Crop Rotation and Complex Dynamics in Interacting Cobweb Markets

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In this paper we extend a recently proposed nonlinear cobweb framework that couples markets by modeling the producers' market entry decision conditional on historical profit differentials. It differs from other models by not directly introducing nonlinear phase lines neither from the demand nor from the supply side. Starting from the special case of producers permanently splitting evenly across markets (classical model), endogenous interactions are introduced by allowing producers to tune their respective supply and to switch markets (myopic crop rotation). The resulting supply-sided model is a four-dimensional system of difference equations. It generates complex dynamics that possibly contribute to the profound price fluctuations prevalent in agricultural markets. Our study differs from existing ones in that it considers adaptive expectation formation as well as different shades of production costs and risk attitudes of producers. Phase space representations, orbit structures, and bifurcation diagrams are used to assess the stabilization effects of modifications. Overall, we find that enriching the model with more sophisticated structures narrows the range of generated complex dynamics. Introducing some inertia through adaptive expectations raises long-term profits and exerts some stabilization by reducing the generation of higher order cycles in prices. Bifurcation analysis reveals a similar effect of high fixed costs differentials for the interacting markets. We confirm that for sufficiently small risk aversion, the steady state of the dynamic system loses its stability via a Flip bifurcation, while a Neimark-Sacker bifurcation scenario prevails for a high level of risk aversion. Finally, we propose some testable implications based on longitudinal characteristics of regional agricultural markets.




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