Frontiers of Economics

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Foreword

Hilma Gabriella Jahnsson, whose centenary was commemorated by this symposium, was a remarkable personality. She was the daughter of a prison guard who became one of the greatest philanthropists in Finland. She held two academic degrees and participated actively in Finnish cultural and political life together with her husband Yrjö, professor of economics at the Institute of Technology in Helsinki. For several years the Jahnssons strongly criticized the economic policies pursued in the 1930s. In their opinion, the monetary policy of the time was far too tight.

Yrjö Jahnsson also put his theory into practice, and the Jahnssons accumulated considerable wealth. In 1954 Hilma Jahnsson established the Yrjö Jahnsson Foundation in memory of her husband, who died in 1936. As early as the 1920s the Jahnssons had laid down the principles guiding the Foundation and had decided that it should support economic and medical research. Apart from making grants, the Foundation has arranged scientific seminars to train young economists, at which many renowned scholars have served as speakers or teachers. Since 1963 it has also arranged a series of lectures, called the Yrjö Jahnsson Lectures, and has published them in English.

As was indicated by its title, the general aim of this symposium was to survey selected areas of economic research, where fruitful theoretical or empirical developments have recently taken place. I would like to take this opportunity to express our gratitude to Professor Kenneth Arrow, who acted as the programme chairman and selected an excellent set of topics and speakers. I would also like to thank the local organizing committee consisting of Dr Seppo Honkapohja, Dr Vesa Kanniainen, Professor Arvi Leponiemi, Mr Antti Suvanto and Professor Esko Vuorela for their work in making the symposium possible. There is no need to say anything about the importance or relevance of the topics chosen because the authors do that eloquently. I would rather thank all six speakers – Robert Aumann,

Jerry Green, Oliver Hart, Mervyn King, Jean-Jacques Laffont and John Taylor – as well as all the persons who acted as discussants at the seminar.

I hope not only that this symposium in Sannäs offered the opportunity for fruitful discussion, but that it will be remembered by our foreign visitors as an enjoyable and memorable sojourn in Finland.

Pentti Vartia

Contents

Introduction

KENNETH J. ARROW AND SEPPO HONKAPOHJA

1 BACKGROUND

This book consists of the proceedings of the symposium with the same title which was held in Sannäs near Helsinki in Finland on 27–30 June 1983 under the auspices of the Yrjö Jahnsson Foundation to celebrate the centenary of Mrs Hilma Jahnsson, who created the Foundation in 1954. The Foundation decided a few years ago to use the occasion as an opportunity to organize a conference, in which the object would be to survey, discuss and evaluate the current state of research in several important areas of economics among a very distinguished group of participants. This was seen to be a valuable service to the field of economics not only in Finland, but also at the international level, through the publication of the proceedings.

The choice of the topics for the symposium was guided by three principles. First, significant results and advances in the area have taken place in the past 10–15 years, and the area is subject to continued extensive research effort at present. Second, some emphasis was placed on theoretical developments, in particular inasmuch as they have contributed improvements to current research in more applied areas of economics, or are likely to do so in the future. Third, in order to permit coverage in sufficient depth we had to be very selective, with the unfortunate consequence that many important topics had to be completely left out. Needless to say, these criteria were far from complete, and the final choice of topics also reflects our personal preferences, judgement and interests.

Looking back to the last decade, we saw several important developments in economics that led us to include those areas in the agenda

of the symposium. After the initial outburst of research activity and the subsequent temporary disenchantment in the 1950s, the theory of games has become an increasingly prominent and widely used analytical tool in economics, though naturally its significance extends to many other sciences as well. We only need to mention the relationships between perfectly competitive equilibrium and some of the cooperative solution concepts of game theory, the vital role of the theory of games with incomplete information in the economics of information, and the close relationship between game theory and oligopoly theory, though these are just a few examples of the numerous applications. Hence we chose to include game theory and economics in the agenda.

The perennial topic of imperfect competition has received a great deal of fruitful research effort in the 1970s. Among the important developments one may perhaps list the attempts to build general equilibrium models with imperfect competition, the extensions of oligopoly theory to include aspects of dynamics and uncertainty, the refinement and clarification of the notion of entry barriers, and improvements in the analysis of advertising, product differentiation, entry, research and development and other phenomena. To these primarily theoretical advances one has to add to the whole extensive applied literature in the field of industrial organization. Imperfect competition was thus a natural selection as a topic for the symposium.

The economics of information has experienced an extremely rapid growth during the past decade and into the present. A large part of recent research has focused on the consequences of incomplete and asymmetric information on the forms of economic organization in different fields, ranging from trading activities to problems of income taxation. Various sophisticated trading arrangements, incentive contracts, signalling devices and nonlinear regulating schemes are used when the contingent markets of the Arrow–Debreu model of general equilibrium under uncertainty fail to exist and facilitate efficient risk-sharing. A related development has been the formulation of the concept of an equilibrium with rational or consistent expectations for price-mediated markets. Consequently, we picked differential information, the market and incentive compatibility as the third topic for the symposium.

The economics of savings behavior has been subject to a lot of both empirical and theoretical research during the 1970s. Much of

it has been stimulated directly by policy considerations such as the problems of social security, but more generally the area is of prime importance in the wider context of the study of wealth accumulation and distribution over time. The life-cycle and permanent income hypotheses, which were developed in the 1950s, are still widely used frameworks, but other aspects such as the potentially important bequest motive have also been coming to the forefront of research effort. We felt that it would be quite useful to have an overview of the main issues in the area, and we thus selected the economics of saving as the fourth topic.

In macroeconomics the 1970s can be seen primarily as a period of reformulation and search for a more solid foundation, after the growing dissatisfaction with the so-called orthodox Keynesian doctrine. Many of the controversies still continue, and different approaches or schools of thought exist. One of the innovative developments has been the formulation of rigorous models of general equilibrium under price rigidity and quantity rationing, which has led to the wide use of fixed-price models in the analysis of short-run macroeconomic questions. After the theoretical advances, econometric methodology has also been developed for these kinds of models. Fixed-price models were therefore added to the agenda.

A fundamental innovation in macroeconomic theory was achieved through the use of the notion of rational expectations in macroeconomic models with flexible prices. Clearly, the agenda would have been deficient if rational expectations models had not been included in it. Though the area is closely interwoven with general equilibrium theory and the economics of information, we decided to emphasize the significance of rational expectations modelling in the field of macroeconomics, in which it has also been studied intensively. Rational expectations models in macroeconomics concluded the roster.

In the symposium, each of the six topics was first surveyed in a major lecture, after which two invited comments were delivered. The surveys and the comments make up the body of the volume. Needless to say, each topic is broad, and quite often the surveys take particular viewpoints which were left to the authors' choosing. In many cases the comments not only reflect on the survey, but also provide supplementary material that was left uncovered. In the symposium a significant amount of time was available for general

discussion of each topic, and a separate session was held to provide an opportunity for additional reflections on the topics and for suggestions and remarks on other currently important related areas and problems for research. In this Introduction we try to provide a guide to the contents of the book by taking up briefly some of the major issues considered by the authors. In doing so we have relied on the discussions at the symposium, and we try to point out at least some matters in which different opinions exist at present, and on which further research would be valuable. We also try to provide an account of the discussions in the final session on open problems and future tasks of research.

Given the nature of the material, this Introduction is organized as follows. Section 2 is confined to game theory and methodology, since Robert Aumann's lecture was on a broad philosophical level, discussing not only game theory but also general issues of importance to economic theory. In section 3, under the heading of 'Resource allocation', we introduce the material on three of the topics: imperfect competition, differential information and incentives, and savings. In section 4, under the title of 'Macroeconomics', we have included the material dealing with fixed-price models and rational expectations models in macroeconomics. Finally, in section 5 we try to provide our interpretation of the open problems and topics for further research that came up in the concluding session of the symposium.

2 GAME THEORY AND METHODOLOGY

A large part of economic theory is awesomely dependent on game theory, borrowing from it the conceptual apparatus for the analysis of various economic problems. To give some examples, the symposium included sessions on imperfect competition, incentive compatibility and perhaps rational expectations. The first part of Robert Aumann's lecture (chapter 1) contains a beautiful broad philosophical essay stating his viewpoint for assessing the usefulness, validity and 'truthness' of game theory, though in fact his arguments can be applied to much of the current contents of mathematical economics, which is based on the hypothesis of rational behavior, and of social equilibrium arising from the interaction of strategically behaving agents.

According to Aumann, the success of game theory should not be judged by innate plausibility, but rather by its ability to facilitate comprehension of the different phenomena under study, in its three components: relationship or 'fitting things together,' unification ('I am not thinking of validity in the usual sense of truth, but rather in the sense of applicability or usefulness; I am measuring validity of an idea by the amount that people use it' (p. 30)) and simplicity. This viewpoint also leads him to argue that the concept of truth applies to observations, not to theories, so that, for example, the pluralism or multiplicity of solution concepts in game theory is an advantage, not a handicap. When applied to the role of the hypothesis of rationality and utility maximization, this viewpoint vitiates much of the critique such as 'Do individuals really maximize utility?' In Aumann's own words, 'it [the significance of utility maximization] derives from its being the underlying postulate that pulls together most of economic theory; it is the major component of a certain way of thinking, with many important and familiar implications, which have been part of economics for decades and even centuries. Alternatives such as satisficing have proved next to useless in this respect' (p. 35). Aumann also points out that in evolutionary biology the doctrine of the survival of the fittest takes the form of maximizing behavior of genes, though 'we know that genes don't "really" maximize anything' (p. 36).[1]

This viewpoint implies a particular way of looking at game theory and economic theory as descriptive sciences, since in reality human beings are motivated and influenced by other factors apart from rationality: 'the criterion for judging our theories cannot be rigid; we cannot ask, is it right or wrong? Rather we must ask, *how often* has it been useful, *how* useful has it been?' (p. 37). Aumann also concludes that the distinction between normative and descriptive models is not as sharp as is often thought, and that normative aspects of game theory are multidimensional.

While Aumann's systematic discussion of methodology has many attractive ideas, it may be felt to be somewhat extreme in that it leaves little or no role for empiricism and falsification of theories by means of experimentation and empirical work. It should be a challenge to economics and game theory to find ways of formulating such tests that face the real world. In his comments Reinhard Selten discusses various viewpoints on the question of empirical relevance

of game theory, and more generally the hypothesis of rationality, opting for 'methodological dualism,' which makes a sharp distinction between normative theories based on rationality and descriptive ones. He bases this on recent work studying learning processes, and emphasizes, as Martin Shubik does in his comments, the importance of the recent experimental work. The use of money rewards in designing experiments has been a particularly important innovation, as was emphasized by Aumann and others at the symposium. When learning situations and the consequent possibilities for convergence to rational behavior are not possible, Selten advocates theories of limited rationality based on experimental research. In this he is supported by Shubik's emphasis on the need to develop satisfactory concepts of limited rationality.

The second part of Aumann's lecture consists of an assessment of the most important solution concepts of game theory: Nash equilibrium, the core, the stable set and the Shapley value. Both Aumann and Shubik stress that the multitude of solution concepts do not provide a basis for criticism of game theory. Each one of the solution concepts focuses on different aspects of rational decision-making and play. Nash equilibrium and its numerous variants and refinements stress individual incentives, i.e. economic agents simultaneously maximize their utility. The core is a cooperative solution concept emphasizing the outcome of unlimited competition in economic situations in which the competition can lead to a stable outcome in that the core is non-empty. Aumann points out that this interpretation of the core is not apparent from the definition, but emerges from the application and existing results. The von Neumann–Morgenstern stable set refines the idea of stability with respect to blocking coalitions of the core: the blocking coalition of a given one should itself have a stability property. Aumann's lecture emphasizes that, somewhat surprisingly, this feature leads, via its applications, to the view that the stable set is a solution concept expressing the idea of social organization, its forms being endogenous and quite subtle. The last of the solutions discussed by Aumann is the Shapley value, which, again through the applications, can be interpreted as describing power, reasonable compromise or outcome of arbitration.

Most of Martin Shubik's commentary concentrates on the use of the apparatus of game theory as a tool of modelling social, economic and other phenomena; and in particular he emphasizes modelling

problems encountered prior to the formulation of the solution concept: 'there is a considerable distinction in the level of detail and nature of aggregation provided in the extensive, strategic, and coalitional forms [of games]' (p. 89), the first being detailed, and the last one becoming pre-institutional in its nature. Shubik provides a schematic summary of this modelling choice and then illustrates it by looking briefly at the theory of competitive equilibrium, market games, oligopoly and financial institutions.

3 RESOURCE ALLOCATION

Different problems of resource allocation or microeconomics were the subject matter of three of the sessions in the symposium, namely those dealing with imperfect competition, incentive compatibility and differential information, and savings behavior. The first two concentrate on recent theoretical work, while the focus of the third is primarily on models used for empirical proposes.

Imperfect competition

In his survey (chapter 2) Oliver Hart provides an extensive review of the general equilibrium models of imperfect competition that have been developed in the recent literature. The starting point is a synthesis of the so-called subjective demand approach, originally due to Negishi (1961), in which the monopolistically competitive firms have perceived demand functions for their products. These functions go through the status quo point but are otherwise subjective or arbitrary. As Hart points out, this approach is quite general, but its main difficulty is that no justification is provided for the subjective conjectures, so that 'to an outside observer who is asked to predict the market outcome but who does not know what these conjectures are, almost anything could be an equilibrium; i.e., the set of allocations that are a monopolistically competitive equilibrium for *some* conjectures ... is very large' (p. 107).

The second set of general equilibrium models with monopolistic competition discussed by Hart is more specific than the Negishi approach in that the conjectures of the firms are required to be correct: 'objective demands' are assumed, in Hart's terminology. Hart first surveys the Cournot-type models with quantity-setting

firms, pointing out some important problems concerning the existence of equilibria; the currently known conditions guaranteeing existence are 'extraordinarily strong' (p. 112). Moreover, 'once one departs from relatively simple cases the [Cournot–Nash] formulation itself becomes unsatisfactory' (p. 114), in the sense that it is not evident what constitutes a plausible conjecture, and the approach requires that each firm make a full general equilibrium calculation in order to make its decisions.

For the second class of models with objective demands discussed by Hart, the starting point is the preceding observation that full general equilibrium calculations for decision-making by imperfectly competitive firms are not very plausible. Rather, it seems more likely that an individual firm takes as given some relevant variables, for example the wealth of the consumers. Hart provides a very interesting and novel justification for this by means of limiting and replication arguments, and he then proves an existence theorem for such imperfectly competitive equilibria, though in part the Roberts–Sonnenschein (1977) problem regarding the nature of the primitive assumptions still remains. As Hart emphasizes, the absence of these feedback effects, or 'Henry Ford effects,' as dubbed by Jean Jaskold Gabszewicz in his comments, leads to a more tractable model, though a less general one.

Hart's general conclusion about these models is that 'the objective demand approach ties equilibrium down to a much greater extent than the subjective demand approach, given particular assumptions about reactions. However, as we vary the assumptions about reactions the number of equilibria that the objective demand approach generates can be very large.... which of these equilibria is the "right" one?' (p. 123). This argument is the basis for the recent research about rational or reasonable conjectures, which attempts to study situations in which strategies are observable, so that underlying conjectures can be considered. In a partial equilibrium context Hart provides an account of the recent results and shows that in many circumstances the requirement of rationality or reasonableness is not sufficient to tie down the indeterminacies that are characteristic in oligopoly theory.

The final part of Hart's survey focuses on the meaning of the economists' favorite notion, perfect competition, in the light of the general equilibrium models of imperfect competition. After rejecting

the validity of the ideas that perfect competition is a special case of Negishi's model, or that it arises out of Bertrand-type price-setting behavior, Hart turns to the view that the Arrow–Debreu model corresponds to the case, where each agent is small relative to the markets in which it operates. In other words, perfect competition is a limiting result for some imperfectly competitive economies, when the number of agents is replicated *ad infinitum*, so that each agent becomes small relative to the markets. The recent results discussed by Hart are based on the non-cooperative viewpoint, in contrast to the well-known theorems about the core and perfect competition in which the apparatus is taken from cooperative game theory. The latter support, of course, the same interpretation of perfect competition as a limiting case.[2]

One of the major simplifying assumptions in the general equilibrium models of imperfect competition surveyed by Hart is that products are homogeneous, so that issues related to the choice of product quality and product differentiation are not considered. In his comments Jean Jaskold Gabszewicz discusses the recent research on product differentiation and relates it to the problem of entry and exit, which is another major topic in the analysis of oligopoly and imperfect competition. On the basis of recent results, he suggests that properties and characteristics of demand can be an important determinant of the nature of equilibrium in an industry.

In his commentary Hugo Sonnenschein takes up some microeconomic aspects of monopolistically competitive situations. First, he suggests that the recent research on auctions and some experimental settings can provide a useful perspective on the use of different strategic variables: 'I understand the game defined by "the monopolist announces a price and each buyer decides whether or not to buy at that price." However, I see no clear game associated with "the monopolist announces a quantity." ... Why should a monopolist not consider labeling his product with two or more different prices?' Sonnenschein goes on to venture that 'monopolistically competitive theory will not go too far until we supply a similar degree of institutional detail [to that of auction theory]' (pp. 171–3). He also suggests that the recent experimental work may provide a lot of insight for future research on imperfect competition.

The opinions about the amount of institutional detail that should be present in modelling monopolistic and oligopolistic competition

varied a great detail in the discussions at the symposium. Some of them echoed Sonnenschein in emphasizing the need for it, while others felt that the basis for monopolistic competition theory should be in the presence of increasing returns and the resulting non-convexities, without specifying too far the precise institutional characteristics.

Both Gabszewicz and Sonnenschein point out the need to model the circumstances leading to cooperation and collusion, the former emphasizing the use of cooperative notions such as the core, atoms and syndicates, and the latter focusing on the possibilities for repeated play which are conducive for cooperation. Repetition creates new issues in using game theory, auctions theory and experimental work in modelling oligopolies.

Differential information, the market and incentive compatibility

Jerry Green's lecture (chapter 3) does not try to provide a complete survey of the area, which, as he points out, has experienced an 'explosion of research' in the past decade. Instead, Green seeks to formulate the common foundations of the diverse literature by viewing it from the perspective of games of incomplete information which is the natural theoretical foundation for many of the economic models involving differential information among the individual agents.

The first distinction made by Green is that of games and generalized games, originally proposed by Debreu (1952). The latter is characterized by the interdependence of individuals' strategy sets and by the presence of 'player O,' who sets the values of certain endogenous variables to achieve a consistent outcome. After summarizing the main features of games of incomplete information, Green points out some potential difficulties in extending that theory to generalized games: one has to specify the information of 'player O' and its communication to other players as part of the equilibrium. This point is related to the important issues in giving better justifications for models of rational expectations. They are much less decentralized than the classical competitive model, since it appears that one is forced to assume that the individuals have a correctly specified structural model, making possible convergence via learning