trading of the contract in question. A consensus is then imposed on the futures market by the factual situation on the actuals' market. Partial removal in the intermediate period would take place in the way a trader hopes, if (1) his own informative situation would become more or less general and if similar or identical conclusions were drawn from this situation by other market participants, or (2) if other information reached the market favouring a price move similar to the one consistent with his own expectations. This would give the change in beliefs sufficient weight to move the futures price consistent with the newly expected price. It implies a partial consensus of market participants, namely with respect to the direction in which the prevailing futures price has to be revised. But in order to allow the participants to trade in a potentially profitable way on their changed beliefs they must be able to trade at a price which does not perfectly reflect their own informative situation and the respective beliefs related to it. Otherwise they would have no incentive to trade because they could merely expect to incur transaction costs. The same applies to those who consider engaging in the opposite position. And it is up to them to eventually provide a resistance line to the price movement

1. This distinction has been emphasized by J. Hirshleifer (1977). But the following reasoning differs from the one of Hirshleifer who uses "consensus beliefs" as a fictitious reference system for defining divergent beliefs which allows him to retain what is basically a rational expectations approach.

with their engagement. Hence, in the period before the closing of trade, any price movement cannot be expected to be arrested at a consensus of beliefs with respect to the future actuals' price. Trading at subjectively false prices will be the rule.

The preceding reasoning has to be qualified in the sense that it applies primarily to the establishment of new open positions in futures. These may come from discretionary hedgers and from speculators in the conventional sense. Furthermore the price movement may have upset the price structure of the various contracts traded and in the case of a storable commodity, the relation to the current actuals' price. As a consequence, there may be opportunities for spreading and arbitrage. Here again, these will be taken largely on divergent beliefs or in the case of pure intertemporal arbitrage, on the basis of at least de-facto¹ divergent beliefs.

However, there are also three sources of transactions where beliefs may not diverge. Part of the transaction demand resulting from a change in beliefs may be accommodated by those who managed to establish open positions before the change in beliefs gained much market weight and who now want to close out at a profit². Another part may come from those who try to cut losses, i.e. who in fact now believe that the price movement is going irreversibly against their own prior beliefs. Finally some traders, particularly scalpers, may accommodate some of the forementioned transactions demand as well as (net) routine hedging by assuming new open positions, although their beliefs do not diverge from the prevailing

-
1. De facto, because a narrowing or widening of the basis (the difference between actuals' and futures price) will, in general, also affect the futures price.
 2. Even closing out may be based on divergent beliefs. In this case, further price changes would be expected, reducing now accessible speculative profits.

market price. The remuneration for this service of making a price could consist of commissions and of a temporary widening of the bid-offer spread ¹. However the latter means in fact that market conditions allow some movement away from the subjectively expected actuals' price in order to provide a sufficient change to earn a return from trading at a "false" price. From the point of view of the routine hedger this would be a risk premium he is prepared to pay.

Interim results

The above view of the interplay of individual trading decisions in futures leads to the following conclusions :

- Traders tend to be induced to take an open position in futures in a discretionary way if, according to their own informative situation and intuition, they anticipate that the current futures price will change, i.e. if they in fact consider the current price to be a wrong forecast of the closing price and hence of the future actuals' price. Only at the closing of trade is a consensus imposed upon traders by the facts of the actuals' market.
- At any time before the close of trading, changes in futures prices indicate that changes in beliefs of traders have received sufficient market weight. But any traded price in this interim period cannot represent a consensus of beliefs, at least as long as new open positions are still being established. It reflects rather a temporary equilibrium of divergent beliefs, arresting the price movement until changes in beliefs resulting from changes in informative situations gain sufficient weight again.

1. One of the first who has drawn attention to this function of scalpers was R.G. Hawtrey (1939/40, p. 204).

- If divergent beliefs are essential for speculative trading in general and futures trading in particular and if allowance is also made for the possibility that some traders may not trust their beliefs with respect to future actuals' prices and resort to routine hedging, then this represents "a fatal objection to the introduction of any aggregates or averages of expectations into economic reasoning" ¹. The inappropriateness of a concept of "representative expectations" or a "suitable average of traders' beliefs" ² for speculative markets also invalidates many econometric estimates of expectation formation in those markets. ³
- The attitude towards risk alone does not explain discretionary participation in futures trading. However, the degree of risk aversion may inversely affect the decision of potential traders to use a change in their informative situation and the related change in beliefs ⁴. As a consequence there may be differences in the speed and the size of price reactions to changes in informative situations in an individual market and between different futures markets.
- A hedger in the conventional sense who manages to trade and re-trade in futures at a profit which can be set against an incurred loss in actuals has, in fact, transferred his risk. But in the case of discretionary hedging the

1. R.G. Hawtrey (1939/40), p. 203.

2. Striking empirical evidence of how meaningless the average can be in view of the highly diverse individual expectations has been provided by E.O. Heady, D.R. Kaldor (1954), p. 38.

3. The fact that quite a number of single-equation estimates of expectation formation in speculative markets prove to be significant by conventional standards does not necessarily lend itself as a strong counterargument. This seemingly positive evidence which refers particularly to forward markets in foreign exchange suffers from two defects : (1) Since the specification of the expectation formation implies in general an autoregressive structure, significant results can be obtained relatively easily. (2) Very frequently it turned out to be difficult to discriminate between the various concepts of expectation formation. Hence the evidence does not appear very conclusive.

4. Cf. M.F. Hellwig (1980), p. 492 f.

risk transfer is the result of his forecast of the future actuals' price or of a change in the basis proving to be superior compared to the forecast of the holder of the opposite position. In the case of pure routine hedging in an unbiased market it can hardly be more than chance.

- Since forecasting quality is decisive for deriving non-random profits from futures trading, it pays to improve the forecasting basis. Besides trying to improve forecasting skills, the most promising way to achieve this is to aim for and consequently make use of, an informational advantage over other potential traders ¹. Whether a given piece of information represents an advantage, however, will be found out only via the clearing process of the market.

3. A division of labour in information activities

Starting from the contention that traders act on divergent beliefs based on different or even equal, informative situations, the futures market represents a clearing centre for what can be interpreted as a division of labour in information activities. Futures markets provide merely a special solution to the Hayekian problem of the "Division of Knowledge" ². In futures analysis, the problem has been most clearly defined by Working ³: "The amount of pertinent information potentially available to traders in most modern markets is far beyond what any one trader can both acquire and use to good effect. Circumstance and inclination lead different traders to seek out and use different sorts of available information ; and if at any time some sort of

1. This has already been emphasized more than 30 years ago by H. Working (1949, p. 155), when he pointed out the fact that "many traders in futures markets give a great part of their attention to acquiring information which has not become generally available, and thus has not been reflected in market expectations".

2. F.A. von Hayek (1937), p. 49.

3. H. Working (1958), pp. 192 ff.

available and useful information is being generally neglected, someone is likely soon to discover that that neglect offers him a profitable field to exploit. In short, traders are forced and induced to engage in a sort of informal division of labour in their use of available information. Using different information, different traders must find themselves often of different opinion...".

Specialization in information activities

Again, this clearing function of futures trading may become inaccessible by an abstraction. Most models of futures markets dichotomize the market participants into hedgers and speculators in the conventional sense¹. If, however, the multitude of observable types of transactions is taken into account, it becomes apparent that the price for a given futures contract is assessed by the market participants correspondingly from quite different perspectives². Considering the major types of transactions, the relevant information and beliefs may be related to

- individual futures prices : speculation in futures in the conventional sense ;
- differences between futures prices and corresponding current actuals' prices as well as the way in which changes in these differences may be brought about : the various, differently motivated, types of hedging ;
- differences between (a) prices for the same contract but with different closing dates, (b) prices for different

1. A notable exception are M.H. Peston and B.S. Yamey (1960), who show that price formation on futures markets already becomes quite complex and indeterminable if storage decisions are considered in addition to straight-forward hedging and speculation.

2. For a more elaborate presentation of what follows, c.f. M.E. Streit and R. Quick (1982, forthcoming).

contracts referring to substitutable commodities but with equal closing dates, (c) prices for different contracts for the same commodity but at different exchanges : intracommodity, intercommodity, and inter-market spreading ;

- differences between (a) prices for the same contract at different exchanges and (b) prices for a futures contract and the corresponding actuals : pure inter-market and intertemporal arbitrage respectively.

In view of the fact that information is costly to procure and to process, also in terms of opportunity costs of time, and that its return in terms of improving trading decisions is uncertain, it is likely that market participants specialize in their information activities. This can be achieved, first, by concentrating on information which is of special relevance to a particular type of transaction. For example, a search for information which may give a clue to the size of a future crop will be a more likely activity for speculation in the conventional sense than an inquiry into changes in the costs of substitution for two traded commodities which will be of particular importance for intermarket spreading. Second, the costs of information procurement can be reduced by concentrating on fields of information which are more easily accessible because they are closely related to a trader's business in actuals or other experience. Although assumed in some recent models of speculative markets, it does not seem plausible that, for example, producers, traders and processors of a commodity will not use their business knowledge when making trading decisions¹. Third, specialization on a particular kind of information may help to economize on evaluation as a matter of experience (learning by doing). This would be consistent with the observation that traders on futures

1. This is one of the strange features of the similarly structures models by S.J. Grossman (1976, 1977) and by S.J. Grossman and J.S. Stiglitz (1976, 1980). A crucial role in explaining a possible breakdown of futures trading is played by a class of uninformed traders who "form their beliefs about a future price from the information of informed traders which they learn from observing current prices" (S.J. Grossman, 1976, p. 573).

markets tend to specialize in certain types of transactions¹. All this does not exclude the possibility that some information may also be acquired just by chance.

Information clearing

The fragmented information and the individual beliefs which are related to it, become part of the social process of the division of labour in information activities as soon as individuals try to trade on the basis of their beliefs. The belief or objective knowledge on which an attempt to trade is based will diffuse faster the more it is shared by others. The latter may be the result (1) of independently formed beliefs, (2) of information activities induced by the observed trading attempts of others, (3) of imitation, i.e. "going with the market", and (4) of attempts to "read" the behaviour of major traders when they try to establish positions, i.e. Keynes' "beauty contest".

A full internalization of what later on turns out to be an informative advantage over other traders is only possible if (1) the derivable beliefs are not initially shared with others and (2) trade can be conducted on these beliefs at the prevailing market price. In this case a price movement in the anticipated direction will only take place when the change in the informative situation and when similar beliefs gain sufficient market weight. However, no individual trader can avoid announcing a potential information advantage via his attempt to trade. Hence his attempt to use information produces external effects. The medium through which the information is transmitted as an external effect, although in a codified way, is -as always in the case of externalities-

1. The observable specialization of some local traders not only on spreading but on spreads between specific months may serve as an example.

a public good : the futures market. The initial signal is a combined quantity-price signal, i.e. the quantity offered to be traded at the prevailing or a stated price.

The trading which may follow such an initial signal and the market process in general can be interpreted as an information clearing in the following sense. Any market signal will be assessed by different traders (1) out of equal but also different perspectives in terms of the type of transactions envisaged, and (2) on the basis of a fragmented knowledge which is mainly the result of a specialization in information activities and of the experience acquired with the different types of transactions. In this way a futures price will not only be revised in the light of changing and divergent beliefs but also be kept in line with both contracts of different maturity dates and the development on the actuals' market as well as the conditions in futures markets for the various kinds of substitutes. These rather complex feed-back processes and the accumulation of information over time with respect to the likely actuals' price constitute the core of a process of transient convergence to the actuals' price of maturity¹.

4. Informational externalities, time and equilibrium

A revealing impossibility theorem

The interpretation and modelling of futures trading as a process during which information is disseminated as an external effect of trading activity has led more recently to the formulation of an impossibility theorem². It serves as

-
1. If this process, involving diverging beliefs, is crucial for the handling of the information problem on speculative markets, one must seriously question the purpose of exercises which "deal exclusively with the case of a common prior distribution (of beliefs, M.E.S.) for all agents" (J.Green, 1981, p. 335) and still refer to futures trading.
 2. Cf. the already quoted articles by S.J. Grossman and J.E. Stiglitz, particularly however S.J. Grossman (1977), because of the explicit introduction of futures markets.

an argument against Fama's widely used proposition that in efficient speculative markets at any time prices fully reflect all available information¹. Leaving aside the usefulness of the proposition in this context which also concerns the assumption of costless information and its consequence that markets and the price system as a "mechanism for communicating information"² would, in principle, no longer be required, the impossibility theorem itself is derived in a quite revealing way. It is basically the result of a constructed free-rider problem which leads to an erosion of futures markets as public goods. The possibility of a free ride in information activities is constructed by assuming (1) that traders have to decide whether they want to be informed by acquiring costly information about future economic conditions (states of the world) or not and (2) that all traders form Muth-rational expectations³ which are specific in the sense that they know under which economic conditions which market-clearing price occurs but also vice versa, i.e. from observed prices they can infer correctly the underlying information on future economic conditions⁴. If then prices convey all information which informed traders collect, other traders could get the information free by just observing market prices. Given the possibility of a free ride there would be no incentive to collect information. Hence speculative markets cannot be informationally efficient. Their signals have to be sufficiently noisy to make information activities profitable by allowing trade based on divergent beliefs.

The theorem is revealing because it throws some light on the inadequacy of the abstraction from time and the

1. E.F. Fama (1970), p. 383.

2. F.A. Hayek (1945), p. 526.

3. J.F. Muth (1961). The term Muth-rational is used following W.H. Buiter's (1980, p. 35) argument that they are not generated by a rational cost-benefit calculus applied to information activities.

4. Following R. Radner (1979), the corresponding rational expectations equilibrium is a revealing full communication equilibrium. It is one-to-one in the sense that it maps different signals into distinct price vectors which then allows to infer the underlying signal from observing the market price.

related limitations of temporary equilibrium analysis¹.

Time and informational advantage

According to the impossibility theorem, noise in the dissemination of information via prices is a necessary condition in order to establish a profitable advantage of the informed traders over the uninformed. The condition, whether realistic or not, becomes necessary because the analysis abstracts from time². If the collection and dissemination of information in speculative markets is in essence a process, comparative static analysis must be inadequate. But it may nevertheless be useful to identify some misconceptions resulting from the attempt to abstract from time.

The informational externality created via trading can only endanger the existence of a speculative market if an informed trader has no chance to trade before his new informative situation has become general. As already argued (section 2), a trader cannot avoid announcing his divergent beliefs if he wants to trade correspondingly. However, the smaller the market weight of his transaction demand and the less he has to share the informative advantage with others, the greater his chance to trade at a price which is false in the light of his beliefs and to re-trade at a profit if his beliefs turn out to be correct.

The result which this kind of reasoning has in common with the discussed theorem is that speculative markets

-
1. Specific limitations of the used class of rational expectations are sketched by R. Radner, op. cit.
 2. This criticism of the theorem is also made by M.F. Hellwig (1981). Equally, R. Radner (1979) mentions this deficiency in passing (p. 656) without questioning, however, the validity of a comparative static approach.

cannot be informationally efficient in the sense of Fama. But there exists an important difference. In the case of the theorem, informational inefficiency is a necessary condition for the existence of such markets. However, in terms of market dynamics, inefficiency is part of the process of discovery and communication of information. Noise guarantees a kind of rent distributable to informed traders which must be sufficiently high to cover their costs of being informed¹. However, in a dynamic context, inefficiency in the above sense is the result of some traders being able to trade at a temporary informative advantage. The derived profit can be interpreted as a premium for being faster in the acquisition and correct reading of new pieces of information, and also for re-interpreting already available information more quickly. The premium is highly uncertain and exposed to the competitive information activities of other traders. This competition for a temporary informational monopoly determines not only the informational quality of prices but also the speed at which changes in beliefs and underlying information are disseminated. As in other cases of socially useful competition, inefficiency from a static point of view can be the source of dynamic efficiency. And from this perspective of discovery and adaptation, the basically static verdict of Pareto non-optimality² carries little weight if any.

-
1. In passing, a further implausible result related to the required noise may be worth mentioning. When introducing futures trading for a storable commodity it seems necessary to add even more noise to the system. Because the uninformed have now two prices from which to infer, it is argued that the initially introduced noise will be completely removed from the system (S.J. Grossman, 1977, p. 443). This requires the absence of a feedback mechanism between futures and actuals price. However, in the case of storable goods this feedback is provided by intertemporal arbitrage. As a consequence, futures and actuals' prices become highly correlated, at least in periods of a negative difference between actuals' and futures price (positive carrying charge).
 2. E.g. S.J. Grossman (1976), p. 584 ; S.J. Grossman, J.E. Stiglitz (1976), pp. 246, 252 ; S. Figlewski (1978), p. 581.

Communication, trading and equilibrium

There is a further difficulty of comparative statics which is also demonstrated by the analysis underlying the impossibility theorem. It is related to the analytical need to solve the problem in one step starting from the description of the solution, i.e. the equilibrium conditions being fulfilled. In the case of the basic model underlying the theorem, the difficulty can be demonstrated by asking how the information acquired by some traders is signalled into the system. The analytical approach can be interpreted as allowing in fact only one round of trading during which a new equilibrium has to be found. This requires that the information be conveyed to the uninformed before any transaction has taken place, which corresponds to the assumption of a Walrasian tâtonnement.

The forementioned assumption could be approximated in a more practical way by requiring that the information be conveyed via the prices asked by those who would like to make transactions on the basis of a new informative situation. However this is implausible because those who anticipate a price change on the basis of acquired information would like to trade at the prevailing futures price in order to be able to re-trade at a profit. It shows again that this kind of analysis can hardly explain the communication via markets.

5. Equilibrium, uncertainty and rational expectations

A seeming solution for a perennial problem

An important feature of the more recent models of speculative markets is the way in which equilibrium is brought about. The perennial problem of equilibrium analysis seems to have been solved. It appears possible to drop the assumption of correct foresight which so far has reduced equilibrium analysis to an exercise in pure logic. The problem has been clearly stated by von Hayek some 45 years ago¹, namely "how the spontaneous interaction of a number

1. F.A. von Hayek (1937), p. 49.

of people, each possessing only bits of knowledge, brings about a state of affairs ... which could be brought about by deliberate action only by somebody who possesses the combined knowledge of all those individuals".

The suggested solution consists of the proposition that expectations have to be rational in the sense of Muth. Then the economic agents are able to derive subjective probability distributions of future actuals' prices conditional on their informative situation, and for all of them these distributions correspond to the objective conditional probability distribution. In other words, they are able to make best, unbiased predictions conditional on their informative situation. Communication of information via prices is possible and, without noise, it could even be perfect if prices reflect a revealing full communication equilibrium. Those who do not possess a certain piece of information can then infer from the observed price the underlying information.

If rational expectations represent unbiased predictions they must be formed by simultaneously taking into account the market clearing conditions. Under such conditions convergence to an equilibrium, or in the case of noise, to "an equilibrium degree of disequilibrium"¹) can be secured. But how much does this rational expectations equilibrium differ from the empirically empty equilibrium criticized by von Hayek ? "It appears that the concept of equilibrium merely means that the foresight of different members of the society is in a special sense correct. It must be correct in the sense that every person's plan is based on the expectation of just those actions of other people which those other people intend to perform,

1. S.J. Grossman, J.E. Stiglitz (1980), p. 393.

and that all of these plans are based on the expectation of the same set of external facts, so that under certain conditions nobody will have any reason to change plans".¹

Ignored objections

Even if one leaves aside this, in a sense anticipatory, objection, it is surprising how little impact contemporary and competent criticism has so far had on the use of Muth-rational expectations in modelling markets as information systems. One apparent attraction of rational expectations in general is that they imply that a future price cannot be known perfectly and should rather be conceptualized as a random variable with a probability distribution and an expected value. However, the additional assumption that market participants do not only take into account the random character but also decide on the knowledge of the true probability distribution reduces again the realism of the proposition. What remains is a weaker form of the Arrow-Debreu theorem for a general intertemporal equilibrium which proves that perfect foresight produces consistent results².

A second objection is related to the decision situation implied by rational expectations. The expected value of the conditional probability distribution is usually and conveniently ³ supposed to be the only statistic relevant for the decision of an individual. Seen as a process, which remains completely unexplored, the market participants are assumed to be able to learn the true probability distribution, for example, in a conventional Bayesian way. However, this seems to be reasonable only "in the tranquillity of a long-run steady-state equilibrium"⁴. And this corresponds

1. F.A. von Hayek (1937), p. 41

2. K.J. Arrow (1978), p. 159. For an early statement and qualification of the basic idea see the model of a pure "Futures Economy" by J.R. Hicks (1939, pp. 136, 138).

3. As pointed out by R.J. Shiller (1978, p. 4).

4. Cf. W.H. Buiter (1980), p. 38. Also e.g. M.E. Shubik (1954) p. 635.

to "insisting that the long period means long enough, that trial and error must be supposed to continue until all error has been exhausted and wisdom at last distilled"¹. The objection does not imply the denial of opportunities of learning. In the case of futures markets experience can be a valuable capital. But even if the price-generating process were stable, of which nobody could be sure, there would still remain the possibility of shocks which are difficult to identify². Otherwise speculation purely based on charting would have proven to be a much more profitable approach.

A third objection is related to the second and refers to a further aspect of the concept of the steady state treating time with disdain by assuming it to be "of so little consequence that any amount can be used up"³. On futures markets time is moving underneath a whole series of contracts expiring at different dates, with new contracts being consecutively added to it. Their quotations are highly interdependent mainly because of spreading and, in the case of storable commodities, because of intertemporal arbitrage. This reflects a basic property of the actuals' price at maturity of a contract. It is not a closed-end fix-point in time to which both, actuals' and futures price, tend to converge. It is as transient as the separation of the past from the future by the present. "The shadow of the future and future's future"⁴ is always present in speculative markets. To ignore it represents an abstraction, the inadequacy of which is particularly striking in the case of futures trading.

But perhaps the most important argument against Muth-

1. G.L.S. Shackle (1972), p. 128.

2. E.g. J. Tobin (1980), p. 25.

3. G.L.S. Shackle (1972), p. 127.

4. J. Tobin (1978), p. 25.

rational expectations is that they are conducive to a complete misconception of the market process ¹. The major advantage of competitive markets is the ability to merge and communicate highly diverse pieces of information. Speculative markets, including the comparatively few futures markets, serve as clearing centres for different beliefs based not only on general categories of information but also on the knowledge of individual circumstances which nobody else may have. Under such conditions it is an inadequate abstraction to assume that the beliefs of the market participants are based on the same general economic model or even sufficient approximations of it ². Furthermore, while markets are supposed to allow economies not only of information procurement, but also of information processing ability as a scarce resource, rational expectations in a sense imply abundance of both. They require from market participants a superior performance when deriving their subjective probability distribution and reading market signals ³. And if they all performed in this manner, trading on speculative markets would have to be artificially revitalized by introducing noise.

Possible defenses

A potentially misleading way to defend rational expectations is to argue that they may be approximated particularly within the limited framework of a single market. This would be the case if there existed a small number of very sophisticated and highly professional forecasters ⁴. Such a market

1. K.J. Arrow (1978), pp. 164 f.

2. Hence it means severely underrating the abstraction if it is argued that "a thorough theoretical analysis of this situation probably requires a more detailed specification of the trading mechanism than is usual in general equilibrium analysis. Nevertheless, it is tempting to try to obtain results that are as independent as possible of the specifics of the trading mechanism, by using some suitable concept of equilibrium" (R. Radner, 1979, p. 255).

3. For one of the few empirical analyses, providing evidence of only a moderate sophistication in forming expectations, see E.O. Heady, D.R. Kaldor (1954).

4. E.g. R.J. Shiller (1978), p. 36.

structure would allow "a kind of weeding-out process over time by which those with inferior information gradually loose money to those whose information is better, with the result that in the long run the market puts the heaviest weight on the best information in forming a market price"¹. But this view can be misleading because it disregards at least two important facets of speculative markets. There is, first, a turnover of market participants which means that different forecasting abilities will prevail ² and disturb this kind of convergence to informational efficiency of the market. Secondly, the observable division of labour in procuring and processing information and the specialization on specific kinds of transactions is ignored. Under such circumstances superior forecasting ability is a necessary but not a sufficient condition for lasting success.

A final argument to defend Muth-rational expectations would in fact be rather agnostic with respect to the functioning of markets as information systems. It would start with Muth's observation that "information is scarce, and the economic system generally does not waste it" ³. And it would take note of his rejection "that the scratch work of entrepreneurs resembles the system of equations (representing the relevant economic theory, M.E.S.) in any way ; nor does it state that predictions of entrepreneurs are perfect or that their expectations are all the same" ⁴. The defensive conclusion which could be drawn from these two assertions is that competitive speculative markets perform as if rational expectations were dominant. But this would imply, also for Muth, a disclamation of knowledge on how expectations are actually formed. It would secure the observable informational efficiency on these markets. However, the theory of rational expectations would be reduced to an

1. S. Figlewski (1978), p. 596.

2. K.J. Arrow (1978), p. 165.

3. J.F. Muth (1961), p. 316.

4. *ibid.*, p. 317.

Alice-in-Wonderland proposition, i.e. "a grin without a cat".

6. Possible analytical revisions

To criticize the discussed abstractions of more recent models of speculative markets is not to deny the possibility of modelling these markets at all in order to be able to analyse them. It implies merely a pledge to avoid abstractions and analytical approaches, the use of which is bound to produce misleading results in view of the phenomenon to be dealt with. The then remaining research programme is still extremely challenging and can be only illustrated here :

- If rational expectations only allow the derivation of "a grin without a cat" and not a testable proposition about traders' formation of expectations, they unnecessarily complicate the analysis of the aggregate performance of speculative markets. Efforts to analyse market efficiency which are centred around the concept of the random walk ¹ and efficiency tests via the search for profitable trading rules can do without this concept.
- If the information activities of traders and the information diffusion in particular as well as the structure of speculative trading in general cannot be plausibly modelled within a comparative static framework, the admirable technical and analytical skill devoted to this kind of modelling could be more efficiently used in the design of dynamic or at least quasi-dynamic ² models. Possible unsatisfactory results in terms of highly complex or even indeterminate solutions would be less deceiving than the determinateness of static equilibria.

1. For an early and clear presentation of the basic argument see H. Working (1949), pp. 160 ff.

2. The modelling of a temporary informational advantage and of the resulting inefficiency by M.F. Hellwig (1981), although still based on rational expectations, can be considered as a step in this direction.

- If the informal division of labour in information activities is reflected to a considerable extent by a specialization of traders in terms of transactions, such an institutional aspect can hardly be abstracted from¹. This is all the more important because there are still unexplored possibilities to model the transient convergence to the actuals' price at maturity of a contract via the interplay of this multitude of differently structured transactions.
- If divergent beliefs are essential in explaining speculative trading, expectations must be modelled accordingly although not more than a rough approximation will ever be possible in view of the basic criticism that there is no way to aggregate divergent beliefs even on a small scale. However, it may be worth trying to segment the market according to transactions and positions taken and to analyse the consequences of correspondingly segmented expectations².

Whether, however, it will be possible to model convincingly the spontaneous information process on speculative markets with the currently available analytical tools and concepts, may still be doubted. But using inadequate abstractions to shape the economic problem in a way which allows the application of an analytical instrument does hardly lead to more than a pretense of knowledge.

-
1. A first step away from this abstraction represents the already quoted paper by M.H. Peston and B.S. Yamey (1960).
 2. The segmentation into transactions and, in the case of speculation, into long and short positions, as used by B.A. Goss and D.E.A. Giles (1981) may serve as an example from the empirical analysis of futures trading.

References

- K.J. Arrow (1978), The Future and the Present in Economic Life, *Economic Inquiry*, vol. 16, pp. 157-169.
- W.H. Buiter (1980), The Macroeconomics of Dr. Pangloss - A Critical Survey of the New Classical Macroeconomics, *Economic Journal*, vol. 90, pp. 34-50.
- E.F. Fama (1970), Efficient Markets : A Review of Theory and Empirical Work, *Journal of Finance*, vol. 25, pp. 383-417.
- S. Figlewski (1978), Market "Efficiency" in a Market with Heterogeneous Information, *Journal of Political Economy*, vol. 86, pp. 581-597.
- M. Friedman (1969), In Defense of Destabilizing Speculation ; in : M. Friedman, *The Optimum Quantity of Money and other Essays*, Chicago 1969, pp. 285-291.
- N. Georgescu-Roegen (1971), *The Entropy Law and Economic Progress*, Harvard University Press.
- D.E.A. Giles, B.A. Goss (1980), The Predictive Quality of Futures Prices, With Application to the Sydney Wool Futures Market, *Australian Economic Papers*, vol. 19, pp. 291-300.
- B.A. Goss, D.E.A. Giles (1981), Comparative Modelling of Price Determination and Storage in United States and Australian Commodity Markets : Soybeans and Wool, Paper presented to the Western Economic Association International Conference, San Francisco, July 2-6, 1981.
- R.W. Gray (1960), The Characteristic Bias in Some Thin Futures Markets, *Food Research Institute Studies*, vol. 1, pp. 296-312.
- R.W. Gray, D.J.S. Rutledge (1971), The Economics of Commodity Futures Markets : A Survey, Review of Marketing and Agricultural Economics, vol. 39, pp. 57-108.
- J. Green (1981), Value of Information with Sequential Futures Markets, *Econometrica*, vol. 49, pp. 335-358.
- S.J. Grossman (1976) , On the Efficiency of Competitive Stock Markets Where Traders Have Diverse Information, *Journal of Finance*, vol. 31, pp. 573-585.
- S.J. Grossman (1977), The Existence of Futures Markets, Noisy Rational Expectations and Informational Externalities, *Review of Economic Studies*, vol. 44, pp. 431-449.

- S.J. Grossman, J.E. Stiglitz (1976), Information and Competitive Price Systems, *American Economic Review*, vol. 66, pp. 246-253.
- S.J. Grossman, J.E. Stiglitz (1980), On the Impossibility of Informationally Efficient Markets, *American Economic Review*, vol. 70, pp. 293-408.
- R.G. Hawtrey (1939/40), Mr. Kaldor on the Forward Market, *Review of Economic Studies*, vol. 7, pp. 202-205.
- F.A. von Hayek (1937), Economics and Knowledge, *Economica*, vol. 4 (New Series), pp. 33-54.
- F.A. von Hayek (1945), The Use of Knowledge in Society, *American Economic Review*, vol. 25, pp. 519-530.
- E.O. Heady, D.R. Kaldor (1954), Expectations and Errors in Forecasting Agricultural Prices, *Journal of Political Economy*, vol. 62, pp. 34-47.
- M.F. Hellwig (1980), On the Aggregation of Information in Competitive Markets, *Journal of Economic Theory*, vol. 22, pp. 477-498.
- M.F. Hellwig (1981), Zur Informationseffizienz des Kapitalmarktes, Paper presented at the Annual Meeting of the German Association for the Economic and Social Sciences (Verein für Sozialpolitik) at Graz.
- J.R. Hicks (1939), Value and Capital - An inquiry into some fundamental principles of economic theory, 2nd edition, reprinted London 1968.
- J. Hirshleifer (1977), The Theory of Speculation under Alternative Regimes of Markets, *Journal of Finance*, vol. 32, pp. 975-999.
- G.W. Hoffman (1932), Future Trading Upon Organized Commodity Markets in the United States, Philadelphia.
- J.M. Keynes (1930), A Treatise on Money, vol. 2, London.
- J.F. Muth (1961), Rational Expectations and the Theory of Price Movements, *Econometrica*, vol. 29, pp. 315-335.
- M.H. Peston, B.S. Yamey (1960), Inter-Temporal Price Relationships with Forward Markets : A Method of Analysis, *Economica*, vol. 27-28, pp. 355-367.
- R. Radner (1979), Rational Expectations Equilibrium : Generic Existence and the Information Revealed by Prices, *Econometrica*, vol. 47, pp. 655-678.

- Ch. S. Rockwell (1967), Normal Backwardation, Forecasting, and the Return to Commodity Futures Traders, Food Research Institute Studies, vol. 7 (supplement), pp. 107-130.
- G.L.S. Shackle (1972), Epistemics and Economics - A critique of economic doctrines, Cambridge University Press.
- R.J. Shiller (1978), Rational Expectations and the Dynamic Structure of Macroeconomic Models - A critical review, Journal of Monetary Economics, vol. 4, pp. 1-44.
- M. Shubik (1954), Information, Risk, Ignorance, and Indeterminacy, Quarterly Journal of Economics, vol. 68, pp. 629-640.
- M.E. Streit, R. Quick (1982), Informationsaktivitäten und Preisbildungsprozesse auf Terminkontraktmärkten, Jahrbücher für Nationalökonomie und Statistik, vol. 197, forthcoming.
- J. Tobin (1980), Asset Accumulation and Economic Activity - Reflections on Contemporary Macroeconomic Theory, Oxford.
- H. Working (1949), The Investigation of Economic Expectations, American Economic Review, vol. 39, pp. 150-170.
- H. Working (1953), Futures Trading and Hedging, American Economic Review, vol. 43, pp. 314-343.
- H. Working (1958), A Theory of Anticipatory Prices, American Economic Review, vol. 48, pp. 188-199.
-

