Nash Equilibrium in a Three-stage Model of Vertical Product Differentiation

Margarita Gladkova
Graduate School of Management
St. Petersburg University
Volkhovsky Per. 3
St. Petersburg, 199004, Russia
e-mail: rita.gladkova@gmail.com

Nikolay Zenkevich
Graduate School of Management
St. Petersburg University
Volkhovsky Per. 3
St. Petersburg, 199004, Russia
e-mail: zenkevich@som.pu.ru

Abstract

We examined a three-stage game-theoretical model of symmetric duopoly and vertical product differentiation. It is assumed, that there are two firms on some industrial market which produce homogeneous product differentiated by quality. We suppose as well that quality range is defined and firms can manage it.

Thus, the talk presents the results of the research of a three-stage model of duopoly, when at the first stage companies define quality range, at the second one - quality level and at the last stage they compete in product price.

The profit function of the firm i which produces the product of quality s_i , where $s_i \in [\underline{s}, \bar{s}_i]$ and $\bar{s}_i \in [\bar{s}_0, \bar{s}_0 + \Delta\bar{s}]$, is the following:

$$\Pi_i(p, s, \bar{s}) = p_i(s)D_i(p, s) - c(s_i) - F(\bar{s}_i), i = 1, 2, \qquad (1)$$

where p_i - product price of the firm i, $p = (p_1, p_2)$ - a vector of product prices of the competitors, $s = (s_1, s_2)$ - a vector of product qualities, $D_i(p, s)$ - the demand function for the product of quality s_i, which is specified, $c(s_i)$ - production costs of the product of quality s_i for the firm i (expenses for attraction of workers of demanded qualification, rent and the maintenance of premises, workers salary, service of technical equipment, administrative charges, etc.), $F(\bar{s}_i)$ - firm's investments into increasing of product quality range (capital construction, purchase of a new technological line, opening of new workplaces, expenses for professional upgrading, development of the innovative and advanced manufacturing, expenses for employees trainings, etc.). Both cost functions $c(s_i)$ and $F(\bar{s}_i)$ are quadratic functions.

The results of the game depend on the initial parameters which characterized the investigated industrial market. For any set of initial parameters we received the unique Nash equilibrium in the model in an explicit

form both for covered and uncovered market case. Some quantitative simulation examples are given.