

Original Articles

# Equilibrium stability of a nonlinear heterogeneous duopoly game with extrapolative foresight

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Received 1 November 2011; received in revised form 8 April 2012; accepted 9 April 2012

Available online 14 May 2012

## Abstract

We make a further attempt to investigate equilibrium stability of a nonlinear Cournot duopoly game with adaptive adjustment toward best reply by assuming heterogeneous firms where one firm only uses naive expectations whereas the other employs a simple forecast technology to form sophisticated expectations. More precisely, based on the knowledge of actual production of the competitor and its actual rate of change, the clever firm is able to evaluate its opponent's output in the near future by virtue of straightforward extrapolative foresight. We finally arrive at a conclusion that this seemingly rational mechanism takes a positive effect on convergence to equilibrium behavior. Inconsistent with common intuition, we demonstrate that stronger foresight ability is not always better to stabilize the equilibrium. Particularly, perfect foresight does not give rise to the best stabilizing factor.

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*Keywords:* Cournot game; Adaptive adjustment; Short-term extrapolative foresight; Equilibrium stability; Local bifurcations

## 1. Introduction

Complex dynamic behavior involving chaos is typically undesirable in traditional economic systems where stationary states are mainly focused on [8]. Many economically plausible mechanisms are introduced in order to improve the stability of economic dynamics. For example, Shamma and Arslan [10] propose such a learning mechanism that each player adjusts its belief by considering the opponent's strategic setting in the near future under two famous classes of evolutionary game dynamics, the fictitious dynamic as well as the gradient dynamic. They demonstrate that convergence to Nash equilibria can always be achieved in an ideal case of exact derivative measurements. Quandt [9] adopts a short-term forecast method to enhance the stability of a continuous adaptive adjustment dynamic in a Bertrand game. Kamalinejad et al. [7] show in Cournot competition the stability of a discrete adjustment dynamic can be always guaranteed by taking into account linear regression and recursive weighted least-squares expectations. Besides, Huck et al. [6] reconsider the best reply dynamic by incorporating inertia to virtually slow the adjustment process and to ultimately ensure the stability of Cournot equilibrium.

In this paper, we investigate equilibrium stability of a nonlinear Cournot duopoly game with heterogeneous firms, who update their outputs adaptively toward best reply [1,2,5]. In particular, we assume one firm is endowed with naive expectations so that it believes the rival's output to be invariable. The other firm, on the other hand, is assumed

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