

Studies
in Economic
Theory
25

Christian Schultz
Karl Vind
Editors

Institutions, Equilibria and Efficiency

Essays in Honor
of Birgit Grodal



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Studies in Economic Theory

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Essays in Honor
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With 21 Figures
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Birgit Grodal

Preface

This symposium is published in honor of Birgit Grodal (1943–2004). Birgit Grodal was diagnosed with cancer for the second time in the spring of 2002. Many of her friends, colleagues and former students wanted to show their support. John Roemer expressed the idea that we should have a conference in honor of her. The Institute of Economics, University of Copenhagen organized a conference, The Birgit Grodal Symposium: Topics in Mathematical Economics, in September 2002, where 50 of Birgit Grodal's friends participated. They heard co-authors of Birgit Grodal's unpublished papers present the papers, as well as an impressive list of fellow economists express their appreciation of Birgit Grodal's friendship, advise, and cooperation. The participants decided to write papers for a volume in her honor. Economic Theory agreed to publish an issue dedicated to Birgit Grodal. On Birgit Grodal's 60'th birthday June 2003 20 papers in her honor appeared as working papers from Institute of Economics. For different reasons some of the papers will be published in other journals, and a couple of papers were added later. The authors were asked to write very short papers to ET, and it was agreed that complete versions would appear in this symposium.

Birgit Grodal started as a mathematician. Werner Fenchel was her teacher. Her first publications were on atomless economies and representations of preferences. Her latest publications have mostly been jointly with Hildegard and Egbert Dierker and with Bryan Ellickson, Suzanne Scotchmer, and Bill Zame. The papers in this issue are in many different areas of economics, they are almost all directly or indirectly influenced by Birgit Grodal. This shows that Birgit Grodal's importance for economics has not been just her own publications. Her interest in economics has been very broad, and her advice to students and colleagues has had an importance also outside the areas of her own research.

VIII Preface

Birgit Grodal has been very active in other ways as well. She has been department chairman and head of the institute. She has been on the council of Econometric Society, and she has been very active in European Economic Association. She was elected President for EEA for 2005. Birgit Grodal died May 4, 2004.

Copenhagen,
April 2004 and June 2005

Christian Schultz
Karl Vind

This symposium as well as the preceding volume of ET has been edited by Karl Vind, Birgit's old advisor and life long friend. Karl was instrumental in setting up the conference in honor of Birgit and it was his idea that the contributions in honor of her should appear in this volume.

While working on the volume, Karl was diagnosed with cancer in June 2004 and died after a short period of illness July 14th 2004. It became my task to finish Karl's work with the volume.

Copenhagen,
June 2005

Christian Schultz

Karl Vind was born in 1933 and studied economics in Copenhagen from 1951. There he found an environment of economists who generally did not appreciate the use of mathematics in economics - with Professor Frederik Zeuthen as an important exception. From the very beginning of his studies Karl Vind saw the potential in using mathematical language and tools in the study of economic problems. After finishing his master degree in economics and military service he started teaching mathematics and statistics for economic students at University of Copenhagen. In 1962 he got a Rockefeller fellowship to visit University of California, Berkeley. The inspiration from Gerard Debreu became very important for the research of Karl Vind.

Karl Vind initiated his research in the beginning of the 1960's and published his first contribution to economic theory in 1964: an influential paper on the core (or the Edgeworth allocations) of atomless economies. At the age of 33 in 1966 he became a full professor of economics at the University of Copenhagen, a position he held until retirement in 2003. He continued as an active researcher even after retirement. The editorship of this volume witnesses to this fact.

During his carrier he has made profound contributions to many parts of mathematical economics including among others core theory, general equilibrium under different institutional structures, representation of preferences under risk and uncertainty as well as of time preferences. His results have been widely published, and in 2003 Springer Verlag published his monograph *Independence, Additivity, Uncertainty*, which summarizes and develops his research on preference representations - and contains contributions by Birgit Grodal.

At the Institute of Economics, University of Copenhagen, he created a strong research group within the field of mathematical economics, attracting and inspiring talented students and researchers from economics and mathematics. They founded the international reputation of the Institute, and kept a strong international network. Karl Vind had close and long lasting collaborations with many scholars and he repeatedly returned to Berkeley at sabbaticals.

The group also had a large influence on the development of the economics programme at the University of Copenhagen in turning it into a modern programme taking the students to the research frontier. Karl Vind pushed for many years for a joint programme in mathematics and economics, and in 1986 these efforts were rewarded with the introduction of the math-econ programme.

Karl Vind was an inspiring teacher, a good friend, an excellent scholar, and a wonderful storyteller. The Institute of Economics and his colleagues and friends world wide will miss him.

Copenhagen,
June 2005

Jørgen Birk Mortensen, Christian Schultz, and Birgitte Sloth

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Birgit Grodal: A Friend to Her Friends*†

Andreu Mas-Colell

Universitat Pompeu Fabra

It was much too soon. We knew it could happen. She participated in the proceedings of the conference in her honor held in Copenhagen in September 2002 with a display of her usual acumen and vigor, but we left worried. I do not know if the time ever comes for anyone, but it had not come for her. It is hard to accept. With the passing of Birgit Grodal the European Economic Association loses its 2005 president, the community of European economists one of its shapers and leading figures, the worldwide community of economic theorists and mathematical economists an outstanding general equilibrium theorist, and her many friends, a friend.

Birgit started her career as a mathematician. She did her Ph.D. under the great Danish convexity specialist William Fenchel. For a whole generation of economists the legendary Fenchel notes on convexity were a source of knowledge and of inspiration. It was most natural to move from Fenchel and convexity analysis to mathematical economics and economic theory, especially under the gentle push of economic and social concerns. This was the road that Grodal took.

On it she got connected early to the two cauldrons of mathematical economics research of the late 1960s and early 1970s: Berkeley, where Gerard Debreu, Dan McFadden, Roy Radner, David Gale, Steve Smale, John Harsanyi, William Shephard, were mentoring; and CORE, with Jacques Drèze, Jean François Mertens, Jean Gabszewicz, Werner Hildenbrand, and many others. Both institutions teemed with visitors, including many Americans at CORE and many Europeans at Berkeley. Birgit Grodal became a thriving member of this network, and from these origins a successful research career was launched.

* Acknowledgment: I want to acknowledge the help of Karl Vind in the preparation of this text. Note added in proofs: it is with much regret that I learned at the beginning of last July of the passing of Karl Vind, eminent economist, lifelong friend and dear colleague of Birgit Grodal.

† This obituary is reprinted with the kind permission of the Journal of European Economic Association

I will attempt to describe and summarize Grodal's contributions to economic theory, all of them falling into the realm of general equilibrium theory broadly understood, under six general headings.

1.1 Preference and Demand Theory

Her background in convexity theory and the intellectual environment of the late 1960s made preference and demand theory, on the one hand, and the theory of the core on the other, the points of entry of Grodal into general equilibrium analysis.

In preference and demand theory she carried out a very useful task early on, and she did it at the moment that it was needed. The measure theoretic approach to atomless economies, viewed as a model of perfect competition, which was initiated by Robert Aumann, Karl Vind, and, emphasizing a distributional approach, by Werner Hildenbrand, rested, technically speaking, on the possibility to define topological and metric structures on spaces of agent's characteristics—in particular, on spaces of preferences. In one of her first published papers (modestly called "A Note on . . .", see Grodal 1974) she carried out the most thorough and general analysis of this matter. Without doubt, it constitutes the definitive contribution.

Samuelson once said that preference and demand theory is for many economists a partial but lifelong devotion. Grodal did not fail to go back to these theories on a number of occasions. For a particularly nice instance we refer to the paper she wrote with Hildenbrand (Grodal and Hildenbrand 1989), where a most simple example of an aggregate excess demand function not satisfying the weak axiom of revealed preference is offered: a type of result with significant implications for the uniqueness and the stability analysis of equilibrium. In the example there are four commodities: two factors of production that do not enter into the utility functions and are initially owned by consumers, and two consumption goods. Suppose that there are at least two consumers that are different (in a precise and natural sense). Then the aggregate excess demand will not satisfy the weak axiom!

1.2 Core Theory

As a tool for the analysis of equilibria, the core is present in Grodal's research throughout her career. But, more specifically, in her first period Grodal made two important contributions to the then emerging core equivalence theorem. In Grodal (1972) she inaugurated, with two companion papers (by David Schmeidler and Karl Vind), an important theme in core analysis. Namely, the idea that if an allocation can be improved upon (that is, it is not in the core), then there are many improving coalitions; and, in fact, improving allocations can be subjected to a number of additional restrictions without losing the validity of the core equivalence theorem. In the quoted contribution Grodal showed that the Theorem would still obtain if the improving coalitions were required to be formed as the union of at most L small clusters of almost identical consumers (here L is the number of commodities).

In the second contribution (Grodal 1975), she extended, in a far-reaching way, a theorem of Debreu on the rate of convergence of the core to the set of Walrasian equilibria. The result of Debreu was for a type economy (that is, the number of consumers tends to infinity, but their characteristics—preferences and endowments—belong to an a priori given finite set). In contrast, Grodal's result was completely general. I cannot resist recording the key, and beautiful, mathematical result that she established in order to unlock the door to a generalization. (Maybe I am not seeing this in an entirely objective way. At the time we shared an office at Berkeley and I was witness to the weeks of impasse and to the feeling of exhilaration when at last the nut was cracked). It goes as follows: Suppose that for every N you have a set of $2N$ vectors $z_i(N)$ in \mathbf{R}^L . These vectors add up to zero and, independently of N , they are all norm-bounded by a constant K . Then for every N you can select a group of N vectors from the collection corresponding to N such that their sum adds up to a vector norm-bounded by K (hence the average individual adjustment to make it zero in the aggregate is of order K/N).

1.3 Integral Representations

There was an intensely mathematical but economically grounded and difficult topic on which Birgit worked, on and off, all her professional life, namely integral representations as order-homomorphisms on totally preordered function spaces. The economic motivation of this work comes from the need to determine conditions allowing the representation of suitably defined separable preferences by means of additive utility functions. The challenge that Grodal tackled was the extension of the theory, confined until then to a finite number of components, to an infinite number of components. She had to face, therefore, the need to seek the representation not simply as a sum of component utilities but as an integral of such. Her interest on this topic was aroused at CORE, and, in fact, there is a 1968 CORE working paper with Jean-François Mertens on this matter. Much later the research was gathered into two working papers of the Institute of Economics of the University of Copenhagen that appeared in 1990. It is to be desired that they do not remain unpublished. It is conceivable that with her usual very high self-imposed standards she had ideally planned to elaborate more and to polish further the working papers. Unfortunately, she will not be able to do so, but, in truth, it is not clear that the work needs it. Publication would seem fitting.

1.4 Equilibrium with Coordination

In her mature stage, the heart of the contributions of Grodal were to equilibrium theory, competitive and noncompetitive. For competitive theory we have—beyond the work on the core—the research on clubs and markets that will be reviewed shortly, and two papers that she wrote with Karl Vind on coordinated equilibrium (see Grodal and Vind 2001). We could qualify the latter concept as a Danish School item