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Convergence of Bayesian learning to general equilibrium in mis-specified models

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Abstract

A central unanswered question in economic theory is that of price formation in disequilibrium. This paper lays the groundwork for a model that has been suggested as an answer to this question in, particularly, Arrow [Toward a theory of price adjustment, in: M. Abramovitz, et al. (Ed.), The Allocation of Economic Resources, Stanford University Press, Stanford, 1959], Fisher [Disequilibrium Foundations of Equilibrium Economics, Cambridge University Press, Cambridge, 1983] and Hahn [Information dynamics and equilibrium, in: F. Hahn (Ed.), The Economics of Missing Markets, Information, and Games, Clarendon Press, Oxford, 1989]. We consider sellers that monopolistically compete in prices but have incomplete information about the structure of the market they face. They each entertain a simple demand conjecture in which sales are perceived to depend on the own price only, and set prices to maximize expected profits. Prior beliefs on the parameters of conjectured demand are updated into posterior beliefs upon each observation of sales at proposed prices, using Bayes' rule. The rational learning process, thus, constructed drives the price dynamics of the model. Its properties are analysed. Moreover, a sufficient condition is provided, relating objectively possible events and subjective beliefs, under which the price process is globally stable on a conjectural equilibrium for almost all objectively possible developments of history.

JEL classification: C11; C51; C62; D21; D43; D83

Keywords: Disequilibrium theory; Oligopolistic price setting; Bayesian learning; Conjectural equilibrium; Global stability

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1. Introduction

In economic theory, a key role in the coordination of behavior is played by prices. As a consequence, the so-called price mechanism is much debated, and the need for it operating freely often stressed. Yet, there are many open research questions on the matter of prices, especially on how they come to take on equilibrium values. For one thing, it is generally left unexplained whose business it actually is to call and change prices. Particularly in models in which price-taking behavior is assumed, this is a pressing question. Reliance on a unique price vector indicates it is left to a single person or institution, and a number of models has been presented in which the central person is in fact an altruistic auctioneer, e.g. in the tâtonnement process, the Edgeworth process, and the Hahn process.[1]

Apart from the fact that it seems odd, if not plainly inconsistent, to model all behavior but that of the auctioneer as resulting from constrained rational choice, at least two things meet the eye in these explanations. First, these processes need an exogenous central coordinator to explain the rise of equilibria that are meant to be the outcome of decentralized competitive economies. Second, the conditions these processes need for convergence on equilibrium price values for arbitrary initial prices, i.e. for global stability of the disequilibrium process—have been found to be pretty strong.

A number of suggestions has been made to study the disequilibrium behavior of prices more seriously. An early one is in Arrow (1959), in which Arrow proposed to make price a choice variable of individual firms, that consequently need to come equipped with some local monopoly power, at least as a disequilibrium phenomenon. To Arrow, the construct of perfect competition did not allow for an explanation of price behavior. More recently, Fisher (1983) develops an elaborate model of disequilibrium behavior in which there is clarity on who is setting prices. It is done by dealers, who specialize in differentiated goods, which gives them the local monopoly power to act as a coordinator and set prices. How prices are adjusted with changes in perceptions, however, is not discussed in depth in the monograph, yet indicated as an area of promising further research. Finally, in Hahn (1989) several partial examples are given of perception changes and associated behavior that may indeed be plausible for monopolistically competing price-setters to develop—including a rudimentary version of the behavior we study in this paper. Yet, the consequences of such behavior, particularly when performed in general equilibrium settings, are only hinted upon.

When prices are choice variables of firms, the way firms perceive their market position, and especially changes in these perceptions, can account for the dynamics of prices. This idea is used in the present paper to construct a model of individually rational price adjustment and study its limit behavior, particularly its stability properties. In the present model, each of a number of firms is in monopolistic price competition, but does not have perfect information on the market demand it faces. At each moment in time, based on its information to date on past prices and sales, each firm entertains a demand conjecture instead. Naturally, this conjecture has a structural form different from that of objective demand. Particularly, we consider the most extreme case where firms only consider their own price as an explanatory variable, and do not consider the price effects of competing products.

[1] For an extensive survey of the disequilibrium literature and its problems, as well as pointers to an alternative modeling route on which the present model takes a small step (see Schinkel, 2001).