

# Regularities of Digital Gadgets Market in Primorsky Region

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**Abstract** — The Government program of the digital economics requires that all participants of the economic interrelations, including citizens, be able to use electronic devices, which realize not only communications but also some special transactions including —electronic government” services.

These devices are often called digital gadgets. In practice this means that gadgets should be available for citizens of any age, any social status and should provide the necessary functions in accordance with the owner’s demands. Fail to fulfill this condition makes the clients’ information services realization reasonless. The aim of this investigation was to reveal the trends in the participant’s behavior on the digital gadgets market of the Primorsky region. This work shows the analysis results based on the applied statistics models and the Theil-Kawasaki-Zimmermann method (the system of statistical indices). Conclusions have been made on the trends of the price levels for gadgets, the trends in the assortment supply and the degree of the customer’s satisfaction.

**Keywords**— digital economy, digital gadgets, applied statistics analysis, the Theil-Kawasaki-Zimmermann method, customer satisfaction

## INTRODUCTION

Concept of the digital economy is transition of economic intercommunication of enterprises, individuals, government bodies and public organizations into the virtual information space.

The formation of the digital economic environment is impossible without the citizen’s mass supply with the devices realizing communications, information storage and processing. The devices mentioned are often defined as digital gadgets [1; 2; 9; 10].

Obviously, digital gadgets should be affordable for all groups of population, independently of age, education level and revenue [11; 12; 13]. On the other hand, any participant of the economic intercommunications – the client of the information services and the services customer – should make the reasonable meaningful choice of the digital device [8; 14; 16; 17]. The purpose of our research is detecting the trends in the behavior of the digital gadget market participants on the basis of open affordable data. Such investigations are especially important for regions with low population density where the economic effect from the market size falls short.

The results obtained by us, allow to answer the following questions:

1. Do the technical characteristics of the gadgets offered by different trading networks differ considerably?
2. Which characteristics-consumer or technical ones - influence on the item price most of all.
3. To what extent do the brand and the country of origin influence on the item price
4. To what extent does the goods supply correspond with the customers’ expectations.

## DATA AND SOURCES

In the research two approaches for forming of sampling were applied: using trading enterprises data basis application and active data collection by polling. So the research was based on the open accessible data from the goods electronic catalogues of

the large trading companies, who work in Primorsky region, and on the field studies data. Field studies were carried out by survey of customers.

## METHODS AND MODELS OF THE MARKET REGULARITIES INVESTIGATION

The researches were based on the informational methods of the data collection (inquiries, questionnaires), data structuring methods, and applied statistics analysis. Regularities of the digital gadgets market offering was analyzed by the applied statistics techniques. Statistical factors interdependences analysis was based on the correlation analysis: (Pearson) correlation coefficients were calculated, partial correlation coefficients [7]. Gadgets technical and consuming characteristics influence on the prices was formalized by the regression equations. Questionnaire approach (panel technologies application) to the economic information collection has some principal peculiarities which allow significantly enlarge the factors structure and improve their information value. First, surveys provide an opportunity to collect not only quantitative but also qualitative factors (for instance, hindrances of production growth, capacity adequacy estimation, and finished products stock appraisal). Second, questionnaire provide an opportunity to receive obtain the information which is possessed only by the heads of the enterprises (for instance, trading enterprises plans for commodities production and prices conformity to customers preferences, feasibility of demand changing).

We hypothesize that the best results of such data processing can be obtained by the Theil-Kawasaki-Zimmermann method [5; 6; 8; 15]. The basis of the ordinal data statistical analysis is the factors (questions) contingency matrix of X and Y – M(X, Y) (figure 1). Matrix M(X, Y) elements are the proportional frequencies of the respondents replies combination about the X and Y factors (changes or estimations).

		Y		
		+	=	-
X	+	++	+=	+ -
	=	=+	==	= -
	-	-+	- =	--

Fig. 1 Factors contingency matrix

Theil was the first author, who suggested the system of specific factors for analysis customer surveys. Respondents expectations accuracy factors were introduced on the basis of the matrix of  $X_t$  factors changes predictions contingency, and real changes of the same factor in the following inquiry  $X_{t+1}$ .

Modified matrix of the  $X_{t+1}$  factors contingency or the Theil factors contingency matrix is shown in figure 2.

		$X_{t-1}$		
		+	=	-
$X_t$	+	++	+=	+ -
	=	=+	==	= -
	-	-+	- =	--

Fig. 2. Theil factors contingency matrix

Kawasaki-Zimmermann propose generalized indices of the predictions shifting on the basis of the errors summarized simple factors described above.

$$B_1 = \frac{OE_1 - UE_1}{OE_1 + UE_1}$$

OE<sub>1</sub> is the sum of the contingency matrix of off-diagonal elements, i.e. respondents ratio whose predictions (expectations) proved to be overestimated.

UE<sub>1</sub> is the sum of the contingency matrix of below-diagonal elements, i.e. respondents ratio whose predictions (expectations) proved to be underestimated.

In our opinion, Theil-Kawasaki-Zimmermann statistical factors system is more universal and can be used to investigate the consumers preferences issues and final consumers satisfaction level using the results of the market inquiries and to arrange price and some other monitoring on the specified markets.

MODELLING RESULTS

Regularities for pads pricing level

Initial data is the assortment of the premium pricing level tablet PC (the price starting at 35 000 rubles) [17]. The source is the electronic catalogues of large trading companies available in Primorsky region: DNS, “Eldorado”, “V-Laser”, and “Domotechnica”. General sampling volume is sixty. Each of the commodities was characterized by twelve characteristics. Five characteristics of them are technical, which are numerical values; seven characteristics are consuming ones, which are both numerical and qualitative. Numeric consuming characteristics include retail prices and production year.

Our research was based on correlation analysis, variation analysis and regression analysis [6; 7; 12; 13]. The paired and partial correlation coefficients were estimated. As a whole, the calculations show statistically significant level of the tablet PC technical characteristics correlation. High level of the correlation association between technical characteristics certifies the conformance of the samplings to the object of observation.

In spite of the low correlation coefficient value (less than 40%) they are statistically significant. “Processor Frequency” factor is the exclusion. However, partial correlation coefficients demonstrated that this significance is the result of the statistical connection of the operative memory volume and stock volume. When the “operative memory” characteristics affect is excluded, all paired and partial correlation coefficients become insignificant (table 1). So, it may be stated that the premium pricing segment tablet PCs are priced without considering the devices objective technical characteristics.

TABLE 1. THE PARTIAL COEFFICIENT MATRIX OF PRICES CORRELATION WITH TABLET PCS TECHNICAL CHARACTERISTICS, THE “OPERATIVE MEMORY” BEING THE EXCLUDED VARIABLE.

	Storage	Number of nuclei	Processor frequency	Price
Storage	1.000	-0.432	0.040	-0.248
Number of nuclei	-0.432	1.000	0.040	-0.248
Processor frequency	0.040	0.040	1.000	0.070
Price	-0.248	-0.248	0.070	1.000

Regression linear models confirm the correlation analysis conclusions. Variables “operative memory” and “storage volume” are statistically significant. The model is also statistically significant. However it explains only 13% of the explained factor “price” spreading. Independent variables are significant at the level of 0.4%. High correlative association between independent variables allows constructing only paired models. This statement is easily checked while the multiple regression model estimation. When three factors are included

into the model the significance level of any of them is more than 10%. That confirms the impossibility of the multiple regression model application.

The results of the consumer-oriented characteristics influence on the price level estimation are rather interesting. The brand country influence on the price level has not been confirmed either. DNS store network is more connectible with the brand country (USA, China) than the “Eldorado” network. At this the influence on the price is negligible. Although the value level (p-value = 0.01) allows speaking about the statistical connection of the price level and the DNS network.

Regularities for laptop pricing level

Initial data is the assortment of the premium pricing laptops (the price starting at 50 000 rubles) [Ошибка! Источник ссылки не найден.]. The source is the electronic catalogues of the large trading companies available in the Primorsky region: DNS, “Eldorado”. General sampling volume is 365. Each of the commodities was characterized by eight characteristics. Four characteristics of them are technical, three of each are numerical values. Four others are consumer-oriented ones. Numeric consumer-oriented characteristics include retail prices. The calculations showed low correlation association for laptops technical characteristics (table 2). This is because the technical characteristics presented are not objectively interdependent.

TABLE 2. CORRELATION MATRIX FOR LAPTOPS TECHNICAL CHARACTERISTICS

	Operative memory	Processor cash	Hard disk	Monitor (diagonal)
Operative memory	1	0.131	0.031	0.302
Processor cash	0.131	1	-0.346	-0.025
Hard disk	0.031	-0.346	1	0.199
Monitor (diagonal)	0.302	-0.025	0.199	1

So, we might say, that the on-line resources of the trading networks have given not enough information about technical characteristics.

Technical characteristics influence on the gadget price is shown in the conformable correlation coefficient matrix (table 3).

TABLE 3. COEFFICIENT MATRIX OF PRICES CORRELATION WITH THE LAPTOPS TECHNICAL CHARACTERISTICS

	Operative memory	Processor cash	Monitor (diagonal)	Price
Operative memory	1	0.131	0.302	0.713
Processor cash	0.131	1	-0.025	0.257
Monitor (diagonal)	0.302	-0.025	1	0.129
Price	0.713	0.257	0.129	1

The “Pearson Correlation Test” is low for factors “monitor” and “cash” (less than 30%), but it is statistically significant due to the sampling volume. However, our results show that the premium class laptop price significantly depends upon the operative memory volume.

The estimation of partial correlation confirms the statement of the authors about the independence of the presented technical characteristics. If the “cash” characteristics influence is excluded the paired and partial correlation coefficients differ from the initial estimations not significantly.

Correlation analysis demonstrates zero statistical association the laptop prices with consumer-oriented characteristics. The impact of the trading network on the price level is statistically significant, but the correlation coefficient is extremely low (-13.8%). The consumer-oriented characteristics “the country of

production” of this sampling have a slight spreading and so it is slightly connected with the price level. The attempt to improve the regression model by including the consumer-oriented characteristics has failed. So the best regression equation is the following:

$$Y = 28\,236.5 + 5\,671.2 * X_{cash} + 4\,824.7 * X_{ROM},$$

where:  $X_{cash}$  is a cash processor volume;  $X_{ROM}$  is a laptop operative memory volume. Significance levels of all independent variables and the regression intercept are less than 1%. The equation allows saying that the premium segment of the objective technical characteristics influence on the laptop process level. However, the fact that the model explains not more than 53% of the price variation, has been confirmed our assumption that the business conditions significantly influence to the pricing.

Logistic models estimation did not add anything to the results, which mentioned above. Neither laptop technical characteristics nor price levels differ in the trading networks DNS and Eldorado.

#### Customer satisfaction survey

The periodical panel survey of the consumer’s preferences and final consumers satisfaction with the economy class laptops assortment offered on the market by the retail networks was carried out in the framework of the IT-market examination in Vladivostok [3].

The regularities were analyzed by using the contingency matrix and the Theil-Kawasaki-Zimmermann method [4].

Estimate of consumer’s satisfaction level with the laptops assortment offered in Vladivostok are shown by dynamic's chart: base period is November-December. 2002; the first period is November-December. 2007; the second period is November-December. 2012; and the third period is November-December. 2017.

As we seen from the figure 3, the share of the respondents satisfied with the goods offer decreased from 28.0% up to 17.3% during the period of the investigation. While the share of the respondents negatively estimating the goods offer increased from 72.0% up to 82.7%. So the majority of the respondents are extremely unsatisfied with the goods offer. The share of the respondents who optimistically estimate the goods offer changes has been practically unchangeable for the last 10 years and it ranges about one third of the total number of respondents. But the share of “pessimists” is increasing from year to year, expanding from 40.0% at the initial stage of the survey up to 49.33% in 2017. That is about half of all respondents.

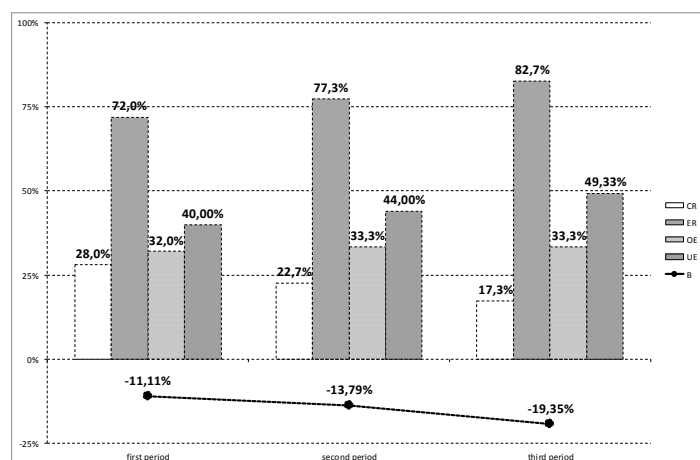


Fig. 3 Graphical representation of the analysis results of the final consumers satisfaction with the laptops assortment offered on the Vladivostok laptop market by the retail networks in dynamics for the period from 2002 up to 2017.

Negative values of the estimator bias index shows the trading networks underestimation of the consumers preferences. Therefore, the final consumer has to choose from the goods offered which don’t satisfy his demands in technical and consuming characteristics as well as unclear pricing system.

The results of the analysis show that there is a disproportion between the demand and supply. i.e. retailers have been making products offering and assortment policy in this market segment without taking into consideration final consumers’ preferences for a long period of time. And this disproportion has increased almost as much as twice (from 11.11% to 19.35%) during this period.

#### CONCLUSIONS

The investigation results demonstrated above allow formulating the following statements.

These digital gadgets technical characteristics offered by different trading networks are not statistically identifiable.

Prices for tablet PCs are fixed by the trading networks without taking into consideration the devices technical or consumer-oriented characteristics. The prices level of laptops is associated with the technical characteristics. However even in this case the devices objective characteristics allow explain only 53% of price level variations. Brand or country of assembling does not significantly influence on the prices

Inquiry results demonstrate nonconformity of the commodities offer to the consumers expectations. Obviously, retailers activities don’t provide affordability of digital gadgets for broad sections of the population.

Accordingly the digital economy project requires legislative and administrative decisions which will allow regulating the situation in the given market segment of the digital devices.

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