FORMATION OF COMPETITIVE SUPPLY IN HEAT ENERGY SECTOR: LITHUANIAN CASE

Svazas Mantas
Kaunas University of Technology, K. Donelaicio str. 73, Kaunas, Lithuania

Navickas Valentinas
Kaunas University of Technology, K. Donelaicio str. 73, Kaunas, Lithuania

Jegelaviciute Rusne
University of Alexander Dubcek in Trencin, Študentská str. 3, Trencín, Slovakia

Abstract

The authors of the article have investigated the constituents of competitive supply and have presented the algorithm of its formation in the sector of thermal power. The investigations conducted by them indicate that in a given market the supply of goods and services must be presented in proportion to their demand. In this way the business losses and costs from the unrealized demand are reducing and its general competitiveness is growing. The investigations conducted by the authors indicate that the bigger number of the market participants, the bigger influence is made to the business competitiveness by its ability to structurize the supply appropriately. To achieve competitive supply a stable business structure is necessary which enables to form business structures having a stable financial basis. As in the investigated market the action takes place with one product – thermal power – one can efficiently concentrate on the processes of formation of competitive supply. The information collected during the statistical investigation has indicated that the dynamics of untilled areas of agricultural destination can significantly affect the price of heat. By reclaiming these areas and starting to grow energetic plants one can achieve the reduction of the price of heat. Conditions to re-orientate the energy system towards the production of the green energy are created. In this way an opportunity to form a competitive supply in respect of the business entities using fossil fuels appears.

Keywords: competitive supply, heat energy sector, clusters, modeling.

JEL code: M13, M21, Q40, Q41.

Introduction

During the performance of actions of business development, it is necessary to take into consideration both the demand dynamics and the opportunities to offer goods and services to the market. In evaluating the opportunities of formation of competitive supply big importance is attached to the market analytics. It is performed by invoking a clearly structured plan with specific mechanisms of control. The analysis of the supply is very important in such cases when the market condition consists of a big number of market participants. In the case of thermal power, the market consists of equipment of heat generation using different types of fuel located in one locality. According to the used fuel one can judge about the possible cost price of selling of energy. The boiler-rooms using the renewable fuel have competitive advantage of the power plants using fossil fuels. That enables to simplify the price system and act in the market in a simpler way.

The scientists define the constituents of competitive supply and their significance in doing business in different ways. Ambiguous opinion on the factors which assist in the development of competitiveness in the market exists. According to the assertion of Dune, Lusch

(2005) the process of formation of goods or services supply consists of the principal actions – analysis, planning, control.

Most often these three actions manifest themselves in the following forms – realizing, getting goods and accumulating their stocks. In the literature there are four principal stages of formation of goods supply which are singled out. During the first stage the nature of the goods supply is established. During the second stage the composition of the goods supply is pending. During the third stage the width and depth of the goods supply is established and during the fourth stage the function of control is performed. The stage of control means that all the stages are started anew, as the formation of the goods supply is a process constantly renewing the goods supply. The choice of the trade profile is the only of these stages which is performed once – during the establishment of a trade enterprise; however, it as well can be reviewed once in a while, if it appears that the demands of the consumers have changed radically.

For achieving competitive supply, a stable structure of business enabling to form business structures having stable financial basis is necessary. Attention should be drawn to the fact that the formation of competitive supply is not disembodied from the price of an article as well, as successfully acting economics is influenced by three principal elements:

- Profit;
- Competition;
- Price system.

Namely the price system assists in establishing what services or goods are necessary for a potential customer and in what form they must be presented, so before starting to analyze the factors influencing the formation of competitive supply it is important to familiarize with the concept of price. In the case of thermal power business, the power-plants using biofuel gain competitive advantage. They fueling with local fuel can optimize expenses and provide a bigger share of heat to the cities localities. As the investment into heat production continues longer than one year, according to it the competitive policy of the enterprise is formed. It enables to maximize the obtained financial benefit during the short period.

Survey of literature of the competitive supply formation concept

The enterprise competitiveness in the market and ipso facto the supply advantage formed by it is determined by different factors. They depend on the sort of economic activity and the region of activity. The adolescence of the market makes an influence as well – in conditionally new markets or markets which lack changes it is simpler to present the goods or services created by a business entity. After systematizing the works of Hair, Anderson, Tatham, Black (2006) 8 most important factors of competitiveness are singled out:

- The potential of domestic economy according to which the degree of activeness and efficiency of the economics can be established;
- The internalization of the economy, the degree of its openness and opportunities for international trade and direct investments;
- The activity of the government – that is the activity which stimulates the competitiveness (the size of the state sector, the monetary and taxes policy, political-social stability);
- The financial sector – optimal opportunities of distribution of resources through alternative investment offers and their support via banks system;
- The infrastructure and satisfying of business demands (transport system, telecommunication, use of electric power);
- Management, its effectiveness and orientation to the quality of the product and the buyer;

- Science and technology – expenses for scientific-research work, improving the engineering qualification, economy innovation, protection of intellectual property, commercialization of new technologies;
- Human resources – age, qualification of the man power, labour relations, life quality, expenses for studies.

The decisions of the supply policy of the enterprises engaged in trade are influenced by a plenty of most various factors. According to some authors, for example, Pajuodis (2005) the factors influencing the supply policy are determined by 4 groups:

- External;
- Internal;
- Market;
- Assortment ties.

It should be emphasized that during the formation or improvement of the goods supply often the demands of the consumers are an essential factor. So, every enterprise during the formation of the goods supply must evaluate such essential aspects as the demands of the consumers, the benefit from the enterprise goods they perceive, the fact how much time, efforts and money cost for the buyer to find the goods of the enterprise and choose the necessary one. Kotler, Amstrong, Saunders, Wong (2003) are apt to focus the principal attention on the nearer enterprise environment and internal policy. In conformity with the opinion of these authors one can state that the changes of formation of goods supply proportions are influenced by such factors as the branch of the trade in which the enterprise is functioning, size of the enterprise, location of the registered office, size of the capital and so on. Speaking about external environment (economic, political and so on) attention should be paid to the fact that it is important for every enterprise, however, it does not have direct influence for the formation of goods supply completely.

During the formation of competitive goods supply attention should be devoted to a certain relation of the goods, the comprehensiveness of the supply, to the fact that the use of certain goods is interrelated, as in a competitive environment the enterprises must constantly strive to adapt to the changing market, changes in the supply and demand. In the formation of competitive goods supply such factors as seasonal supply and demand, management of the streams of the buyers, properly benefited retail spaces and so on are also important, as that determines the buyers' choice of the purchase of goods.

Kök, Fisher, Vaidyanathan (2006) single out the methods of formation of competitive supply levels, evaluation of the position on the shelves, management of resources, formation of polynomial supply, demand, the methods substantiated on the evaluation of local factors and the consumers behavior. Fisher, Vaidyanathan (2009) also add the model based on goods profitability and the model of optimization of competitive supply. Attention should be devoted to the fact that the choice of the methods of formation of competitive supply, as the majority of authors state, greatly depends on the situation in the enterprise of retail trade, on its policy, also the fact that the majority of methods are related to the evaluation of demand, buyers' needs, policy of retail trade enterprise.

It should be noted that the methods of competitive supply differ, so both the ones and the others have drawbacks and advantages. For example, according to the statement of Koetler (2003) the management of supply must take place in two stages. The author names the first stage as the analysis of the range of goods when the constant gathering of information about the volumes of sales and profit according to a separate goods unit, the establishment of the share of sales of separate article units and the profit of the range of the article takes place. The author notices that if a high share of sales volume falls to several article units, the product line is vulnerable. Namely due to this in this stage the competitiveness of the product line is established as well. During the second stage decisions regarding the length, corrections or strengthening of

the product line are passed. On the basis of analyses conclusions, the decision on the length of product line is passed. It should be noted that the indicator of proper length is the total profit of the enterprise.

In summary one can state that the processes of formation of competitive supply depend on the market in which the activity takes place and on the plenty of its participants. In the case of employment of biofuel in power economy the competitive supply is influenced by the present level of prices, plenty of competitors, decisions of the local government on the matters of power economy. The formation of competitive supply in the sector of power economy is possible when new equipment using renewable fuel are introduced in the system of power economy. The author will attempt to substantiate it by Lithuania‘s example. The country has been using biofuel for producing heat for a long time and that enables it to reduce the prices of heat energy to the consumers.

Mathematical modeling of formation of competitive supply in the sector of Lithuanian thermal power

The formation of competitive supply in the sector of thermal power is substantiated on the analysis of price and the method of manufacturing of heat. During the formation of competitive supply, one must evaluate the ways in which the market is influenced in different localities during the use of different production sources. Lithuania‘s example has been invoked for the investigations. Within a decade the country has re-orientated its power system from the employment of fossil fuels to the burning of local fuel. That has enabled to change the dynamics of supply in the regions of the country involving the local fuel suppliers. Herewith that has enabled to reduce the heat prices significantly. For investigations the SPSS program by invoking the data of separate Lithuanian regions is used.

Aiming to perform the actions of economic modeling the market of the thermal power has been chosen and the data of Lithuanian municipalities have been invoked. For regression analysis the municipalities which for the production of heat mostly use imported natural gas have been chosen. It has been proved that these municipalities in the majority of cases pay for heat a bigger price than those which are heating employing the local renewable fuel. In Table 1 the data used for making regression analysis are presented.

Table 1. Data used for making regression analysis (Concluded by authors based on Lithuanian Department of Statistics, 2016, VKEKK, 2017, LŠTA, 2018, VŽF, 2018, VMT, 2018)

Region	Heat price, ct/kwh	Unemployment rate	Woodland level	Biofuels consumption, proc.	Gas consumption, proc.	Regional coefficient	Fallow areas, ha	Ln Forest coverage	Ln Fallow areas
Vilnius district municipality	7,39	11	41,6	30	70	0,8158	8467,95	3,73	9,04
Vilnius city municipality	6,9	6,9	34,6	10	90	0,064	940,72	3,54	6,85
Trakai district municipality	7,55	6	49,9	20	80	2,3005	4570,12	3,91	8,43
Salcininkai district municipality	7,23	11,5	48	50	50	3,1503	1437,42	3,87	7,27
Prienai district municipality	9,06	8,3	27,7	20	80	3,4778	1316,3	3,32	7,18
Kaunas city municipality.	6,17	8,3	17,7	20	80	0,1255	59,77	2,87	4,09
Kaunas district municipality	6,17	8,2	32,5	35	65	1,2231	1067,02	3,48	6,97
Kedainiai district municipality	6,08	7,7	25,1	6	94	1,338	715,66	3,22	6,57
Ukmerge district municipality	7,34	13,3	32,5	4	96	1,3823	2830,15	3,48	7,95

Region	Heat price, ct/kwh	Unemployment rate	Woodland level	Biofuels consumption, proc.	Gas consumption, proc.	Regional coefficient	Fallow areas, ha	Ln Forest coverage	Ln Fallow areas
Panevezys district municipality	7,07	10,8	34,9	20	80	0,1867	1224,28	3,55	7,11
Panevezys city municipality	6,08	10,1	2,1	23	77	2,5752	57,81		4,06
Anyksciai district municipality	9,31	12,8	32,6	5	95	2,5086	2743,79	3,48	7,92
Visaginas district	4,32	13,1	58	39	61	0,4284	12,71	4,06	2,54
Klaipeda city municipality	6,04	8,1	19,8	40	60	0,1	179,42	2,99	5,19
Klaipeda district municipality	6,04	7,4	26	0	100	0,5377	1331,64	3,26	7,19
Jurbarkas district municipality	6,17	15,6	38	0	100	2,7134	381,79	3,64	5,94
Telsiai district municipality	7,49	9,8	35,2	7	93	1,7726	764,03	3,56	6,64
Radviliskis district municipality	5,71	11,3	25,7	11	89	1,9154	442,67	3,25	6,09

All the presented data are of 2015. The data characterize the principal factors related with power economy, also the influencing indirect factors such as the rate of unemployment which is especially relevant in the districts using biofuel, also the relative ratio – the Location Quotient is invoked. The ratio is intended for elucidation of the opportunities to develop the biofuel business in separate regions of the country. The Location Quotient has been invoked during the evaluation of the activity of regional clusters and their concentration. The ratio is calculated according to the formula (Moineddin, Beyene and Beyene, 2003):

$$LQ = \frac{\frac{E_{ij}}{E_j}}{\frac{E_{in}}{E_n}} \quad \text{or} \quad LQ = \frac{\frac{E_{ij}}{E_{in}}}{\frac{E_j}{E_n}}, ;$$

In the formula:

E_{ij} – employment i in industry j in the region;

E_j – general employment j in the region;

E_{in} – national employment i in industry;

E_n – total national employment.

If the Location Quotient exceeds 1, the relative employment in certain region and industry is higher than the average industrial employment in the country. If the Location Quotient is less than 1, the employment in the branch of industry is less than the country‘s average. The value of the Quotient exceeding 1.25 indicates the regional specialization in a certain branch of industry.

As in this case the data are scarce, for a more accurate evaluation of the data normality Shapiro-Wilk test is used for the evaluation of values of which the hypotheses of the verification of normality have been formed:

H_0: variable values distribute by normal distribution;

H_1: variable values not distribute by normal distribution.

If the calculated probability p is bigger than the confidence level α which is equal to 0.05, the null hypothesis H0 is accepted, meaning: the distribution of the values of the variable is normal. If the probability p is less than α, alternative hypothesis H1 is accepted (Table 2).

Table 2. Data Normality Assessment

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Heat price, ct/kwh	,176	17	,167	,933	17	,243
Unemployment level	,208	17	,050	,949	17	,436
Biofuels consumption, proc.	,171	17	,200*	,918	17	,138
Gas consumption, proc.	,171	17	,200*	,918	17	,138
Regional coefficient	,135	17	,200*	,927	17	,196
LN_DIRV.P	,187	17	,115	,915	17	,120
LN_Forest coverage	,144	17	,200*	,977	17	,931

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

It should be noted that the indicators of the level of the long-unused areas and woodlands are presented by applying modifications – taking the logarithm. That has been done due to the fact that the primary data have either not corresponded to the primary condition of normality or so that isolations were avoided. In the table one can see that the probabilities of the variables calculated with the help of Shapiro-Wilk test exceed the confidence level $\alpha = 0.05$, so in all the cases the null hypothesis H0 is accepted – all the values of the variables are distributed according to the normal law. One can state that all the variables are suitable for the creation of the regression model.

The results obtained during correlation analysis indicate that probabilities p calculated between the dependent variable and two analyzed independent variables – Location Quotient and LN_DIRV.P are less than α, so in this case an alternative hypothesis H1 is accepted – notional linear connection exists between the variables.

As between the price of the heat (independent variable), Location Quotient and the quantity of long-unused areas in the logarithmic form (independent variables) linear connection which is notional exists, from these data the model of multiple regression (DTR) is created. The further investigations of significance are conducted with independent variable LN_DIRV.P. Aiming to evaluate the opportunities of the model for further investigations, its accuracy is evaluated. It appears that in this case the accuracy of the model according to the result of R. Square indicator reaches 49.5. That would enable to obtain a bit more substantiated results in future investigations. The calculated probability of Fisher‘s criterion p, equal to 0.001, is less than the confidence level α, so alternative hypothesis H1 is accepted – the model of linear regression is notional. The final stage of the model analysis is the evaluation of the significance of the parameters and its results have been presented in Table 3.

Table 3. The significance of DTR model parameters assessment (heat price, ct/kwh and LN_DIRV.P)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,483	,859		4,057	,001	1,663	5,304
	LN_DIRV.P	,508	,128	,703	3,959	,001	,236	,779

a. Dependent Variable: Heat price, ct/kwh

According to the table it appears that probability p of LN_DIRV.P parameter t (Student) criterion is less than the confidence level α, so an alternative hypothesis H1 is accepted, i.e. the independent variable LN_DIRV.P makes a significant impact for the change of the dependent variable Heat price, ct/kwh. The expression of the formed regression model:

$$Y= 3,483+0,508*\ln(x)$$

or:

$$\text{Heat price, ct/kwh}= 3,483 + 0,508 * \text{LN\_DIRV.P}$$

During the analysis of the models of linear regression the author arrives at the conclusion that a more accurate regression model is between the dependent variable – Heat price, ct/kwh and independent variable - LN_DIRV.P, the accuracy of the model reaches 49.5 per cent. After making the analysis of linear regression models analytical actions are performed in the analogous way in the case of non-linear regression models.

When we have a formed DTR model, we can take predicational actions. As the data of heat market of the municipalities of 2015 are available, we will attempt to predict the heat price of the next year in the regions where for the production of heat mostly natural gas is employed. So, using the obtained DTR model:

$$Y= 3,483+0,508*\ln(x)$$

or:

$$\text{Heat price, ct/kwh}= 3,483 + 0,508 * \text{LN\_DIRV.P}$$

The heat price predicted in the municipalities for the next year is obtained which is presented in Table 4.

Table 4. The predicted heat cost in gas-consuming municipalities

Region	Heat price, ct/kwh	Fallow areas, ha	ln_Fallow areas	Predicted heat price
Vilnius district municipality	7,39	8467,95	9,04	8,08
Vilnius city municipality	6,9	940,72	6,85	6,96
Trakai district municipality	7,55	4570,12	8,43	7,76
Salcininkai district municipality	7,23	1437,42	7,27	7,18
Prienai district municipality	9,06	1316,3	7,18	7,13
Kaunas city municipality.	6,17	59,77	4,09	5,56
Kaunas district municipality	6,17	1067,02	6,97	7,03
Kedainiai district municipality	6,08	715,66	6,57	6,82
Ukmerge district municipality	7,34	2830,15	7,95	7,52
Panevezys district municipality	7,07	1224,28	7,11	7,09
Panevezys city municipality	6,08	57,81	4,06	5,54
Anyksciai district municipality	9,31	2743,79	7,92	7,50
Visaginas district	4,32	12,71	2,54	4,77
Klaipeda city municipality	6,04	179,42	5,19	6,12
Klaipeda district municipality	6,04	1331,64	7,19	7,14
Jurbarkas district municipality	6,17	381,79	5,94	6,50
Telsiai district municipality	7,49	764,03	6,64	6,86
Radviliskis district municipality	5,71	442,67	6,09	6,58

It appears that in six municipalities the heat price would decrease and in the remaining ones increase. In the municipalities distinguished for decreasing price there are quite many long-unused land areas, so one can make an assumption that if these areas were employed for growing energetic plants and in the districts the infrastructure necessary for burning appeared, the heat price would be apt to decrease. In those districts where the heat price is increasing the number of such areas is rather big as well, but the increase is moderate and conditionally less than the falling of prices in the other municipalities.

The formation of competitive supply according to the example of the thermal power market indicates that the regions employing natural gas in bigger volume generate higher heat

prices. The analysis has indicated that the essential indicator enabling to evaluate the dynamics of the supply changes are the long-unused areas expressed in logarithm. That enables to predict the heat prices and herewith to investigate the opportunities of correction of the supply. In the regions where higher heat prices are prevailing prerequisites to make investment decisions by changing the supply dynamics exist. In this way the phase of competitive supply can be achieved, when by producing energy from the local resources the consumers are provided according to a competitive price.

Concluding remarks

For the formation of competitive supply exhaustive analysis is necessary with the help of which it is possible to achieve the aim of market saturation. Having the disposition of the necessary analytical data it is possible to achieve activity efficiency and expenditure optimization by offering goods or services to the market. In the case of the thermal power market the situation of competitive supply correction can be secured by employing local renewable resources. Consecutive market analysis can enable to occupy a significant share of the market efficiently during the short period and during the long period conditions for stable business activity are created. As in the market the activity takes place with one product –heat energy – one can productively concentrate on the processes of formation of competitive supply. The results obtained according to the performed mathematic modeling have indicated that the heat price can be significantly influenced by the dynamics of the untilled areas of agricultural destination. By reclaiming these areas and starting to grow energetic plants one can achieve the reduction of the heat price. In this way conditions to re-orientate the energy system to the production of the green energy are created. In this way the opportunity to form a competitive supply in respect of the business entities employing fossil fuels appears.

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