FUZZY LOGIC IN CONSUMER POLICY

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Abstract

Consumer policy is considered to be an integrated part of the economic policy of each country. In general, consumer policy improves the market functioning using the information about products and services which are important to help consumers with the rational choice. The policy protects consumers against the market imperfections due to which they are in the disadvantageous position in a comparison with retailers or suppliers of goods and services. Firstly, this contribution determines the importance of consumers, their behaviour, trendology and also the changes in their behaviour and new trends both caused by altered economic conditions. Secondly, the principles and procedures of fuzzy sets are used to measure the level of consumer policies in the chosen European countries to show the differences throughout the union. Fuzzy logic is a theory enabling to model uncertainty in the natural language which means that it comes close to approximate than to exact basic of thinking. The theory of fuzzy sets and fuzzy logic were developed to enable to process mathematically the linguistic terms.

Key words: consumer, consumer policy, consumer behaviour, fuzzy logic, fuzzy set

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Introduction

Customer is considered to be the king and so the companies try to affect them to increase their profit and market share. Consumers are people who consume products and services gained on the market and they are the aim of all economic processes and relations which are realized in the society. And this is the reason why consumer policy is one of the most important parts of the country economic policy.

The consumer is the bearer of the consumption and two main types can be defined: an individual consumer and secondly an organizational consumer. Šíbl (2002) defines the consumer as following: it is a term used for identification of two different consumption units, the personal consumers and the organizational. The personal consumer is an individuality who purchases products and services for their own consumption, for the family member, family usage or as a present for another person. In all the mention cases, the product is bought for

final consumption of individuals, so called final consumers. The second group of consumers is divided into some groups: private companies, state authorities (local, regional, national) and institution purchasing products, equipment and services to be able to provide their operation regardless of the fact if they are profitable or not. The activity which leads to consumer needs´ satisfaction is called consumer interest.

A consumer is generally thought of as a person who identifies a need or desire, makes a purchase and then disposes of the product during the three stages in the consumption process. In many cases, however, different people may be involved in the process (Solomon, 2006). Consumers may be organizations or groups in which one person may make the decisions involved in purchasing products that will be used by many, as when a purchasing agent orders the company's office supplies. In other organizational situations, purchase decisions may be made by a large group of people. Consumers are usually influenced by various factors and these create their behaviour. Stašenková (2006) claims that consumer behaviour is an important and constant decision-making process of searching, purchasing, using, evaluating and disposing of products and services. Customer taste and preferences are changing, leading to radical transformation in lifestyle and shopping patterns, which in turn is giving rise to new and developed business scope (Das, Kumar, 2009). However, consumer behaviour may vary according to several factors: sale promotion, product satisfaction, good packaging, recommendation, advertisement (Das, Kumar, 2009), relationship between involvement and brand loyalty (Knox, Walker, 2003), travel distance, preference for an in-store production, level of sale assistance and the most significant- altered economic conditions. Lagged changes in consumer sentiment and the frequency of recent reversals of sentiment are found to be significant predictors of a change (Yao, Partington & Stevenson, 2013).

Every aspect of the consumer market, together with the factors that influence consumer behaviour, creates consumer policy. In general, consumer policy improves the market functioning using the information about products and services which are important to help consumers with the rational choice. For the purpose of this paper, fuzzy logic is to be used to evaluate and compare the level of consumer policy. The way we cognize the world is vague and multivalued. The more we aim at realizing coherence with the world, the more we encounter fuzziness (Magni,Malagoli & Mastroelo, 2006). Fuzzy logic is a theory enabling to model uncertainty in the natural language which means that it comes close to approximate than to exact basic of thinking. It is possible to use it in the various fields. The number of scientific contributions using fuzzy logic in business and finance has sharply increased

recently. Fuzzy logic may be safely and usefully applied to business, financial, industrial applications (see, for instance Craiger, Coovert & Teachout, 2003, for predicting job performance using fuzzy logic or Chen, Tzeng & Tang, 2005, for an example of fuzzy multiple criteria decision making). In this article the principles and procedures of fuzzy sets are used to measure the level of consumer policies.

In this paper is firstly realized a literature review in order to identify consumers, their behaviour, trendology and new trend caused by altered economic conditions. Further, using data from secondary sources and fuzzy logic application, the main differences between the consumer policies in the Slovak Republic and Great Britain were analyzed, and finally the situation in the field of European Union consumer policies is portrayed.

## 2 Fuzzy logic application in consumer policy

As an example of practical application of fuzzy systems two European Union countries - United Kingdom and Slovakia were selected. This selection is subjective and aimed to compare our country which adopts various measures to increase awareness of consumers and retailers and the UK, which has been considered to be the country with the highest level of consumer policy. Fuzzy system is applied and tested to determine the level of consumer policy in these countries on the basis of four chosen criteria. The program FuzzyTech 5.5 was used for the analysis. The process of fuzzy processing contains of four steps: fuzzification – the phase associated with the definition of the universe (universal set representing particular inputs) and fuzzy sets (sets that are constructed over the universal sets); base of rules - in this phase is formed mutual interdependence between inputs and outputs; calculation - coupled to the process of fuzzy reasoning and deffuzification - the result of the final phase is to define a fuzzy set, which resulting shape is derived from the shape of the activated output set. A universal set presents individual inputs which affect a single output, in this case it is the level of consumer policy in the country. Except for input values, the rule base (in this case two - one base for Slovakia and the other for the UK) and output variables (level of consumer policy in the UK and Slovakia) are determined. Each output is influenced by 4 inputs, so four universal input sets can be set (Fig. 1[1]): number of RAPEX notification which poses a serious risk to the consumer (RAPEX), knowledge of consumer

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[1] All tables in this paper are the author's own processing and the output of the program FuzzyTech 5.5.

policy by retailers (ZSLO), changes of consumers´ mindset due to media (MEDIA) and customer trust in consumer organizations to protect their consumer rights (SPOTORG).

Fig. 1: Fuzzy model scheme
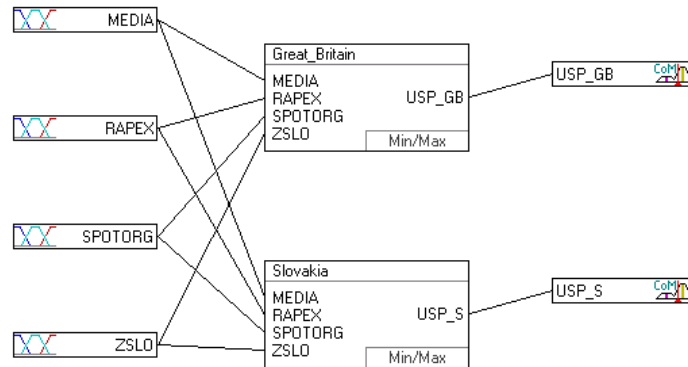
Each universal set is constructed of fuzzy sets which may take various linguistic variables and values. In this practical example input linguistic variables (RAPEX, MEDIA, SPOTORG and ZSLO) can acquire the following linguistic values: low, medium and high while the output can be very low, low, medium, high and very high. Therefore the task is to place an element of a set, e.g. RAPEX, into one of three sets (low, medium, high). The boundaries among these sets are not sharp – that is why there are fuzzy sets. To depict the situation clearly only chosen linguistic variables are used in the model.

Fuzzification process of input data is shown on the input criteria RAPEX. In 2010 there were 1953 notifications in the European Union (Zmeškal et al., 2004) which varied from 5 reports in Luxembourg to 204 notifications in Germany. Thus, this variable can take values from <5; 204>. In the fuzzification process these crisp inputs are changed to linguistic variables (low, medium, high). For example, Slovakia had 62 notifications in 2010, while the United Kingdom 88. The higher the number of notifications of serious risk on the market, the higher the level of consumer policy. This fact is then taken into account in the formation of the rule base. In the next step of fuzzy process, base of rules, it is necessary to set the rules and their weights between inputs and outputs. In the whole process this step is the most important, as it provides all the basic combinations necessary for the proper model functioning. Weighs may change during the program optimization. In this illustration four inputs were chosen, each of which can take three values, which in practice means that for each block of rules (for both the UK and Slovakia) $3^4 = 81$ combinations can be created. Short sample of rules with weights of block of rules of United Kingdom is demonstrated in

Fig. 2. Similar procedure was used to set block of rules for Slovakia. When creating fuzzy rules, it is necessary to take the weight of each entry criteria into account, for instance the influence of media has a lower degree of importance than the knowledge of consumer legislation. The level of importance of each criterion is combined with real values that the factor takes. Subsequently, the linguistic values of particular variables are evaluated by using <IF; THEN> function, the output of which is determination of the output value for each combination. Therefore, when setting the rules both factors must be considered.

Fig. 2: Rule base of the United Kingdom

#	IF				THEN	
	MEDIA	RAPEX	SPOTORG	ZSLO	DoS	USP_GB
1	low	low	low	low	1.00	very_low
2	low	low	low	medium	0.90	very_low
3	low	low	low	high	0.80	low
4	low	low	medium	low	0.90	very_low

In the first line it may be seen that if the impact of the media is low, the number of RAPEX notifications is low, consumer confidence in consumer organizations and knowledge of consumer legislation by retailers are also at low level, the overall level of consumer policy in Britain is defined as very low. This way is set an accessible, understandable and transparent data base of this issue. The pre last step of the process is to set the values of the individual attributes which are necessary for final evaluation of the consumer policy in the countries. The last step is the process of defuzzification. The main task is to convert the resulting output functions to the real (crisp) value. Values of particular inputs are set (statistical values published by the European Commission were taken into consideration) and on the basis of the rule base the output value is defined. Defuzzification is performed by the program itself when the input data is set properly. The overall result therefore shows that the level of consumer policy based on selected criteria is ranked as high in Slovakia, while in the UK as very high.

Fig. 3: Level of consumer policy in the Slovak republic and in the United Kingdom
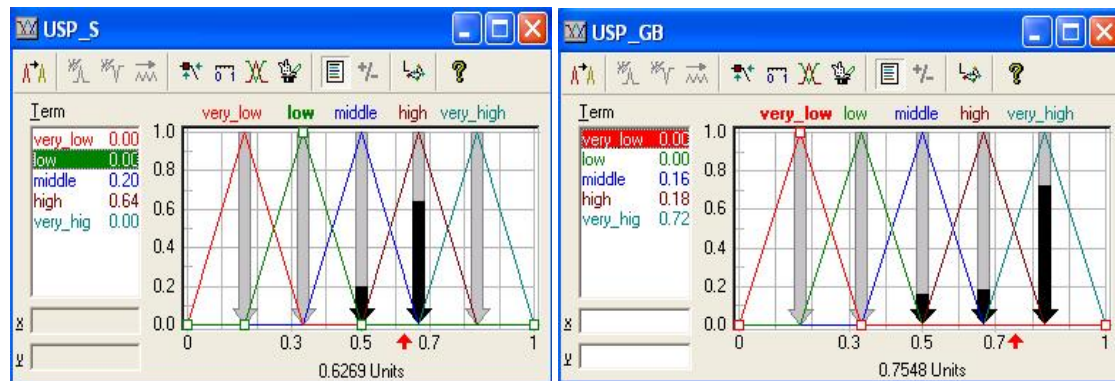
a) Slovakia   b) Great Britain

This fact is confirmed by the statistics issued by the European Commission, which evaluated (using CCI index) consumer policy in these two countries in 2011 as follows: CCI index for Slovakia recorded a slight increase of one point compared to 2010 and in 2011 it reached a value of 54. The prevalence of unfair commercial practices is a reason for concern. The United Kingdom had the second highest CCI index from all EU countries and with value of 73 in 2011. The United Kingdom has experienced a slight decrease in its Consumer Conditions Index, from 74 in 2010 to 73 in 2011. (Directorate-General for Health and Consumers, 2012).

3   Current situation of European consumer policy

Consumers worldwide have been influenced by economic recession which has had a significant impact on their behaviour and decision-making. During the economic recession many changes have made their presence, resulted in the new consumer shopping behaviour. The one associated with wasteful, impulsive spending was replaced by thoughtful, responsible spending which is and also will be more socially acceptable. The thing is that the economic recession has completely changed the shopping behaviour: seventy-two percent of all shoppers recently indicated that their shopping behaviour has changed significantly or somewhat as a result of the economic environment, and only 7% have made no changes at all (Kantar retail and Pricewaterhouse Coopers, 2010). Consumers try anyhow to spend minimally and maximize their savings. To achieve the given objective they use many tools, techniques and programs to help them, e.g. they prepare shopping lists, plan meal, use coupons, vouchers or compare shops.

Traditional consumers were usually not involved in production, defined as conformists and most often uninformed. Their behaviour was largely motivated by a need for comfort. Bohlen in his research done for McKinsey in August 2009 found that, in any given category, an average of 18 percent of consumer-packaged-goods consumers bought lower-priced brands in the past two years. Of the consumers who switched to cheaper products, 46 percent said they performed better than expected, and the large majority of these consumers said the performance of such products was much better than expected. As a result, 34 percent of the switchers said they no longer preferred higher-priced products, and an additional 41 percent said that while they preferred the premium brand, it "was not worth the money (Bohlen, 2010)."

Not surprisingly, information is the force that operated the consumers. Technology adoption and the recession are two key factors that have likely impacted consumer´s definition of necessity (Rodrigues, 2009). Due to expansion of information technology and the Internet, information is now cheaper and available to almost all consumers. It is no wonder, that more and more consumers are buying online and online services and social media have become the main source of information. Smart shopping needs to be mentioned as many consumers more often look for bargains. On the other hand, consumers are less likely to visit entertainment centres, eat out, etc. and they incline to stay at home and spend time there.

As a consequence of all the economic changes, several new trends in shopping behaviour can be identified. Deal-seeking behaviour is the one that is based on taking advantage of sales, using coupons, comparison shopping and will be only partly abandoned post-recession. The type of behaviour, when consumers are buying only truly needed things, postponing purchases or buying fewer things is defined as limiting behaviour. This trend is in the post-recession time mostly expected by older shoppers. The last one, trading-down behaviour, is related to the choice of retailer, product or brand. Its essence can be found in private trademarks, especially those which guarantee high quality at lower prices.

Informed, empowered and sophisticated consumers who understand the abundant and complex choices they face tend to reward efficient and innovative businesses, thereby sharpening competition and stimulating growth. However, the European Union portrays consumer as someone who is "reasonably well-informed, and reasonably observant and circumspect" (Directorate-General for Health and Consumers, 2012). Consumer policy can give consumers real power to act as drivers of innovation and growth. Better consumer conditions not only improve consumer welfare, but can also benefit the economy as a whole. Consumers' capacity to share and compare information more and more rapidly can have a

substantial impact on their ability to foster the most efficient and productive parts of the economy, and hence stimulate growth. Thus, the level of consumer policy is an important factor and it also has been influenced by the economic crisis as it may be seen in the following table, Tab. 1. It cannot be said in general that the crisis has had the same impact on every country, but if there was any decrease in the level of consumer policy, measured by CCI index[2], it was in 2009, which was a consequence of altered economic conditions.

In the next part of the paper, the fuzzy logic is used to measure the level of consumer policy in the chosen countries. It would be interesting and useful to compare mutually the level of consumer policies among the European Union countries. As it is, in the use of fuzzy sets, lengthy and complicated process (especially the rule base), which is the subject of further research, the level of consumer policies in other Member States is described by the CCI index in the Tab. 1.

Tab. 1: Level of consumer policy in the EU member states (2008-2011)

EU member state	CCI 2008	CCI 2009	CCI 2010	CCI 2011	EU member state	CCI 2008	CCI 2009	CCI 2010	CCI 2011
Austria	61	64	67	70	Latvia	54	49	54	59
Belgium	66	57	61	68	Lithuania	48	44	49	52
Bulgaria	38	37	42	49	Luxembourg	63	68	70	74
Cyprus	59	49	54	54	Malta	61	54	58	60
Czech Republic	50	48	52	54	Netherlands	64	61	66	69
Denmark	67	60	65	71	Poland	54	45	55	55
Estonia	57	54	54	57	Portugal	50	55	57	57
Finland	70	67	66	70	Romania	44	44	46	51
France	58	59	59	65	**Slovakia**	**50**	**51**	**53**	**54**
Germany	59	57	63	67	Slovenia	57	53	54	52
Greece	54	44	48	49	Spain	55	49	53	55
Hungary	56	57	53	58	Sweden	65	58	62	65
Ireland	63	67	72	70	United Kingdom	67	68	74	73
Italy	49	52	66	57	EU 27	57	55	60	62

Source: Directorate-General for Health and Consumers, 2012

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[2] The Consumer Conditions Index provides an overview of the key indicators describing the consumer environment at national level, as measured through surveys of perceptions, attitudes and experiences of consumers in particular. The purpose of this index is to create a long-term data set which can be used by national policymakers and stakeholders to assess the impact of their policies on consumer welfare. By comparing national outcomes with those of other countries, best practices can be identified and promoted. The higher the index, the better the level of consumer policy.

Conclusion

Every change of the social or economic situation can change the way the consumer purchases, but especially what do they buy and why. In the European countries consumers´ purchases are more purposeful, economical and responsible. Thus, consumers have become more vigilant and their behaviour influenced by thrifty regime in the time of recession will, surely, continue in post-recession time. Despite the fact that the consumer policy of our country is evaluated as high, proved by application of fuzzy logic and confirmed by CCI index, there still are many problems to solve. Although, the level of consumer policy in the EU countries was influenced by altered economic conditions, the situation may just start to be better.

Acknowledgment

References

[1] Bohlen, B. (2010). How the recession has changed us consumer behaviour. Retrieved fromhttps://www.mckinseyquarterly.com/How_the_recession_has_changed_US_consumer_behavior_2477

[2] Chen, M., Tzeng, G., & Tang, T. (2005). Fuzzy MCDM approach for evaluation of expatriate assignments. (Vol. 4, No. 2, p. 277–296). International Journal of Information Technology & Decision Making.

[3] Craiger, J. P., Coovert, M. D., & Teachout, M. S. (2003). Predicting job performance with a fuzzy rule-based system. (Vol. 2, No. 3, p. 425–444.). International Journal of Information Technology & Decision Making.

[4] Das, G., & Kumar, R. V. (2009). Impact of sales promotion on buyer behaviour: An empirical study of indian retail customers. (Vol. 3, pp. 11-24). Journal of Management.

[5] Directorate-General for Health and Consumers. (2012). Consumer conditions scoreboard – consumers at home in the single market 7th edition – may 2012. (p. 128). Luxembourg: Office for Official Publications of the European Union. Retrieved from http://ec.europa.eu/consumers/consumer_research/editions/cms7_en.htm

[6] Kantar Retail and PricewaterhouseCoopers. (2010). The new consumer behavior paradigm: Permanent or fleeting? Retrieved from http://www.wpp.com/NR/rdonlyres/1BF0C6E8-C8AF-4B91-93F2-0482526B6004/0/newconsumerbehaviorparadigm.pdf

[7] Knox, S., & Walker, D. (2003). Empirical developments in the measurement of involvement, brand loyalty and their relationship in the grocery market. (Vol. 11, pp. 271-286). Journal of strategic marketing.

[8] Magni, C. A., Malagoli, S., & Mastroelo, G. (2006). An alternative approach to firms' evaluation: Expert systems and fuzzy logic. (Vol. 5, No. 1, pp. 195-225). International Journal of Information Technology and Decision Making.

[9] Rodrigues, S. (2009). Consumer behaviour report: Economic trends in consumer spending.. Retrieved from https://mr.pricegrabber.com/Economic_Trends_in_ConsumerSpendingJune2009CBR_1.pdf

[10] Solomon, M., et al. (2006). Consumer behaviour: A European perspective. (3rd ed., p. 731). England: Pearson education limited. ISBN 978-0273-68752-2.

[11] Stašenková, B. (2006). Prečo a ako vzdelávať spotrebiteľa. (p. 58). Bratislava: Metodicko- pedagogické centrum Bratislavského kraja. ISBN 80-7164-408-0.

[12] Šíbl, D. (2002). Veľká ekonomická encyklopédia. (p. 967). Bratislava: Sprint. ISBN: 8089085040

[13] Yao, J., Partingnton, G., & Stevenson, M. (2013). Predicting the directional change in consumer sentiment. (Vol. 38, No.1). Australian Journal of Management.

[14] Zmeškal, Z., et al. (2004). Finanční modely. (p. 236). Praha: EKOPRESS I. ISBN 80-86119-87.

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