

Dynamic model of the competition in regional market of e-commerce enterprises

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Summary. Dynamic model of competition in market of e-commerce enterprises to evaluate conditions of market competitive and appropriate reasoned decision-making during the management of competitiveness level is considered. The model had been tested for to reach equilibrium and steady state. Testing of the model was carried out on the example of the regional market of e-commerce enterprises in Lugansk (Ukraine).

Keywords: dynamic model, steady state, online-shop, competitive environment, competitiveness, e-commerce.

INTRODUCTION

Assessment and management of enterprise competitiveness is a complex process [1, 3, 4, 14, 15, 16]. A person who makes decisions in the management of competitiveness should base their decision on a comprehensive in-depth analysis of the market, which is the competitive struggle, evaluating the competitiveness of the investigated companies and other players in the market, and also available information on industry trends, macroeconomic performance in country, changes in market demand, and so on [2, 3, 13, 20, 21]. E-commerce scope in Ukraine is developing very rapidly. This form of business is already familiar to many businesses and consumers. In the context of research and competitiveness of their enterprises management had been important and needed to analyze the competitive environment of the market, and identify major regularities and prospectives of its functioning and development.

THE OBJECTS OF RESEARCH

Problems of controlling the competitiveness of the enterprises had been researched by such foreign and domestic scientists of economic as: M. Porter, I. Ansoff, A. Dajan, P. Druker, B. Karloff, F. Kotler, M. Meskon, F. Rodgers, R. Yoterman, A. Hoskina, I. Shumpeter, V. S. Andrianov, G. A. Azoev, E. A. Gorbashko, M. I. Gelvanovski, A. P. Gradov, M. G. Dolinskij, V. Zhukovski, U. Kormnov, I. V. Lipsich, A. Seleznev, R. A. Fathutdinov, A. U. Udanov, N. S. Yashin, U. B. Ivanov, N. A. Kisim, A. N. Tishenko, A. E. Voronkova, T. S. Maksimova and others. Nevertheless, nowadays there is not only single approach to the system of controlling the competitiveness of the enterprise, but also a single definition of the essence of competitiveness of enterprise and competition, as a motive force of social and economic development for society [1, 2]. Having analyzed the works of leading economists in this field, it is possible to make a conclusion that each of them is doing an accent on one or another constituent of competitive activity in a greater or less measure, and some of them are defending the systematic approach in controlling the competitiveness, taking into the account all factors [5, 10, 17].

The purpose of this research is to develop a dynamic model of competition in the market of e-commerce enterprises to evaluate competitive conditions of the market and appropriate management make informed decisions on the management of competitiveness level.

THE RESULTS AND THEIR ANALYSIS

For modeling of market besides information about all the players the data on the total volume of goods (services) offered on the market, and which is effective demand of consumers are necessary. E-commerce enterprises, such as online shops can be characterized as trading enterprises, because they offering market certain goods at a certain price. Volume of goods (in terms of money), offering the enterprises at the market in each period t is denoted as $X(t)$. Accordingly, the volume of goods that offer all the other players in the market during the time period t denoted as $Y(t)$. The total volume of demand for goods in the market is denoted as $S(t)$.

A volume of goods offered by the investigated company and all others on the market depends on the levels of competitiveness of the enterprises in the market. Let the competitiveness of the investigated company as $k_x(t)$, and it directly affects on $X(t)$, and also changes in space of time t . Similarly, the average level of competitiveness of other players in the market will determine as $k_y(t)$. Both are integral indexes for multiple component indicators that characterize the enterprise competition. It is logical that the competitiveness of all other firms use average of integrated competitiveness indicators, because the market is as strong and weak competitors. If the research is interesting behavior of any particular competitor, it would be appropriate to discharge its individual strategy by some indicators, such as $k_z(t)$ and $Z(t)$.

As limits of the model we introduce performance limitations of upper and lower limits of the volume of goods offered by the investigated enterprise and all other at the market. The lower boundary of the volume of goods offered on the market by investigated enterprise f_x and other players in the market f_y , define the minimum thresholds of offerings on the market, in which companies can operate with regard to their financial capabilities and common sense. That is the work of companies that offers on the market less than this rate of the volume of goods is unprofitable and uneconomical. Upper limits F_x and F_y characterize that depend level of the investigated company and the market, respectively, if they had, in spite of an increase in market supply, begin to bear financial losses due to lack of competitiveness. So we have a situation where the company receives consumer's orders more than

serviceable due to a greater level of dissatisfaction with some consumers and the competitiveness of enterprises falling. Both upper and lower bounds are not constants, and depend on the particular circumstances operation of the investigated enterprise and the market.

In light of the above designations may define "motive force" of change in sales of goods for $X(t)$ and $Y(t)$:

1. Advantages of enterprises that determine the level of competitiveness in the market, respectively, for the investigated company (1) and the other players in the market (2):

$$(k_x(t) - k_y(t)) * X(t), \tag{1}$$

$$(k_y(t) - k_x(t)) * Y(t), \tag{2}$$

considering that the growth rate of enterprise competitiveness are proportional of the volume of goods growth in the market.

2. Terms of rational volume of proposals in the market that do not lead to financial losses (3, 4):

$$(F_x - X(t)) * (X(t) - f_x), \tag{3}$$

$$(F_y - Y(t)) * (Y(t) - f_y). \tag{4}$$

3. The balance of supply and demand in the market (5):

$$(S(t) - X(t) - Y(t)). \tag{5}$$

Among the indicated parameters the level of competitiveness is the management factor for the investigated company (6) and other enterprises in the market (7) in each period of time:

$$\dot{k}_x(t) = -\alpha_1 \dot{X}(t) + \beta_1 \dot{Y}(t), \tag{6}$$

$$\dot{k}_y(t) = -\alpha_2 \dot{Y}(t) + \beta_2 \dot{X}(t), \tag{7}$$

where: α_1, α_2 - the coefficients that reflect the level of response to the volumes of investigated enterprise's goods changing on a market;

β_1, β_2 - the coefficients that reflect the level of response to the volumes of other competitor's goods changing on a market.

Then the system of equations of the state of e-commerce enterprise's market would have the following form (8).

In order to bring the system to the relative units divide all the components for $S(t)$ and denoted

$$x(t) = \frac{X(t)}{S(t)}, \text{ and } y(t) = \frac{Y(t)}{S(t)}. \text{ These attitudes from an}$$

economic point of view describing the share of enterprises in the market, which is very necessarily factor in the analysis the state of competitiveness on the market. Thus, the system of equations (8) will be rewritten as (9).

$$\left\{ \begin{aligned} \dot{X}(t) &= a_1(k_x(t) - k_y(t))X(t) + b_1(F_x - X(t))(X(t) - f_x) + c_1(S(t) - X(t) - Y(t)), \\ \dot{Y}(t) &= a_2(k_y(t) - k_x(t))Y(t) + b_2(F_y - Y(t))(Y(t) - f_y) + c_2(S(t) - X(t) - Y(t)), \\ \dot{k}_x(t) &= -\alpha_1\dot{X}(t) + \beta_1\dot{Y}(t), \\ \dot{k}_y(t) &= -\alpha_2\dot{Y}(t) + \beta_2\dot{X}(t), \\ X(0) &= X_0, Y(0) = Y_0, k_x(0) = k_x^0, k_y(0) = k_y^0, \end{aligned} \right. \quad (8)$$

where: a_1, a_2 - the coefficients that reflect the rate of change in demand formed by the balance of the competitiveness levels;

b_1, b_2 - the rate of reaction on the ratio of the volume of supply and the limits of rational proposals;

c_1, c_2 - the coefficients of reaction to balance of supply and demand on the market;

$a_1, a_2, b_1, b_2, c_1, c_2, \alpha_1, \alpha_2, \beta_1, \beta_2 > 0$.

$$\left\{ \begin{aligned} \dot{x}(t) &= a_1(k_x(t) - k_y(t))x(t) + \bar{b}_1\left(\frac{F_x}{S(t)} - x(t)\right)\left(x(t) - \frac{f_x}{S(t)}\right) + c_1(1 - x(t) - y(t)), \\ \dot{y}(t) &= a_2(k_y(t) - k_x(t))y(t) + \bar{b}_2\left(\frac{F_y}{S(t)} - y(t)\right)\left(y(t) - \frac{f_y}{S(t)}\right) + c_2(1 - x(t) - y(t)), \\ \dot{k}_x(t) &= -\bar{\alpha}_1\dot{x}(t) + \bar{\beta}_1\dot{y}(t), \dot{k}_y(t) = -\bar{\alpha}_2\dot{y}(t) + \bar{\beta}_2\dot{x}(t), \\ x(0) &= x_0 = \frac{X_0}{S_0}, y(0) = y_0 = \frac{Y_0}{S_0}, k_x(0) = k_x^0, k_y(0) = k_y^0, \bar{b}_1 = b_1S(t), \bar{b}_2 = b_2S(t), \\ \bar{\alpha}_1 &= \alpha_1S(t), \bar{\alpha}_2 = \alpha_2S(t), \bar{\beta}_1 = \beta_1S(t), \bar{\beta}_2 = \beta_2S(t). \end{aligned} \right. \quad (9)$$

A system of equations (9) is stable, because the second part of the first two equations need to decrease the volume of supply of goods in the market for technical reasons, and the third component of the same equations require a decrease the volume of the supply of goods in the market due to excess supply in the market of consumer demand. So get such balanced economic system where the volume of goods offered now on the market, and its share in the market cannot grow boundlessly, and have fairly reasonable economic limitations.

The next step will conduct the testing of the proposed model for the analysis of state of the competitive the regional e-commerce enterprises market to track the prospects of development of separate enterprises and market segments. As the players model will take the investigated company (Online shop Bomond), the cluster of the leading companies on the market besides the investigated company (Magazon, Dumping, Zakaz), and all other players in the market. The leader's cluster of the market selecting to a separate strategy is logical from the point of view that the enterprise in the market stand out for a higher level of competitiveness, and averaging their performance on average for the market would not be objective. Define the basic parameters of the model in accordance the information that we know about the market (table 1).

Table 1. Parameters of dynamic model for the regional market

Variable	Value	Justification
1	2	3
S	4500 thousands of UAH	Total monthly volume commodity market in the Luhansk region defined by the statistical and expert ways
F_1	800 thousands of UAH	The upper limit of the supply of goods volume in the market an investigational enterprise, which is defined by experts on the basis of organizational, financial and macroeconomic indicators in consideration of the current capabilities of the enterprise
F_2	2200 thousands of UAH	Similarly, the upper limit of the supply of goods volume on the market in total the market leaders besides the investigated company
F_3	4500 thousands of UAH	Similarly, the upper limit of the supply of goods volume on the market in total all the other enterprises besides the market leaders
f_1	200 thousands of UAH	Lower boundary of the supply of goods volume in the market of investigated enterprise, which is defined by the rationality of the functioning
f_2	600 thousands of UAH	Lower boundary of the supply of goods volume in the market of leaders in the market (besides the investigated companies), which defined by the rationality of the functioning

1	2	3
f_3	1200 thousands of UAH	Lower boundary of the supply of goods volume in the market of all the other enterprises (besides the market leaders), which defined by the rationality of the functioning
$x(0)$	0,07	The share of the supply of goods volume of the investigated company, determined by the expert and the statistical ways
$y(0)$	0,25	The appropriate supply of goods volume of the other three market leaders besides the investigated company
$z(0)$	0,8	The respective share of the proposals of goods volume all other firms in the market
$k_x(0)$	3,409	The integral indicator of competitiveness of the investigated company
$k_y(0)$	3,257	The average level of competitiveness of the market leaders (except for the investigated company)
$k_z(0)$	2,570	The average level of competitiveness of other enterprises in the market (besides the market leaders)

As is seen from (table 1), the amount of parts of supply of goods volumes in the market of online shopping of electronics and computer equipment greater than one, indicating a super saturation of the market and is fully consistent the state of affairs in real life. All the factors that affect the "sensitivity" of model's behavior ($a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3, \alpha_1, \alpha_2, \alpha_3, \beta_1, \beta_2, \beta_3 > 0$) were chosen by experiments and the available information about the "aggressive" behavior of various players. Results of the model testing that conduct as graphs of levels of competitiveness and parts of supply of goods volumes had shown in (fig.).

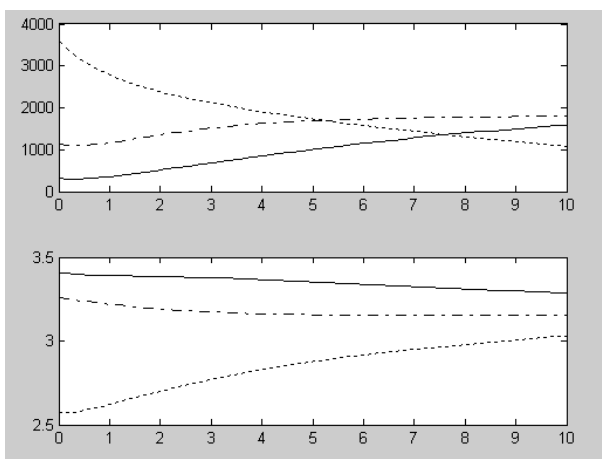


Fig. The results of testing of dynamic model of competition in the regional market

Let us analyze the results of the model and make the appropriate conclusions, that together with the other data will help in making informed management decisions by the person concerned. The first thing that can be noted from these graphs - the model balances the excess of supply in the market, which is reflected in the redistribution of the parts such a way that they are roughly equal in total level of market volume. Thus, given the initial levels of competitiveness of all three "players" of the model, the market leaders and the investigated companies improves its market positions over time, and all other enterprises lose. This comes with a small decrease in levels of competitiveness of the investigated companies and market leaders, and a substantial increase in the other market players. This suggests that at a time when market leaders will begin to "select" the market, it will become a push all other small players in the market to struggle for keep the position. This will be encourage them to an increase the competitiveness through the introduction of competitive advantage. This implementation of model cannot unequivocally say that with time on the market will be observe this situation and that the market leaders just will improve its positions and all the other players lose, or even some of them completely leave the market. This model helps us to understand the market trends while maintaining the current levels of competitiveness and the the coefficients of reaction to the behavior of other players. That is due to the effect of enterprises to the degree of reaction to changes the market, they can change the character of the market developing. This could be achieved through regular monitoring of the market, competitors, and their actions in the market. Using this model, an expert should be carried in each interval of time, which is defined for the management process of the e-commerce enterprise competitiveness.

CONCLUSIONS

As part of this research a dynamic model of competition in the e-commerce enterprises market to evaluate the competitive conditions of the market and to make informed decisions for managing the level of competitiveness has been developed. The developed model verified on the stability, and results have shown that regardless of the initial data and the nature of the conduct competing entities in the market their trajectories with a certain amount of time iterations come to the steady state. Approbation of the model

conducted on the example of the regional market of e-commerce enterprises in Lugansk (Ukraine).

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ДИНАМИЧЕСКАЯ МОДЕЛЬ КОНКУРЕНЦИИ НА РЕГИОНАЛЬНОМ РЫНКЕ ПРЕДПРИЯТИЙ ЭЛЕКТРОННОЙ КОММЕРЦИИ

*Султан Рамазанов, Леонид Истомин,
Алексей Дюбанов*

Аннотация. В этом исследовании авторами предложена динамическая модель конкуренции на рынке предприятий электронной коммерции для оценки конкурентного состояния рынка и соответствующего принятия аргументированных решений для управления уровнем конкурентоспособности предприятия. Разработанная модель проверена на устойчивость. Апробация модели выполнена на примере регионального рынка предприятий электронной коммерции в городе Луганск (Украина).
Ключевые слова: динамическая модель, устойчивое состояние, конкурентоспособность, конкурентная среда, электронная коммерция, интернет-магазин.