why intermediaries act as dealers in some markets while acting as brokers in some other markets. Finally, there are potential inefficiencies in the matching stage; the profit maximizing matching of buyers and sellers by an intermediary may not be the same as the welfare-maximizing matching. These issues are relevant for policy makers as well.

Theory of the firm is essential to the study of economics, and this book makes an essential contribution to our understanding of the formation and market-making activities of firms. Intermediaries play critical roles in almost every market and, as the author states, intermediation has not received the attention that it deserves. This book makes an excellent attempt at filling this gap in the literature. It will be a valuable source for students and researchers on the theory of the firm.

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E   Macroeconomics and Monetary Economics

Learning and Expectations in Macroeconomics. By George W. Evans and Seppo Honkapohja. Princeton: Princeton University Press, 2001. Pp. xviii, 421. $49.50. ISBN 0–691–04921–1.

For most macroeconomists, the rational expectations "revolution" laid to rest the vexing but critical question of how to model agents' expectations. However, for a small group of researchers the revolution has led only to further, deeper questions such as how agents might ever learn to form rational expectations and whether the stability of such learning processes might be useful as a selection criterion in environments with multiple rational expectations equilibria. Two decades of research into these and related questions have been expertly summarized by George Evans and Seppo Honkapohja in this important new book.

Evans and Honkapohja follow Sargent (1993, *Bounded Rationality in Macroeconomics*, Oxford: Oxford University Press) in arguing that the rational expectations assumption endows agents with more knowledge than is possessed by research economists. Rational expectations agents know the exact reduced form specifications of the model environment including the correct parameterizations of these equations. By contrast, econometricians must estimate these parameter values and face uncertainty about their model specifications. Both Sargent, and Evans and Honkapohja, advocate recasting economic agents closer to our own image, as econometricians seeking to form accurate forecasts using initially misspecified models of how the variables of the environment evolve over time. Whereas Sargent provided a broad survey of various approaches to modeling these boundedly rational agents, Evans and Honkapohja propose a unified modeling framework centered around a stability condition known as "expectational stability" (E-stability). Evans and Honkapohja show us how to apply this E-stability condition in every variety of macroeconomic model in use today. In this sense, their book takes us a step further beyond Sargent's introduction to the topic.

Evans and Honkapohja's approach begins by relaxing the assumption that agents have rational expectations. Instead, agents have a "perceived law of motion," represented by its parameter vector θ. This perceived law of motion usually (though not necessarily) nests the rational expectations equilibrium (REE) solution $\bar{\theta}$, so the departure from rational expectations modeling is not as great as one might imagine. Agents are boundedly rational because they do not initially know $\bar{\theta}$ and they attempt to learn this REE solution over time using an adaptive inference process, typically least squares regression. Using their perceived law of motion, agents form expectations which enter into the model's reduced form equations in lieu of rational expectations. The result is an "actual law of motion" consisting of a map, $T(\theta)$, from the perceived law of motion to the actual realizations of the variables agents are attempting to forecast. The candidate REE is said to be learnable or *E-stable* if the differential equation

$$\frac{d\theta}{d\tau} = T(\theta) - \theta,$$

evaluated at $\bar{\theta}$ is locally asymptotically stable. This differential equation arises from application of

stochastic approximation techniques to the adaptive learning algorithms that characterize the agents' parameter updating process. While it is sometimes possible to directly analyze or simulate these adaptive learning processes, it often turns out to be simpler to check the stability of the associated ordinary differential equation. Evans and Honkapohja provide conditions under which stability of this differential equation implies that the adaptive learning process converges on the candidate REE with probability 1. The authors argue that this stability condition, when satisfied, provides a justification for the use of the rational expectations assumption. Furthermore, in environments with multiple REE, researchers could reasonably eliminate from consideration those REE that are not found to be E-stable.

I think this motivation for and use of the E-stability condition are right on the mark. While E-stability analysis is almost always local rather than global and the critical question of how agents come to coordinate on a perceived law of motion is not addressed, a satisfactory resolution to these issues may be some time in coming. The E-stability condition provides us with a previously missing microfoundation for equilibrium selection that can be applied right now, and this book shows us how to do it.

The book is organized into five parts consisting of two to five chapters each, and includes a substantial amount of previously unpublished material. Part 1 discusses the rationale for studying learning and provides a gentle introduction to the E-stability concept in a number of standard macroeconomic models. Chapter 2 in this part would be a good addition to the reading list of a first year graduate macroeconomics course. Part 2 provides the mathematical background and stochastic approximation theory necessary to understand adaptive learning systems and the E-stability condition. In part 3, the authors use linear models to generalize the E-stability concept to cases where agents have heterogeneous perceived laws of motion or use models that are overparameterized relative to the REE solution as well as to REE solutions that are explosive or involve sunspot variables. Part 4 shows how to apply the E-stability concept to nonlinear models. Finally, in part 5, the authors discuss alternative approaches as well as recent extensions of the E-stability condition to cases where agents' models are underparameterized relative to the REE or where agents take account of the possible misspecification of their models; the latter case can result in the interesting phenomenon of persistent learning dynamics.

In short, Evans and Honkapohja have done an excellent job motivating, applying and generalizing the E-stability condition. Due in large part to their efforts, the theory of the local stability of REE under adaptive learning is, in their own words, "essentially complete" (p. 386). This assessment raises the question of what further theoretical progress might be made by careful study of this book. The answer, I think, is a clearer sense of how to model economic agents as we really are: boundedly rational but econometrically sophisticated adaptive learners.

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National Accounting and Capital. By John M. Hartwick. Cheltenham, U.K. and Northampton, MA: Elgar; distributed by American International Distribution Corporation, 2000. Pp. xv, 214. $90.00. ISBN 1–84064–206–8.

National income accounting is recognized as one of the most important policy-making tools, providing information about a nation's assets and wealth, indicators of current income based on actual and imputed values, and measurement of financial and real flows in the economy. In this ten-chapter monograph, Professor Hartwick undertakes the difficult but important task of analyzing national accounting. In so doing, he expands the existing literature by addressing issues such as the incorporation of heterogeneous capital—both man-made and natural—and financial services into national accounts, the simultaneous accounting for net national product (NNP) and net national income (NNI), and welfare dimensions and the greening of national accounts.

The author begins by setting up a basic framework using a national accounting matrix (NAM) representation, which is employed throughout the monograph to simultaneously determine NNP and NNI. A simple single,