

Using nonlinearity in understanding market forces: Researchers clarify factors affecting competitive advantage

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There are certain markets within the U.S. and global economies in which two major corporations dominate. For example, Coca-Cola Co. and PepsiCo Inc. are the two major firms that compete with each other in the soft drink market. These situations are called duopolies and they create an interesting set of dynamics within the market.

Understanding the many forces that affect product placement, price and competition in the local and global marketplace is a significant challenge. A team of Italian researchers have tackled the subject using a multidisciplinary approach that combines [dynamical systems theory](#) with economic findings to provide new economic insights that can be applied in real market conditions in this week's *Chaos*.

In a duopoly, like Pepsi vs. Coca-Cola, the products are characterized by a certain level of product differentiation as perceived by consumers, and firms can use this to set the price of their goods. However, the company's owners do not necessarily make decisions about the price of their products. In these firms, rather the decisions can be made by managers whose compensation is based on the difference between the profits of his firm and that of his rival company. Given limited information, each firm may choose the price of goods and services based on some behavioral rules. Consequently, using a nonlinear model takes into account the behavior of the duopoly over time revealing several interesting phenomena, such as fluctuations in prices, multiple possible

outcomes, and even the possibility that competing firms may coordinate themselves in the long term.

"While in the last few decades a great deal of attention has been paid to the study and development of nonlinear duopoly models following quantity-setting behaviours (i.e. firms choose the quantity to be produced and sell in the market), scarce attention has been given to the analysis of duopolies where firms choose the price of their products," said Luca Gori, an economist at the University of Genoa and co-author on the paper. Interest has increased in this new research agenda concerning managerial firms and the present study combines both these aspects in a unique framework.

The research team, which also included researchers from the University of Pisa and the University of Macerata, both in Italy, used an interdisciplinary approach combining dynamical system theory with economic findings. The results of the analysis and experiments were then interpreted in light of the economic system under scrutiny, since the final aim of the work is to provide economic insights and policy suggestions that can be applied in actual markets. Due to the nonlinearity and the analytical complexity of the model, some results were obtained by through numerical simulations. Researchers used the software MatLab to perform the experiments. Multiple iterations using several different initial conditions resulted in interesting pictures that show the complexity of the studied model, and provided new insights into the duopoly.

"One important result of our work was the realization that the more managers' attitudes (the degree of cooperation or competition of the managers) differ between them and/or the more products are perceived as complements or substitutes, the more likely there are fluctuations in prices," Gori explained, "This result shows, at least in the case of homogeneous products, one should expect a more regular behavior of

the economy."

These results have possible policy applications in product differentiation. In actual markets, the extent of product differentiation depends on advertising investments, which in turn directly affect how consumers perceive the degree of substitutability or complementarity of products. These measures have significant long term implications for managers who are rewarded according to relative profit contracts.

The study's insights can help companies strengthen their competitive position and can impact advertising and marketing decisions that ultimately drive sales and profits.

More information: "Multistability and complex basins in a nonlinear duopoly with price competition and relative profit delegation," Luciano Fanti, Luca Gori, Cristiana Mammana and Elisabetta Michetti, *Chaos*, September 20, 2016. [DOI: 10.1063/1.4962296](https://doi.org/10.1063/1.4962296)

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