Global Asymptotics in a Dynamic Learning Model of Oligopolies

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ABSTRACT

In this paper N-firm single product oligopolies without product differentiation and bounded rational agents are considered. The demand and cost functions are linear. While cost functions are completely known by all firms, they only partially know the demand function. In particular, each firm knows the total production level when price becomes zero, but they misspecify the slope. Each firm selects a different "reference" price function and, on the basis of this function, it computes its equilibrium output and the one of the industry, as well as the corresponding believed price. This price assessment is then compared to the actual market price that the firms actually receive. On the basis of the discrepancy between these prices each firm adjusts its own price assessment, resulting in a learning process which is described by a system of nonlinear difference equations. It is shown that the system has a unique positive steady state, that corresponds to the perfect knowledge of the price function by all firms. Two particular situations are analyzed: the case of oligopoly with n-homogeneous players and a duopoly with heterogeneous players. In the case of homogeneous players starting from identical initial productions the learning process is described by a one-maildimensional difference equation that describes the behavior of a representative player. The study of the local dynamic properties of the generating map shows that there is a unique positive fixed point and according to the assumed values of the model parameters, it can lose stability through a flip bifurcation. The global dynamics of the map are also examined and conditions are derived for complex dynamics. In the case of two heterogeneous players the focus is on the role of heterogeneity. In this case the learning process is described by a map of two difference equations, which has a unique positive fixed point, that represents the true demand function. The study of local stability of the equilibrium derives the stability region in the parameters' space. The equilibrium may lose stability either via a flip or a Hopf bifurcation. Global properties of the model are studied when the learning process fails to converge to the true demand, i.e. the agents behavior is such that persistent mispecification of the demand function occurs. Changes in the values of the parameters can influence the stability region such that some bifurcation paths can have both stabilizing and destabilizing effects. In order to study the global properties of the 2-dimensional map numerical simulations are developed. They show not only the creation of chaotic attractors, but also the creation of complex basin boundaries, which are typical features of noninvertible maps.