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ANALYSIS AND MODELING OF THE LITHUANIAN REAL ESTATE SECTOR

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Abstract. The model for an efficient real estate sector as suggested by this research is based on the presumption that the efficiency of a real estate sector depends on many macro and micro level variables. The presence of specific macro and micro level variable factors right away imposes objective limitations for efficient activities within the real estate sector. The real estate sector, in the presence of these objective limitations, tries to perform its functions within their bounds with the utmost efficiency. The research aimed at producing a model of a rational real estate sector by undertaking a complex analysis of micro and macro environment factors that affect it and to provide recommendations that would increase its competitive ability. In order to demonstrate the application of the above research by developing a model for an efficient real estate sector, a selection of rational housing investment instruments and lenders will be considered in this paper as a sample.

Keywords: real estate sector, micro and macro level factors, conceptual and quantitative information, multiple criteria analysis and model.

1. Introduction

To be efficient the real estate sector must operate within certain boundaries that have been imposed by micro and macro level factors. It is also necessary to utilize knowledge and experience concerning real estate practices, so as to increase the efficiency of the real estate sector's environment in the country under consideration. This may be achieved by analyzing the experiences and knowledge from advanced industrial economies and by applying them to Lithuania.

Having investigated the effects of the variables that affect the real estate sector in advanced industrial economies, some differences have been identified between these countries and Lithuania. On the basis of these differences, the main implications for Lithuania can then be identified. The study of only one advanced industrial economy could lead to any inferences that may be purely subjective. However, by studying a number of countries any bias can be diminished. In other words, the presence of specific variable micro and macro level factors immediately imposes objective limitations on the efficient activities of interested parties. In turn interested parties, in the presence of these objective limitations, try to perform their activities in a more rational way.

Based on the above considerations, it is possible to propose a model of an efficient real estate sector on the basis of the performed search for rational variable micro and macro level factors for Lithuania. Upon completion of such a model, the interested parties will be able to use their financial resources in a more rational manner by taking into consideration the existing limitations and the existing possibilities of a real estate sector's environment.

This paper is structured as follows: Following the introduction, Section 2 outlines the literature's review on modeling and the forecasting of a real estate sector and its environment. In Section 3 we describe the main stages of forming a Lithuanian real estate sector's development model. The conceptual and quantitative description of a real estate sector is introduced in Section 4. The determination of rational housing investment instruments and lenders is presented in Section 5. In Section 6 we describe a case study on multiple criteria analysis of alternative loans. Finally,

some concluding remarks are provided in Section 7.

2. Literature Review on Analysis and Modeling of Real Estate Sector and its Environment

The models of econometrics, portfolio theory, neural networks, multiple criteria analysis, etc. are used for the modeling and forecasting of a real estate sector and its environment and for its development trends. Depending on the subject and goals of the research, as well as the amount and objectivity of the available data, it is believed to be reasonable to use different modeling and forecasting models.

Theoretical and practical aspects of modeling and forecasting of a real estate sector and its macro- and micro-level environment were dealt with in various research papers.

Tiwari and Hasegawa [16] estimated the compensated demands of households for a particular housing attribute based on the nonlinear hedonic nature of housing prices. Fullerton et al. [5] produced an econometric forecasting analysis of residential construction activities in regional markets. Fletcher et al. [4] were concerned as to whether it is more appropriate to use aggregate or disaggregate models in forecasting house prices when using hedonic modeling. Baffoe-Bonnie [1] analyzed the dynamic effects of four key macroeconomic variables on housing prices and the stock of houses sold at national and regional levels by using a non-structural estimation technique. Dua et al. [3] used Bayesian vector autoregressive models to examine the usefulness of leading indicators in predicting U.S. home sales. Wheaton et al. [19] applied structural econometric methodology for estimating and forecasting the greater London office market. Lizieri and Satchell [12] utilized the UK's equity market and property company share data to explore the relationships between real estate and the rest of the economy by using a two sector analytic model. Leece [10] considered the choice of mortgage instrument when the rate of interest is fixed for a short duration, with reversion to a variable (bullet) rate mortgage contract. Marček [14] presented an applied presentation of the time series models of the amount of the time and savings deposits of households useful in forecasting its data. Magdisyuk [13] considered some aspects of using a cascade-correlation network in the investment task, in which it is required to determine the most suitable project to invest money. Thiel and Mroz [17] solved the problem of pointing at the best heating system by applying multi-criterion analysis. Leung and Hui [11] attempted to introduce the application of the option pricing theory to the valuation of property development projects by integrating both the capital budgeting and the strategic planning that were based on the London Docklands saga. Kvederytė et al. [9] and Zavadskas et al. [23] described the multivariant design and a multiple criteria analysis of a building's life cycle. Ginevičius and Andruškevičius [6] analyzed the planning of real estate guarantee service costs by applying correlative-regressive analysis. Zavadskas et al. [21] presented an analysis on the modeling and forecasting of housing credit access by applying developed methods of multiple criteria analysis. Zavadskas et al. [24] described the multiple criteria analysis of a facilities management.

Applying multiple criteria analysis methods may increase the efficiency of modeling and forecasting of real estate sector and its macro- and micro-level environment and its development trends.

3. Main Stages of Forming a Lithuanian Real Estate Sector's Development Model

The research's aim was to produce a rational real estate sector model for Lithuania by undertaking a complex analysis of micro and macro level variables affecting it (i.e. legislation, taxes, liquid secondary market, market transparency, professional bodies, lending institutions, mortgage, the techniques of selling property, insurance, ICT, education, valuer's liability, valuer's fee levels, contracts, investment instruments, credit access, etc.) as well as providing recommendations on how to increase its efficiency. The research was performed by studying the expertise of advanced industrial economies and by adapting the findings to Lithuania. A simulation was also undertaken to provide insight into creating an effective real estate sector's environment.

The research included the following stages. Stage 1: determination and description of micro and macro level factors affecting the efficiency of a real estate sector; Stage 2: a conceptual description of the existing situation of the Lithuanian real estate sector and countries in transition and advanced industrial economies. Development of a conceptual database of micro and macro level factors; Stage 3: a quantitative description of the existing situation of the Lithuanian real estate sector, countries in transition and advanced industrial economies. Development of quantitative database of micro and macro level factors; Stage 4: determination of common regular features of development trends of the real estate sector in advanced industrial economies; Stage 5: determination

of rational micro and macro level factors; Stage 6: working out a model of the Lithuanian real estate sector's development trends. Upon completion of such a model, the interested parties, by taking into consideration the existing limitations and existing possibilities of the real estate sector's environment will then be able to use their financial resources in a more rational manner.

In order to throw more light on the subject a more detailed description of some of the above-mentioned stages of analysis follows:

- Development of a conceptual and quantitative description of real estate sector,
- Determining rational housing investment instruments and lenders.

4. Conceptual and Quantitative Description of a Real Estate Sector

In order to find the most efficient real estate sector's environment for a particular country an exhaustive conceptual and quantitative description should be made. A quantitative and conceptual description provides information about various aspects (i.e. economical, social, technical, infrastructural, qualitative, legal, institutional, management, etc.) of a real estate sector. The data from this quantitative and conceptual analysis was used to identify a real estate sector's development trends in EU and the U.S. as well as for providing some recommendations for use in Lithuania.

Conceptual descriptions of a real estate sector presents textual, graphical, numerical, visual information and the criteria used for their definition, as well as giving the reason for the choice of this particular system of criteria, their values and weights. Conceptual information is needed to make a more complete and accurate evaluation of the alternatives that were considered. It also helps to get more useful information as well as developing a system and subsystems of criteria and defining their values and weights.

The development of a real estate sector's conceptual description for Lithuania was done by means of an analysis of experiences and knowledge from advanced industrial economies and by their adaptation to Lithuania. In the research, different versions of advanced industrial economies' practical experiences and policies in the field of real estate sectors were analyzed. Initially, a determination of micro and macro level factors describing the real estate sector was made. Then, the existing situation of a real estate sector in Lithuania and of advanced industrial economies was described in conceptual form. Subsequently the determination of development trends (general regularities) of the real estate sector in advanced industrial economies and their differences from those of Lithuania was made.

A conceptual analysis of major trends in advanced industrial economies helped to create a model that reflects the Lithuanian trends in real estate sector's development. However, the choice of an actual development trend in Lithuania is highly dependent on a particular situation. While forming a model of the Lithuanian real estate sector's development major international trends of real estate sector's developments were considered and took into consideration the particular and actual economic, social, legislative, political and technological situation in Lithuania.

Using the conceptual information that is here presented formed the quantitative information. The quantitative information is based on criteria systems and subsystems, units of measure, values and initial weights. The determination of the utility degree of the micro and macro level factors under investigation and the establishment of the priority order for its implementation does not present much difficulty if the criteria's numerical values and weights are obtained and the multiple criteria decision making methods are used [20].

The process of determining the system of criteria, qualitative criteria initial weights and numerical values of the micro and macro level factors under investigation is based on the use of various literature sources, expert methods, www, etc. The magnitude of weight indicates how many times one criterion is more/less significant than another in the multiple criteria evaluation of micro and macro level factors. The results of the comparative analysis of the micro and macro level factors are presented as a grouped decision making matrix.

The above comparative conceptual and quantitative analysis of real estate in developed countries and in Lithuania allowed us to identify areas where the situation in Lithuania is comparable, partly comparable or quite different from the level attained by advanced industrial economies. The data from this conceptual and quantitative analysis were used in identifying real estate sector's development trends in EU and the USA as well as providing some recommendations for Lithuania [2, 8, 22]. In order to give a full assessment of the influences from the micro and macro level factors in influencing the total efficiency of a real

estate sector, it is necessary to analyze them in more detail and in conceptual and quantitative forms. In order to demonstrate the application of the above techniques to developing of a rational real estate sector's conceptual and quantitative models for Lithuania a determination of rational housing investment instruments and lenders will be considered below as a sample.

5. Determining Rational Housing Investment Instruments and Lenders

5.1. Various Factors and Interested Parties Affecting the Efficiency of Housing Investment Instruments

A great number of effective housing investment instruments have been developed and successfully used in advanced industrial economies [7, 15, 18]. Economic, legislative, political, social, technical and cultural situations are not the same in various countries. There is also a diversity of traditions. Market economy has been developed to a various extent as well. This means that often the efforts to introduce housing investment instruments into the economy of some other state proved to be efficient in some countries but did not succeed in others. It is known that researchers and practitioners use diverse criteria when analyzing the efficiency of housing investment instruments. Basing oneself on their expertise, the efficiency of housing investment instruments may be approached by taking into account the following issues: compatibility of an investment instrument with an available market system; the availability of parties interested in using an instrument and capable of using it; compatibility of an investment instrument with a state's legislative system; interest rates; period of maturity; down payments; sweat equity; loan-to-value ratios; administration; marketability; loan repayment and payment of interest; risk and guarantee; waivers of closing costs; delinquency on loans, etc.

Efficiency of housing investment instruments also depends on the interested parties such as the homeowners, State government, local government, financial institutions, landlords, builders and developers, speculators and real estate agents.

5.2. Development of Quantitative and Conceptual Data Bases as Housing Investment Instruments

In order to find the most efficient housing investment instruments for a particular country, the country's exhaustive conceptual and quantitative description should be formed. The data then obtained should be subject to multiple criteria analysis, so as to help to choose the most rational variants.

The results of the conceptual comparative analysis of the investment instruments are presented as a matrix where columns contain *n* alternative investment instruments that are being considered (Fixed-Rate Mortgage, Low-Income Housing Tax Credits, Mortgage Credit Certificates, Mortgage Pass-Through Securities, Housing Bonds, Housing Trust Funds, Mortgage Revenue Bonds, etc.) while all conceptual information pertaining to them is found in *m* lines (see Figure 1).

A conceptual description of an investment instrument's life cycle presents textual, graphical, numerical, mathematical and other forms of information on the investment instruments and the criteria used for their definition, as well as giving the reason for the choice of this particular system of criteria, their values and significances. Conceptual information is needed to make a complete and accurate evaluation of the alternatives that are being considered. It also helps to get more useful information as well as developing a system and subsystems of criteria and defining their values and significances. Figure 1 illustrates the development of a conceptual database's fragment that contains information on housing investment instruments.

The results of the quantitative analysis of the investment instruments are presented as a grouped decision making matrix where columns contain *n* alternative investment instruments that are being considered, while all quantitative information (system of criteria, measuring units, criteria numerical values and weights) pertaining to them is found in *m* lines (see Table 1).

5.3. Searching for Rational Housing Investment Instruments and Lenders

The quantitative and conceptual databases that are being developed now give an exhaustive description of housing investment instruments and allow for their multiple criteria analysis. This, in turn, helps to determine the investment instruments that are efficient for the country in question. Moreover, the databases and multiple criteria analysis offered could also be used in searching for efficient lenders.

Since the efficiency of alternatives of a housing investment instrument and a lender is determined by taking into account a lot of different information a multiple criteria analysis should include methods that

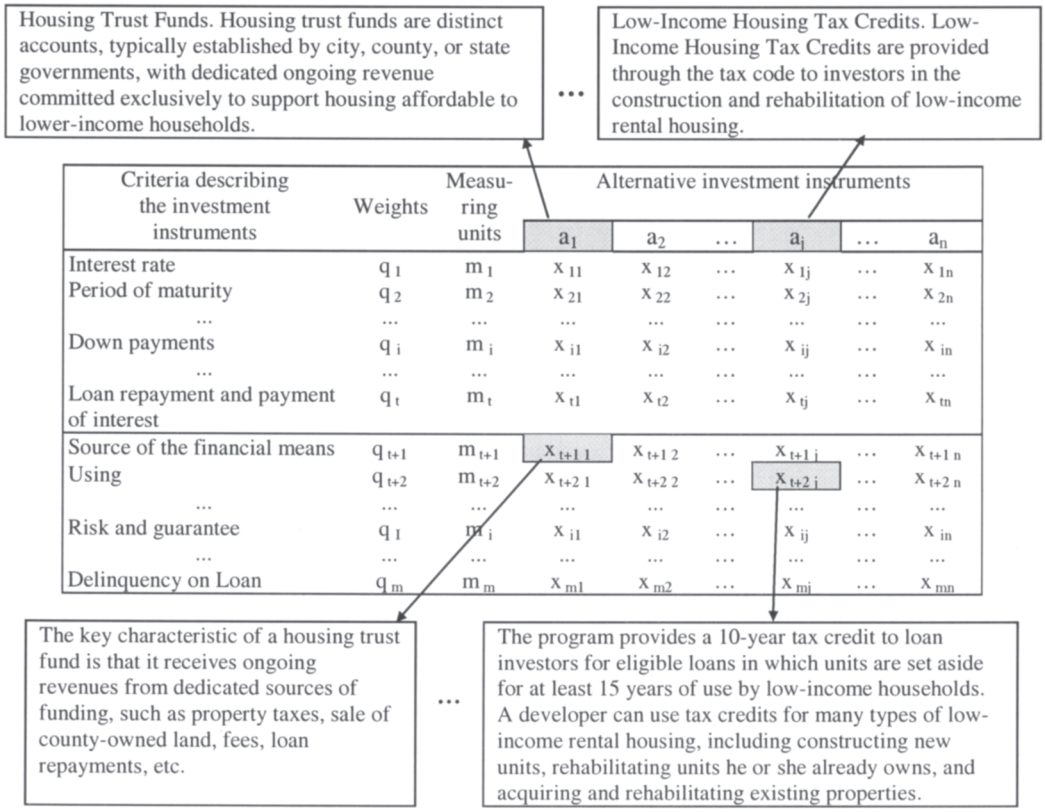

Figure 1. A fragment of developing housing investment instruments conceptual database

Table 1. A fragment of developing housing investment instruments quantitative database

Criteria describing the investment instruments	Weights	Measuring units	Compared investment instruments					
			a_1	a_2	…	a_j	…	a_n
Interest rate	q_1	m_1	x_{11}	x_{12}	…	x_{1j}	…	x_{1n}
Period of maturity	q_2	m_2	x_{21}	x_{22}	…	x_{2j}	…	x_{2n}
…	…	…	…	…	…	…	…	…
Down payments	q_i	m_1	x_{i1}	x_{i2}	…	x_{ij}	…	x_{in}
…	…	…	…	…	…	…	…	…
Loan repayment and payment of interest	q_t	m_t	x_{t1}	x_{t2}	…	x_{tj}	…	x_{tn}
Source of the financial means	q_{t+1}	m_{t+1}	$x_{t+1\,1}$	$x_{t+1\,2}$	…	$x_{t+1\,j}$	…	$x_{t+1\,n}$
Using	q_{t+2}	m_{t+2}	$x_{t+2\,1}$	$x_{t+2\,2}$	…	$x_{t+2\,j}$	…	$x_{t+2\,n}$
…	…	…	…	…	…	…	…	…
Risk and guarantee	q_1	m_i	x_{i1}	x_{i2}	…	x_{ij}	…	x_{in}
…	…	…	…	…	…	…	…	…
Delinquency on Loan	q_m	m_m	x_{m1}	x_{m2}	…	x_{mj}	…	x_{mn}
Utility degree of alternatives			N_1	N_2	…	N_j	…	N_n
Priority of investment instruments			Q_1	Q_2	…	Q_j	…	Q_n

enable a decision maker to implement a comprehensive analysis of the variants and so lead to the making of a proper choice. The following methods are aimed at performing this function [20]:

- A method for determining the initial weights of the criteria,
- A method for the criteria weights establishment,
- A method for multiple criteria analysis and the setting of priorities,
- A method for the determining of alternatives of a utility degree.

6. Multiple Criteria Analysis of Alternative Loans

6.1. Sample Problem Solution

To illustrate the efficiency of the model suggested a

sample problem and solution is given below. Firstly, a study case will be described and the problem formulated.

A family of 3 persons would like to obtain a mortgage loan for purchasing a new 2–room apartment. The value of the housing to be bought is 100,000 Litas. An approximate amount of the loan is 70,000 – 85,000 Litas and depends on the terms of mortgage loans provided by the financial institutions that are under consideration. The net family income per month is 3,200 Litas. The maturity of the loan is 10 years. (1 EUR = 3,45 Litas 2004).

By regarding the terms of mortgage loans issued by seven financial institutions: the Baltic-American Enterprise Fund (BalAEF) (I), Vilnius Bank (II), NORD/LB Lietuva (III), Hansabankas (IV), Snoras Bank (V), Sampo Bank (VI) and Nordea Bank Lietuva (VII) and by taking into account the information collected on criteria system (see Table 2) an estimate can be made.

The Complex Determination of the Weights of the Criteria Taking into Account their Quantitative and Qualitative Characteristics [20].

A decision-making matrix is made (see Table 2) when one uses a description of the presented conceptual alternatives. The total complex weight of major criteria pertaining to the alternative loans is based on their quantitative and qualitative characteristics and may be determined from the above matrix.

The calculation of the criteria weights is carried out in seven stages. Stage 1: the determination of the sum of values for every quantitative criterion; Stage 2: the total monetary expression of every quantitative criterion describing the investigated loan is obtained; Stage 3: the overall quantitative criteria magnitude sum expressed in money terms is determined; Stage 4: the quantitative criteria weight describing the loan that can be expressed in money terms is determined; Stage 5: in order to achieve full coordination between the weights of quantitative and qualitative criteria, a compared standard value (E) is set; Stage 6: the initial weight v_i of the qualitative criteria is determined by using expert methods by comparing their relative weight to the weight E of the selected compared standard; Stage 7: the weight of qualitative criteria is determined. The calculation results are provided in Table 2.

The above method allows for the determination of weights of criteria that are maximally interrelated and depend on qualitative and quantitative characteristics of all criteria.

The Multiple Criteria Complex Proportional Assessment of Versions (COPRAS) [20].

This method assumes direct and proportional dependence of significance and priority of investigated versions on a system of criteria and adequately describes the alternatives on values and weights of the criteria. The system of criteria is determined and experts also calculate the values and initial weights of criteria.

Interested parties taking into consideration their pursued goals and the existing capabilities can then check and correct all this information. The assessment results of alternatives that fully reflect the initial data are jointly submitted by experts and interested parties.

The determination of significance and priority of alternatives is carried out in four stages. Stage 1: the weighted normalized decision-making matrix D is formed; Stage 2: the sums of weighed normalized indexes describing the j version are calculated; Stage 3: the significance of comparative versions is determined on the basis of describing positive loan ('pluses') and negative loan ('minuses') characteristics; Stage 4: loan's priority determination. The greater the Q_j the higher the efficiency of a loan. Since $Q_{II} > Q_I > Q_{III} > Q_{IV} > Q_{VI} > Q_{VII} > Q_V$, then priority of the 2nd version (loan issued by Vilnius Bank) is the best (see Table 3).

An analysis of the method presented makes it possible to state that the method may be easily applied to evaluating loans and in selecting the most efficient one, while being fully aware of a physical meaning of the process. Moreover, the method allows for the formulating of a reduced criterion Q_j that is directly proportional to the relative effect of the compared criteria values x_{ij} and weight q_i at the end result.

6. 2. The Utility Degree of Loans

The degree of loan utility is directly associated with the related quantitative and conceptual information. With the increase/decrease of the significance of an analyzed loan, its degree of utility also increases/ decreases. The degree of loan utility is determined by a comparison of the analyzed loan with the most efficient loan. In this case, all the utility degree values related to the analyzed loan will range from 0% to 100%. This will facilitate a visual assessment of the loan's efficiency.

The degree of a loan's utility reflects the extent to which the goals pursued by the interested parties are attained. Therefore, the utility degree may be used as

Table 2. Weight determination of criteria, including their quantitative and qualitative characteristics

The criteria considered	Measuring units	*	Numerical values of criteria of the compared loans							Determination of			
			I	II	III	IV	V	VI	VII	sum of criteria, S_i	initial weight of criteria, p_i	total monetary expression of criteria, P_i	weight of criteria, q_i
Quantitative criteria													
1. Loan repayment and payment of interest	Litas/month	-	909	777	931	965	848	952	953	6335	120	760200	0,8059
2. Hypothecation bond registration, notaries/legal and property registration fees	Litas	-	910	900	900	890	890	910	880	6280	1	6280	0,0067
3. A one-off loan administration fee	Litas	-	800	300	300	300	450	200	400	2750	1	2750	0,0029
4. Life insurance	Litas/year	-	0	270	280	0	280	280	0	1110	10	11100	0,0118
5. Insurance of the housing to be purchased	Litas/year	-	240	220	200	230	240	230	230	1590	10	15900	0,0169
6. The initial payment	Litas	-	20000	30000	15000	15000	30000	15000	20000	145000	1	145000	0,1537
7. Property assessment fee	Litas	-	280	300	290	280	290	300	290	2030	1	2030	0,0022
											V = 947460		
Qualitative criteria													
8. Maturity of the loan	Years	+	10	10	10	10	10	10	10	–	0,2536	–	0,2434
9. General terms and conditions of the loan	Points	+	9,07	8,86	7,95	8,05	7,15	8,11	8,03	–	0,3158	–	0,3031

* - The sign (+ (-)) indicates that a greater (less) criterion value is better
1 EUR = 3,45 Litas

Table 3. Multiple criteria evaluation of alternative loans from different financial institutions

The criteria considered	Measuring units	*	Weights	Weighted normalized values of criteria of the compared loans						
				I	II	III	IV	V	VI	VII
1. Loan repayment and payment of interest	Lt/month	-	0,8059	0,1156	0,0988	0,1184	0,1228	0,1079	0,1211	0,1212
2. Hypothecation bond registration, notaries/legal and property registration fees	Litas	-	0,0067	0,0010	0,0010	0,0010	0,0009	0,0009	0,0010	0,0009
3. A one-off loan administration fee	Litas	-	0,0029	0,0008	0,0003	0,0003	0,0003	0,0005	0,0002	0,0004
4. Life insurance	Lt/year	-	0,0118	0,0000	0,0029	0,0030	0,0000	0,0030	0,0030	0,0000
5. Insurance of the housing to be purchased	Lt/year	-	0,0169	0,0025	0,0023	0,0021	0,0024	0,0025	0,0024	0,0024
6. The initial payment	Litas	-	0,1537	0,0212	0,0318	0,0159	0,0159	0,0318	0,0159	0,0212
7. Property assessment fee	Litas	-	0,0022	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003
8. Maturity of the loan	Years	+	0,2434	0,0348	0,0348	0,0348	0,0348	0,0348	0,0348	0,0348
9. General terms and conditions of the loan	Points	+	0,3031	0,0480	0,0469	0,0421	0,0426	0,0379	0,0430	0,0425
The sums of weighted normalized maximizing indices of the loans S_{+j}				0,0828	0,0817	0,0769	0,0774	0,0726	0,0777	0,0773
The sums of weighted normalized minimizing indices of the loans S_{+j}				0,1415	0,1374	0,1410	0,1427	0,1469	0,1439	0,1465
Significance of loans Q_j				0,2270	**0,2301**	0,2215	0,2204	0,2115	0,2195	0,2165
Priority of loans				2	**1**	3	4	7	5	6
Utility degree of loans, %				98,63 %	**100,00 %**	96,27 %	95,77 %	91,90 %	95,37 %	94,08 %

* The sign +/- indicates that a greater/lesser criterion value is better; 1 EUR = 3,45 Litas

a basis for determining the loan's value. The more objectives attained, the more significant the objectives are, and the higher the loan's degree of utility and its value will be.

The results of the multiple criteria evaluation of alternative loans from different financial institutions are given in Table 3. From the values, it can be seen that the 2nd version is the best one. The utility degree $N_2 = 100\%$. The 1st version according to its priority was established as the second best variant. The utility degree of it $N_1 = 98.63\%$.

The degree of a loan's utility reflects the extent to which the goals pursued by the interested parties are attained. For example, the significance of the difference between the utility degree of loan 2 ($N_2 = 100.00\%$) and loan 5 ($N_5 = 91.90\%$) shows that loan 2 is more useful by 8.10% than is loan 5.

Results acquired after calculation (Table 3) show that the first variant of the loan as per established conditions conformed to the client's purposes and needs. This analysis of loans from different financial institutions was made from a client/user's position. Taking into consideration the acquired results, various participants of housing credit may also adjust their decisions in accordance to their priorities and the present conditions.

7. Conclusions

In modeling and forecasting future perspectives and the main development trends of the Lithuanian real estate sector, it is possible to be prepared for effective changes in micro and macro environments. The micro and macro analysis of a real estate sector in developed countries and in Lithuania can allow one to identify areas where the situation in Lithuania is comparable, partly comparable or quite different from the level attained by developed countries. Data from the above analysis can be used in identifying real estate sector's development trends in developed countries as well as providing some recommendations for Lithuania. In order to demonstrate the application of the above research to developing a rational institutional model of the Lithuanian real estate sector some recommendations for improving the real estate sector were presented.

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