Collusive behavior in soft-drink market econometric analysis

Brief Summary

This paper proposes a methodology to study a firm’s strategic behavior by combining game theoretic concepts and recent economic developments. It analyses various forms of collusive behavior of firms on two strategic variables-price and advertising- in a differentiated market dominated by a duopoly. The econometric methodology adopted is fully structural. The methodology involves specification of demand and cost functions and hypotheses about the strategic interactions among players. The parameters of the demand functions and the cost functions are estimated under different strategic hypotheses.

Prior work have modeled strategic interactions (output and pricing decisions) in a non-cooperative static method using static conjectural variation models. However, recent developments in game theoretic work as well as experimental evidence have shown evidence of cooperation among players in repeated game contexts even under the assumption on non-cooperative behavior. Such kind of cooperation is referred to as tacit collusion. Given the complexity of empirical study of collusive behavior, the authors deal with the black box of strategic dynamic interactions by selecting a sufficiently rich range of formulations expressing various degrees of collusion. With two observable instruments of competition-price and advertising, the authors offer various simple formulations of collusive behavior and select among them. The merits of each formulation is based on the range of possible levels of collusion.

Since the econometric models are nonnested, tests for nonnested hypotheses is performed to select the most adequate model. The models are estimated by full information maximum likelihood methods. This study also extends the traditional conjectural approach for the empirical analysis of market power. The proposed methodology is then applied to the soft drink industry which is dominated by The Coca-Cola Company and Pepsico duopoly. Three models of non-collusive behavior and three models of collusive behavior is estimated. Based on the results, the hypotheses of non-collusive behavior is rejected. The results suggest some tacit collusive behavior in advertising between the Coca-Cola Company and Pepsico for period covered by the sample data. However, collusion on prices does not seem to be well supported by the data.

The methodology allows for various switching regimes specifications because there is a potential change of behavior in the middle of the sample. The paper estimated models with two regimes- before and after 1976. Results show that Coca-Cola is a Stackelberg leader in price and advertising until 1976, and after 1976 there is collusion in advertising and prices. Results also show an increase in market power for both the firms after 1976 based on the Lerner indices calculations.

Key Strengths

Simplifies demand and cost specifications by imposing restrictions on parameters as per economic theory

On the broader level, there is a formidable task of simultaneously estimating demand and cost functions, and to determine the most adequate collusive

hypotheses. Because of this enormous demand on data, there is a need for simple specifications that limit the number of estimated parameters with the risk of having results that can be strongly affected by the implied misspecifications. So a simple demand specification is chosen for analytical and empirical tractability. This is done by imposing restrictions on parameters based on economic theory.

So based on economic theory, constraints are imposed on the parameters signs. The given demand specification implies diminishing returns in advertising and also allows for a wide range of cross-advertising effects. The effect of advertising has also been restricted only for the given quarter. This restricted form of advertising effects decreases the complexity of the reduced form. Constraints are also imposed on the parameters of cost functions based on economic theory. A choice of constant marginal cost is made for analytical and empirical tractability.

Takes into account model misspecification with respect to statistical inference

Model misspecification can happen when the models are simplified as in this case and when the models are not correctly specified. So the models that are statistically dominated by another competing model are misspecified. However, statistical inference can be made on the parameters of these models provided White robust t statistics are used.

Adopts full information maximum likelihood method for getting reliable estimates

Limited or full information estimation by 2SLS and 3SLS methods have certain drawbacks. One such drawback is that it does not provide estimates of some structural parameters such as the collusion parameter and the coefficients in the cost functions. Another drawback is that they produce unreliable estimates. Also, the standard Wald statistics cannot be used directly because each set of nonlinear restrictions appear in the explicit or parametric form. Instead one must use the generalized Wald statistics that requires a nonlinear minimization for each set of restrictions. The last drawback is that selection among the models can only be done indirectly through these generalized Wald tests. This may lead to undesired outcomes. To avoid the above mentioned issues, the authors adopt a direct method that estimates by maximum likelihood (ML) each model with its defining set of nonlinear constraints. This method produces in most cases very reliable estimates.

Computes multiple elasticity measures to get a better grasp of the magnitude of parameter estimates

The authors are able to calculate own price, cross-price and income elasticities for each demand equation. They also calculate the own and cross-advertising elasticities. The cross advertising elasticity has been further decomposed into predatory advertising elasticity and global advertising elasticity based on the concepts of predatory and spillover effects introduced by Roberts and Samuelson (1988). Predatory advertising elasticity gives the rate of change of the market share of firm j caused by a 1% increase in the advertising of firm i. Global advertising elasticity gives the rate of change of the total market demand caused by a 1 % increase in the

advertising of firm i. The spillover effect of advertising corresponds to a distribution of the change in total demand due to the advertising of firm i in proportion to the share of firm j. This can be defined from the decomposition of cross advertising elasticity.

The model allows for various switching regimes specifications

The price of Coca-Cola showed an unusual increase in fall 1976 and was immediately followed by a sharp fall. This period corresponds to the mid-1970s sugar crisis. So on the basis of this observation the authors have extended their work by formulating and estimating models with two regimes- before and after 1976. The two regime models are estimated using a switching dummy variable which has the role of imposing the proper set of nonlinear constraints on the general linear model within each period. The results indicate that Coca-Cola is a Stackelberg leader in price and advertising until 1976, and that collusion in advertising and competition in price takes place after 1976.

Extends the conjectural variation approach and compares it with the collusive models used

The authors extend the traditional conjectural variation approach to the case of differentiated products with two control variables- price and advertising. When contrasting this approach to theirs, the authors find evidence that their collusive models cannot be viewed as special cases of conjectural approach. The conjectural model and any of the collusive models used in the paper are nonnested. Particularly, the conjectural model imposes a different

set of restriction on the parameters of the general linear model in comparison to the restrictions imposed by collusive models.