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УДК 659.113

***MUSHKINA I.B.*, *MELNIKOV O.S.*,** Ph.D. in Economics

ESTIMATING EFFICIENCY OF ADVERTISING IN A DIFFERENTIATED PRODUCTS INDUSTRY

Increased competition between producers in Ukraine has led many firms to increase their advertising efforts. According to the data of State Statistics Committee of Ukraine, total advertising expenditures in Ukraine in year 2007 amounted to 3 billion 893,8 million hryvnas [1]. However, how to measure the economic effect of advertising precisely remains unclear. Hence, a model for quantifying the impact of advertising on profits, outputs, and prices would be of considerable theoretical and practical interest.

The role of advertising in the competition between firms has always been a matter of scientific interest. Economists have developed quantitative models to study the impact of advertising. Stigler (1961), Grossman and Shapiro (1984) examine models with informative advertising messages [2]. Nelson (1974), Schmalensee (1977), analyze models where firms use signaling advertising [3], etc.

We investigate the impact of advertising in a oligopolistic competition within the multinomial logit framework, pioneered by McFadden (1973) [4]. There exist N firms, each controlling a single product. Products, indexed by $j = 1, ..., N$ are differentiated by consumers' perception of its quality ¢_j, which can be affected by advertising. Consumers also differ by their preferences for product's design, color, brand name, etc. (stochastic component of the utility function). More precisely, consumer's utility from choosing a product j is given by this utility function:

$$U_j = \text{¢}_j + \text{£}_j, \qquad (1)$$

where £_j is a stochastic component of consumer's utility, described by extreme value distribution with a cdf:

$$F(x) = e^{-e^{-x}} \quad . \qquad (2)$$

$¢_j$ in (1) represents a mean utility level from buying a product j:

$$¢_j = \mathbf{x}_j^T \quad - \sim p_j + ¥ A_j \cdot , \qquad (3)$$

where $\mathbf{x}_j^T = (x_{j1}, ..., x_{jm})$ is a vector of product's characteristics.

It is well-known [5] that market shares in the above setting are given by:

$$s_j = \frac{e^{¢_j}}{1 + \sum_{k=1}^{n} e^{¢_k}} \quad . \qquad (4)$$

Assuming constant marginal costs, the profit maximization problem for firm j is given by:

$$®_j = (p_j - c_j) S_j - A_j \xrightarrow[A_j, p_j]{} \max \quad , \qquad (5)$$

where c_j is a marginal cost of production for j-th firm.

The first-order conditions for (5) are:

$$\frac{d®_j}{dp_j} = S_j - \sim (p_j - c_j) \left[S_j (1 - S_j) \right] \quad ; \qquad (6)$$

$$\frac{d®_j}{dA_j} = ¥ (p_j - c_j) \left[S_j (1 - S_j) \right] - 1 \quad . \qquad (7)$$

Jointly (6)-(7) define a system of $2n$ non-linear equations in $2n$ unknowns. Solving this system yields a Cournot-Nash equilibrium in price levels and advertising expenditures. Let (A_j^*, p_j^*) be equilibrium advertising intensities and price levels. We can than measure quantitatively the impact of advertising as :

$$L_j(A_j) = ®_j(A_j, \mathbf{A}_{-j}^*; \mathbf{p}^*) - ®_j(\mathbf{A}^*; \mathbf{p}^*) \quad . \qquad (8)$$

Obtaining a solution to above problem presents a difficult problem, however, as (6)-(7) is a system of non-linear equations of a high dimension. Thus, numerical methods must be employed instead of analytical ones. We developed an efficient fixed point numerical procedure for solving (6)-(7) by exploiting certain features of demand functions (4). The numerical procedure is implemented as a package in Matlab. Using this package allows to change environment variables, such as firm's costs, product characteristics, industry structure etc. to obtain a numerical impact of changing own firm's strategic variables. Such simulations can be valuable to all firms engaging in promotion activities to find proper advertising expenditures and to study robustness of the solution to changes in the business environment.

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УДК 796.231.12

***НЕРУЧОК А.А.*, *БЛИЗНЕЦОВА З.А.*,** доц.

ВНЕДРЕНИЕ АВТОМАТИЗИРОВАННОЙ ИНФОРМАЦИОННОЙ СИСТЕМЫ УПРАВЛЕНИЯ УЧЕБНЫМ ПРОЦЕССОМ В РАБОТЕ СО СТУДЕНТАМИ СПЕЦИАЛЬНЫХ МЕДИЦИНСКИХ ГРУПП

Тенденция развития современного общества, его ярко выраженная информатизация обосновывают необходимость всё более широкого применения информационных технологий в сфере образования, и особенно возрастает значимость создания и использования информационных банков данных на кафедре физического воспитания. Это объясняется тем, что способы хранения и обработки информации, которые применяются в настоящее время в управлении физическим воспитанием, связаны с большими затратами времени и ручного труда и не соответствуют современным требованиям, предъявляемым к системам управления физической подготовленностью студентов.

Опыт применения автоматизированных информационных систем для управления организацией и контролем учебного процесса кафедры физического воспитания встречается достаточно редко [1,2,3].