

This book is based on a symposium organized by the
Yrjö Jahnsson Foundation

Frontiers of Economics

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and Seppo Honkapohja

Basil Blackwell

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First published 1985

Basil Blackwell Ltd
108 Cowley Road, Oxford OX4 1JF, UK

Basil Blackwell Inc.
432 Park Avenue South, Suite 1505,
New York, NY 10016, USA

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British Library Cataloguing in Publication Data

Frontiers of economics.

1. Economics

I. Arrow, Kenneth J. II. Honkapohja, Seppo

III. Yrjö Jahnsson Foundation

330 HB171

ISBN 0-631-13408-5

ISBN 0-631-14599-0 Pbk

Library of Congress Cataloging in Publication Data

Frontiers of economics.

Papers presented at a symposium honoring Hilma Gabriella Jahnsson.

Includes index.

1. Economics - Congresses. 2. Jahnsson, Hilma

Gabriella. I. Arrow, Kenneth Joseph, 1921-

II. Honkapohja, Seppo, 1951- . III. Jahnsson,

Hilma Gabriella.

HB21.F76 1985 330 84-21610

ISBN 0-631-13408-5

ISBN 0-631-14599-0

Typeset by Unicus Graphics Ltd, Horsham

Printed in Great Britain by TJ Press Ltd, Padstow

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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 Kanninen, 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

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 proposals.

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 micro-economic 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

in a stationary environment, or else that they have the same information at the outset.

After this Green develops the main elements of the welfare analysis of games of incomplete information. He discusses the three viewpoints for welfare evaluation, based respectively on *ex ante*, interim and *ex post* utilities of the individuals with respect to the information on which the utilities are conditioned, and he then outlines the main features of the normative aspect of the welfare analysis, usually called mechanism design, emphasizing the significance of the revelation principle in simplifying the analysis. He also points out that the study of the design problems without a mediator is a nearly unstudied area.

In the classification of some of the important economic models, Green stresses that, formally, in many of them the corresponding game is supplemented by further constraints arising from the specific circumstance under study, and these can be classified as 'participation constraints,' expressing constraints on utilities and arising from the partial equilibrium nature of the models, and 'auxiliary equilibrium conditions,' which relate to dependencies among endogenous variables not in the form of constraints on expected utilities. The classifying material is then concluded by an emphasis on the potential problems arising from dimensionality considerations with respect to both observable and unobservable variables, many of the economic models being one- or zero-dimensional in both. Green concludes his lecture by discussing the most important results of the welfare analysis of some economic models.

Bengt Holmström's commentary is a general appraisal of the literature in its focus on illustrative applications, central economic issues and limitations and challenges of the research. According to him, the most important accomplishments have to do with the multitude of non-market organizational structures that can arise from asymmetric information, but which the complete information competitive model is unable to account for. The examples include cost-sharing contracts, bonus payments, monitoring practices, incidence of strikes and the like. Holmström stresses that 'these naturally occurring inefficiencies... reflect nothing more than legitimate costs of information transfer,' or that 'they may also be viewed as stemming from rents that accrue to parties who hold an informational monopoly' (p. 204). Holmström goes on to suggest that the main

difficulty of the 'new institutional economics' is that it is too easy to explain many of the institutions, and empirical work should be developed to discriminate between the alternative theories. Another difficulty emphasized by him and others at the symposium is that, so far, the nature of information costs is not comprehensive enough. The inefficiencies relate to strategic costs, but information has other aspects that should be considered as well. One of them concerns the costs of observations and information-gathering which is technological and not due to strategic behavior of parties possessing pieces of it. Holmström also discusses the complications to efficiency concepts caused by private information.

In his comments, John Riley develops the economics of competitive and monopolistic self-selection as another concrete illustration of the recent research. After discussing the main implications of the signalling model, initially due to Spence (1974) and others, Riley points out the problem of the non-existence of equilibria and the refined equilibrium concepts that have been proposed to resolve the issue. As examples of monopolistic self-selection mechanisms he first outlines the case of a public monopoly in which the mechanism design leads to the problem of finding information-constrained Pareto optima, with the basic result of d'Aspremont and Gérard-Varet (1979) concerning cases in which the full-information optimum can be attained. Second, Riley considers a private monopoly in which the natural criterion is to maximize the gain of the monopolist. As an illustration he outlines the derivation of the revenue equivalence theorem of auction theory and discusses the recent efforts studying the weakening of the basic assumptions about the symmetry of beliefs, independent valuations and risk neutrality. On the basis of the apparent complications, Riley ventures the speculation that 'even in relatively simple and highly specialized models, we may be asking too much in the search for non-cooperative equilibria in order to explain observed behavior. Perhaps the best we can hope for in some cases is to identify a set of logically consistent strategies' (p. 224).

Savings behavior

The object of Mervyn King's lecture on savings behavior (chapter 4) is to provide a detailed account of the recent work on consumption

and savings decisions of households and their application to econometric analysis. The determinants of savings have been an important element in a number of topical debates, and King focuses on the different variants of the well-known life-cycle hypothesis, which he interprets broadly to mean that 'individual behavior is forward-looking, that individuals optimize over their expected remaining lifetime, and that the cost of acquiring information about the future is not so prohibitive that only current observations are used to determine current consumption' (p. 228).

The first part of King's survey deals with the various theoretical elements of the life-cycle model, and he discusses both the deterministic and stochastic variants, laying special emphasis on the various parametric specifications that have been used in empirical analysis. A particularly important one of these is the often-used separability condition on preferences, both over time and within the period with respect to consumption and labor supply. King suggests that 'tests of the life-cycle model ... are unlikely to be conclusive because they are tests of the joint hypothesis that (a) individuals are life-cycle savers, and (b) preferences are parametrized in a particular way' (p. 239). King also reports some simulations concerning the profile of assets over a lifetime, as predicted by a life-cycle model and compared with empirical evidence, based on King and Dicks-Mireaux (1982) and other work. The main difficulty of the model is that in reality the pattern of wealth decumulation at old age is far less pronounced than is predicted by the model, though King suggests that this might perhaps be reconciled by extending the model to include a stochastic date of death. Mordecai Kurz and Peter Diamond point out, in their comments, that this idea would also have other implications, such as market provision of insurance against it, with the appearance of the consequent demand for indexed annuities.

In the discussion on alternative models to the life-cycle hypothesis, King focuses on the potential significance of unemployment and quantity constraints in capital markets, relegating the treatment of bequests to a later section. He points out that problems of aggregation are likely to be very difficult, when some individuals are subject to these constraints while others are not. He also mentions the recent literature pointing out difficulties in expected utility theory and rational decision-making in the presence of major uncertainties. Diamond also stresses this issue in his comments.

In reviewing the empirical studies of savings behavior, King discusses first those that have employed aggregate time-series data. He points out that such data are likely to contain aggregation biases which make testing of the life-cycle model hazardous, as 'almost any set of aggregate data could be consistent with underlying rational individual behavior' (p. 271), and that the tests 'have been rather disappointing' (p. 272), though they seem to provide some support to the view that consumption is rather more sensitive to current income than is predicted by the simple life-cycle model.

The second class of studies reviewed by King has utilized household data, and King stresses that its accuracy can often be a major problem. This obstacle was emphasized by many others in the conference, and it would be desirable in future studies to have a more detailed explanation and assessment of the data used. Cross-section data also bring into relief the basic issue of heterogeneity in the population, and King concludes that 'support for the life-cycle model is mixed' (p. 282) at best. In this he is supported by Diamond, whose comments provide some further information on wealth accumulation from the study by himself and Hausman (1984) suggesting great diversity in behavior. Kurz also agrees with the need to account for heterogeneity, though his focus is primarily on bequest motives in savings decisions.

King devotes some space for a review of problems encountered in studying bequests and assessing their significance, and the topic is discussed in great detail by Kurz in his comments. Kurz argues that the interpretation of the life-cycle hypothesis as meaning that agents are 'forward-looking' in their behavior is too broad, since it does not distinguish between the life-cycle motive and the bequest motive. After an account of the theoretical elements of the latter, which he calls the 'intergenerational hypothesis,' Kurz discusses first the empirical evidence on social security and life-cycle savings and the evidence on the bequest motive, pointing out as a general conclusion that neither hypothesis appears to be in agreement with the empirical results, even if one takes notice of several severe methodological problems, especially in studies using cross-section data. Second, Kurz discusses evidence from several studies concerned with the quantitative significance of life-cycle motives, which suggest that only a small share of the US wealth stock can be accounted for by them. He concludes that other motives for wealth accumulation are very

diverse and complex, so that 'research should concentrate on studying statistical regularities of the stochastic process that results from aggregating over a heterogeneous population' (p. 325) and less on estimating parameters of hypothetical utility functions.

In the discussions, many participants felt that there was a great need for further work, but that in it one should carefully specify one's objectives and the questions addressed. Clearly, a good deal of population heterogeneity in motives for wealth accumulation exists, and polar hypotheses probably cannot account for them. On the other hand, it is possible in principle that a large fraction of the households behave in a way not too far removed from the life-cycle model and its extensions, as they do not have large estates and significant amounts of wealth. For some policy considerations, studies of behavior of these households may provide important empirical information. This is an open field, with much controversy, in which the benefits from clear statements of purpose can be substantial in narrowing down the points of disagreement.

4 MACROECONOMICS

Two of the topics of the symposium belong to the domain of macroeconomics, as they survey important developments of the last decade, namely fixed-price models and rational expectations models in macroeconomics. In both lectures the emphasis is to a large extent empirical, so that problems and issues of econometric research in the areas is discussed, together with an overview of the underlying basic theory.

Fixed-price models

Fixed-price models, often called disequilibrium or non-Walrasian models, attempt to provide a unified framework for the analysis of circumstances in which, owing to price rigidities, markets do not clear, and discrepancies between demands and supplies can prevail at least in the short run. In his survey (chapter 5) Jean-Jacques Laffont first outlines a prototype of the macroeconomic models used in the literature, and then summarizes the main features of the four empirical macro-models that have been developed so far.

Laffont emphasizes four empirical and methodological issues that each of the four studies have had to resolve in econometric implementation. The first of these is the lack of countercyclical variation in labor productivity, which is in contrast to the implication of the basic theoretical model. According to Laffont, in all four studies this difficulty is resolved in a fairly *ad hoc* way, and there is 'need for a better analysis of labor hoarding from a theoretical point of view' (p. 337). The second major empirical problem is the presence of frictional unemployment in the available data. The remaining two problems are methodological. First, one has to decide the link between realized transactions and demand and supplies, the so-called 'min' condition, for which different specifications have been used. Second, there is the problem of obtaining restrictions that guarantee the existence of a well-defined reduced form, sometimes called the coherency constraints. Laffont points out that these conditions imply restrictions on the size of the spillover effects in piecewise linear models, while for nonlinear models 'the question of uniqueness is more difficult' (p. 340).

After the overview of existing macroeconometric work Laffont turns to recent developments beyond the standard prototype models. First, 'the treatment of inventories as an exogenous variable in models where, by the logic of fix-price equilibria, they are playing an important role as a buffer stock' (p. 341) is a serious weakness in the existing empirical work. Laffont comments that little work has been done in this area, but the existing studies 'suggest that the price dynamics will not be seriously disturbed by the inventories-money holdings dynamics' (p. 346). This takes up the critical issue in fixed-price models, namely the lack of convincing explanations of price rigidity and price adjustment over time. Laffont surveys the existing models, which are based on mechanistic adjustment rules, and stresses that improvements are necessary before reliable conclusions can be made. In this he is supported by Frank Hahn's comments, which suggest that one needs to formulate models with monopolistic competition before such resolutions are obtainable. (Hahn also outlines a framework of this kind.)

The issue of price determination is related to the recent literature on implicit labor contracts, which has sometimes been suggested as a justification for rigid wages. Laffont provides a synopsis of the theory in an appendix, and Hahn comments on the area in detail. In the general discussion it was stressed that the distinction between

nominal and real-price rigidities is important, the contract theory providing an explanation only for real-price rigidity.

When price dynamics are interrelated with investment and growth, various intermediate or long-run tendencies for the economy can emerge, but Laffont cites Malinvaud (1980) and suggests that the foundations of the models are very insecure in two respects: first, the behavioral rules of the economic agents are not derived satisfactorily; and second, the influence of expectations has not been considered in any detail, but is likely to be of fundamental importance. Laffont then concludes with a discussion of problems of aggregation; he reports on some preliminary results using survey data and suggests that 'fix-price theory enables us to look at data from a different point of view which might prove to be useful to economic policy in the short run' (p. 358).

In contrast to Hahn's commentary, which deals with the main problems of fixed-price theory and the related research on labor contracts, János Kornai's discussion provides a brief survey of the recent research on another class of non-Walrasian models, namely those by him and his colleagues that have been designed to analyze the chronic shortage phenomena of the socialist economies. Kornai emphasizes that this work is not within the fixed-price literature but rather is an independent area of studies, of which the major characteristic is that it is concerned with permanent or chronic situation, in contrast to alterations between different regimes.

Kornai also ventures an important conjecture about the nature of unemployment in market economies: 'chronic unemployment is systemic in a market economy... and theorists do not pay great attention to the long-term institutional-structural aspects of the problem' (pp. 380-1). Indeed, many participants felt that the economics profession cannot at present provide a reliable non-controversial explanation for the apparently persistent unemployment in the Western world. In any case, in addition to its weaknesses, the fixed-price models are capable of explaining only temporary unemployment, but not its persistence.

Rational expectations models in macroeconomics

In the beginning of his survey (chapter 6) John Taylor emphasizes that the basic aim of most of the current macroeconomic models with rational expectations is the analysis of business cycles in market

economies, and that the hypothesis of rational expectations seems natural for this recurrent phenomenon. Taylor identifies two distinct branches of the recent literature. First, there are the pioneering macroeconomic models by Robert E. Lucas Jr, Thomas Sargent, Neil Wallace and Robert Barro, in which the primary source for the output-price relationships is informational in that certain informational constraints on suppliers exist: 'the constraints give rise to a perception of a relative price increase [and consequent quantity response] when in reality there is none' (p. 397). These models explicitly make the assumption that in each period prices are perfectly flexible and clear the markets. The second class of models identified by Taylor relies on explicit wage and price-setting behavior and consequent rigidity, so that the markets do not clear. Taylor terms the latter 'sticky price models'.

After a careful outline of the basic elements of both types of models, Taylor provides a summary of the empirical work that has tried to test the validity of the two approaches. The information-based models have been subject to a lot of testing, and Taylor points out that the results give reasons to be doubtful about the models. He is supported by Laurence Weiss, who in his comments states that 'I find the evidence on price surprises and output compelling. ... [The Lucas model] must be judged a failure' (p. 442). The sticky price models have not been tested so extensively, and Taylor suggests that the first results indicate reasonably favorable results, though some problems concerning the explanation of the observed inter-temporal correlations seem to emerge.

In the remaining part of the lecture Taylor reviews rational expectations models of consumption and investment, techniques for estimation and policy analysis, and open problems, stressing in particular questions about agents' learning of their environment and the problem of non-uniqueness of rational expectations equilibria. The latter issue is taken up by Seppo Honkapohja in his comments, in which he demonstrates the existence of non-stationary equilibria in a version of Taylor's models of staggered contracts, concluding with a strong opinion: 'the existence of a continuum of solutions to many rational expectations models, whether of "new classical" or "Keynesian" variety, is a fundamental difficulty in this research' (p. 433).

Honkapohja also takes up the basic characteristics of the rational expectations models with sticky prices, suggesting that they are

problematic in two basic aspects. First, the existing justifications for the assumed price adjustment equations are not fully satisfactory in that at best they can be defended on some basis of limited rationality. Laurence Weiss also points out this questionable feature of the models with sticky prices. The second difficulty is that, since markets do not clear in these models, they should provide an account of the influence of quantity constraints on the behavior of economic agents, with the possibility of several types of equilibria. The existing models postulate that the economy is always in the region of Keynesian unemployment, in the terminology of the fixed-price models.

Laurence Weiss in his comments stresses that the rational expectations models have been an important extension to the existing microeconomic general equilibrium theory, with its emphasis on the role of prices in transmitting information. Weiss also points out that the rational expectations hypothesis has been quite useful in the study of the behavior of interest rates and volatility in asset markets. These innovations in microeconomics have been quite significant, and they may eventually lead to 'strong implications for aggregate economic activity' (p. 442). On the other hand, the debate about the significance of business cycles is far from being resolved, and Weiss suggests that successful models will be based on the assumption of maximizing behavior.

5 OPEN PROBLEMS AND FUTURE RESEARCH TOPICS

The concluding session of the symposium was devoted to an exploration of open problems in economics and suggestions for future research. Edmund Phelps, Jouko Paunio, Eytan Sheshinski and Carl Christian von Weizsäcker started with prepared statements, which were followed by comments by most of the participants in the symposium. What follows is a slightly organized list of the participants' visions of fruitful and needed research topics.

One general statement was made several times: both at this symposium and among economists in general, there was a tendency to shy away from the grandest themes. The fundamental questions of economic change, the theme of Schumpeter's work, are not discussed. It was suggested that economists displayed strong risk aversion in their own choice of research topics.

Despite this admonition, the actual topics proposed tended to be relatively specific and at least apparently researchable. Indeed, there

was some question as to whether a theory of innovation was not a contradiction in terms. An innovation that can be predicted is no longer an innovation. Not surprisingly, the topics covered in the survey lectures and the comments on them were given little weight in proposals for future research. It was felt that they had already been given adequate expression.

For convenience, the topics of suggested high research priority are grouped under several headings.

Macroeconomics

As is not surprising, the dilemmas of unemployment and inflation received the most discussion. The chief emphasis was on providing a foundation in some variant of microeconomic theory for understanding macroeconomic phenomena. It may fairly be said that, among those at the conference, there was very little defence of those rational expectations theories that assume that all markets clear at all times.

One macroeconomic topic suggested was in the class of grand questions otherwise neglected: why are unemployment and excess capacity characteristics of capitalist economies? Equilibrium theory implies equality of supply and demand on all markets, including those for labor and capital goods. Even if the economy departs from equilibrium from time to time, standard theory has no reason why the deviation should be more often in one direction rather than another. Yet it appears to be obvious that periods of excess demand are rare indeed (except perhaps in wartime conditions) compared with periods of underutilization. Thus, as noted earlier in Taylor's sticky price models, the supply is always adequate to meet demand. Only one hypothesis to explain the systematic preference for unemployment was offered: employers keep wages above the market-clearing level so that dismissing an employee is an effective sanction against shirking.

The phenomenon of wage and price stickiness was discussed from several viewpoints. One stressed that some prices, particularly wages, were revised only periodically; this could explain failure to clear markets. One question was to explain the length of the revision period, to make it endogenous to the system. A possible explanatory variable is the cost of changing prices. A price will change only when

the gain to the controlling agent exceeds the cost of the change. This model is parallel to inventory models and leads to the conclusion that the period from one change to another is not constant but depends on the shifts in input prices and shifts in the production function, which determine the relation between price and profit. Analysis so far has been carried out only for single markets.

A somewhat different explanation for wage stickiness is the concept of implicit contracts; risk-averse workers are willing to accept some probability of unemployment in exchange for wage stability. This model explains stickiness in real wages, whereas, it was felt, the phenomenon of stickiness of wages in nominal terms also needs explanation.

Another question raised for research was the cause and effect of occasional collapses of market institutions, such as bank failures or breakdowns of securities and commodity markets. Older literature spoke often of commercial and financial 'crises.' There was no agreement as to the empirical significance or frequency of such collapses.

General equilibrium updated

It was fully agreed that standard general equilibrium theory needed to be extended to cover more adequately incomplete information on the part of individual agents and incomplete markets. Of course, there is already considerable literature in these fields, but it has not yet received a consistent overall formulation comparable in generality to standard general equilibrium theory as set forth, for example, in Gerard Debreu's (1959) *Theory of Value*.

A problem that has proved difficult is to derive rational expectations by optimal learning from the market. If individual agents do not know the probability distributions of parameters observed by others, it is conceivable that they may acquire this knowledge by Bayesian updating through observing what they can of the market outcomes in successive realizations. However, the behavior observed is itself influenced by the fact that others are learning at the same time. It is possible that this process does not converge even under strong assumptions, for example that everyone's prior is the same.

Finally, it was urged that integration of capital asset pricing models into general equilibrium theory was a step that was both useful and likely not to be too difficult. The point is that the proba-

bility distribution of asset returns, which is taken as given in the capital asset pricing model, is endogenous to the general equilibrium under uncertainty, and is itself undoubtedly affected by the prices of assets and the distribution of their ownership.

Efficiency and transaction costs

The topics under this heading aroused a good deal of attention at the conference.

One starting point was the emphasis on adaptation to change as a major source of transaction costs. Suppose the world were actually stationary: the Coase theorem suggests that a fully efficient allocation of resources would be attained. Even though there might be costs of acquiring information and other kinds of transaction costs, they would need to be incurred only once, while the benefits would accrue for ever. Hence, it would always pay to incur the costs. (In this extreme form, it is implicitly assumed that the rate of interest in a stationary world is zero. However, even with discounting it would follow that stationary optimal resource allocations would be much cheaper to arrive at than non-stationary allocations, which have to be renegotiated from time to time or even continuously.) If the world is in fact non-stationary, economic institutions will evolve to minimize the costs of transactions. Therefore, understanding change and its consequences is basic to achieving efficiency and to understanding the particular economic institutions we have.

Hart, in his survey, assumes throughout the law of one price; he does not discuss the case of price discrimination. Hence, at least in the models of imperfect competition that he discusses, price is greater than marginal cost, and there is an inefficient allocation of resources. If it is true that stationary economic systems are efficient, as just argued, then it follows that the inefficiency of imperfect competition must be attributed to the incomplete information associated with economic change.

Fixed and sticky prices typically imply an excess of price over marginal cost; the firm would like to sell more at the going price but faces a sales constraint. Again, there is inefficiency. These remarks suggest that price stickiness may actually be the result of economic change!

Costly search and the achievement of search equilibria provide a basis for analyzing transactions costs. In these models, the expected cost of achieving a sale, for example, depends on the number of buyers who are searching, and this in turn depends on the probability of finding a seller. Hence, transaction costs become endogenous to the model.

If transaction costs are in major part the costs of acquiring information, then it would follow that a sharp reduction in these costs would improve the allocation of resources. Thus, another research topic is the effects of the current information revolution on the general efficiency of the economic system.

At a more technical level, the costs of transactions can be related to communications games, games in which one individual sends messages to another who uses them. The first individual incurs costs in making the information more accurate. The problem is to design a reward system to achieve as efficient an allocation as possible given the informational inequality between the parties. The results suggest implications for the existence and structure of hierarchical economic and other organizations. Typically, they have many equilibria.

Political economy

A more extended theory would have to include the workings of the political system. One approach is to assume that the agents are the same in the political and economic systems and that they are rational and express the same preferences in both. This general remark has of course been the basis of a large body of research over the last 25 years. The importance of this work was stressed at the conference, but only a few specific suggestions emerged.

It was urged that the economic and political systems could both be regarded as games but as operating on very different time scales. The economic game could be regarded as nested into the political; that is, at any moment, the political rules are taken as given, and the economic game is played out under those rules. But over a longer period the political rules themselves are subject to choice as the result of game-playing.

It was also observed, as it had been in Aumann's paper, that the core is typically empty for political games. This suggests that different solution concepts may be appropriate for such games, i.e. those in

which a majority (ordinary or extraordinary) can allocate all resources. On the other hand, it was noted that, if the rules of the game required some protection for minority interests, the core need not be empty.

The modelling of political as well as economic games gives rise to a philosophical problem: in what sense can there be a meaningful welfare economics if political actions are themselves determined? The statement that economic welfare analysis implies that a state of affairs A should be preferred to state B becomes uninteresting if the playing of the political game according to the preferences of individuals will predictably determine the state of affairs. This problem is not far from the theological difficulties of reconciling free will with divine omniscience (or, in more secular form, with scientific predictability).

Alternative models of economic behavior

The economists' assumptions that individuals behave rationally has been under attack at least since the days of Thomas Carlyle. There are many specific dimensions on which criticism can be made, only some of which were raised in the discussions at this symposium.

One point raised and not generally discussed in the current literature is that individuals may have limited knowledge about themselves and about their assets. This was a specific form of a more general observation that there is a tendency in economic theory to attribute too much information to agents. This point is a serious criticism of rational expectations models.

A closely related, if not virtually identical, point is that the complexity of strategies proposed as equilibria for games is more than can be considered reasonable for an individual to understand and use. The ideas of complexity and computability that have been developed in computer science and mathematical logic may be relevant here.

A different, though possibly related, criticism of standard economic behavior assumptions is that tastes are not invariant but are altered by factors endogenous to the economic system. Tastes may alter as a result of past consumption or the consumption of others. Although some models have been suggested in this area, the theory is underdeveloped and the empirical work very limited (except for the much earlier work on relative income hypotheses of savings

behavior, advanced by Dorothy Brady and Rose Friedman (1947) and by James Duesenberry (1949)). If tastes are endogenous, then, again, the basis for welfare economic propositions is undermined.

Finally, it can also be argued that preferences extend beyond individual consumption to the consumption of others. There are non-profit institutions, aimed at the general welfare and motivated and operating without the spur of the profit motive; the Yrjö Jahnsson Foundation may be taken as an example. The law is administered and enforced, however imperfectly, in such a way that the agents concerned do not maximize immediate self-interest. We also observe giving to others, even individuals not personally known to the donor, as exemplified in charities and blood donation. A theory of behavior should also explain these phenomena, which it can be argued have implications even in the more usual fields of economic behavior.

Specific microeconomic issues

As will have been seen, the bulk of the suggestions for future research directions dealt with issues of great generality in economics. There were two questions raised with regard to financial markets specifically. The first was for an explanation of the observed volatility of the securities markets, a degree of variation in prices that seems much too great to be explained by changes in rationally held expectations. One possible line of explanation is based on incomplete rationality in revising expectations on the basis of new information, specifically an experimentally observed over-emphasis on current information as compared with past observations.

A second aspect of financial markets that has received little attention in the theoretical literature is an explanation of the volume of trade. All attention has been concentrated on price changes. In the usual models of the financial markets (intentionally simplified), all agents are assumed to be alike. Then, indeed, there will never be any trade whatever, though prices will fluctuate so as to just barely induce each individual to retain his or her holdings. Since trade does take place, a more sophisticated analysis based on heterogeneity of the securities holders is needed.

A very different point urged in the discussion was a repetition of the demand for greater use of game theory in the analysis of imper-

fect competition, raised in the discussion of Hart's survey (see p. 7 above).

Methodological suggestions

Two general suggestions about the methodology of economic theory were made. The first was that, in view of the number of cases in which theoretical results were non-existent or too difficult to find, reliance should be placed to a greater extent on numerical simulation of models for various values of the parameters. Simulation would also give a greater feel for the sensitivity of results to specific numerical assumptions. Closely related was the urging that, when theorists model a specific area, they should give some indication of the range of parameter values they would regard as basically consistent with the intended applicability of the model.

Discussion time was limited; doubtless more topics would have been raised had there been more time. The title and orientation of the symposium certainly oriented the thinking of its participants to broad and fundamental questions rather than those in more specific fields of economic analysis. We may take these suggestions as at least among the more promising possibilities for extending the frontiers of economics.

NOTES

We are grateful to the participants of the symposium for lively discussions which provided the basis for some of the remarks in this essay, though the views expressed are solely our responsibility. Juha Kähkönen and Arja Turunen deserve thanks for assistance. Mika Pantzar and Timo Rajakangas prepared the index.

- 1 It should be pointed out that this doctrine is based on fairly strong hypotheses, and modelling reproduction as maximizing fitness is valid only under these restrictions. Fitness is viewed as a short-run maximization, and its relation to long-run survival and evolution is the basic issue. There also exist evolutionary changes that have no adaptive motives.
- 2 The definitive work is, of course, the treatise by Hildenbrand (1974), which contains detailed references to the limit theorems.

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