SCIENTIARUM POLONORUM

ACTA

Oeconomia

Wydawnictwo SGGW, ul. Nowoursynowska 166, 02-787 Warszawa
tel. (22) 593 55 20 (-22; -25 – sprzedaż), fax (22) 593 55 21
e-mail: wydawnictwo@sggw.pl
www.wydawnictwosggw.pl

Print: Agencja Reklamowo-Wydawnicza A. Grzegorczyk, www.grzeg.com.pl

From the Scientific Board

There has been the twelfth year of the Acta Scientiarum Polonorum Oeconomia publishing. The Acta is the periodical including several thematic series with uniform graphics and similar format. The publication was set up by group of enthusiasts – employees of agricultural universities and has been published under the patronage of rectors of these universities. Current involvement of academic society in increasing substantive and editorial level of the series, with efforts of the authors, the Programming Board and the Scientific Boards, has contributed to placing the Acta Scientiarum Polonorum (and our Oeconomia series) on the noticeable position in academic research society. Articles can be prepared in Polish with English titles, abstract and keywords. Moreover, we publish also issues in English only. The Scientific Board of the Oeconomia series, concerning the publication range, focus their attention both on substantive content and precision of the form. The articles are revised in "double-blind review" process. All issues of the Acta Scientiarum Polonorum Oeconomia are available in electronic version on the following website http://acta_oeconomia.sggw.pl and abstracts on http://www.acta.media.pl. We are glad to inform that Acta Scientiarum Polonorum Oeconomia are indexed within the AGRIS-FAO, EBSCO, SIGŻ, Copernicus Index, AGRO. Since 2007 every article published in Acta Sci. Pol. Oeconomia is obtaining 9 points at the Ministry of Science an Higher Education ranking list.

<center>*Please send the articles on one of following e-mail addresses:*</center>

<center>*janina_sawicka@sggw.pl*</center>

<center>*acta_oeconomia@sggw.pl*</center>

While sending a printout, please attach also the electronic version on CD or DVD. Letters including note "the Acta Scientiarum Polonorum Oeconomia" should be sent on the following address:

Prof. dr hab. Janina Sawicka
Department of European Policy, Public Finances and Marketing
Faculty of Economic Sciences
Warsaw University of Life Sciences
Nowoursynowska 166, 02-787 Warsaw, Poland
tel.: (+4822) 593 40 70; fax: (+4822) 593 40 77

Yours sincerely
Janina Sawicka
Chairperson of the Scientific Board of the Acta
Sci. Pol. Oeconomia series

EFFICIENCY OF THE PRODUCTION SCALE
OF POLISH DAIRY COMPANIES
BASED ON DATA ENVELOPMENT ANALYSIS

Joanna Baran

Warsaw University of Life Sciences – SGGW

Abstract. This article presents evaluation of efficiency of the production scale of Polish milk processing companies in 1999–2010 performed basing on non-parametric methods. The non-parametric approach stemmed from linear programming method known as the Data Envelopment Analysis (DEA) method. The study involving a sample of 743 objects revealed increasing returns to scale observable in the Polish dairy sector. Further concentration of the dairy sector in Poland should lead to the better results of dairies. This analysis confirmed earlier conclusions of relevant literature.

Key words: production scale, efficiency, dairy sector, Data Envelopment Analysis (DEA) method

INTRODUCTION

Integration with the European Union and ongoing liberalization of international trade has been gradually leading to globalization of the diary market and expansion of the competition area. The dynamically changing environment of the Polish diary companies shows that there is a strong need for a well-thought-out and consistently implemented strategy setting clear objectives with regard to ensuring competitiveness and development. Despite significant transformations that have taken place in the Polish diary business due to market-opening, the sector still lacks sufficient international competitiveness, which results among other things from unfavourable structure (strong dispersion – both with regard to farms and processing plants) and low productivity. In the Polish milk processing sector there are approximately 200 business entities in operation. In Germany the number of diaries is similar to the Polish figures, but it should be stressed that they process over three times as much milk as in Poland with the employment level lower by

Corresponding author – Adres do korespondencji: Faculty of Economic Sciences, Department of Economics and Organization of Enterprises, Warsaw University of Life Sciences – SGGW, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: joanna_baran@sggw.pl.

18% [Seremak-Bulge 2009]. What is more, the Polish diary sector loses its international price competitiveness[1] basing on cheap raw material. In 2009 diaries in countries like Germany, Ireland or the Netherlands paid farmers similar prices for milk, and in Belgium the prices were even lower than in Poland [*Rynek mleka. Stan i perspektywy...* 2009].

Thus, it can be stated that there is a need to improve efficiency and competitiveness of milk processing. Processing efficiency and competitiveness may be increased through growth of production concentration, which should lead to better operational efficiency of milk processing thanks to – among other things – using scale effect and taking advantage of complementarity of resources and skills. The growth of the production scale of diary companies should affect the development of product innovations and bolster the bargaining power with regard to the sale of dairy products.

The concentration of milk processing involves a growth of the scale of production of dairy companies. It should be stressed that so far the problem of analysis and measurement of the effectiveness of the scale of production has not been handled with any common and consistent solution, either in theory or in practice. In the literature a distinction is made among i.a. classic, parametric and non-parametric approach to the analysis of scale efficiency [Pawłowska 2005, Guzik 2009].

In foreign literature it is believed that the milk processing sector exhibits increasing returns to scale [Wiendlmeier 2001, Thiele 2005]. German studies prove that it is possible to significantly reduce unit prices thanks to increasing the scale of dairy production [Wiendlmeier 2001].

The Polish specialist literature does not offer any detailed analysis on the presence of economies of scale in milk processing, either any assessment of the scope of potential benefits arising from scale effect. There is also a gap in the domestic literature with regard to the evaluation of the scale efficiency of milk processing companies basing on different variants of the production function and DEA method. Therefore, the reasons presented above illustrate that it is necessary to address the very important issue for the dairy sector.

The major purpose of the article is to define the type of returns to scale of production of Polish processing companies using non-parametric method for scale efficiency evaluation. In this article the following research hypothesis was formulated: Polish milk processing companies experience increasing returns to scale.

MATERIAL AND METHODS

The studies undertaken cover the Polish milk processing sector in years 1999–2006 (identified as group 10.5 in accordance with the Polish Classification of Activities – standing for milk processing and cheese production, ice cream production excluded). The research objects were selected taking into consideration the pre-defined criteria [Stachak 2003]. The sample included cooperatives operating in the dairy industry and companies having a different legal form which published financial statements in years 1999–2010 in

---

[1] As a consequence of the price increase process in Poland and reduction of prices in Europe.

the Official Journals of the Republic of Poland: "Monitor Spółdzielczy – B" and "Monitor Polski – B". Companies selected from milk processing companies which published financial statements fulfilled the following conditions:
- they prepared an account statement by nature of expenses and
- they achieved more than 70% of revenues from the sale of products.

The first criterion was adopted due to the fact that it was necessary to obtain data needed to achieve the major study objective, i.e. to specify the type of increasing returns to scale in the milk processing sector. The second criterion allowed for evaluating the scale efficiency of companies which actually deal with milk processing, and not companies pursuing a commercial activity as their major source of revenues. The number of companies in the sample corresponded with 28–39% of the number of dairy sector entities depending on the year.

Based on the sample efficiency of the scale of production was evaluated using non--parametric methods. The non-parametric approach to the analysis of the scale efficiency relied on the linear programming methods defined as Data Envelopment Analysis (DEA). The DEA model may be presented mathematically in the following manner [Cooper et al. 2007]:

$$\max \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \qquad u_r, v_i \geq 0$$

where:
- s – quantity of outputs,
- m – quantity of inputs,
- u_r – weights denoting the significance of respective outputs,
- v_i – weights denoting the significance of respective outputs,
- y_{rj} – amount of output of r-th type ($r = 1, …, R$) in j-th object,
- x_{ij} – amount of input of i-th type ($n = 1, …, N$) in j-th object ($j = 1, …, J$).

In the DEA model m of inputs and s of diverse outputs come down to single figures of "synthetic" input and "synthetic" output, which are subsequently used for calculating the object efficiency index [Rogowski 1998, Rusielik 1999]. The quotient of synthetic output and synthetic input is an objective function, which is solved in linear programming. Optimized variables include u_r and v_i coefficients which represent weights of input and output amounts, and the output and input amounts are empirical data [Cooper et al. 2007].

By solving the objective function using linear programming it is possible to determine the efficiency curve called also the production frontier, which covers all most efficient

units of the focus group[2]. Objects are believed to be technically efficient if they are located on the efficiency curve (their efficiency index equals 1, which means that in the model focused on input minimization there isn't any other more favourable combination of inputs allowing a company to achieve the same outputs). However, if they are beyond the efficiency curve, they are technically inefficient (their efficiency index is below 1). The efficiency of the object is measured against other objects from the focus group and is assigned values from the range (0, 1). In the DEA method Decision Making Units (DMU) represent objects of analysis [Charnes et al. 1978].

The DEA models may be categorized based on two criteria: model orientation and type of returns to scale. Depending on the model orientation a calculation is made of technical efficiency focused on the input minimization or of technical efficiency focused on the output maximization (effects). But taking into account the type of returns to scale the following models are distinguished: the CCR model providing for constant returns to scale (the name derives from the authors of the model: Charnes-Cooper-Rhodes), the BCC model providing for changing return to scale (the name derives from the authors of the model: Banker-Charnes-Cooper and the NIRS model providing for non-increasing returns-to-scale) (Fig. 1). The CCR model is used to calculate the overall technical effi-

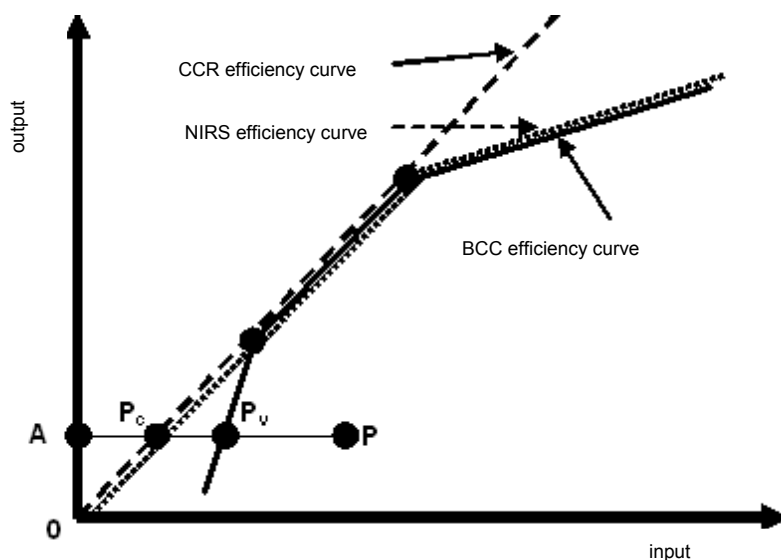Fig. 1.   Scale efficiency according to the DEA method (model: 1 output and 1 input)

Source: Prepared based on Coelli et al. 2005.

---

[2] The graphical presentation of the efficiency curve is possible for models: 1 input and 1 output, 2 inputs and 1 output or 1 input and 2 outputs. In case of multidimensional models the curve equivalent incorporates a few fragments of different hyperplanes linked to each other.

ciency (Technical Efficiency – TE), where TE for P object = APC/AP. The BCC model is used to calculate pure technical efficiency (Pure Technical Efficiency – PTE), where PTE for P object = APV/AP [Coelli et al. 2005].

With the overall technical efficiency and pure technical efficiency calculated, it is possible to determine the object scale efficiency (Scale Efficiency – SE) according to the formula: SE for P object = AP_C/AP_V, i.e. SE = TE/PTE. Scale efficiency (SE) calculated in this manner denotes the degree to which the object is efficient in relation to the optimum enabling the maximal use of inputs. Objects with scale efficiency at the level of 1 experience constant returns to scale. However, scale efficiency calculated in the manner described above does not make it possible to identify objects with increasing returns to scale and objects with decreasing returns to scale. The character of scale (increasing or decreasing) for a particular object may be defined by comparing the NIRS technical efficiency level with the overall technical efficiency (TE). If the figures are equal, it proves that the scale for a given object is increasing. However, if the figures are not equal, the object exhibits decreasing returns to scale [Coelli et al. 2005].

RESULTS AND DISCUSSION

At the first stage of the study a set of variables for the models of Data Envelopment Analysis models was defined. According to the literature total production is normally measured by its volume, i.e. a set of manufactured products expressed either in physical units or in fixed prices [Welfe and Welfe 1996]. In this study total production was measured by revenues earned due to the sale of products, goods and materials (in PLN thou). Due to high diversification of products in milk processing it was difficult to apply other quantitative measure of production (for example – a ton of butter is not comparable with a ton of yogurt).

Production factors are variables explaining the production volume. In the theory of economics a distinction is made of three major production factors, i.e. human labour, objectified labour (capital) and land. As a rule, in non-agricultural companies the land element does not play a vital role, and that is why it is often omitted or replaced with the raw material and material factor [Kamerschen et al. 1992, Samuelson and Marks 1998]. In connection with the above the factor of materials has been defined as costs of material and energy consumption (in PLN thou). The human labour factor is often measured in the literature as manhours or the number of workers [Keat and Young 2003]. Given the data availability the measure of the labour factor was defined in the study as labour costs, i.e. the total cost of wages and social insurance contributions and other benefits for employed people (in PLN thou). According to the literature capital represents the most diversified production factor. The factor involves own funds, acquired loans or unpaid liabilities, as well as elements represented in the form of resources (machinery, production lines, equipment, transportation means, buildings and building structures etc.) [Mercik and Szmigiel 2007]. Given the above, capital in this study was defined to be measured as the value of fixed assets (in PLN thou).

Efficiency of the production scale of dairy companies in years 1999–2010 was evaluated in accordance with the non-parametric method, based on Data Envelopment Analy-

sis (DEA) models. The applied DEA models were focused on minimization of inputs[3], and variables of the models were defined as:

- output: revenues earned due to the sale of products, goods and material (in PLN thou);
- input 1: labour costs, i.e. total costs of wages and social insurance contributions and other benefits (in PLN thou);
- input 2: costs of material and energy consumption (in PLN thou);
- input 3: value of fixed assets (in PLN thou).

For each analyzed year a calculation was made of models providing for constant returns to scale and models providing for variable returns to scale. In the next step a scale efficiency index was determined as a quotient of overall technical efficiency and pure technical efficiency.

In years 1999–2010 the analyzed milk processing companies experienced a growth of an average level of the scale efficiency index (SE) from 0.80 to 0.96 (a median from 0.82 to 0.98) (Fig. 2), which shows that in the period under investigation the average scale of production of the companies reached the optimum level. It should be stressed that a systematic improvement of scale efficiency of dairy companies had been observed since 2002, which can be attributed to the intensification of merger and acquisition processes [Pietrzak and Dworniak 2010].
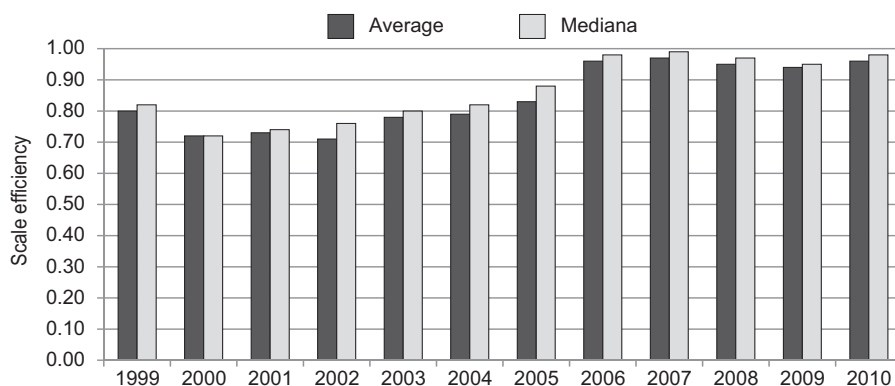

Fig. 2.   Scale efficiency index of dairy companies in years 1999–2010
Source: Own work.

---

[3] In the dairy sector there are administrative restrictions of production volume under the milk quotas system. Given this, milk processing companies striving to maximize outputs (production/revenues, and indirectly also processing) may encounter some problems in this respect. Therefore, the application of the output-oriented DEA model which maximizes results keeping consumed inputs at the same level seems not to be fully justified. The second argument against the DEA models focused on the maximization of outputs and providing for a specific level of inputs arises due to the fact that the domestic demand for dairy products is stable, and it can be even noticed that in the examined period of 1999–2010 it displayed a downward trend. Thus, taking into consideration the above, the potential for the growth of production and sales in milk processing is limited, and so is the possibility to maximize sales revenues. According to the author it is more appropriate to use an input-oriented model. The model minimizes inputs of an object so as to make it efficient, keeping at least the same level of achieved results.

Based on the scale efficiency index (SE) objects operating in the range of constant returns to scale were identified, i.e. objects with SE index equaling 1. The percentage of dairy companies achieving constant returns to scale in the sample amounted on average to 9% (Fig. 3). Calculation of the scale efficiency index for remaining objects allowed only for determining the degree of efficiency of a particular company in terms of scale in relation to companies with an efficient production scale.

Dairy companies with increasing and decreasing returns to scale were identified using a method based on non-increasing returns to scale. The NIRS model indices were compared to pure technical efficiency value (calculated based on the BCC model). The analyses conducted proved that in years 1999–2010 on average 69% of examined dairy companies experienced increasing returns to scale, and 22% – decreasing returns to scale (Fig. 3).
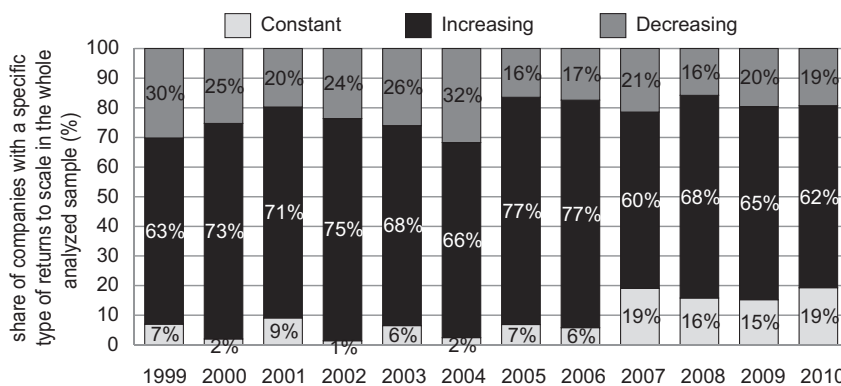

Fig. 3. The type of returns to scale of milk processing companies evaluated based on the DEA method

Source: Own work.

Relying on non-parametric methods it can be assumed that the Polish milk processing sector in years 1999–2010 was characterized by increasing returns to scale, which is in line with the present conclusions presented in relevant literature [Pijanowski and Gaweł 1986, Guba 2000, Pietrzak 2007, Baran 2009]. It means that in most analyzed dairy companies (on average above 70%) the pace of production growth was higher in percentage terms than the growth pace of inputs (production factors). In consequence, the companies achieved increasing returns to scale and falling long-term average costs. Thus, it can be assumed that further growth of the production scale of these companies will contribute to bringing them in the area of constant returns to scale, and thus, to the improvement of their efficiency[4].

---

[4] Confirmation of higher efficiency of companies experiencing constant returns to scale was presented among other things in an article by J. Baran "The returns to scale in relation to economic--financial results of dairy companies in 2004–2006", Zeszyty Naukowe SGGW, EiOGŻ 76/2009, 95–108.

CONCLUSIONS

The studies conducted for the purpose of this article allow for drawing the following conclusions:

1. The gap between the Polish milk processing and leading European countries implies that there is a need for improved efficiency and international competitiveness. One option leading to the improvement of competitiveness may entail concentration of milk processing and resulting growth of the scale of production.

2. Based on non-parametric methods it was concluded that there are increasing returns to scale in the Polish milk processing sector. Given the above, it must be admitted that this conclusion confirms the hypothesis and is in line with the conclusions presented in the relevant literature.

3. Given the fact that most Polish dairy companies experience increasing returns to scale, it is justified to accept the postulate recommending milk processing companies to intensify actions aimed at increasing the scale of production. It should lead to the improvement of their efficiency, and in consequence improvement of international competitiveness. The chance may be used both by companies striving for external growth via mergers and acquisitions and by companies which initiate dynamic internal growth of their own potential.

EFEKTYWNOŚĆ SKALI PRODUKCJI POLSKICH PRZEDSIĘBIORSTW PRZETWÓRSTWA MLEKA BAZUJĄCA NA METODZIE DATA ENVELOPMENT ANALYSIS

Streszczenie. W artykule, bazując na metodzie nieparametrycznej, dokonano oceny efektywności skali produkcji polskich przedsiębiorstw przetwórstwa mleka w latach 1999–2010. Podejście nieparametryczne bazowało na metodzie programowania liniowego określanej jako metoda Data Envelopment Analysis (DEA). Przeprowadzone badania na próbie 743 obiektów wskazały na występowanie rosnących korzyści skali w polskim sektorze mleczarskim. Dalsza konsolidacja polskich przedsiębiorstw przetwórstwa mleka powinna zatem sprzyjać poprawie efektywności tych podmiotów. Badania te potwierdzają wcześniejsze wskazania literatury.

Słowa kluczowe: skala produkcji, efektywność, branża mleczarska, metoda DEA

REFERENCES

Baran J., 2009. The returns to scale in relation to economic-financial results of dairy companies in 2004–2006. Zeszyty Naukowe SGGW, EiOGŻ 76, 95–108 [in Polish].

Charnes A., Cooper W.W., Rhodes A., 1978. Measuring the efficiency of decision making units. European Journal of Operational Research 2 (6), 429–444.

Coelli T.J., Prasada Rao D.S., O'Donnell C.J., Battese G.E., 2005. An Introduction to efficiency and productivity analysis. Springer, New York.

Cooper W.W., Seiford L.M., Tone K., 2007. Data Envelopment Analysis, A Comprehensive text with models, applications, references and DEA-solver software. Kluwer Academic Publishers, New York.

Guba W., 2000. Competitiveness of Polish milk processing industry during the integration to the European Union – Analysis of dynamic comparative advantages. Doctoral dissertation. Faculty of Agricultural Sciences, Georg-August-University, Gottingen.

Guzik B., 2009. Podstawowe modele DEA w badaniu efektywności gospodarczej i społecznej (The basic DEA models in the study of economic and social efficiency). Publisher UE in Poznan, Poznan [in Polish].

Kamerschen D.R., McKenzie R.B., Nardinelli C., 1992. Ekonomia (Economics). Economic Foundation NSZZ "Solidarność", Gdańsk [in Polish].

Keat P., Young P.K., 2003. Managerial Economics. Prentice Hall, Upper Saddle River, NJ.

Mercik J., Szmigiel C., 2007. Ekonometria (Econometrics). Publishing House of Wroclaw University of Technology, Wrocław [in Polish].

Pawłowska M., 2005. Konkurencja i efektywność na polskim rynku bankowym na tle zmian strukturalnych i technologicznych (Competition and efficiency in the Polish banking market against structural and technological changes). Materials and studies of NBP 192. NBP, Warszawa [in Polish].

Pietrzak M., 2007. Korzyści skali w przemyśle mleczarskim w Polsce – na przykładzie sektora spółdzielczego (Economies of scale in the dairy industry in Poland – on the example of the cooperative sector). Problems of Agricultural Economics 1, 105–115 [in Polish].

Pietrzak M., Dworniak J., 2010. Fuzje i przejęcia w warunkach kryzysu w sektorze mleczarskim (Mergers and acquisitions in the context of the crisis in the dairy sector). [in:] P. Urbanek (ed.) Nadzór korporacyjny w warunkach kryzysu gospodarczego (Corporate Governance in the context of economic crisis). Published by the University of Łódź, Łódź, 247–261 [in Polish].

Pijanowski E., Gaweł J., 1986. Zarys chemii i technologii mleczarstwa (Outline of the chemistry and technology of dairy). Vol. III. PWRiL, Warszawa [in Polish].

Rogowski G., 1998. Metody analizy i oceny działalności banku na potrzeby zarządzania strategicznego (Methods of analysis and evaluation of the bank in relation to strategic management). Published by the Higher School of Banking in Poznan, Poznań [in Polish].

Rusielik R., 1999. DEA – Zastosowanie w badaniach efektywności spółek AWRSP (DEA – use in analysis of efficiency AWRSP companies). [in:] M. Świtłyk (ed.) Strategiczne modele funkcjonowania spółek handlowych AWRSP (Strategic business models of the AWRSP companies). Publishing House of AR in Szczecin, Szczecin, 113–176 [in Polish].

Rynek mleka. Stan i perspektywy. Analizy rynkowe (Market milk. Status and prospects. Market analysis), 2009. Zeszyty Naukowe SGGW, IERiGŻ 37 [in Polish].

Samuelson W.F., Marks S.G., 1998. Ekonomia menedżerska (Managerial Economics). PWE, Warszawa [in Polish].

Seremak-Bulge J., 2009. Wpływ reformy i zwiększenia kwot na polskie mleczarstwo (Impact of the reform and an increase milk quota for Polish dairy industry). Dairy Review 1, 28–33 [in Polish].

Stachak S., 2003. Podstawy metodologii nauk ekonomicznych (Basic methodology of economics). Published by Book and Knowledge, Warszawa [in Polish].

Thiele H.D., 2005. Future structural changes in the european dairy industry – Determinants and forecasts. [in:] Enlarged EU dairy market 25. Past experience and prospects (proceedings of the conference "International Management Forum Milk 2005", Ciechocinek, 20–22 April 2005), 1–16.

Weindlmeier H., 2001. Structural change and internationalization in the German dairy industry. [in:] Structural change in the dairy sector. Bulletin of the International Dairy Federation 360, 20–29.

Welfe W., Welfe A., 1996. Ekonometria stosowana (Econometrics). PWE, Warszawa [in Polish].

AN EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN TECHNOLOGICAL AND MARKETING INNOVATIONS: A CASE OF POLISH MANUFACTURING FIRMS

Tomasz Kijek

University of Life Sciences in Lublin

Abstract. The article deals with the issue of the links between technological and marketing innovations. The theoretical part of the paper presents definitions and key features of marketing innovations, as well as it indicates the potential cause-effect relations between decisions to introduce process and product innovations and the implementation of new methods in marketing mix. The empirical part of the paper verifies formulated hypotheses using data derived from the survey on innovation activity of Polish manufacturing enterprises in the years 2008–2010. The results of research show the positive impact of propensity to adapt product innovations on marketing innovations activity of enterprises. Moreover, expenditures on acquisition of knowledge from external sources and expenditures on marketing for new and significantly improved products turned out to be factors stimulating enterprises to implement changes in marketing methods.

Key words: marketing innovations, technological innovations, propensity to innovate, expenditures on innovation activity

INTRODUCTION

Innovation is traditionally perceived as the use of technological inventions, and as such it pertains to a new product introduced on the market and/or new process used in the manufacturing. Such an understanding of innovation has dominated the economic and managerial literature since the pioneering work of Schumpeter [1934]. Recently, the technological view on innovation has been extended to marketing domain. Although the importance of new methods in marketing was expressed as far back as the early work of Levitt [Levitt 1960], the literature on marketing innovation is scare and scattered. This

----

Corresponding author – Adres do korespondencji: Department of Economics and Management, University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin, Poland, e-mail: tomasz.kijek@up.lublin.pl.

dearth of knowledge on marketing innovation and its link with technological innovations becomes quite problematic, since advances in marketing methods are seen as key contributors to long-term firm's success [Ren, Xie and Krabbendam 2010].

This paper attempts to address this gap in the literature by providing both a theoretical insight into the nature of marketing innovation and an empirical analysis of technological drivers of new marketing methods in Polish enterprises. The analysis is based on sector-data obtained from the results of survey on innovation activity of Polish industrial enterprises within the framework of Community Innovation Survey. The method used in the research is the logistic regression. Providing estimation results of the logistic regressions allows for a deeper understanding of the relationship between technological and marketing innovations.

LITERATURE REVIEW

This paper addresses two subject areas. Firstly, the paper attempts to find the nature and key features of marketing innovations. Secondly, the paper tries to establish the link between marketing and technological innovations. In the following, this section will give a concise review of the literature dealing with these two issues.

Definition and nature of marketing innovation

The concept of innovation has been defined in a number of ways [Bareghe, Rowley and Sambrook 2009]. Knight's early and straightforward definition just states: "Innovation is an adoption of a new and significant change by an organization" [1967]. A similar definition was proposed more recently by Damanpour, who claimed that: "Innovation is conceived as a means of changing an organization, either as a response to changes in the external environment or as a pre-emptive action to influence the environment" [1996]. These definitions address two important distinctions. Firstly, they make implicitly allowance for difference between innovation and innovation process. The latter term consists of all the decisions and activities that occur from the recognition of a need or a problem, through research, development and commercialization of an invention [Rogers 2003]. Secondly, innovation regarded as a result is tightly coupled to change. Accordingly, innovations are frequently classified in relation to changes they pertain to. The most common typology includes technological innovation and non-technological innovation. The former can be defined as new products and new processes that embody inventions from the industrial arts, engineering, applied sciences and/or pure sciences. Apart from changes in products and processes, the understanding of innovation is extended also to changes in marketing and management techniques or organizational structures (so-called non-technological innovations) [Garcia and Calantone 2002].

Although the literature on economics and management of innovation was focusing solely on technological innovation for many years, non-technological innovation has received particular attention of scholars and practitioners over the last decade. This extension of the view of firms' innovation efforts has resulted from different reasons. Firstly, the concept of technological innovation seems not to fully correspond to inno-

vation in services. However, the current discussion on whether services can be treated like manufacturing in relation to innovation has not been resolved yet. Secondly, innovation may concern many aspects of firms' activities, e.g. technology, organization and marketing, which may complement each other. In a system approach to innovation, a dispute about the drivers and outcomes of marketing innovation is extremely important, since there is an agreement that marketing innovations are crucial for the long-term success of a firm and for the overall innovation process [Alsamydai, Alnawas and Yousif 2010].

According to OECD definition, marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing not previously used by the firm [Oslo Manual 2005]. A similar stance on defining marketing innovation was adapted by many authors, i.e.: Harms et al. [2002], Rust et al. [2002], Shergill and Nargundkar [2005], Chen [2006], Halper [2010]. An analysis of the definitions introduced by mentioned authors allows for the identification of key features of marketing innovation that can be described as follows:

1. Its scope that encompasses the four P's of marketing. According to OECD, product design changes generally pertain to changes in product form and appearance that do not affect the product's functional or user features [Oslo Manual 2005]. In turn, new marketing methods in product placement primarily mean the introduction of new sales channels, while innovations in pricing involve the use of new pricing strategies. Finally, changes in product promotion refer to the use of new concepts for promoting a firm's goods and services.

2. Its orientation towards customers and markets. Trienekens, Uffelen and Omta [2008] suggest that marketing innovation main relevance is in the understanding of consumer demand. Hurley and Hult [1998] further argue that market orientation can serve as the catalyst for marketing innovation.

3. Its potential to create competitive advantage. Marketing innovation can be regarded as a primary source of a firm's sustainable competitive advantage, given its difficulty to imitate. Ren, Xie and Krabbendam [2010], adapting a resource-based view of the firm, find characteristics of successful marketing innovations (i.e. a sound marketing strategy, management skills and organizational culture within the firm) which may be both drivers of strategic value and imitation barriers for competitors. On the other hand, Chen [2006] provides an economic analysis of marketing innovation in a dynamic duopoly model and proves that marketing innovation which allows a firm to acquire consumer information benefits the innovating firm. These theoretical arguments were empirically proved by a few studies [Weerawardena 2003, Halper 2010].

In addition to the above characteristics of marketing innovation, Schmidt and Rammer [2013] conclude that the new element of marketing mix like the other forms of innovations are associated with uncertainty. However, the risk of failure of marketing innovation is relatively low and can be limited by employing highly-qualified workers. The mentioned authors also stress that marketing innovations are likely to be subject to spillovers. A frequently given reason for this peculiarity is a weak regime of appropriability due to their intangible nature.

Relationship between technological and marketing innovations

As previously mentioned, the term technological innovation refers to product and process innovation. According to OECD, product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses, while process innovation pertains to the implementation of a new or significantly improved production or delivery method [Oslo Manual 2005]. In the economic and managerial literature on innovation, the dispute on the relationship between technological innovations and marketing innovations finally come to deciding whether they are complements or substitutes.

This is quite intuitive that the introduction of a new process or product calls for changes in marketing strategies. For instance, a new product line often requires changes in packaging and sales channels. Lewis and Wackowski [2006] give an example of the tobacco industry, where the introduction of flavoured cigarettes were intensively supported by marketing innovations. Another point of view presented in the literature is that marketing innovations are more than just supporting activities for technological innovations. It is argued that marketing innovations may replace technological innovations, e.g. a product innovation can be substituted by a product design changes. Following this line of arguments, Bhaskaran [2006] and Rammer, Czarnitzki and Spielkamp [2009] note that small and medium sized enterprises, especially from low- and mid-tech industries, may be more willing to engage in possibly less costly marketing innovations rather than in technological innovations. In spite of these opposite perspectives, Schubert [2010] summarizes that marketing innovations are on average rather complements than substitutes for technological innovations, but this relationship is sensitive to external and internal factors such as a firm's size and technological opportunities.

In few recent studies on technological and marketing innovations the analyses not only focus on the direct relationship between these two types of innovations but also deal with the issue of impact of technological innovation activities on propensity to innovate in marketing [Moreira et al. 2012, Kijek, Lisowski and Starzyńska 2013]. In this stream of research, technological innovation activities encompass both investments in intangible assets (e.g. technological knowledge) and tangible assets (e.g. buildings, constructions and machinery). According to Kijek [2012], technological knowledge is a part of innovation capital, which is a bundle of the firm's resources/assets that renders services in the process of new knowledge (innovation) creation and commercialization. Apart from technological knowledge in the form of R&D or intellectual property rights, innovation capital encompasses intangibles that are embodied in the organizational routines and thinking of employees. It is worth noting that employees' knowledge offers a specific innovation competence for a firm, since it is a driver of absorptive capacity that manifests itself in the firm's ability to acquire, assimilate and utilize new knowledge, including marketing innovations. Among few empirical studies dealing with this subject, Kijek, Lisowski and Starzyńska [2013] produce evidence that expenditures on training positively affect the implementation of marketing innovations in enterprises. Moreover, the results of research by Medrano-Sáez and Olarte-Pascual [2012] show that internal R&D is the principal determining factor of all kinds of marketing innovation. Similarly, Moreira et al. [2012] find that the higher the investments in acquisition of machinery, equipment and software, internal R&D and acquisition of external technological knowledge, the greater the propensity of firms to innovate in marketing.

MATERIAL AND METHODS

Based on the considerations in this section with regard to the relationship between marketing and technological innovations, two main hypotheses can be formulated:

Hypothesis 1: The higher a firm's propensity to adopt technological innovations, the higher its propensity to innovate in marketing.

    Hypothesis 1a: The higher a firm's propensity to adopt technological innovations, the higher its propensity to innovate in product design.

    Hypothesis 1b: The higher a firm's propensity to adopt technological innovations, the higher its propensity to innovate in product placement.

    Hypothesis 1c: The higher a firm's propensity to adopt technological innovations, the higher its propensity to innovate in pricing.

    Hypothesis 1d: The higher a firm's propensity to adopt technological innovations, the higher its propensity to innovate in product promotion.

Hypothesis 2: The higher a firm's investments in technological innovation activities, the higher its propensity to innovate in marketing.

    Hypothesis 2a: The higher a firm's investments in technological innovation activities, the higher its propensity to innovate in product design.

    Hypothesis 2b: The higher a firm's investments in technological innovation activities, the higher its propensity to innovate in product placement.

    Hypothesis 2c: The higher a firm's investments in technological innovation activities, the higher its propensity to innovate in pricing.

    Hypothesis 2d: The higher a firm's investments in technological innovation activities, the higher its propensity to innovate in product promotion.

The data used to carry out this research was obtained from the results of survey on innovation activity of Polish industrial enterprises in the years 2008–2010 conducted by Central Statistical Office of Poland within the framework of Community Innovation Survey. Entities participating in surveys were selected on the basis of the Polish Classification of Activities (PKD 2007) which is consistent with the statistical classification of economic activities in the European Community (NACE Rev. 2). The 20 sectors grouped in D section – manufacturing industry – are the objects of the analysis.

The study is divided into two parts. In the first part, the relationship between propensity to adapt technological innovations and propensity to innovate in marketing is verified. In order to be able to formally test whether the decisions to introduce technological and marketing innovations are related I use a logistic regression which has the following form:

$$Y = \ln\left[\frac{P}{1-P}\right] = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_1 X_3 + \alpha_5 X_2 X_3 + \varepsilon$$

where: P_1 – percentage of firms that introduced marketing innovations, P_2 – percentage of firms that introduced changes in product design, P_3 – percentage of firms that introduced changes in product placement, P_4 – percentage of firms that introduced changes in pricing, P_5 – percentage of firms that introduced changes in product promotion, X_1 – percentage of firms that introduced product innovations, X_2 – percentage of firms that introduced process innovations, X_3 – dummy variable for technological opportunities which takes the value 0 for the low and mid-low technology sector or 1 for the mid-high and high technology sector, $X_1 X_3$ – interaction of X_1 and X_2 variables and $X_2 X_3$ – interaction of X_2 and X_3 variables. Adding interaction terms to the model allows for a more precise understanding of the relationships between propensity to innovate in products and process innovations and propensity to innovate in marketing innovations which is likely to be affected by sector R&D intensity.

In the second part of the study, the impact of a firm's investments in technological innovation activities on propensity to innovate in marketing is examined. Apart from technological capital accumulated by investing in internal R&D, acquisition of software and acquisition of knowledge from external sources, the study takes into account another element of a firm's innovation capital, i.e. employees' knowledge accumulated by investing in personal training connected with innovation activity. As far as tangible capital is concerned, the investments in buildings, constructions, land, machinery and technical equipment are treated as explanatory variables. Moreover, expenditures on marketing for new and significantly improved products is chosen as explanatory factor of a firm's propensity to innovate in marketing. In this part of the study the logistic regression has the following form:

$$Y = \ln\left[\frac{P}{1-P}\right] = \alpha_0 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \varepsilon$$

where: P – the same as previously specified, X_4 – expenditures on R&D, X_5 – expenditures on acquisition of knowledge from external sources, X_6 – expenditures on marketing for new and significantly improved products, X_7 – expenditures on personnel training connected with innovation activity, X_8 – expenditures on acquisition of software, X_9 – expenditures on buildings, constructions and land, X_{10} – expenditures on machinery and technical equipment.

Theoretically, taking the appropriate approach to modeling innovation, the explanatory variables in the model should have been measured as stocks, since the flows of services emanating from the capital are proportional to the level of its stock. However, in this study the use of the flows instead of the stocks as the explanatory variables is due primarily to practical reason, i.e. data availability. According to Bosworth and Rogers

[2001], the stability in the R&D expenditure allows for regarding it as a proxy of knowledge capital and in such circumstances the stock becomes proportional to the flow.

RESULTS AND DISCUSSION

Table 1 presents estimation results of the logistic regressions used to test the first hypothesis, assuming the positive impact of technological innovations on propensity to innovate in marketing. Model 1 treats the percentage of firms that introduced marketing innovations as the response variable, while models 2, 3, 4 and 5 treat particular types of marketing innovations as the response variables. The parameters of the models were estimated using the OLS method. In order to identify a set of explanatory variables which have considerable predictive capability, backward elimination was employed.

Table 1.   Impact of technological innovations on the introduction of marketing innovations

Specification	P_1	P_2	P_3	P_4	P_5
Constans	−2.219***	−3.757***	−3.421***	−2.739***	−2.898***
X_1	7.689***	5.875***	10.491***	2.193***	7.819***
X_2	−4.335**	×	−7.736***	×	−6.238**
X_3	−0.408**	×	×	×	−1.261**
X_1X_3	×	×	−1.581*	×	×
X_2X_3	×	×	×	×	4.757**
R^2	0.791	0.731	0.779	0.445	0.769
F (p-value)	20.271 (0.000)	48.873 (0.000)	18.804 (0.000)	14.484 (0.001)	12.536 (0.000)
χ^2 (p-value)	4.310 (0.116)	16.986 (0.000)	1.328 (0.514)	10.055 (0.006)	4.202 (0.122)

× – eliminated variable, χ2 – chi-square statistics in Doornik-Hansen test for normality of random disturbance.
*Statistical significance at 0.1 level, **statistical significance at 0.05 level, ***statistical significance at 0.01 level.

The results show that the introduction of new products has a positive impact on propensity to innovate in marketing which is in line with the literature. This relationship is sensitive to the type of marketing innovation, i.e. the regression coefficient for this predictor is the largest in the model 3 and is the smallest in the model 4. It means that the introduction of new products induces changes in sales channels and, to a lesser extent, in pricing methods. Surprisingly, implementing process innovations has a negative or insignificant impact on the introduction of marketing innovation. This outcome is unexpected on the assumption that product and process innovations are introduced simultaneously but could be partially explained by the fact that some of marketing innovations, i.e. changes in product placement, are aimed at the same purpose as changes in delivery methods (process innovations), so they may be regarded by firms as substitutes.

As far as technological opportunities are concerned, the models 1 and 5 show that firms in the low and mid-low technology sectors innovate in marketing more frequently than firms in the mid-high and high technology sectors. It supports Grimpe and Sofka's

[2009] finding that firms in high-tech industries take the technology-oriented search pattern while firms in low-tech industries focus more on market knowledge. The interesting point discovered in the model 3 is that the positive effect of the introduction of product innovations on the propensity to adapt changes in product placement is weaker for firms in the mid-high and high technology sectors than it is for firms in low and mid-low technology sectors. On the other hand, the negative effect of the introduction of process innovations on the propensity to adapt changes in product promotion is weaker for firms in the mid-high and high technology sectors than it is for firms in low and mid-low technology sectors.

   Table 2 presents estimation results of the logistic regressions used to test the second hypothesis, assuming the positive impact of a firm's technological innovation activities on the propensity to innovate in marketing.

Table 2. Impact of technological innovation activities on the introduction of marketing innovations

Specification	P_1	P_2	P_3	P_4	P_5
Constans	−1.910***	−2.979***	−3.153***	−2.479***	−2.766***
X_4	×	×	×	×	×
X_5	0.005**	×	×	0.007***	0.008***
X_6	0.005*	0.015***	0.008**	×	×
X_7	×	×	×	×	×
X_8	×	×	×	0.011**	×
X_9	×	×	×	−0.001**	×
X_{10}	×	×	×	×	×
R^2	0.518	0.405	0.302	0.697	0.464
F (p-value)	9.153 (0.002)	12.292 (0.002)	7.787 (0.012)	12.322 (0.000)	15.631 (0.000)
χ^2 (p-value)	0.971 (0.615)	13.399 (0.001)	2.808 (0.245)	0.272 (0.872)	2.504 (0.285)

× – eliminated variable, χ^2 – chi-square statistics in Doornik-Hansen test for normality of random disturbance.
*Statistical significance at 0.1 level, **statistical significance at 0.05 level, ***statistical significance at 0.01 level.

   The results reveal that technological innovation activities induce marketing innovations to a limited extent. In more detail, the expenditures on acquisition of knowledge from external sources have a significantly positive effect on the propensity to innovate in marketing in the models 1, 4 and 5. Surprisingly, another innovation activity allowing for the accumulation of technological knowledge, i.e. R&D, have no effect on propensity to innovate in marketing. One reason for this finding is that there is a lag between R&D and its effect in the form of technological innovation which induces marketing innovation [Ravenscraft and Scherer 1982]. As expected, the expenditures on marketing for new and significantly improved products have a significant impact on the introduction of marketing innovations in the models 1, 2 and 3. It is worth noting that one possible explanation for the fact that other innovation activities have no effects on marketing innovations is that these expenditures affect the changes in marketing indirectly via technological innovations.

CONCLUSIONS

Aiming at a better understanding of the relationship between various types of innovation and using data on Polish manufacturing firms, I analyzed the impact of technological innovations on marketing innovations at the sector level. The results show that product innovations influence the decision to introduce marketing innovations, suggesting a complementary relationship. On the other hand, the findings offer little support for the view that process innovations induce marketing innovations. This indicates that process innovations introducing in isolation to product innovations may be regarded as substitutes for some forms of marketing innovations.

In the second part of the study I found that technology innovation activities induce marketing innovations to a limited extent. It should be mentioned that the expenditures on marketing for new and significantly improved products and the expenditures on acquisition of knowledge from external sources have a major impact on the introduction of marketing innovations. In the case of other technology innovation activities it can be assumed that they have indirect impact on marketing innovations via their effects on technological innovations.

The paper is not exempt from some limitations. The main drawback pertains to the one direction analysis. The study only investigated the effect of technological innovations on marketing innovations, but did not analyze the opposite direction. Another shortcoming of the study concerns the data used in the analyses. The data have been aggregated at the sector level, so there is the possibility that micro-relations may be obscured by aggregation biases. In order to overcome these limitations future research should investigate the direction of the link between technological and marketing innovations using longitudinal micro-data.

REFERENCES

Alsamydai M., Alnawas I., Yousif R., 2010. The Impact of marketing innovation on creating a sustainable competitive advantage: the case of private commercial banks in Jordan. Asian Journal of Marketing 4, 113–130.

Bareghe A., Rowley J., Sambrook S., 2009. Towards a multidisciplinary definition of innovation. Management Decision 47, 1323–1339.

Bhaskaran S., 2006. Incremental innovations and business performance: small and medium-sized food enterprises in a concentrated industry environment. Journal of Small Business Economics 44, 64–80.

Bosworth D., Rogers M., 2001. Market value, R&D and intellectual property: an empirical analysis of large Australian firms. Economic Record 77, 323–425.

Chen Y., 2006. Marketing innovation. Journal of Economics & Management Strategy 15, 101–123.

Damanpour F., 1996. Organizational complexity and innovation: developing and testing multiple contingency models. Management Science 42, 694.

Garcia R., Calantone R., 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. The Journal of Product Innovation Management 19, 112.

Grimpe C., Sofka W., 2009. Search patterns and absorptive capacity: low and high-technology sectors in European countries. Research Policy 38, 495–506.

Halper N., 2010. Marketing innovation: Sources, capabilities and consequences at airports in Europe's peripheral areas. Journal of Air Transport Management 16, 52–58.

Harms F., Rohmann S., Heinrich M., Druener M., Trommsdorff V., 2002. Innovative marketing. Pharmaceuticals Policy and Laws 5, 135–149.

Hurley R.F., Hult T.M., 1998. Innovation, market orientation, and organizational learning: an integration and empirical examination. Journal of Marketing 62, 42–54.

Kijek T., 2012. Innovation capital and its measurement. Journal of Entrepreneurship, Management and Innovation 8, 52–68.

Kijek A., Lisowski M., Starzyńska W., 2013. Innovation activity of the Polish manufacturing enterprises. International Advances in Economic Research 19, 33–43.

Levitt T., 1960. Growth and profits through planned marketing innovation. Journal of Marketing 24, 1–8.

Lewis M.J., Wackowski O., 2006. Dealing with an innovative industry: a look at flavored cigarettes promoted by mainstream brands. American Journal of Public Health 96, 244–251.

Medrano-Sáez N., Olarte-Pascual M., 2012. Marketing innovation as an opportunity in a situation of uncertainty: the Spanish case. Studies in Fuzziness and Soft Computing 286, 327–341.

Moreira J., Silva M.J., Simões J., Sousa G., 2012. Drivers of marketing innovation in Portuguese firms. The Amfiteatru Economic Journal 14, 195–206.

Oslo Manual, 2005. 3rd edn., OECD, Paris, 50.

Ravenscraft D.J., Scherer F.M., 1982. The Lag structure of returns to research and development. Applied Economics 14, 603–620.

Rammer C., Czarnitzki D., Spielkamp A., 2009. Innovation success of non-R&D-performers: substituting technology by management in SMEs. Small Business Economics 33, 35–58.

Ren L., Xie G., Krabbendam K., 2010. Sustainable competitive advantage and marketing innovation within firms. A pragmatic approach for Chinese firms. Management Research Review 33, 79–89.

Rust R.T., Ambler T., Carpenter G.S., Kumar V., Srivastava R.K., 2004. Measuring marketing productivity: current knowledge and future directions. Journal of Marketing 68, 76–89.

Schmidt T., Rammer Ch., 2013. The determinants and effects of technological and non technological innovations – Evidence from the German CIS IV. http://www.oecd.org/sti/inno/37450197.pdf (Accessed 12.03.2013).

Schubert T., 2010. Marketing and organisational innovations in entrepreneurial innovation processes and their relation to market structure and firm characteristics. Review of Industrial Organization 36, 189–212.

Schumpeter J., 1934. The theory of economic development. Harvard University Press, Cambridge.

Shergill G., Nargundkar R., 2005. Market orientation, marketing innovation as performance drivers: extending the paradigm. Journal of Global Marketing 19, 27–44.

Trienekens J., Uffelen R., Omta J., 2008. Assessment of innovation and performance in the fruit chain – the innovation-performance matrix. British Food Journal 110, 98–127.

Weerawardena J., 2003. Exploring the role of market learning capability in competitive strategy. European Journal of Marketing 37, 407–429.

ANALIZA EMPIRYCZNA ZALEŻNOŚCI MIĘDZY INNOWACJAMI TECHNOLOGICZNYMI A INNOWACJAMI MARKETINGOWYMI NA PRZYKŁADZIE POLSKICH PRZEDSIĘBIORSTW PRZEMYSŁOWYCH

Streszczenie. Artykuł podejmuje problematykę związaną z relacjami między innowacjami technologicznymi a innowacjami marketingowymi. W części teoretycznej opracowania przedstawiono definicje i charakterystykę innowacji marketingowych oraz wskazano na potencjalne zależności przyczynowo-skutkowe między decyzjami o wdrożeniu innowacji produktowych i procesowych a implementacją nowych metod w zakresie marketingu mix. W części empirycznej artykułu dokonano weryfikacji sformułowanych hipotez badawczych na podstawie danych pochodzących z badania aktywności innowacyjnej polskich przedsiębiorstw przemysłowych w latach 2008–2010. Wyniki badania wskazują na pozytywny wpływ skłonności do wprowadzania innowacji produktowych na aktywność przedsiębiorstw w zakresie stosowania innowacji marketingowych. Ponadto, czynnikami stymulującymi przedsiębiorstwa do implementacji zmian w metodach marketingowych okazały się nakłady inwestycyjne na zakup wiedzy ze źródeł zewnętrznych oraz nakłady inwestycyjne na marketing dotyczący nowych i istotnie ulepszonych produktów.

Słowa kluczowe: innowacje marketingowe, innowacje technologiczne, skłonność do innowacji, nakłady na działalność innowacyjną

SOCIO-ECONOMIC EFFECTS OF MIGRATION FOR ECONOMIC PURPOSES OF RURAL POPULATION FROM THE PODHALE REGION

Magdalena Kowalska

Cracow Agricultural University

Abstract. The presented study takes up the issues of migration for economic purposes experienced by rural population coming from two Podhale districts: Czarny Dunajec and Poronin and focuses on social and economic consequences of this phenomenon – both in its positive and negative aspect. The research was conducted on a 90-people sample of adult inhabitants of the districts by means of a survey questionnaire. It was addressed to people who directly (emigrated themselves) or indirectly (due to emigration of a member of the closest family) experienced migration for economic purposes. Analyzing the economic effects of migration, it is essential to pay attention to the improvement of the situation of families (increasing the standard and quality of life) and loss posed by the outflow of labour. Among the social consequences of migration in both municipalities is difficult to identify those that can provide a significant adverse change in the social structure and the functioning of migrant families – for this state of affairs is influenced mainly by regular, working abroad and short-term migrations.

Key words: migrations, social effects, economic effects, rural population

INTRODUCTION

The phenomenon of migration is characterized by a multi-dimensional nature and consequently we are dealing with interdisciplinary research over its essence. It is an object of interest of several scientific disciplines and is analyzed at different geographical levels. In literature on the subject related to the concerned phenomena, many definitions of migration may be found. The lack of an explicit definition of the discussed process is caused mainly by a great number of theories, levels of analysis, aspects and stages as well as its classification and typology.

Corresponding author – Adres do korespondencji: Institute of Economic and Social Sciences, Cracow Agricultural University, Mickiewicza 21, 31-120 Kraków, e-mail: mkowalska@ar.krakow.pl.

In the encyclopaedic outline migrations (journeys, spatial mobility) consist in "relatively permanent change of the place of residence by entities or social groups within a specific space" [Bokszański 1999, p. 244]. In the research of the National Statistical Office (GUS) [2003, p. 23] migrations of population are understood as "movement of population associated with change in place of residence for permanent or temporary residence and consisting in crossing the administrative border of the basic territorial unit". Migration is thus a change of district of residence, and in the case of rural-urban district, moving from urban areas to rural or vice versa. Migration is also called a change of country of residence. The surveys carried out by the National Statistical Office (GUS) do not regard change of the address within the same district, regardless of its type, as migration. Migration also does not include short-term movement that lasts up to three months inclusive and movement of tourist nature and the so-called commuting, namely travel between towns of residence and work or learning [GUS 2003].

Within migration two phenomena may be distinguished, namely immigration and emigration. The first one consists in inflow of social entities or entire groups to the area of a given administrative entity in order to settle within its area, while the other one applies to outflow of population from an administratively specific area in order to settle elsewhere. Both forms, as Giddens says [2005, p. 282] "constitute global patterns of migration, connecting countries of migrants' origin with target countries and contribute to cultural and ethnic enrichment of many societies, shape their demographic growth as well as the business and the social one".

Owing to the subject matter adopted in this study it is worth defining the phenomenon of migration for economic purposes. It consists in "spatial movements of entities or social groups that are professionally active" [Zamojski 1997, p. 15]. Migrations for economic purposes are done to obtain financial resources necessary to maintain present forms of life and management, or to obtain funds for upgrading the standard of one's own life and the life of the family members. In Musiał's [2009] opinion: "the process significantly or even decisively affects on face socio-economic sub-regions, and its impact varies depending on the type of migration, its purpose and economic effects of migration in relation to the sub-region".

The typology of migration for economic purposes is based mainly on the socio-professional status of migrants. An additional criterion is migration duration and the type of migration cycle. Occupation as well as the level of qualifications on the other hand are characteristics that clearly reflect the aforementioned status of migrants. On their basis such types of migration for economic purposes can be separated as e.g.: migrations of highly-qualified employees who are representatives of the so-called freelance professions, migrations of employees with secondary vocational education, migrations of people without a particular profession (most often young people searching for better perspectives of life beyond family areas), migrations of non-qualified people, who are looking for a paid job, as they have no possibility to do it on the domestic market, seasonal and temporary migrations of different time duration undertaken by rural population in any other time free from farm tasks and regarded as additional work, intended to maintain the previous social status [Zamojski 1997].

MATERIAL AND METHODS

The presented study deals with the issues of migration for economic purposes experienced by rural population coming from two Podhale districts: Czarny Dunajec and Poronin, and focuses mainly on social and economic consequences of this phenomenon – both in its positive and negative aspect. It is worth mentioning that the surveyed districts can be found within the Podhale, a region which, as compared to the whole Poland, is characterized by particular migration processes intensification and is famous for long traditions related to departures for economic purposes.

The research was carried out in 2011 on a 90-people sample of adult inhabitants of both districts using a survey questionnaire. It was addressed to people who directly (emigrated themselves) or indirectly (due to emigration of a member of the closest family) experienced migration for economic purposes.

RESULTS AND DISCUSSION

Economic effects of migration for economic purposes of inhabitants of the surveyed districts

The economic consequences for the places of workforce outflow in scientific literature and in the studies are examined both in positive and negative context. Economic benefits resulting from the concerned phenomena, to which the attention of researchers is drawn most often, are, above all: decrease in unemployment, flow of capital from abroad as well as growth in wealth in a given community. Negative consequences in the economic sphere are mainly: outflow of workforce, including highly-qualified and educated employees, structural inflation and loss of financial benefits under taxes etc. paid by emigrants [Markowski 2008].

Analyzing the economic effects of migration for economic purposes, attention should be paid to, in particular, how they influence the change of material situation of respondents and their families. As it seems from the research conducted, foreign trips of inhabitants of Czarny Dunajec and Poronin involve mainly positive economic effects. Work abroad, both by respondents and their closest family, significantly affects increasing material status of families of emigrants – in both cases more than three fourths of respondents emphasized improvement in the material situation of their family (a small percentage of the respondents did not feel improvement but nobody was certain). The problem with assessment of financial status change of a family after leaving abroad concerned similar percentage in the examined cases and in the case of persons departing, from their immediate family in both districts – 15 and 18% respectively.

In order to get to know other economic consequences resulting from migration for economic purposes among population of the surveyed districts, the most important directions of intended use of financial means originating from abroad should be examined. The largest percentage among respondents who earn money abroad spends the money earned there on current expenses. It usually involves increase in standard of living and development of local entrepreneurship and trade. One fifth of the respondents invest in purchase

of apartments or building a house, which results in development of the local real estate market and construction industry. A significant percentage of emigrants spends funds from work abroad on helping the family that frequently is in worse material situation. Almost every tenth surveyed treats, as the most important objective of intended use of the money earned abroad, education of family members and the remaining few respondents spend the mentioned means on recreation, purchase of a car or in the case of other expenses – purchase of electronic equipment.

A very similar situation may be observed in the case of most important objectives of intended use of cash received from members of the closest family who earned money outside the borders of Poland. As it results from research, almost three fourths of foreign financial streams are used for current expenses, purchase of a flat or building a house and help for the family. Also as in the previous case, the lowest percentage are expenses on recreation or purchase of a car. What is interesting, both the money received from abroad and earned there, the respondents used to start own business to a minimum extent.

Apart from benefits on economic level related to cash inflow from abroad, there are also negative effects of migration for economic purposes. In the case of the surveyed districts it applies, above all, to workforce outflow. The respondents and the closest members of their families, before starting work abroad were professionally active people – in both districts respectively 48 and 53% of the surveyed. Such a situation results in shortages on the labour market, often among qualified employees. It took place particularly after Poland's accession to the European Union and opening of new labour markets. A significant outflow of workforce, especially construction employees, forced a pretty big increase in remuneration in this sector of economy. Emigration of professionally active people also means loss of capital receipts under taxes or social insurance. A positive effect in the concerned sphere and at the same time concerning workforce is migration for economic purposes of people who remain unemployed. It has impact on decrease in unemployment level on the local labour market. This phenomenon applied to a similar percentage of respondents and members of their families starting work abroad – 15% in the first and 16% in the second analyzed case. Economic loss are also trips abroad made by pupils and students, particularly in the case of emigration for permanent residence – this situation is connected to a significant extent with the loss of capital invested in their education. This problem applied to a similar, quite significant percentage of respondents (17%) and members of their closest family who experienced migration for economic purposes (18%). Drejerska [2009] indicates that having educating and additional skills are important determinants of economic activity of the rural population. In her opinion higher education (3.6-fold) and additional qualifications (2.3-fold) reduces the probability of economic inactivity, "which confirms the theory of human capital accent more job opportunities for people with a higher level of human capital". Unfortunately, very often young people have such an activity beyond the borders of our country.

Economic consequences of migration for economic purposes, among others from the area of the Podhale region, were analysed in an interesting research conducted by the Department of Analyses and Forecasts of the Ministry of Economy of the Republic of Poland [2007]. In the case of the aforementioned region attention was paid to a tough economic situation and centuries-old family traditions as the main determinants of trips

abroad for economic purposes. Investigating the economic consequences of the mentioned phenomenon for a local labour market, they focused on double consequences of capital inflow from abroad. The first is deterioration of employment rate in the country caused by treatment of foreign transfers as sufficient measures for current expenses and life (which seems to be confirmed by research conducted by the author).

On the other hand the inflow of capital results in lightening the accumulative barrier and investment increase, which, in turn, positively affects productivity and employment. In the final report it was diagnosed that regions characterized by particular concentration of the migration phenomenon, including the Podhale, are usually characterized by higher standard of life of their community. It mostly applies to better comfort of apartments and their equipment in household devices, as well as better sanitary infrastructure. The research proved that transfer of financial measures abroad is also spent, though to a definitely lower extent, on the investment sphere and not only on current expenses or increasing the standard of life. In the Podhale it becomes evident by accommodation base modernization for tourists and increase in the number of small companies operating in this industry [Department of Analyses and Forecasts 2007].

Social effects of migration for economic purposes of inhabitants of the surveyed districts

Apart from economic effects of migration for economic purposes, an equally important category are their social consequences. In the research over the mentioned phenomenon they are examined mainly in negative categories. Negative, social effects of migration for economic purposes are, first of all, weakening bonds and destabilization of balance in families, disintegration of marriages or disturbances within the social structure [Kępińska 2008]. Less frequently, attention is paid to their positive consequences such as: promotion in the social hierarchy as a result of growth in wealth or development of local communities by imitating modern patterns of behaviour, taken from migration experience. The analysis below focuses on social consequences of migration for economic purposes which are experienced by the inhabitants of Czarny Dunajec and Poronin.

Analyzing social effects of migration for economic purposes, attention should be paid, in particular, to the effect and degree to which they affect family relations. As it results from the research, foreign trips in both districts in most cases do not result in changes of family relations – the situation is almost the same in the case of respondents working abroad and members of their families who emigrated for economic purposes (ca. 60% of the selected answers for the response "have not changed"). What is interesting, a part of the examined families (ca. 10%) experienced even improvement in family bonds, while almost every fifth respondent had a problem with evaluation of the degree of changes that took place in family relations.

According to the respondents family relations deterioration took place to a greater extent after emigration for economic purposes of a member of the closest family than in the case of respondents themselves. Negative effects of migration for economic purposes did not however apply to a significant percentage of the surveyed and their families (only ca. 18%). Undoubtedly a significant meaning in this case can be attributed to the development of means of communication namely common access to the Internet and cellular

telephony, low costs of calls, including video calls. All this is favourable for keeping in touch between emigrants and members of the family remaining in Poland, which, in turn, contributes to maintaining family bonds at an unchanged level and maintaining positive relations between active and passive participants of migration processes for economic purposes.

Both the respondents and the members of their closest family migrating for economic purposes in the vast majority of cases come to Poland regularly – this applies to ca. two thirds of the surveyed cases. Such a situation certainly affects the aforementioned issue of changes in family relations as a result of migration for economic purposes. Regular comebacks to Poland are favourable for maintaining good family relations and do not cause significant weakening of bonds.

The consequences of migration for economic purposes in the social sphere are significantly affected by the time of stay abroad. The longer the absence of an emigrant in the country and among relatives, the more socially unfavourable balance of this departure. Among respondents the situation does not look alarming, as their predictions with regard to the length of departure are mostly "season" or "no longer than a year" (the lowest percentage was constituted by permanent stay – on average ca. 5% of the selected answers).

The next, very important consequences of migration for economic purposes at the social level is change in the model and functioning of emigrants' families. Departure of a family member forces taking their roles and obligations over by other people. After starting paid work by the surveyed emigrants from Czarny Dunajec and Poronin, their roles were taken over by above all: spouses – 52% and parents – 26% of all cases, and only in four percent these responsibilities were taken by their children. After departure of almost one-fifth of respondents nobody took over family, domestic or farm obligations. The situation seems to be slightly otherwise when taking over obligations after the closest members of the family of respondents who emigrated for economic purposes. Just like previously, these are mostly spouses and parents, 34 and 24% respectively, ca. 11% of them entrusted their duties to children and almost one third people did not want their duties to be taken by anybody. Hence, in the majority of cases, both respondents themselves and the leaving members of their families, someone took over responsibilities of the emigrants. Such a situation is mostly a result of the fact that 82% of the leaving among closest family members of respondents are married persons.

Considering social, positive consequences of migration for economic purposes of rural population from the surveyed districts, what can be mainly indicated is promotion in the social hierarchy. This applies to particular entities or entire families which as a result of trips abroad for economic purposes have significantly increased their material status. Social promotion being a consequence of growth in wealth is particularly visible among families with migration traditions of many generations.

To recapitulate, it may be assumed that migrations for economic purposes among rural population from the surveyed districts does not involve significant, negative consequences at the social level. Despite the general impression that persons directly experiencing separation because of starting work abroad are experiencing a kind of trouble and temporary family problems, in the eyes of the respondents these trips did not affect their families in a definitely destructive manner.

Interesting research was conducted by priest Stańkowski [2007] on the social effects of emigration for economic purposes. He focused on the effect of the mentioned phenomenon with regard to raising children and teenagers and his research covered the area of the whole Podhale. Its results confirmed the opinion that trips abroad for economic purposes are mainly the result of bad situation in the local environment, unemployment and lack of perspectives for development. It also invalidated the hypothesis that the phenomenon of migration for economic purposes in a definite and destructive manner affected functioning of the surveyed families. The above research also did not confirm the assumptions concerning educational problems among children and teenagers caused by the absence of the earning parent abroad.

CONCLUSIONS

Migration movements in the old periods of history particularly resulted from such factors as wars, natural disasters or persecution on religious or political background. At present, these factors play a small role in generating migration and its primacy was lost for economic reasons.

The surveyed inhabitants of Czarny Dunajec and Poronin who experienced migration for economic purposes, as well as members of their closest family, pointed out as the main reasons of trips abroad mainly the desire to improve the financial situation and possibility to start a better paid work than in Poland. These premises of purely economic nature are mainly the effect of unemployment and low earnings on the local job market. Determinants beyond economy related to few cases of emigration. When analyzing the economic effects of migration for economic purposes, attention should be paid to, in particular, the fact that more than three-fourth respondents noticed improvement in the material situation of their family. Also the manner of use of independently earned money or money received from abroad is very important. In both cases these funds are mostly spent on current expenses, building a house or purchase of a flat and help for the family. It therefore mainly aids the growth in consumption in the analyzed area, and thereby development of trade and services. The aforementioned categories and ways of spending the money are used to increase the standard and comfort of living for persons experiencing migration for economic purposes.

Looking at migrations for economic purposes in terms of their negative economic consequences attention should be paid to losses related to the outflow of workforce and emigration of qualified employees often creates a problem for local companies with finding appropriate professionals.

Social effects of migration for economic purposes, to which presently special attention is paid, include negative changes in the social structure or migration families functioning, leading even to their disintegration. Referring to the surveyed districts, on the basis of the conducted research, it is difficult to state that emigration for economic purposes of its inhabitants implies significant and undesirable consequences in the concerned sphere. In the case of most respondents and emigrating members of their closest family there is the opinion that after their departure family relations have not changed (their deterioration was emphasized by insignificant percentage of those examined). Such a state of affairs is

affected by, first of all, regular comebacks of those working abroad and short-term trips. Among social consequences of migration for economic purposes in both districts it is difficult to indicate the ones that can prove significantly unfavourable changes within the social structure or the age of the local community. Undoubtedly, this situation results from high population growth [Demographic Yearbook 2012] and not frequent trips abroad for permanent residence, which, to a significant extent, balances the outflow of population.

Positive social effects of migration for economic purposes of the inhabitants of Czarny Dunajec and Poronin should be sought mostly in promotion in the social hierarchy by families that significantly increased their material status through work of its members abroad.

REFERENCES

Bokszański Z., 1999. Encyclopedia of Sociology. Vol. 2. Oficyna Naukowa, Warszawa [in Polish].
Departament of Analyses and Forecasts, 2007. Impact of emigration on the Polish economy. The Ministry of Economy, Warszawa [in Polish].
Drejerska N., 2009. Economic activity of rural inhabitants – model approach on the base of own research. Acta Scientiarum Polonorum, Oeconomia 8 (4), 32.
Giddens A., 2005. Sociology. Wydawnictwo Naukowe PWN, Warszawa [in Polish].
Internal migration 2002, 2003. Central Statistical Office, Warszawa, 23 [in Polish].
Kępińska E., 2008. Seasonal migration from Poland to Germany. Publishing House at the University of Warsaw, Warszawa [in Polish].
Markowski K., 2008. Economic aspects of migration. [in:] M.S. Zięba (ed.) Migration – Challenges XXI century. Studies on migration. Vol. 1. KUL, Lublin, 37–52 [in Polish].
Musiał W., 2009. Demographic and social determinants of disadvantaged rural areas emergence. Acta Scientiarum Polonorum, Oeconomia 8 (2), 97.
Demographic Yearbook. 2012. Central Statistical Office, Warszawa [in Polish].
Stańkowski B., 2007. Family and school problems – the repercussions of the educational sector. Research report among high school students in Podhale. Education Quarterly 3, 129–152 [in Polish].
Zamojski J.E., 1997 (ed.). Migration and society: a collection of studies 2. Institute of History PAN, Warszawa [in Polish].

SPOŁECZNO-EKONOMICZNE SKUTKI MIGRACJI ZAROBKOWYCH LUDNOŚCI WIEJSKIEJ PODHALA

Streszczenie. Prezentowane opracowanie podejmuje problematykę zjawiska migracji zarobkowych doświadczanych przez ludność wiejską pochodzącą z dwóch gmin podhalańskich: Czarnego Dunajca oraz Poronina i skupia się na społecznych i ekonomicznych skutkach tego zjawiska, zarówno w pozytywnym, jak i negatywnym aspekcie. Badania zostały przeprowadzone na 90-osobowej próbie dorosłych mieszkańców, przy wykorzystaniu kwestionariusza ankiety. Były one skierowane do osób, które w stopniu bezpośrednim (same emigrowały) lub pośrednim (ze względu na emigrację członka najbliższej rodziny) doświadczyły migracji zarobkowych. Analizując ekonomiczne skutki migracji zarobkowych, należy przede wszystkim zwrócić uwagę na poprawę sytuacji materialnej rodzin (podwyższenie standardu i komfortu życia) oraz na straty, jakie niesie ze sobą odpływ siły roboczej.

Wśród społecznych następstw migracji zarobkowych w obu gminach trudno wskazać takie, które mogą świadczyć o znacząco niekorzystnych zmianach w strukturze społecznej czy funkcjonowaniu rodzin migracyjnych – na taki stan rzeczy mają wpływ przede wszystkim regularne powroty pracujących za granicą oraz krótkookresowe wyjazdy.

DESCRIPTION AND PRICING OF SELECTED TWO-ASSET OPTIONS AND SUGGESTIONS CONCERNING THEIR USE ON THE GRAIN MARKET IN POLAND

Monika Krawiec

Warsaw University of Life Sciences – SGGW

Abstract. Multi-asset options are options with payoffs affected by at least two underlying instruments. These instruments can be assets such as stocks, indices, currencies or commodities. An important factor influencing values of multi-asset options is correlation among log-returns of underlying assets. Thus the options are also called correlation options. In the paper there are presented description and models for pricing selected correlation options: quotient, product, spread and two-color rainbow options. There are also given some examples of their use on the grain market in Poland.

Key words: multi-asset options, correlation, Black-Scholes model modifications, grain market

INTRODUCTION

Option contracts have been known and used for a long time now. A story about Thales presented in the works by Aristotle is believed to be the first mention of practical use of options. The story is about Thales' idea to exercise option on olive presses [Ong 1996]. However, the origin of contemporary option markets dates back to 1790 when options on agricultural commodities were introduced into the United States of America in order to hedge against price fluctuation of cereals supplied only after harvest. First financial options, i.e. stock options, were introduced in the 19th century. Originally, they were sold on the over-the-counter market. It was in 1973, when the Chicago Board Options Exchange was established, that these options became subject to public trading. Shortly after, other financial assets became underlying assets for options: in 1981 – debt instruments, in 1982 – currencies and futures contracts, and finally in 1983 – stock indexes [Dębski 2005]. Nowadays, the most important world exchanges, such as the Chicago Board of Trade,

Corresponding author – Adres do korespondencji: Department of Econometrics and Statistics, Faculty of Applied Informatics and Mathematics, Warsaw University of Life Sciences – SGGW, Nowoursynowska 159, 02-787 Warsaw, Poland, e-mail: krawiec.monika@gmail.com.

Chicago Mercantile Exchange, New York Board of Trade, Euronext.Liffe, Borsa de Mercado e Futuros or South African Futures Exchange, offer both commodity and financial options[1].

As far as exchange traded commodity options are concerned, options on futures contracts constitute the majority. Nevertheless, wider range of commodity options is available on the over-the-counter market. These are as a rule non-standard contracts (so-called exotic options) for which underlying assets are mainly spot prices and not futures prices of goods. The range of non-standard options is virtually unlimited. If an investor needs innovative construction, financial engineering methods enable him/her to invent a family of new exotic products meeting his/her preferences. Nevertheless, in practice certain types of options are popular and belong to the following classes: path-dependent options, time--dependent options, binary options and correlation options. According to Alexander and Venkatramanan [2008], in the case of commodity options, hybrid options (caps, floors, corridors) are generally used, and then: Asian options, barrier options and spread options. However, Geman [2007] mentions multi-asset options, namely quanto, exchange and the aforesaid spread options, apart from Asian and barrier options. She is inclined to believe that spread options are the most popular on energy markets together with forward start options belonging to the group of time-dependent options.

Apart from exchange and spread options, other popular examples of particularly interesting group of multi-asset options are quotient options, product options, basket options and rainbow options. Description, pricing methods and examples of using basket options on agricultural products can be found in the book by Krawiec and Krawiec [2002] and exchange options – in the paper by Krawiec [2010]. The present paper is aimed at describing and discussing methods for pricing as well as presenting exemplary uses of selected two-asset options on the grain market in Poland.

METHODS FOR PRICING SELECTED TWO-ASSET OPTIONS

Multi-asset, multivariate or correlation options are instruments whose payment depends on at least two underlying assets not necessarily belonging to the same class. These include stock prices, exchange rates, index values or prices of commodities. Options that are written on various types of assets are referred to as cross-asset options [Pruchnicka--Grabias 2006]. Although multi-asset options may cover any number of assets, in practice the majority are two-asset options (basket options, usually written on a great number of underlying assets, are exception to the rule).

In the case of every multi-asset option, there are more variables that have effect on the value of such an option (compared to one-asset options). For two-asset options, these variables are underlying assets prices S_1 and S_2, exercise price or prices X (in the case of multi-asset options there may be one or two exercise prices), volatilities of underlying assets σ_1 and σ_2, risk-free rate r, dividend yields of underlying assets q_1 and q_2, time to expiration T and correlation in the form of coefficient of correlation between log-returns

---

[1] A detailed discussion on derivatives offered by separate exchanges was provided by Banks [2003].

of underlying assets ρ. Since the number of variables determining the value of option is greater, the number of Greek parameters[2] to be analyzed is greater as well. In the case of two-asset options, one should calculate and interpret two deltas, gammas and vegas as well as additional Greek parameter – chi that determines sensitivity of option premium with respect to the correlation between asset values [Zahng 2006].

Quotient options

As the name suggests, quotient, ratio or relative outperformance options are written on the quotient of prices of two underlying assets. They may be used for deriving benefits from relative change in two securities, markets or portfolios. Although similar objectives may be accomplished by means of spread options, quotient options have certain advantage over them, namely for the purpose of pricing one may easily adopt analytical approach in the form of simple modification of Black-Scholes model. The holder of quotient call option captures profit if the quotient is subject to increase, whereas the buyer of quotient put option – when the quotient is subject to decrease. On the day of expiration a quotient call option gives the following payoff:

$$\max\left[\frac{S_1}{S_2} - X,\, 0\right]$$

and a quotient put option pays off:

$$\max\left[X - \frac{S_1}{S_2},\, 0\right],$$

where: S_1 and S_2 – prices of the first and the second underlying asset respectively,
$\quad X$ – exercise price.

The value of quotient call option may be evaluated in a following way [Haug 2007]:

$$c = e^{-rT}[FN(d_2) - XN(d_1)] \tag{1}$$

and the value of quotient put option:

$$p = e^{-rT}[XN(d_1) - FN(d_2)] \tag{2}$$

---

[2] Greek parameters measure the sensitivity of option value to small changes in given underlying parameters. Basic Greeks are: delta (it measures the rate of change of option value with respect to changes in underlying asset price), gamma (it measures the rate of change in the delta with respect to changes in the underlying asset price), vega (it measures the sensitivity to the volatility of underlying asset), theta (it measures the sensitivity of the value of the option to the passage of time) and rho (it measures the sensitivity to the interest rate). For more detailed information on traditional and modern Greeks, see Haug [2007], Kolb and Overdahl [2007], Zahng [2006] or Hull [2012].

where:

$$F = \frac{S_1}{S_2} e^{(b_1 - b_2 + \sigma_2^2 - \rho \sigma_1 \sigma_2)T} \tag{3}$$

$$d_1 = \frac{\ln(F/X) + T\hat{\sigma}^2/2}{\hat{\sigma}\sqrt{T}} \tag{4}$$

$$d_2 = d_1 - \hat{\sigma}\sqrt{T} \tag{5}$$

$$\hat{\sigma} = \sqrt{\sigma_1^2 + \sigma_2^2 - 2\rho \sigma_1 \sigma_2} \tag{6}$$

and
σ_1, σ_2 – historical volatilities of assets 1 and 2 respectively,
r – risk-free rate,
T – time to expiration,
b_1 and b_2 – costs of carry[3] of assets 1 and 2,
$N(d)$ – the cumulative probability distribution function for a standardized normal distribution.

The value of quotient option decreases monotonically with the correlation coefficient. Chi, measuring the sensitivity of premium to change in the correlation between the continuously compounded returns of the two underlying assets, takes negative value both for call option and put option. The higher the positive (negative) correlation between underlying assets, the greater the probability that prices will change in the same (opposite) direction and that the value of ratio will be lower (higher). For the owner of quotient call option, increase in the price of the first asset and decrease in the price of the second asset is advantageous. Whereas for the owner of quotient put option decrease in the price of the first asset and increase in the price of the second asset is favorable. Figure 1 presents quotient call and put prices depending on the value of correlation between underlying assets.
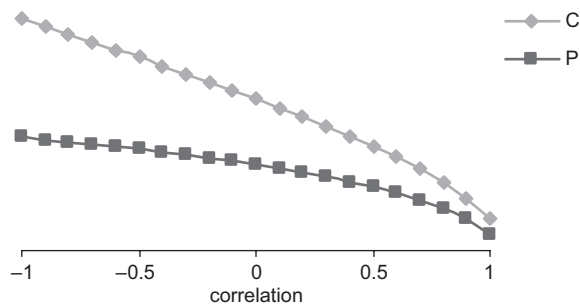

Fig. 1.   Quotient call and put prices as a function of the correlation between underlying assets log-returns

Source: Own elaboration.

---

[3] For a non-dividend-paying stock, the cost of carry is r, for a stock index, it is $r - q$, for a currency, it is $r - r_f$, for a commodity that provides income at rate q and requires storage costs at rate u, it is $r - q + u$, and so on [Hull 2012].

Product options

Product options are written on the product of prices of two underlying assets. Exchange rate is often one of these assets. It is expressed in domestic currency. The other is the price of asset that is traded on foreign stock exchange markets. Such a construction is referred to as foreign domestic option [Gudaszewski and Łukojć 2004]. Furthermore, product options can be used for hedging the revenue of a company, because the revenue is the product of the commodity sales and the product price. Then the price of product is the price of the first security (S_1) and sold production is the value of the second security (S_2).

On the day of expiration a product call option gives the following payoff:

$$\max(S_1 \cdot S_2 - X, 0),$$

and a product put option similarly:

$$\max(X - S_1 \cdot S_2, 0).$$

Formulas for their pricing were given by Haug [2007], respectively for a call option:

$$c = e^{-rT}[FN(d_2) - XN(d_1)] \tag{7}$$

and a put option:

$$p = e^{-rT}[XN(d_1) - FN(d_2)] \tag{8}$$

where:

$$F = S_1 S_2 e^{(b_1 + b_2 + \rho \sigma_1 \sigma_2)T} \tag{9}$$

d_1, d_2 and $\hat{\sigma}$ follow equations (4), (5) and (6).

Value of product option depends, among other things, on correlation between two underlying assets. The higher positive correlation, the more changeable the product of prices. The values of underlying assets change in an analogical way, and rise or decline is increased by multiplying two prices. The stronger positive correlation, the higher the call and put options premiums and chi always takes positive values. Figure 2 presents product call and put prices depending on the value of correlation between underlying assets.
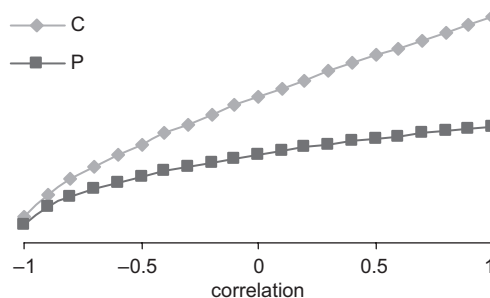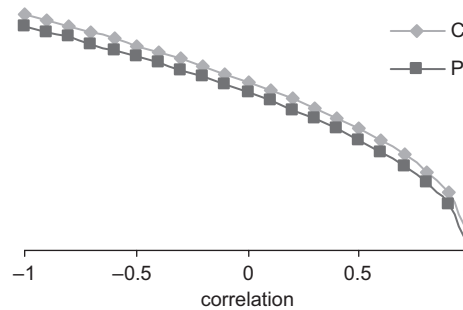

Fig. 2.   Product call and put prices as a function of the correlation between underlying assets log--returns

Source: Own elaboration.

Spread options

Spread options, just as quotient options, are characterized by the fact that their payoffs depend on relative changes in the prices of two assets. These options may be used when investor wants to alter his/her exposure or construct in a synthetic way exposure to asset to which he/she has no or limited access for certain reason. Buying options on the difference between the price of product and the price of material used to manufacture it, enterprise may protect its margin of operating profit. This practice is particularly popular among companies refining crude oil. In 1994 the New York Mercantile Exchange placed on the market options on the difference between the price of lead-free petrol and the price of crude oil. Other examples of crack spread options may include: heating oil versus crude oil, gas oil versus crude oil, jet oil versus crude oil, white sugar versus raw sugar [Nelken 2000].

On the day of expiration a spread call option gives the following payoff:

$$\max(S_1 - S_2 - X, 0),$$

whereas a spread put option payoffs:

$$\max(X - S_1 + S_2, 0).$$

Thus, a holder of a spread call option will exercise it if the spread between the prices of the first and the second asset is higher than the exercise price. A spread put option is to be exercised when the spread between prices is lower than the exercise price.

Spread options values may be evaluated by the use of some Black-Scholes model modification proposed by Kirk [1995]. Its generalized form was provided by Haug [2007]:
- for a call:

$$c \approx (Q_2 S_2 e^{(b_2 - r)T} + X e^{-rT})[S N(d_1) - N(d_2)] \tag{10}$$

- for a put:

$$p \approx (Q_2 S_2 e^{(b_2 - r)T} + X e^{-rT})[N(-d_2) - S N(-d_1)] \tag{11}$$

where:

$$d_1 = \frac{\ln(S) + (\sigma^2 / 2)T}{\sigma\sqrt{T}} \tag{12}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{13}$$

$$S = \frac{Q_1 S_1 e^{(b_1 - r)T}}{Q_2 S_2 e^{(b_2 - r)T} + X e^{-rT}} \tag{14}$$

$$\sigma \approx \sqrt{\sigma_1^2 + (\sigma_2 F)^2 - 2\rho\sigma_1\sigma_2 F} \tag{15}$$

$$F = \frac{Q_2 S_2 e^{(b_2 - r)T}}{Q_2 S_2 e^{(b_2 - r)T} + X e^{-rT}} \tag{16}$$

and Q_1, Q_2 are quantities of assets 1 and 2 respectively.

Analogically to previous cases, correlation between assets has an impact on the value of spread options. High positive correlation implies that S_1 and S_2 are subject to a similar change. Difference between them is characterized by lower volatility and value of call option is lower then. The same is the case with put option, and chi takes the same value for spread call and put options with analogical input variables. Figure 3 presents spread call and put prices depending on the value of correlation between underlying assets.

Fig. 3.   Spread call and put prices as a function of the correlation between underlying assets log-
             -returns

Source: Own elaboration.

As far as spread options are concerned, value of options is also determined by the spread between two assets. The higher the spread, the higher the call option and the lower the put option premiums.

Rainbow options

Rainbow options, likewise other multi-asset options, are written on more than one underlying asset. At the same time, every asset is analyzed individually, which makes rainbow options different from basket ones. The majority of rainbow options are stock options or stock indexes options. In this case, payoff is a difference between maximum or minimum value of underlying asset and exercise price (for call options) or between exercise price and maximum or minimum value of underlying asset (for put options) on a prespecified expiry date. If this difference is not positive, payment is not made. Depending on the number of underlying assets, rainbow options are referred to as two-colour, three-colour, four-colour etc. However, two-colour options constitute the majority. Rainbow options may be used by investors who are not sure about the market on which they want to invest their resources.

Although Kolb and Overdahl [2007] described series of different rainbow options (call on the best of two risky assets and cash, call on the maximum of two risky assets, call on the better of two risky assets, put on the maximum of two risky assets, call on the minimum of two risky assets, call on the worse of two risky assets, and put on the minimum of two risky assets), here we focus on the following four basic ones:
–   call on the minimum of two assets paying off: $\max[\min(S_1, S_2) - X, 0]$,
–   call on the maximum of two assets paying off: $\max[\max(S_1, S_2) - X, 0]$,
–   put on the minimum of two assets paying off: $\max[X - \min(S_1, S_2), 0)$,
–   put on the maximum of two assets paying off: $\max[X - \max(S_1, S_2), 0]$.

Formulas for pricing options on the minimum or the maximum of two assets, proposed for the very first time in 1982 by Stulz, are cited by Haug [2007]:
– for call on the minimum of two assets:

$$c_{min}(S_1, S_2, X, T) = S_1 e^{(b_1 - r)T} M(y_1, -d; -\rho_1) + S_2 e^{(b_2 - r)T} M(y_2, d - \sigma\sqrt{T}; -\rho_2) - \\ -Xe^{-rT} M(y_1 - \sigma_1\sqrt{T}, y_2 - \sigma_2\sqrt{T}; \rho) \tag{17}$$

where:

$$d = \frac{\ln(S_1/S_2) + (b_1 - b_2 + \sigma^2/2)T}{\sigma\sqrt{T}} \tag{18}$$

$$y_1 = \frac{\ln(S_1/X) + (b_1 + \sigma_1^2/2)T}{\sigma_1\sqrt{T}} \tag{19}$$

$$y_2 = \frac{\ln(S_2/X) + (b_2 + \sigma_2^2/2)T}{\sigma_2\sqrt{T}} \tag{20}$$

$$\sigma = \sqrt{\sigma_1^2 + \sigma_2^2 - 2\rho\sigma_1\sigma_2} \tag{21}$$

$$\rho_1 = \frac{\sigma_1 - \rho\sigma_2}{\sigma} \tag{22}$$

$$\rho_2 = \frac{\sigma_2 - \rho\sigma_1}{\sigma} \tag{23}$$

and $M(\bullet)$ – bivariate normal cumulative probability;

– for call on the maximum of two assets:

$$c_{max}(S_1, S_2, X, T) = S_1 e^{(b_1 - r)T} M(y_1, d; \rho_1) + S_2 e^{(b_2 - r)T} M(y_2, -d + \sigma\sqrt{T}; \rho_2) - \\ -Xe^{-rT}[1 - M(-y_1 + \sigma_1\sqrt{T}, -y_2 + \sigma_2\sqrt{T}; \rho) \tag{24}$$

– for put on the minimum of two assets:

$$p_{min}(S_1, S_2, X, T) = Xe^{-rT} - c_{min}(S_1, S_2, 0, T) + c_{min}(S_1, S_2, X, T) \tag{25}$$

where:

$$c_{min}(S_1, S_2, 0, T) = S_1 e^{(b_1 - r)T} - S_1 e^{(b_1 - r)T} N(d) + S_2 e^{(b_2 - r)T} N(d - \sigma\sqrt{T}) \tag{26}$$

    – for put on the maximum of two assets:

$$p_{max}(S_1, S_2, X, T) = Xe^{-rT} - c_{max}(S_1, S_2, 0, T) + c_{max}(S_1, S_2, X, T) \qquad (27)$$

where:

$$c_{max}(S_1, S_2, 0, T) = S_2 e^{(b_2-r)T} + S_1 e^{(b_1-r)T} N(d) - S_2 e^{(b_2-r)T} N(d - \sigma\sqrt{T}) \qquad (28)$$

Coefficient of correlation between underlying assets is a significant parameter affecting the value of rainbow option, too. The following rule is observed for a call on the minimum of two assets and for a put on the maximum of two assets: the closer the correlation coefficient is to +1, the more expensive the options, and the closer the correlation coefficient is to –1, the lower the option premiums. Different relation is observed in the case of call on the maximum of two assets and put on the minimum of two assets: the closer the correlation is to +1, the less expensive the options, whereas the closer the correlation is to –1, the more expensive the options [Pruchnicka-Grabias 2006]. Figures 4 and 5 present rainbow call and put prices depending on the value of correlation between underlying assets.
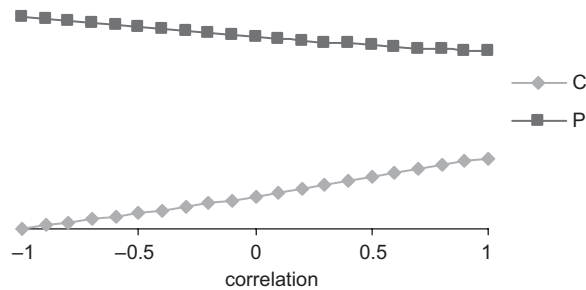

Fig. 4.   Prices of rainbow call and put on the minimum of two assets as a function of the correlation between underlying assets log-returns
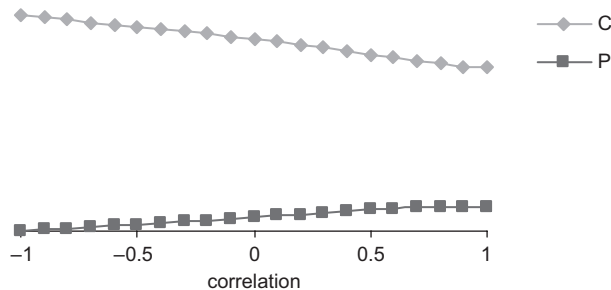
Source: Own elaboration.

Fig. 5.   Prices of rainbow call and put on the maximum of two assets as a function of the correlation between underlying assets log-returns

Source: Own elaboration.

EXAMPLES OF USING SELECTED TWO-ASSET OPTIONS
ON THE GRAIN MARKET IN POLAND

In order to develop input variables for two-asset options, empirical data was used in the form of average weekly prices of cereal in Poland. It is collected as a part of Integrated System of Agricultural Market Information and available at the website of the Ministry of Agriculture and Rural Development (www.minrol.gov.pl). The aforementioned data were used for determining historical volatilities of particular underlying assets (σ), their prices on the day contracts were written (S_0) and on the days of their expiration (S_T), and correlation between the logarithmic rates of return (ρ). Two variants of option life were taken into account, namely $T_1 = 6$ and $T_2 = 12$ months. It was assumed that the options were issued on 20th July 2010. Consequently, expiry dates were 20th January 2011 and 20th July 2011 respectively[4]. Table 1 and Table 2 present variables essential for pricing. Both historical volatilities and correlation coefficients were determined on the basis of data for six months before the issue of options. It might be noticed that throughout the period under analysis the highest volatility was the case with feed barley, whereas the lowest one – with feed corn. Nonetheless, this outcome is similar to the results for milling wheat (Table 1). The highest positive correlation was observed for the pair: milling wheat – feed wheat, and the lowest (not significant at 0.05) for the pair: milling wheat – feed barley (Table 2).

Table 1. Basic parameters of underlying assets for considered two-asset options

Parameter	Commodity			
	milling wheat	feed wheat	feed barley	feed corn
σ (%)	11.8	13.4	19.9	11.6
S_0 (PLN$\cdot$t^{-1})	555	555	413	602
S_{T1} (PLN$\cdot$t^{-1})	930	878	794	854
S_{T2} (PLN$\cdot$t^{-1})	920	882	718	963

Source: Own elaboration.

Table 2. Matrix of coefficients of correlation between log-returns of analyzed commodities

Commodity	milling wheat	feed wheat	feed barley	feed corn
Milling wheat	1	×	×	×
Feed wheat	0.78	1	×	×
Feed barley	0.03	0.40	1	×
Feed corn	0.52	0.68	0.42	1

Source: Own calculations.

---

[4] The dates were selected after the detailed analysis of cereal prices from 2007 through 2011. It was aimed at revealing 6- and 12-month periods reflecting different market conditions in order to show alternative consequences of adopting separate options.

In the next step of the research separate two-asset options were created end priced. As all of them were European options that could be exercised only on the day of expiration, for the purpose of their pricing one could use models, presented in the first part of the paper, being modifications of the Black-Scholes method. While pricing the options under analysis, the following rule was applied: contracts on commodities that are investment assets are evaluated analogically to contracts on an investment asset that provide no income, for example a non-dividend paying stock. 6- and 12-month WIBOR rates on 20th July 2010 were taken as risk-free rates for options with 6- and 12-month time to maturity respectively. Separate types of options were designed for pairs of commodities with different correlations.

Quotient options

Quotient options were created for the following pairs of underlying assets: milling wheat – feed corn, feed wheat – feed barley, milling wheat – feed barley. Table 3 presents input parameters for separate quotient options and results of pricing.

Table 3. Results of pricing quotient options

Parameter	Pair		
	milling wheat – feed corn	feed wheat – feed barley	milling wheat – feed barley
S_1 (PLN·t^{-1})	555	555	555
S_2 (PLN·t^{-1})	602	413	413
X (PLN·t^{-1})	0.9	1.3	1.3
σ_1 (%)	11.8	13.4	11.8
σ_2 (%)	11.6	19.9	19.9
r_1 (%)	3.99	3.99	3.99
r_2 (%)	4.25	4.25	4.25
T_1 (years)	0.5	0.5	0.5
T_2 (years)	1	1	1
Correlation	0.52	0.40	0.03
$C(T_1)$ (PLN·t^{-1})	0.04	0.13	0.12
$C(T_2)$ (PLN·t^{-1})	0.05	0.17	0.17
$P(T_1)$ (PLN·t^{-1})	0.02	0.06	0.05
$P(T_2)$ (PLN·t^{-1})	0.03	0.08	0.08

Source: Own calculations.

Payoff for the quotient call option on the pair milling wheat – feed corn, expiring six months after the date of issue, amounts to $\frac{930}{854} - 0.9 = 0.19$ minus premium (0.04). Hence, net profit obtained by the owner of this option amounts to 0.15 PLN·ton^{-1}.

In the case of call option expiring after one year, payoff is calculated in the following way: $\frac{920}{963} - 0.9 = 0.05$. Once the premium is taken into consideration, the profit is zero. In the case of both put options on the aforementioned pair, i.e. milling wheat – feed corn, one should allow them to expire worthless and thus lose the premium he/she paid (0.02 and 0.03 PLN·ton^{-1} respectively). Analogical analysis for the pair feed wheat – feed barley enables one to draw the following conclusions: the holder of both types of call options cannot exercise them profitably and the options expire worthless, so he/she incur losses corresponding to premiums paid (0.13 and 0.17 PLN·ton^{-1}). Put option expiring after six months enables the owner to earn net profit amounting to 0.13 PLN·ton^{-1}. By contrast, put option expiring after one year generates net loss of 0.01 PLN·ton^{-1}. Nevertheless, it ought to be exercised (to acquire a long position in the option the trader paid 0.08 PLN·ton^{-1}, so it would be foolish not to exercise). Both call options on the pair milling wheat – feed barley expire worthless. Put option expiring after six months generates net profit amounting to 0.08 PLN·ton^{-1}. Option expiring after one year should be exercised in order to minimize losses.

Product options

Product options were created for the following pairs of underlying assets: feed wheat – feed barley, milling wheat – feed corn, milling wheat – feed barley. Pricing results are reported in Table 4.

Table 4. Results of pricing product options

Parameter	Pair		
	feed wheat – feed barley	milling wheat – feed corn	milling wheat – feed barley
S_1 (PLN·t^{-1})	555	555	555
S_2 (PLN·t^{-1})	413	602	413
X (PLN·t^{-1})	230,000	330,000	230,000
σ_1 (%)	13.4	11.8	11.8
σ_2 (%)	19.9	11.6	19.9
r_1 (%)	3.99	3.99	3.99
r_2 (%)	4.25	4.25	4.25
T_1 (years)	0.5	0.5	0.5
T_2 (years)	1	1	1
Correlation	0.40	0.52	0.03
$C(T_1)$ (PLN·t^{-1})	20,335	29,834	19,771
$C(T_2)$ (PLN·t^{-1})	32,973	47,993	32,200
$P(T_1)$ (PLN·t^{-1})	11,865	11,258	11,311
$P(T_2)$ (PLN·t^{-1})	14,045	13,156	13,294

Source: Own calculations.

On the base of results for the pair feed wheat – feed barley, given in Table 4, one can state that both call options generated net profits: the option with 6-month time to maturity: 446,797 PLN·ton^{-1} (payoff: 697,132 – 230,000 = 467,132 offset by the premium of 20,335 PLN·ton^{-1}) and the option with 12-month time to maturity: 370,303 PLN·ton^{-1} (payoff: 633,276 – 230,000 = 403,276 offset by the premium of 32,973 PLN·ton^{-1}). In the case of the pair both put options should not be exercised producing losses equal to premiums paid. Analogous situation occurs for the pair milling wheat – feed corn (net profit on the 6-month call option equals 434,386 PLN·ton^{-1}, and on the 12-month call option 507,967 PLN·ton^{-1}, while put options expire worthless) and for the pair milling wheat – feed barley as well. Net profits on 6- and 12-month call options equal respectively 488,649 and 398,360 PLN·ton^{-1}. Put options should not be exercised.

Spread options

Spread options were created for the following pairs of underlying assets: feed corn – feed barley, feed corn – feed wheat, milling wheat – feed barley. Results of their pricing are displayed in Table 5.

Table 5.   Results of pricing spread options

Parameter	Pair		
	feed corn – feed barley	feed corn – feed wheat	milling wheat – feed barley
S_1 (PLN·t^{-1})	602	602	555
S_2 (PLN·t^{-1})	413	555	413
X (PLN·t^{-1})	190	50	140
σ_1 (%)	11.6	11.6	11.8
σ_2 (%)	19.9	13.4	19.9
r_1 (%)	3.99	3.99	3.99
r_2 (%)	4.25	4.25	4.25
T_1 (years)	0.5	0.5	0.5
T_2 (years)	1	1	1
Correlation	0.42	0.68	0.03
$C(T_1)$ (PLN·t^{-1})	24.69	15.32	31.66
$C(T_2)$ (PLN·t^{-1})	36.52	22.60	45.35
$P(T_1)$ (PLN·t^{-1})	21.93	17.33	26.90
$P(T_2)$ (PLN·t^{-1})	29.61	23.52	37.52

Source: Own calculations.

Analysis of results obtained for the pair feed corn – feed barley suggests an investor not to exercise the 6-month call, whereas an owner of the spread call with 12-month time to maturity captures net profit equal to 18.48 PLN·t^{-1} (payoff: 963 – 718 – 190 = 55 minus

premium amounting 36.52). Opposite situation occurs for put options: one should exercise the option with 6-month time to maturity achieving net profit of 108.07 PLN·ton[−1] (payoff 190 − 854 + 794 = 130 PLN·t[−1] reduced by 21.93 PLN·t[−1] premium) and should not exercise the option with 12-month time to maturity (the loss equals the value of premium). Analogous results were obtained for the pairs feed corn – feed wheat and milling wheat – feed barley. Call options with 6-month time to maturity expire worthless. Call options with 12-month time to maturity produce net profits: for the pair feed corn – feed wheat 8.40 PLN·t[−1], and for the pair milling wheat – feed barley 16.65 PLN·ton[−1]. Exercise of the 6-month spread put on the pair feed corn – feed wheat generates net profit equal to 56.67 PLN·t[−1], whereas exercise of the option on the pair milling wheat – feed barley produces net loss of 22.90 PLN·t[−1], though lower than the loss an investor would suffer from not exercising the option. Put options with 12-month time to maturity should not be exercised.

Rainbow options

Rainbow options were created for the following pairs of underlying assets: milling wheat – feed wheat, milling wheat – feed corn, milling wheat – feed barley. Tables 6 and 7 display results of pricing options on the minimum of two risky assets (Table 6) and options on the maximum of two risky assets (Table 7).

All rainbow call options on the minimum and on the maximum of two risky assets bring their owners net profits if they decide to exercise them. In the case of the pair

Table 6.   Results of pricing options on the minimum of two risky assets

Parameter	Pair		
	milling wheat – feed wheat	milling wheat – feed corn	milling wheat – feed barley
S_1 (PLN·t[−1])	555	555	555
S_2 (PLN·t[−1])	555	602	413
X (PLN·t[−1])	555	580	500
σ_1 (%)	11.8	11.8	11.8
σ_2 (%)	13.4	11.6	19.9
r_1 (%)	3.99	3.99	3.99
r_2 (%)	4.25	4.25	4.25
T_1 (years)	0.5	0.5	0.5
T_2 (years)	1	1	1
Correlation	0.78	0.52	0.03
$C(T_1)$ (PLN·t[−1])	17.45	10.32	2.58
$C(T_2)$ (PLN·t[−1])	28.09	19.47	7.43
$P(T_1)$ (PLN·t[−1])	19.79	27.75	78.63
$P(T_2)$ (PLN·t[−1])	23.80	29.65	80.72

Source: Own calculations.

Table 7. Results of pricing options on the maximum of two risky assets

Parameter	Pair		
	milling wheat – feed wheat	milling wheat – feed corn	milling wheat – feed barley
S_1 (PLN·t^{-1})	555	555	555
S_2 (PLN·t^{-1})	555	602	413
X (PLN·t^{-1})	555	580	500
σ_1 (%)	11.8	11.8	11.8
σ_2 (%)	13.4	11.6	19.9
r_1 (%)	3.99	3.99	3.99
r_2 (%)	4.25	4.25	4.25
T_1 (years)	0.5	0.5	0.5
T_2 (years)	1	1	1
Correlation	0.78	0.52	0.03
$C(T_1)$ (PLN·t^{-1})	33.54	42.72	67.02
$C(T_2)$ (PLN·t^{-1})	52.68	62.15	83.13
$P(T_1)$ (PLN·t^{-1})	9.28	5.38	1.13
$P(T_2)$ (PLN·t^{-1})	10.79	6.70	2.31

Source: Own calculations.

milling wheat – feed wheat exercise of the 6-month call on the minimum of two risky assets generates net profit amounting 305.55 PLN·t^{-1} (payoff: min (930, 878) – 555 = = 323 PLN·t^{-1} minus premium equal to 17.45 PLN·t^{-1}), whereas exercise of the 6-month call on the maximum of two risky assets produces net profit amounting 341.46 PLN·t^{-1} (payoff: max (930, 878) – 555 = 375 PLN·t^{-1} minus premium of 33.54 PLN·t^{-1}). Net profits for 12-month contracts are the following: for call on the minimum of two risky assets 298.91 PLN·t^{-1} and for call on the maximum on two risky assets 312.32 PLN·t^{-1}. On the day of expiration rainbow call options on the pair milling wheat – feed corn generate the following profits: the 6-month call on the minimum of two risky assets: 263.68 PLN·t^{-1}, the 12-month call on the minimum of two risky assets: 320.53 PLN·t^{-1}, the 6-month call on the maximum of two risky assets: 307.28 PLN·t^{-1}, the 12-month call on the maximum of two risky assets: 320.85 PLN·t^{-1}.

Then, exercise of rainbow call options on the pair milling wheat – feed barley also let their owners gain profits: 291.42 PLN·t^{-1} (the 6-month call on the minimum of two risky assets), 210.57 PLN·t^{-1} (the 12-month call on the minimum of two risky assets), 362.98 PLN·t^{-1} (the 6-month call on the maximum of two risky assets) and 336.87 PLN·t^{-1} (the 12-month call on the maximum of the maximum of two risky assets). All put options on the minimum and on the maximum of two risky assets regardless the length of the time to maturity should not be exercised. Hence, their owners incur losses corresponding to the premiums already paid.

Generally, taken into consideration call and put two-asset options expiring after one year, regardless of the type (i.e. quotient, product, spread and rainbow), are more

expensive than options expiring after six months. The relation is analogical to the relation for standard options: the longer time to maturity, the higher values of both call and put options.

CONCLUSIONS

As a result of progressing globalization, investment and business activity often entails taking actions on many markets simultaneously. Such an activity and its aspects are exposed to significant risk comprising many factors. Therefore, it is essential to provide effective complex protection in the form of multi-asset options that are more adequate than hedging strategies involving a great number of assets each of which protects against a single risk factor. Furthermore, using multi-asset options may reduce the cost of adopted strategy. The purchase of one multi-asset option instead of several single options minimizes transaction costs since the price of correlation options is always lower than the cost of buying a series of single options. However, due to the fact there are numerous variables determining the value of multi-asset options, many risk factors are to be monitored both by option writers and buyers. Nevertheless, correlation options are effective at reducing the risk faced by enterprises.

The aim of the paper was presenting the description and methods for pricing selected correlation options, with special reference to two-asset options. Examples of using such options on Polish grain market were presented as well. Commodity correlation options may be effective tool for minimizing the risk faced by companies operating also in agri-food sector. Producers and food processing enterprises can make use of multi-asset options in order to protect themselves against the risk from change in the price of raw materials and final products and to protect the margin of operating profit. Such entities are, for instance, mills, sugar plants, producers of spirit products, producers of meat products etc. Exporters, selling their products on a number of foreign markets, can also make use of multi-asset options, e.g. in order to eliminate exchange rate risk. Nonetheless, before adopting a particular tool, one should familiarize with its construction and attributes, which will enable him/her to assess potential gains and losses (depending on the state of the market).

REFERENCES

Alexander C., Venkatramanan A., 2008. Commodity options. The Handbook of commodity investing. John Wiley & Sons, Hoboken, New Jersey, 570–595.
Banks E., 2003. Exchange Traded Derivatives. John Wiley & Sons, Chichester.
Dębski W., 2005. Rynek finansowy i jego mechanizmy. Wydawnictwo Naukowe PWN, Warszawa.
Geman H., 2007. Commodities and commodity derivatives. John Wiley & Sons, West Sussex.
Gudaszewski W., Łukojć A., 2004. Wycena wieloczynnikowych opcji egzotycznych. Rynek Terminowy 2, 12–22.
Haug E.G., 2007. Option pricing formulas. McGraw-Hill, New York.
Hull J., 2012. Options, futures, and other derivatives. Prentice Hall, Boston.

Kirk E., 1995. Correlation in the energy markets. Managing energy price risk. Risk Publications and Ennron, London.

Kolb R.W., Overdahl J.A., 2007. Futures, options, and swaps. Blackwell Publishing, Malden.

Krawiec M., 2010. Charakterystyka, wycena i zastosowania opcji wymiany na towary rolne. Roczniki Naukowe SERiA Vol. XII, No 4, 39–45.

Krawiec B., Krawiec M., 2002. Opcje na giełdach towarowych w Polsce. Wydawnictwo Naukowe PWN, Warszawa.

Nelken I., 2000. Pricing, hedging, and trading exotic options. McGraw-Hill, New York.

Ong M., 1996. Exotic options: the market and their taxonomy. The Handbook of exotic options. IRWIN Professional Publishing, Chicago-London-Singapore, 3–44.

Pruchnicka-Grabias I., 2006. Egzotyczne opcje finansowe. CeDeWu, Warszawa.

Stulz R.M., 1982. Options on the minimum or the maximum of two risky assets. Journal of Financial Economics 10, 161–185.

Zahng P.G., 2006. Exotic options. World Scientific Publishing, Singapore.

CHARAKTERYSTYKA I WYCENA WYBRANYCH OPCJI DWUCZYNNIKOWYCH ORAZ PROPOZYCJE ICH WYKORZYSTANIA NA RYNKU ZBÓŻ W POLSCE

Streszczenie. Opcje wieloczynnikowe są kontraktami, których wypłata zależy od co najmniej dwóch instrumentów bazowych. Mogą to być akcje, indeksy, waluty lub towary. Istotnym czynnikiem, wpływającym na wartość opcji wieloczynnikowych, jest korelacja stóp zwrotu instrumentów bazowych. Dlatego często są one określane mianem opcji korelacyjnych. W pracy przedstawiono charakterystykę i modele wyceny wybranych opcji korelacyjnych: opcji ilorazowych, iloczynowych, rozpiętościowych i dwukolorowych opcji tęczowych. Podano również przykłady ich zastosowania na rynku zbóż w Polsce.

Słowa kluczowe: opcje wieloczynnikowe, korelacja, modyfikacje modelu Blacka-Scholesa, rynek zbóż

GROCERY PRODUCTS IN SENIOR'S SHOPPING BEHAVIOUR

Dagmar Lesáková

University of Economics in Bratislava

Abstract. The objective of the paper is to identify the preference factors in the choice of shopping place by seniors and key factors influencing seniors decisions in grocery stores. To explore views and opinions of older people in relation to preferred place of shopping, a research sample of 126 senior participants was created. Decision factors and motives in 5 areas have been explored: price policy, product policy, staff policy, store characteristics, communication policy. As the seniors are rather multidimensional and very complex segment, three age subgroupings in the large segment of seniors were formed: seniors aged 60–69, 70–79 and 80+. The purpose of the exploration was to determine characteristics affecting store choice and shopping behaviour of older people.

Key words: seniors, grocery products, shopping behaviour, preference factors, marketing mix, Slovak Republic

INTRODUCTION

Seniors constitute large and constantly growing group of consumers. They form potentially significant market segment for the near future. According to the Office of National Statistics in Slovakia, this segment has at present nearly a fifth (19%) of the Slovak population and is expected to grow in the next decade due to decreased fertility and increased longevity. An aging population has implications for healthcare policy, pension policy, but also marketplace policy. Older consumers build a remarkable market for many products and services and have unique shopping habits. Even though a substantial part of the seniors are poor, they represent a market, which is greater than the youth market, which is more attractive for many firms.

In spite of the size of senior's group, little attention was devoted to this segment from retailers in Slovakia and extensive research to identify their shopping behaviour is expected in order to suggest relevant marketing actions [Lesáková 2010].

Corresponding author – Adres do korespondencji: University of Economics in Bratislava, Dolnozemska 1, 852 35 Bratislava, Slovak Republik, e-mail: dagmar.lesakova@euba.sk.

Older consumers are (because of age) more experienced, request more information about the products than younger customers and have enough time to verify the obtained information. Their time spent on purchase decisions is longer in comparison with a young buyer. Senior customers have different needs and desires to compare with younger people when they choose shopping places and stores. Such attributes as low prices, smaller package sizes, store location, staff courtesy or easy access to the stores etc. cause satisfaction or dissatisfaction of older shoppers.

There is a tendency in the practice to treat everyone over 60 years old as "a one-dimensional, monolithic market", despite the literature and research on the richness and diversity of the older people and seniors consumer behaviour [Moschis 2004].

With the successive age, people become more diverse. As a result, within the large seniors market exist smaller subsegments (subgroupings), requiring different marketing strategies. Responding to the demographic changes involves an understanding of the growing diversity within the older population [Moschis and Mathur 1993].

Older people have less in common with each other than younger people have with each other, because they are no longer overloaded by the career, children and family formation. Seniors do not live with the unifyinig influence of new technologies and global media that creates high commonality among younger generations. There are some characteristics of older consumers that differentiate them from the younger ones. These include: tendency to risk avoidance, higher levels of store loyalty, convenience and simplicity of products. These characteristics have implications for retailers [Majaro 1991].

Moschis and Mathur [1993] have emphasided the importance of understanding the heterogeneous nature of the senior's market. They argue that numerous life experience results in a wide range of personality-building circumstances produce greater heterogeneity to compare with younger age segments. The complexity of this segment indicates that it could be more difficult to successfully target the whole 60+ segment than exploring needs and preferences of smaller subgroupings within this segment.

Within the existing literature there is agreement that low prices, attitudes of service staff, avoiding long queues at checking points and accessibility of products on shelves are particularly important to seniors shopping. It is also important for seniors that shopping places have easy access [Richterová 2011, Lesáková 2012a].

In the paper the importance of factors influencing seniors decision-making in selection of grocery shopping places is explored, based on the results of interviewing focus groups.

MATERIALS AND METHODS

To communicate more effectively with older consumers, the retail industry needs to understand this segment. Considering the need for understanding this market segment, the purpose of the paper is to identify shopping requirements of the senior market. In order to serve seniors effectively, retailers need a clear understanding of the seniors needs and wants.

Two main goals were stated as key for the research: the identification of preference factors in the choice of a shopping place for grocery products by seniors and selection of

factors influencing seniors decisions in grocery stores. Following questions were raised: "what are the factors that influence seniors decisions for particular grocery store selection" and "what are the implications for retail management".

Grocery shopping was chosen as the focus of the research for two reasons. First, grocery industry is extremely important, because food represents one of the key components of health and well-being. Second, food expenditures represent one of the largest items in the seniors household budget. The development of the grocery retail sector has brought various store alternatives in terms of size, location, product sortiment and customer services. In this context there is an essential question, why seniors choose and prefer particular store to others.

We are aware that age alone is not the most significant factor in explaining differences in shopping behaviour. However, older age has an impact on decreasing family size. Also such factors like multiple sources of income (pension, part-time work), mobility and health conditions have significant influence on shopping behaviour [Lesáková 2012b].

To understand views and opinions of older consumers in relation to preferred place of shopping, research sample of 126 seniors was explored. Questions regarding patterns of shopping were raised. Interviews took place during February and March 2012.

In order to indicate the key characteristics in the shopping behaviour of seniors, three age subgroupings in the whole large segment of seniors were formed: seniors aged 60–69, 70–79, and 80+.

The purpose of the interviewing was to determine factors affecting store choice and shopping behaviour of older people. Recommendations on how the retail sector could respond effectively to this were developed based on the empirical outcomes.

The preference factors in store selection were identified by asking the respondents to indicate which of the 13 factors was important to them for prefering a specific store. They were asked to indicate as many factors as they needed. The factors were grouped into five categories representing the key policy areas of retailers: price policy, product policy, communication policy, staff policy and store accessability with store characteristics.

RESULTS AND DISCUSSION

Customers may prefer stores for a number of reasons. Thirteen store choice attributes were explored in the research: price level, price discounts, quality of products, sortiment breath, familiarity of brands, knowledge and courteousy of staff, products display in stores, location and access to stores, cleanliness in stores, advertising and same-age people influence to visit the store.

Some of the attributes have been documented in the literature: price-level, adequate access to and within the store, problems associated with queuing. Courtesy and behaviour of store staff are described in the literature also as an important aspect [Schiffman and Kanuk 2004, Solomon 2004].

Respondents were asked to indicate what factors of the 13 given factors apply to their decision to select a certain store.

The results show that the perception of the importance of the 13 factors in choosing stores changes with age, as indicated by the 3 subgroupings of seniors (Table 1).

Table 1. Importance of factors in store selection by senior subsegments (in %)

Factors	Age subsegments			Mean
	60–69 (*n* = 62)	70–79 (*n* = 39)	80+ (*n* = 25)	
Price policy				
Low prices	82.4	86.5	94.9	87.6
Price discounts	80.9	83.9	94.9	86.6
Product policy				
High quality products	70.4	64.2	60.2	64.9
Broad sortiment	66.9	62.5	40.2	56.5
Carry brands familiar to seniors	63.7	69.2	83.7	72.2
Staff policy				
Knowledgeable staff	67.4	66.6	69.1	67.7
Staff helpful, courteous	69.0	69.2	69.1	69.1
Store characteristics				
Location near senior's home	63.7	72.1	87.7	74.5
Easy access to entrance/exit	48.0	62.9	73.0	61.3
Products display in store	55.5	55.1	51.2	53.9
Cleanliness in store	46.4	47.2	44.6	46.0
Communication policy				
Advertising	50.3	35.1	30.5	38.6
Recommendation by same-age people	58.6	62.5	67.7	62.9

Source: Own calculation.

Younger seniors place the highest importance among all subgroups on aspects of product policy and the lowest importance on aspects of price policy. Aspects of brand familiarity or store location were considered less important for them, probably because they have the transport means and are flexible in store choice.

In generally, seniors aged between 70–79 years are price-sensitive, cautious, demanding staff courteousy (the highest value among all subgroupings). Large differences were identified between 60–69 age group and 70–79 age group in accessability factors and communication policy.

The oldest seniors put in their store choice the highest value to price and store accessability. Shoppers in this group were identified often as living alone, female, with a lower social and economic status. As a result of restricted mobility and economic situation, these seniors would give up many aspects of store offer to the lowest possible prices and accessibility requirements. While they placed high emphasis on price aspects, it was secondary for them the breath of assortment or quality of products.

Based on Dunn Test 4 groups of factors were indicated across all age sub-groups (Table 2). General results for the whole segment of seniors without differentiating into subsegments indicate that low prices were mentioned by nine in ten of seniors as a reason in their decision to patronize certain stores. Price proved to be the most important factor in buying decision in all subsegments. The same applies to price discounts.

Further, nearly three quarters of all senior respondents indicated that the location plays an important role in the selection of a certain store. Location near the respondent's

Table 2. Factors influencing store selection by seniors as a whole (in %)

Factors	Frequency	Mean of importance	A	B	C	D	p
			All senior subsegments				
			Groups of factors				
Price policy							
Low prices	126	87.6	×				p < 0.001
Price discounts	126	86.6	×				p < 0.001
Product policy							
High quality products	126	64.9		×			p < 0.001
Broad sortiment	126	56.5			×		p < 0.001
Carry brands familiar to seniors	126	72.2	×				p < 0.001
Staff policy							
Knowledgeable staff	126	67.7		×			p < 0.001
Staff helpful, courteous	126	69.1		×			p < 0.001
Store characteristics							
Location near senior's home	126	74.5	×				p < 0.001
Easy access to entrance/exit	126	61.3		×			p < 0.001
Products display in store	126	53.9			×		p < 0.001
Cleanliness in store	126	46.0				×	p < 0.001
Communication policy							
Advertising	126	38.6					p < 0.001
Recommendation by same-age people	126	62.9		×		×	p < 0.001

A (most relevant factors): low prices, price discounts, brands familiarity, location near one's home; B (very relevant factors): products quality, easy access to store, knowledge and courteousy of staff, recommendations by others to visit the store; C (relevant factors): breath of sortiment, products display in store; D (slightly relevant factors): advertising.

Source: Own calculation.

residence is highly influencing factor. More than two thirds of seniors in all subsegments indicated that their preference was motivated by familiar brands or items.

There was a high level of agreement among respondents that sales staff is of importance to older customers.

Opinions and views presented by older shoppers should be of concern for the store managers and store staff, in order to satisfy effectively the needs and wants of seniors and to gain their loyalty.

a) *Staff policy*

The staff was described as a very important determinant of the satisfactory shopping experience for older people.

Both two factors representing staff policy were considered important by about 66 to 69 per cent or more respondents (Table 1). Slightly larger percentage rated courteous and friendly staff higher than professional knowledge of the retail staff. Several respondents mentioned the quality of service received in the past by small grocery stores as a strength and an opposite to big stores with their non-personal culture in recent years.

The friendly, helpful and courteous staff is considered equally important by all three subgroups. At present, the idea of relationship marketing requires a lot of attention among retailers. A positive staff-customer relationship with older consumers is a very strong preference motive, with evidence that this factor becomes more important with age.

b) *Product policy*

In the category of product policy importance of two factors declines with successive age: quality of products and sortiment's breath. On the contrary, brand familiarity shows an increase with age: a larger percentage of older seniors than younger seniors value their familiarity with brands.

A larger percentage of youngest subsegment (66.9 percent), in comparison with 40.2 percent in oldest subsegment patronize stores because of their sortiment. Seniors putting emphasis on sortiment (60–69 years) expected the possibility of broader choice. Based on these results we could conclude that the reasons for store choice that were considered to be important by the younger seniors show a bias towards product-related rather than store related attributes. The product-related factors such as quality and broad sortiment have been the highest valued by the youngest age category (60–69). They consider product quality and product features as central issues.

Brands familiar to the shopper are of a greater importance to the oldest seniors, with 83.7 percent, reporting this factor to be relevant in their store preference decision, in comparison with 63.7 percent in the youngest subsegment.

Unexpected to the assumption, product quality was not rated as the highest priority and the most important factor by more than one third of the respondents. The importance of quality shows a slight decline with age.

During interviews some other important product features have been mentioned by seniors. Small size of text on products has a consequence that seniors with eye and reading defficiences hardly understand information about prices and products attributes. Reading product and package labels can be a problem because of small print size. Seniors have also difficulties to differentiate colors of similar intensity. Pastels, as well as dark colors, could be particularly difficult. These aspects should be taken into account in marketing decisions when developing packaging, product materials, advertising illustrations or store design [Gardner and Sheppard 1989].

Also package size seems to be too large for senior households. Family-size packages are not appropriate for older people both for their budget constrains and usually smaller food portions consumed by seniors. Hence, grocery stores should incorporate small packages popular by older people into their merchandise offer.

c) *Store characteristics*

With the successive age older seniors prefer to shop close to home and to have nearby bus routes. Decreasing mobility with increasing age diminishes the preference of those retailers which are located in suburban parts and away from the homes of older consumers. Location near their home is an important preference motive for store choice especially for the oldest 80+ subsegment (87.7 percent).

Another factor of concern for older customers is easy access to store entrance. Access to the store is far more important for the oldest group than to the youngest senior group

(73 vs 48 percent). Older respondents also indicated they would welcome a place to sit and rest during their shopping in the grocery stores.

Approximately five in ten seniors across all three age groups indicated that products display in store is very important for them. Several interviews suggested that seniors find it difficult when the stores change their layout frequently.

Cleanliness in store was considered important by 44.6–47.2 percent between all respondents.

d) *Price policy*

Older consumers are very price sensitive. Price was the most influential factor, central to the vast majority of seniors for their store choice decision. It was the highest rated factor in all age subsegments, with 82.4 percent in the youngest subsegment (60–69 years) and 94.9 percent in the oldest subsegment (80+ years).

Seniors are focused on price and actively seek out products with the lowest possible price. They are prepared to travel a lot in order to get the minimal price. Price becomes increasingly important with age in late life.

e) *Communication policy*

Older people are heavier consumers of mass media, particularly radio and television, than other adult population segments. In spite of the fact that they use media as an important source of information, they are rather skeptical to media advertising, as the research discovered.

Five in ten youngest seniors (60–69), in comparison with only three in ten oldest seniors (80+), consider advertising as an important factor influencing their store selection. Word-of-mouth recommendation from the same-age people is far more important than advertising in all senior age subgroups, with the highest level of importence in the subsegment aged over 80 years (67.7 percent).

Most of the respondents in the research indicated they do not like to try new products or services. Older people have been shown to resist the purchase of new consumer items.

We found that elderly respondents interviewed would not buy foods advertised primarily for older people. It has to do with individually perceived age by seniors, which is lower than biological age. Product strategies appealing to all age segments have higher chances of success in developing positive responses from older consumers. In case that age is used as a main element in advertisements focused on older people, it should be applied with high sensitivity, featuring positive aspects of old age, such as experience, knowledge etc.

CONCLUSIONS

Developing better understanding of seniors is crucial for business success so that organizations can better appeal to this important segment.

As people age they become more diverse. More segments exist within the large seniors market, requiring different marketing strategies.

Although certain aspects of the store choice are common to all seniors, there are also differences in the degree of emphasis put on various factors by different subsegments of seniors. The shopping behaviour of older people does not only differ from the behaviour of the younger people, it also varies by various subsegments. The research presented in the paper reveals differences in the way how seniors respond to various marketing stimuli. Knowledge of factors which are patronized by seniors in their store selection, is essential for retail management.

Seniors may prefer stores for a number of reasons. Following factors show significant increase with age:

- The importance of store location in relation to senior's home and easy access to store grow with age and become important factors for seletion of a ceratin store.
- Low prices and price discounts become increasingly important with subsequent age for oldest seniors.
- Finally, the influence of brands familiarity increases with age.

On the other hand, three factors show decline in shopping behaviour and store choice with successive age: advertising influence, breath of sortiment and quality of products.

Our data provide evidence of the senior's preference to shop in a store where staff is knowledgeable, polite and helpful. Price was rated as most important factor across all subsegments. The "young" old (60–69) put more emphasis on quality of products and broad products sortiment, while the "old" old (80+) emphasize location aspects of shopping place and familiarity of brands in store. Because of the physical and other healthy problems of older population, stores should pay attention to the store layout and location. Reading various package and product information remains a serious problem for many older consumers. More attention also needs to be given by manufacturers and retailers to the needs of seniors in the area of package size, that is often too large for senior's small consumption.

Developing a better understanding of the senior consumers is crucial for retailers in order to respond better to their needs and to develop the loyalty of this constantly growing segment.

Acknowledgements

REFERENCES

Gardner C., Sheppard J., 1989. Consuming Passion: the rise of retail culture. Unwin Hyman Publishing, London.
Lesáková D., 2010. Zmeny v nákupnom a spotrebiteľskom správaní obyvateľstva SR (Changes in consumer behavior and shopping within Slovak population) [in:] Kolektív: Trendy nákupného a spotrebiteľského správania zákazníkov v podmienkach ekonomickej nestability: zborník vedeckých statí. Ekonóm Publishing, Bratislava [in Slovak].

Lesáková D., 2012a. Vplyv veku na nákupné správanie seniorov (The impact of age on purchasing behavior of seniors) "Studia commercialia Bratislavensia". Obchodná fakulta Ekonomickej univerzity v Bratislave, Bratislava, Vol. 5, 18 [in Slovak].

Lesáková D., 2012b. Determinanty nákupného rozhodovania seniorov (Determinants of seniors purchase decision) [in:] Kolektív: Vedecké state Obchodnej fakulty 2012: zborník. Ekonóm Publishing, Bratislava.

Majaro S., 1991. The Creative marketer. Butterworth – Heinemann, Oxford [in Slovak].

Moschis G.P., 2004. Gerontographics. Journal of Consumer Marketing 10 (3), 43–53.

Moschis G.P., Mathur A., 1993. How they´re acting their age. Marketing Management 2 (2), 40–50.

Richterová K., 2011. Ja, slovenský spotrebiteľ (Me, the Slovak consumer) [in:] Kolektív: Trendy nákupného a spotrebiteľského správania zákazníkov v podmienkach ekonomickej nestability: zborník vedeckých statí. Ekonóm Publishing, Bratislava [in Slovak].

Schiffman L., Kanuk L., 2004. Consumer behaviour. 8th edn. Upper Saddle River, New York – Pearson Prentice-Hall, Englewoods Cliffs.

Solomon M., 2004. Consumer behaviour: buying, having, being. 6th edn. Pearson – Prentice Hall, Englewoods Cliffs, NJ.

ZACHOWANIA ZAKUPOWE SENIORÓW NA RYNKU ARTYKUŁÓW SPOŻYWCZYCH

Streszczenie. Celem artykułu jest identyfikacja czynników preferencji w wyborze miejsca zakupów dokonywanych przez seniorów i czynników kluczowych wpływających na decyzje podejmowane przez seniorów w sklepach spożywczych. Aby poznać poglądy i opinie osób starszych dotyczące preferowanego miejsca zakupów, przebadano 126 starszych uczestników rynku. Badaniem objęto czynniki decyzyjne i motywy w następujących obszarach: polityka cenowa, polityka produktu, polityka kadrowa, cechy sklepu, polityka komunikacyjna. Ponieważ seniorzy stanowią wielowymiarowy i bardzo złożony segment rynku, wyodrębniono trzy grupy wiekowe: seniorzy w wieku 60–69, 70–79 oraz 80+. Głównym celem badania było określenie cech wpływających na wybór sklepu i zachowania zakupowe osób starszych.

Słowa kluczowe: seniorzy, artykuły spożywcze, zachowania zakupowe, czynniki preferencji zakupowych, marketing mix, Słowacja

SOCIO-ECONOMIC AND ENVIRONMENTAL DETERMINANTS OF SUISTAINABLE DEVELOPMENT OF RURAL COMMUNES IN MAŁOPOLSKA PROVINCE

Łukasz Paluch[1], Wojciech Sroka[2]

Agricultural University of Cracow[1], State Higher Vocational School in Tarnów[2]

Abstract. Disproportions of economic, social and environmental in the development of rural areas occur at every level of an administrative division of a country. These disproportions are applicable to the actions which are and should be taken not only to better the economic situation of rural areas, but to increase the standard of living for the villagers as well. The aim of this article is both to identify and to evaluate the influence of factors which characterize the level of socio-economic development of environmental sustainability of rural communes in Małopolska Province. Analyses are based on multiple regression model which represents the approach used by Classical Statistics Analysis (enables the observation of the correlation between multi dimensional structures). Research embraces 125 rural communes, with the exception of urban and urban-rural communes, in Małopolska Province. The conducted researches demonstrate that factors of economic nature, particularly the size of own incomes of a commune and means of EU project financing, exert the most powerful influence on the level of environmental sustainability of the researched rural communes.

Key words: sustainable development, zero unitarization method, multiple regression, own incomes, rural communes, Małopolska Province

INTRODUCTION

In today's publishing world, the necessity to maintain sustainable development is highlighted. The concept of sustainable development is understood as social, economic and environmental capacity of a country to meet material and non-material needs of both current and future generations [Brelik 2012]. It is not without reason that the main

Corresponding authors – Adres do korespondencji: Łukasz Paluch, Agricultural University of Cracow, Institute of Social and Economic Studies, Faculty of Economy and Economic Policy, Mickiewicza 21, 31-120 Cracow, Poland, e-mail: lukasz.paluch@ur.krakow.pl; Wojciech Sroka, State Higher Vocational School in Tarnów, Institute of Administration and Economy, Faculty of Economy, Mickiewicza 8, 33-100 Tarnów, Poland, e-mail: wsroka@ar.krakow.pl.

goal of a particular country is to secure a high standard of living for the community as a whole. This goal is said to be accomplished when the use of natural resources is rational [Dobrzański 2010]. In order to preserve the stability of environment-economy-society macro-system, environmental factors, which have a profound influence on this particular macro-system, should come under close scrutiny [Michałowski 2011]. It should be noted that the area of interest of economy-society-environment-oriented economists has switched from the concept of economic growth to the paradigm of sustainable development which opens up new possibilities for various observations and analyses.

First and foremost, multifarious economic, social and environmental disproportions in the degree of development of rural areas occur at every level of an administrative division of a country [Siekierski and Popławski 2008]. These disproportions are applicable to the actions which are and should be taken not only to better the economic situation of rural areas, but to increase the standard of living for the villagers as well. It is important to mention that the main differences in the degree of development of rural areas, which have arisen from the past economic development, are to be seen at the level of rural communes [Paluch and Sroka 2012].

On the one hand, sustainable development of, and the rate of change of a commune is determined by miscellaneous exogenous and endogenous determinants, which are the source of information about functionality of this particular commune. But on the other hand, the given process is also a result of a number of factors influencing the change in system of values and in an environmental model of consumption. This change is accomplished when the pressure accompanied by economic development never surpasses the ability of this development to self-regenerate [Lewandowski 2007]. Taking into account the situation described above, it seems that the best option is to examine the relation between economy and environment. The main goals of human activity, namely the maximum rise in profits and material production, have been prevalent in literature ever since. The mention of these two goals dates back to the first works of the classical school of economics. Classical economists equated the increase in material prosperity with the improvement of quality of life. This axiom applied to both a planned and market economy. Hence, during the past decades, social policy has been preoccupied mainly with the promotion of benefits which resulted from intensive economic growth [Daly 1996, p. 2]. Not only have these practices threatened environmental and social values, but also natural limits to economic development have emerged. It should be highlighted that economy is responsible for changes in natural environment as well as for an exploitation of natural resources.

Despite there is a strong tendency to level a number of changes against neoclassical economics, such as social inequalities and degradation of environment, its achievements should not be discredited. However, the neoclassical school of economic thought have not contributed to the betterment of environmental policy. These deliberations lead to a question whether there are any tangible interactions between the realization of economic and environmental goals. In today's world, it is assumed that highly developed countries and regions are characterized by their effective realization of environmental policy. The research conducted by Bołtromiuk [2011] indicates that highly developed communes in Poland are more likely to achieve environmental sustainability. Paluch [2012], similarly to Bałtromiuk, notices the correlation between the degree of socio-economic develop-

ment of rural communes and environmental sustainability in Małopolska Province It is believed that the dimension of economic development is linked not only with continuity and sustainability, but also with the rate of social and environmental change [Kokoszka 2011].

In most researches, concerned with the conditions of sustainable development of rural areas, emphasis is put on a local policy. Hence, the local authorities and institutions are faced with multifarious, yet tough decisions. Various objectives, which are aimed to fulfill goals and principles of local government units, are achieved by these units and are said to constitute the basic tool used in the process of economic planning and in the implementation of sustainable development. Thus, the rational development policy is concomitant with the application of specific economic as well as non-economic instruments. These processes can both stimulate and hamper development which in turn is dependent on the condition and level of diversification of resources and on the degree of attractiveness and competitiveness of socio-economic space, including environmental conditions of a particular commune.

MATERIALS AND METHODS

The main aim of this research is to identify and evaluate the factors of environmental sustainable development of rural communes in Małopolska Province. Scientific measures are taken to provide a definite answer to the pivotal question of what kind of socio-economic characteristics, including tools of budgetary policy, contribute to the increase in the level of environmental sustainability in local government units. Thus, the obtained results may have a profound impact on future decisions that are to be made by other local governments. These results may give a hint on how to effectively take advantage of the existing conditions and achieve the high level of environmental development.

This research is based mainly on the data taken from Local Data Bank of Central Statistical Office, Institute of Soil Science and Plant Cultivation in Puławy, Regional Directorate for Environmental Protection in Kraków and the so-called SAS (a system aimed at monitoring local public services). This study is narrow in scope and covers six years from 2004 to 2010.

This scrutiny embraces 125 rural communes, with the exception of urban and urban-rural communes, in Małopolska Province. Urban-rural communes are excluded because of the lack of statistical data concerning the division into urban and rural areas. This investigation is also supplemented by Classical Statistics Analysis aimed at an observation of the correlation between multidimensional structures. Due to their multidimensionality, evaluation and measurement of sustainable development should be constructed around the description of numbers as well as the assessment of mutual disproportions, which exist in either a spatial or temporal dimension. The collection of chosen indexes is a statistical reflection of the descriptive definition of sustainable development [Paluch and Płonka 2011, p. 70].

In the first part of this research, the degree of environmental sustainability of given communes is estimated by the use of multidimensional zero unitarization method. Every rural commune out of 125 is evaluated on the basis of an established unit of diagnostic

variables. The established unit of diagnostic variables is used to give an exhaustive out-
line of the described phenomenon. Initial studies are based largely upon a wide array of
variables describing the degree of environmental sustainability of rural communes. In
order to reduce the number of variables, formal criteria are taken into account. Hence,
the formal criteria imply that diagnostic variables should barely correlate with each other
so as not to duplicate the information they carry[1]. The values of calculated Pearson prod-
uct-moment correlation coefficients are used to determine the degree of correlation be-
tween variables. Additionally, it is accepted that these variables should be characterized
by a high degree of variability which is expressed by the coefficient of variation and the
relative communicative value. It is generally claimed that the value of coefficient of vari-
ation, which is calculated for particular variables, should be more than 10% [Sobczyk
1983, Kukuła 2000, Bąk and Sompolska-Rzechuła 2006, Młodak 2006, p. 27]. The level
of environmental sustainability is characterized by the use of such diagnostic variables
as:

$x_{1(s)}$ – the average value of expenditure on municipal engineering and protection of en-
vironment per capita (zł),

$x_{2(s)}$ – the length of water supply network in km per km^2 of an area,

$x_{3(s)}$ – the length of sanitary sewer network in km per km^2 of an area,

$x_{4(s)}$ – the share of legally protected areas in the whole area (%),

$x_{5(s)}$ – the size of collected municipal solid waste per capita (kg),

$x_{6(s)}$ – the population serviced by Industrial Water Treatment in the overall percentage of
population (%),

$x_{7(s)}$ – the index of agricultural quality of production areas (points),

$x_{8(s)}$ – the share of forests and forest lands in the overall areas (%),

$x_{9(s)}$ – the share of organic farms in the overall number of agricultural holdings (%).

The normalization (comparability) of diagnostics variables is achieved by the use of
following normalization formulas [Kukuła 2000]:

– for the so-called stymulanta (larger the better): $z_{ij} = \dfrac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}},$

– for the so-called destymulanta (smaller the better): $z_{ij} = \dfrac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}}.$

Analysing the given transformation all standardized variables (z_{ij}) fall in (0,1) range,
it should also be noted that the least favourable condition of every variable results in value
0, whereas the most favourable condition results in value 1. On the basis of the achieved
values of standardized variables, calculations have been made to establish a composite
indicator $(\bar{z}_j)$ for every subject (rural commune):

---

[1] However, it is hard to decide upon the level of correlation between variables, it can be done when
one divides variables into "high" and "low" category [Kukuła 2000].

$$\bar{z}_j = \frac{\sum\limits_{i=1}^{n} z_{ij}}{n} \quad (i = 1, 2, \ldots, r),$$

where: $\bar{z}_j$ – the average value j of this standardized variable,

$\quad\quad z_{ij}$ – the value i of this subject (rural commune) for j of this standardized variable,

$\quad\quad n$ – the number of researched subjects (rural communes).

In the second part of this research importance is attached to an evaluation of the impact of socio-economic characteristic on the level of environmental sustainability of rural communes. In cause and effect researches, one of the frequently used types of statistical modeling is the analysis of regression. For the purpose of this analysis, a composite indicator of environmental sustainability should be treated as a dependent variable (Y_i). An analysis of regression is based not only on the estimation of parameters of theoretical equation, which can thoroughly reproduce the existing correlation, but also on the graph of a function, which will optimally move into the direction of every point on a certain scale. Not only is the analysis of regression essential to evaluate strength and form of a relation between the agreed diagnostic characteristics, but it also enables to predicate the dependent variable, whose base is combined with the observed values of correlation coefficients and exogenous variables [Stanisz 2007, pp. 59–63]. Multiple regression has its roots in simple regression, thus multiple regression consists of one dependent variable (Y_i) and a set (q) of independent variables: (x_{ip}): $Y_i = b_0 + b_1 x_{i1} + b_2 x_{i2} + \ldots + b_p x_{ip} + \varepsilon_i$.

In a regression equation, the value of Y_i variable is estimated for the i observation, and similarly x_{ij} ($j = 1, 2, \ldots, p$) are the values of p variables meant to explain the i observation. Furthermore, where ε_i is a random error of the i observation, b_0 and b_j are unknown parameters of this model. The application of this method is possible only when certain conditions are to be met by both exogenous and endogenous variables. Not only should exogenous variables correlate with a variable they describe, but they should also be characterized by a suitable coefficient of their own variability. Under no circumstances can exogenous variables be interdependent. It should also be noted that the number of estimated parameters (k) may not surpass the number of observation (n). It is important to mention that the lack of an observational error in a dependent variable Y_i as well as in exogenous variables (x_{ip}) is the essential premise of a regression. Other assumptions are related to the lack of correlation between random elements, to the distribution of random elements, which should be similar to a normal distribution, and finally to the variance of random elements and their expected values. Additionally, when analyzing regression, the parameters b_0 and b_j are unknown, hence they should be estimated in data fitting as well as chosen in such a way to minimize the sum of squared residuals. The method of least squares is one of the well--known approaches to regression analysis [Stanisz 2007, pp. 59–63].

The statistical phenomenon of multicollinearity and the effect of catalysis can be prevented by the use of various methods. Despite the methods vary greatly in calculation, they come down mainly to a selection of the amount of variables and an elimination of exogenous variables, which are correlated too strongly with other independent variables. During the reduction of a set of initially distinguished characteristics, which will take

part in the construction of multiple regression model, only these exogenous variables for whom the correlation coefficient is smaller than the value of a coefficient which represents the interdependence between exogenous and endogenous variables, should be marked out. A potential exogenous variable carries the information about an endogenous variable [Paluch 2012].

According to the previously described method of analysis, from among the initially chosen set of characteristics (in total 17 variables) that are meant to construct multiple regression model, independent variables (x_{ip}) are distinguished. These independent variables, assuming that the level of trust is 95%, are characterized by a relatively high value of correlation coefficient with dependent variable (Y_i) and by higher value of correlation coefficient when compared to the correlation between these independent variables:

x_2 – own income of communes (per inhabitant in zł),
x_7 – means of UE project financing (per inhabitant in zł),
x_8 – age dependency ratio,
x_{12} – education index,
x_{13} – the number of non-governmental organizations (per 1,000 inhabitants),
x_{15} – the index of economic servicisation.

Among other things, the variable x_1 (total incomes of communes) is not included in the set described above. The variable x_1 is not taken into consideration because the correlation coefficient together with the variable x_2 (own incomes of communes) has been over twice as great (0.77) than the value of correlation coefficient which describes the dependence of variable x_1 with a composite indicator (Y_i), i.e. 0.33. Similar procedure has been used in the case of remaining variables. Majority of the calculated correlation coefficients between the composite indicator and the analyzed exogenous variables have revealed value added in the 0.16 to 0.36 range.

The procedure of forward stepwise regression[2], based on a partial F-test, has been used to analyze the dependence between socio-economic and environmental dimension of the sustainable development of rural communes in Małopolska Province [Gradziuk 2005]. First and foremost, the aim of forward stepwise regression is to find exogenous variable which not only is the most powerfully correlated with endogenous variable, but it also determines a model of significant parameters. Secondly, next step involves choosing another exogenous variable, whose values are strongly correlated with the remainders from the first step. Since every step entails the inclusion of a new variable $x_{ip,}$ partial F-test[3] is used to revise the evaluation of significance of variables. The procedure is ended either when there is no new exogenous variables to improve the model or when the inclusion of a new variable leads to the loss of significance of the whole model.

---

[2] The procedure of stepwise regression can be done in two ways: either in a forward or in a backward way [Gradziuk 2005].
[3] Partial F-test is used to evaluate a relative significance of the part of a model (a certain k among m variables). A relative significance of k refers to a premise that $m - k$ variables remain in a model. Partial F-statistics is regarded as a check on this test. Partial F-test, which is aimed to check the significance of a singular variable, can be treated as t-test when hypothesis of a relative significance of one variable x_{ip} among other variables included in the model is tested [Bitner 2007].

Additionally, so as to check the significance of particular angular coefficients in the equation (b_p), t-test is carried out. The aim of t-test is to reduce the number of irrelevant variables, i.e. those which have a marginal impact on a formation of the value of Y_i variable [Bitner 2007].

The evaluation of a divergence between the values of a dependent variable and the values obtained from the model are considered an important premise of multiple regression analysis. Standard deviation of remainders or more popular coefficient of determination (R^2) is used to measure multiple regression. The best suited model is characterized by the value of a coefficient (R^2) which is close to unity, where value 1 refers to a perfect adjustment while $R^2 = 0$ refers to the lack of correlation between variables. Coefficient of determination is used to measure which part of a total variability of dependent variable is estimated by regression. While assessing quality of the model, the comparison of R^2 with the same value estimated for an alternative model, which is described by a different function, can be made. If the value R^2 of an alternative model is larger, this alternative model can be seen as more suitable to describe data. Adjusted coefficient of determination (R_S^2) is required to use when the number of exogenous variables increases.

RESULTS AND DISCUSSION

The lineral model, which is based on six exogenous variables, has been constructed as a result of analyses that have made use of forward stepwise regression model. Hence, this lineral model have enabled to determine the force of an impact of particular variables, which characterize the socio-economic dimension, on the level of environmental sustainability (Y_i):

$$Y_i = 0.300\,x_2 + 0.224\,x_{15} - 0.280\,x_8 + 0.181\,x_7 + 0.161\,x_{12} + 0.125\,x_{13}$$

t =	$\|3.525\|$	$\|2.725\|$	$\|-3.140\|$	$\|2.164\|$	$\|1.922\|$	$\|1.422\|$
p =	$\|0.001\|$	$\|0.007\|$	$\|0.002\|$	$\|0.033\|$	$\|0.048\|$	$\|0.157\|$

R = 0.762 $R^2 = 0.516$ $\bar{R}_S = 0.477$

F = 8.097 $p < 0.000$ $S_e = 0.064$

In this model own incomes of a commune per inhabitant in zł (x_2) are an exogenous variable, which greatly ($b_p = 0.300$) influences the value of a composite indicator (Y_i – composite indicator of environmental sustainability). This equation is supplemented by all remaining variables which have met the established methodological premises, hence the remaining variables include: the index of economic servicisation (x_{15}) per 1,000 inhabitants ($b_p = 0.224$), which refers to the number of people employed in the sector of both market and non-market services, age dependency ratio (x_8) per 1,000 inhabitants ($b_p = -0.280$), which is the number of people at non-working age, means of EU project financing (x_7) per inhabitant in zł ($b_p = 0.181$), education index (x_{12}), which is the weighted mean of particular levels of education ($b_p = 0.161$), combined with the number of non-governmental organizations (x_{13}) per 1,000 inhabitants ($b_p = 0.125$).

Five out of these variables, taken to form the equation x_{ip}, show value added, which means that the increase of one standard deviation in whichever variable leads to the

increase in the value of dependent variable of b_p value of its standard deviation. Limiting oneself only to the interpretation of own incomes of a commune, which are a key independent variable (x_2), it should be pinpointed that the increase of one standard variation in this independent variable will lead to the increase in the value of variable Y_i of 0.300 of its standard deviation. The remaining exogenous variables should be interpreted similarly. The opposite situation happens when the reduction of age dependency ratio (x_8) should contribute to the increase in the value of composite indicator (Y_i).

An assumption that there is a lineral dependency between dependent variable (Y_i) and exogenous variables (x_{ip}) has been positively verified by F-test, (6.118) = 8.097. Hence, the value of R^2, which equates 0.516, explains that the variability of composite indicator amounts to 51.6%. However, the analysis of outliers has demonstrated that the absolute values of remainders for observation 4, 50 and 19 are larger than the value of standard deviation. Hence, not only has the procedure of robust statistics been implemented, but also the equation of multiple regression has been estimated again (Table 1).

Table 1.　The result of resistance estimation of the model Y_i – composite indicator of environmental sustainability

| Step | Divergence | | R^2 | $\bar{R}_S$ | F | | S_e |
	Number	Value of a remainder			Value	p	
1	4 50*	−0.106 0.111	0.516	0.477	8.097	< 0.000	0.064
2	4* 19	−0.103 −0.097	0.518	0.478	8.101	< 0.000	0.045
3	19*	−0.096	0.543	0.504	8.955	< 0.000	0.044
4	Lack	–	0.557	0.519	9.447	< 0.000	0.042

*Observations removed in the next step, where: 50 – Tarnów commune, 4 – Trzciana commune, 19 – Igołomia--Wawrzeńczyce commune.

Source:　Own calculations.

It is a quite common phenomenon that in cross-sectional data models there are one or a few outliers in which the relation between endogenous variable and exogenous variables is disparate from the dominant number of subjects in a research. The results of estimation can be strongly influenced by one or a few observations which are usually disproportionate to their overall significance. One of the main problems of economic statistical analysis is both the detection of outliers and the prevention of their impact on the results [Jajuga and Walesiak 2007, p. 595]. As a result of the elimination of outliers, the final multiple regression model[4], which depicts the correlation between the level of

---

[4] During the research other alternative models, based on curvilineral functions, have been constructed. These alternative models include both power and exponential function which have been subjected to the process of lineralization. The obtained R^2 and R_S^2 values have been lower than in the case of the obtained lineral function.

socio-economic development and the level of environmental sustainability of rural communes in Małopolska Province, has taken the form of:

$$Y_i = 0.327\,x_2 + 0.244\,x_{15} - 0.298\,x_8 + 0.202\,x_7 + 0.161\,x_{12} + 0.134\,x_{13}$$

| t | = | |3.787| | |3.029| | |−3.568| | |2.452| | |1.626| | |1.847| |

t = |3.787| |3.029| |−3.568| |2.452| |1.626| |1.847|
p = |0.001| |0.003| |0.001| |0.016| |0.049| |0.106|
R = 0.797 $R^2 = 0.557$ $\bar{R}_S = 0.519$
F = 9.447 $p < 0.000$ $S_e = 0.042$

The given model, similarly to the previous one, demonstrates that the variable x_2 (own incomes of a commune per inhabitant in zł, $b_p = 0.327$) has the largest impact on the value of composite indicator (Y_i), which characterizes the level of environmental development of rural communes in Małopolska Province. The remaining exogenous variables, at the level of 0.05 significance, are coincidental and statistically significant. An exception to the principle is the variable x_{13} (the number of non-governmental organizations per 1,000 inhabitants) whose value in t-test has amounted to 1.847 while the value of p statistics has come to 0.106. Moreover, the value of p statistics has been over twice higher than the established level of significance (> 0.05). According to F-test, the high value of F-statistics (9.447) demonstrates that the inclusion of variable x_{13} to the equation of regression has not shattered the significance of the whole model.

In the described model there is a relatively strong as well as statistically significant correlation between the dependent variable (Y_i) and exogenous variables (x_{ip}). Furthermore, the results of regression model demonstrate that the formally selected independent variables, which characterize the level of socio-economic development of rural communes in Małopolska Province, have a varied impact on the value of composite indicator of environmental sustainability. Own incomes of a commune, whose increase of one standard deviation in the value leads to the increase in the value of endogenous variable (Y_i) of 0.327 of its standard deviation, have turned out to be the main determinant. Smaller significance is given to the index of economic servicisation (0.244), age dependency ratio (–0.298), means of UE project financing (0.202), education index (0.161) and the number of non-governmental organizations (0.134). Additionally, the negative value of age dependency ratio informs that its reduction may lead to the increase in the value of composite indicator (Y_i).

Coefficient of determination (R^2) and standard error of estimation (S_e) has been calculated to evaluate fitting of the constructed model. The value of coefficient of determination (R^2), which determines how the model fits the actual data, has amounted to 0.557. Hence, it should be noted that at least 56% of the variability of composite indicator (Y_i) is explained by exogenous variables (x_{ip}) whereas the remaining 44% can be explained by other characteristics, which have not been included in the equation.

CONCLUSIONS

On the basis of presented analyses, it should be highlighted that the main factor of environmental sustainability of rural communes in Małopolska Province is the rate of their

own incomes. Own incomes of communes are extremely significant because they enable effective realization of statutory tasks mainly concerning environment protection. The researched subjects, thanks to own incomes of a commune, can absorb extrabudgetary funds which are indispensable to take investment measures mainly of infrastructural nature. Due to their great expense, the management of these investments has an effect on the increase in the level of development of three basic dimensions of sustainability, namely social, economic and environmental. It is claimed that the intensive development processes will be carried out in units that are financially stable. Assuming that the financially stable units have enough own incomes, they will be able to take multifarious actions. Hence, these actions will be taken as part of strategic and operational plans, which are made in accordance with the premises of sustainable development. Apart from factors of economic nature (own incomes of a commune and the index of economic servicisation), huge impact is also attributed to a special kind of demographic potential represented by age dependency ratio. The conducted researches demonstrate that units of no great age dependency ratio are distinguished by their relatively high level of environmental development.

In addition, an analysis of correlation between the established unit of variables, which characterize the level of socio-economic development of communes, has demonstrated that the level of age dependency ratio does not contribute to the increase in the value of own incomes of a commune. This lack of correlation is revealed in a low value of correlation coefficient (–0.05). From what has been presented, it appears that people at working age are characterized by high ecological awareness in contrast to people at non-working age. This awareness is seen as one of the most important factors influencing the formation of environment by local communities. This awareness enables people to understand the natural phenomena as well as makes them more sensitive to particular problems. Moreover, it also influences the pro-ecology attitudes of inhabitants and the course and type of decision processes made by local governments.

REFERENCES

Bąk I., Sompolska-Rzechuła A., 2006. Ranking województw Polski pod względem poziomu produkcji artykułów rolnych (Ranking of the Polish Regions in terms of the level of agricultural production). Acta Agraria et Silvestria Vol. XLVII. PAN Kraków, 63–70 [Abstract in English].

Bitner A., 2007. Konstrukcja modelu regresji wielorakiej przy wycenie nieruchomości (Construction of the multiple regression model in real estate valuation). Acta Scientiarum Polonorum, Administratio Locorum 6 (4), 61 [Abstract in English].

Bołtromiuk A., 2011. Uwarunkowania zrównoważonego rozwoju gmin objętych siecią Natura 2000. (Determinants of sustainable development in communities of the areas of Natura 2000). Instytut Rozwoju Wsi i Rolnictwa PAN, Warszawa [in Polish].

Brelik A., 2012. Sustainable tourism development – case of the Wolin Region (Zrównoważony rozwój turystyki na przykładzie Regionu Wolińskiego). Acta Scientiarum Polonorum, Oeconomia 11 (2), 19–27.

Daly H.E., 1996. Beyond growth. Beacon Press, Boston.

Dobrzański P., 2010. Wzrost zrównoważony a ochrona środowiska. Podstawowe aspekty polityki gospodarczej (Sustainable growth and environmental protection. Basic aspects of

Economic Policy) [in:] M. Winiarski (ed.) Gospodarka: innowacje i rozwój. Materiały z seminarium naukowego (Economy: innovations and the development. Materials from the scientific seminar). Vol. I. Prawnicza i Ekonomiczna Biblioteka Cyfrowa. Uniwersytet Wrocławski, Wrocław, 25–34 [in Polish].

Gradziuk B., 2005. Czynniki sprzyjające osiąganiu sukcesu przez gospodarstwa rolnicze – na przykładzie Zamojskiego Towarzystwa Rolniczego) (Determinants of supporting achieving success by farms – for the example of Zamojski Society Farming). PhD thesis unpublished. Szkoła Główna Gospodarstwa Wiejskiego w Warszawie, Warszawa [Summary in English].

Jajuga K., Walesiak M. 2007. Klasyfikacja i analiza danych: teoria i zastosowania (Classification and the data analysis: the theory and applications). Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław [in Polish].

Kokoszka K., 2011. Czynniki determinujące zrównoważony rozwój terenów wiejskich w Polsce (Determinants of sustainable rural development in Poland). Wydawnictwo Roczniki Naukowe SERIA Vol. XIII, Issue 1, 183–189 [Abstract in English].

Kukuła K., 2000. Metoda unitaryzacji zerowanej (Zero Unitarization Method). Wydawnictwo Naukowe PWN, Warszawa [in Polish].

Lewandowski A., 2007. Zrównoważony rozwój i konkurencyjność (Sustainable development and competitiveness) [in:] J. Broszkiewicz (ed.) Euroregiony – Polska (Euroregions – Poland) Issue 61. Euro-Regional Press, Katowice 29 [in Polish].

Michałowski A., 2011. Przestrzenne usługi środowiska w świetle założeń ekonomii zrównoważonego rozwoju (Spatial environmental services in the approach of the assumptions of economics for sustainable development). Problemy Ekorozwoju (Eco-development problems) Vol. 6, No 2, 117–118 [Abstract in English].

Młodak A., 2006. Analiza taksonomiczna w statystyce regionalnej (Taxonomical analysis in regional statistics). Difin, Warszawa [in Polish].

Paluch Ł., 2012. Uwarunkowania zrównoważonego rozwoju gmin wiejskich w województwie małopolskim (Determinants of sustainable rural development in communities of the Małopolska Region). PhD thesis unpublished. Szkoła Główna Gospodarstwa Wiejskiego w Warszawie, Warszawa [Summary in English].

Paluch Ł., Płonka A. 2011. Differentiation of socio-economic and environment al development in rural municipalities in Małopolskie Province – gauging and evaluation exercise (Zróżnicowanie rozwoju społeczno-gospodarczego i środowiskowego gmin wiejskich w województwie małopolskim – próba pomiaru i oceny) [in:] Economics of Agriculture and Environmental Sciences in the Context of Globalization and Regional Challenges. National University of Life and Environmental Science of Ukraine. CP Komprint, Kijiv.

Paluch Ł., Sroka W., 2012. Identyfikacja i ocena czynników zrównoważonego rozwoju gmin wiejskich województwa małopolskiego (Identification and evaluation of the determinants for sustainable development of the rural communes in Małopolska Region). Wydawnictwo Roczniki Naukowe SERIA Vol. XIV, Issue 8, 81–94 [Abstract in English].

Siekierski J., Popławski Ł. 2008. Scenariusze zrównoważonego rozwoju obszarów wiejskich (Balanced Development Scenarios of Rural Areas). Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie 1 (11), 223–255 [in Polish].

Sobczyk M., 1983. Analiza porównawcza produkcji rolniczej w województwie lubelskim (Comparative analysis of the agricultural production in the Lublin Province). Wiadomości Statystyczne (Messages of statistics) Issue 12. GUS, Warszawa [in Polish].

Stanisz A., 2007. Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny (Course in statistics with applying STATISTICA PL for examples from medicine) Vol. 2. Modele liniowe i nieliniowe (Linear and non-linear models). StatSoft, Kraków [in Polish].

SPOŁECZNO-GOSPODARCZE I ŚRODOWISKOWE DETERMINANTY ZRÓWNOWAŻONEGO ROZWOJU GMIN WIEJSKICH WOJEWÓDZTWA MAŁOPOLSKIEGO

Streszczenie: Dysproporcje poziomu rozwoju obszarów wiejskich w ujęciu jego trzech wymiarów, tj. gospodarczego, społecznego i środowiskowego występują na każdym szczeblu podziału administracyjnego kraju. Dotyczą one m.in. zakresu działań jakie są i powinny być podejmowane w celu poprawy sytuacji gospodarczej obszarów wiejskich oraz jakości życia mieszkańców wsi, przy zachowaniu racjonalności wykorzystania zasobów środowiska przyrodniczego. Celem opracowania jest więc próba identyfikacji oraz oceny wpływu czynników charakteryzujących poziom rozwoju społeczno-gospodarczego na zrównoważenie środowiskowe gmin wiejskich województwa małopolskiego. Do przeprowadzenia analiz posłużyła metoda regresji wielorakiej reprezentująca podejście oparte na metodzie klasycznej analizy statystycznej (z ang. Classical Statistics Analysis), pozwalającej na obserwację zależności struktur wielowymiarowych. Badaniami objęto 125 gmin województwa małopolskiego o statusie wiejskim. Uzyskane wyniki wykazały, że największy wpływ na poziom zrównoważenia rozwoju badanych gmin wiejskich w wymiarze środowiskowym mają głównie czynniki natury ekonomicznej, w tym szczególnie wielkość ich dochodów własnych oraz rozmiar środków pozyskanych na finansowanie projektów UE.

Słowa kluczowe: zrównoważony rozwój, unitaryzacja zerowana, regresja wieloraka, dochody własne, gminy wiejskie, województwo małopolskie

THE DEVELOPMENT OF RETAIL TRADE IN THE BORDER AREAS IN POLAND IN THE LIGHT OF SELECTED THEORETICAL APPROACHES

Halina Powęska

Warsaw University of Life Science – SGGW

Abstract. Over the past twenty years, retail trade in the border zone areas in Poland has been characterized by a great dynamics of change, mainly due to unregistered cross-border trade. The present article investigates the process in the light of theoretical approaches to the problem. The existing models, however, are applied to economic conditions in which the range of activity of the commercial enterprise depends mainly on its entrepreneurship, innovation and investment opportunities. The conditions of conducting commercial activity in the border regions of Poland during the period under investigation were fairly unstable and made the entrepreneurs respond rapidly to the changes underway. This is the reason why the concept of self-organization has been used to fully demonstrate the specificity of the development of cross-border trade and its complex, multi-faceted and multi-stage character.

Key words: retail trade, cross-border shopping, border areas, Poland

INTRODUCTION

Retail trade in Poland's border regions during the past twenty years has been characterized by a great dynamics of changes, mainly due to unregistered cross-border trade [Powęska 2008a]. Commercial activity required frequent adjustment to the changing conditions stemming from the implementation and enforcement of new laws pertaining to the mode and possibilities of crossing borders as well as the socio-economic transformation in Poland and the neighbouring countries [Powęska 2008b]. However, great financial profits from cross-border trade caused many business entities and natural persons to conduct commercial activity. In the 1990s, this was reflected in an increasing number of stores and marketplaces [Powęska 1995], and in the first decade of the 21st

Corresponding author – Adres do korespondencji: Department of European Policy, Public Finance and Marketing, Faculty of Economic Sciences, Warsaw University of Life Sciences – SGGW, Nowoursynowska 166, 02-787 Warsaw, Poland, e-mail: halina_poweska@sggw.pl.

century modern retail shopping centre formats began to appear in the border zone areas (for example, the Sanowa Gallery in Przemyśl).

MATERIALS AND METHODS

The aim of the study is to formulate a theoretical concept in order to explain the development of retail trade in a view of rapidly changing external factors affecting retail trade in the border zone areas of Poland over the past twenty years. The results of fieldwork research show that in the realm of trade in border regions the assumptions of the self-organization theory have been fulfilled, therefore this study attempts to create a model of the development of retail trade in cross-border zone areas to be based on this scientific principle [Nicolis and Prigogine 1977, Ayers 1988].

This objective has been achieved in two stages. The first step was to analyze the selected theories of the development of trade from the perspective of their adequacy to the problems of retail trade in the border regions during the transformation period. Next, taking into consideration that retail trade has fulfilled the assumptions of the concept of self-organization, the stages of development of retail trade have been presented according to this concept. The analysis of theoretical approaches based on literature has been enriched with empirical literature and the observations made by the author.

SELECTED THEORIES OF THE DEVELOPMENT OF TRADE AND THEIR IMPLEMENTATION

The models taking into account the time lapse factor and the theories used to analyze the development of trade under the influence of the surrounding environment play a significant role in the analysis of the development of retail trade [Grzesiuk 2010]. From the group of models taking into account the element of time the following ones were taken into consideration in this study: the wheel of retailing theory, life-cycle theory of a commercial enterprise [Sławińska 2008] and Tordjman's concept [Czubała 2001]. From the approaches analyzing the development of trade under the influence of the surrounding environment the evolutionary theory of retail trade has been taken into consideration.

The **wheel of retailing theory**, which was worked out in the form of a graphic model in the middle of the 20th century, represents the development of trade as three consecutive phases: market entry, attaining maturity (trading-up) and entry into the state of susceptibility to the threats from outside (vulnerable phase). During the phase of the market entry trading companies set low prices and the range of their products offered for sale is not very wide. This is possible thanks to low profit margins and a small number of employees. This enables the newly established firm to enter the market; however, other business entities emerge very quickly and they operate according to the same rules. This is the reason why the firm raises the standard of trade-related services through various kinds of investments, for example in the realm of store furnishings, by improving the quality and quantity of the goods offered for sale, by introducing the accompanying services etc. The investment costs cause the increase in profit margins and prices. This is the transition of

the entity to the trading-up phase during which a range of goods and services offered for sale is being expanded. This leads to further increases in prices. For this reason, the firm introduces innovations and undertakes investment activities. This results in an increase in sales and increased participation of the enterprise in the market. Sustaining high quality of goods and services entails a continuing rise in costs. That is why commercial entities enter the phase of susceptibility to the threats from outside during which they are gradually replaced by new retailers who offer their goods at low prices. This is the third phase of development. In the third phase, the "mature" commercial entity often continues to hold a strong market position; however, in order to maintain its position in the market it must conduct new activities including, among other things, market segmentation, product positioning, introduction of the new forms of promotion, changing the hitherto existing product packaging etc. [Borusiak 2008].

The wheel of retailing theory can hardly help to explain the development of retail trade in Poland's border zone areas during the period under investigation. The main reason behind it is a dynamic growth of unregistered cross-border trade, a remarkably high share of foreign customers among buyers as well as changes in the intensity of commercial activities being the result of the political, social and economic transformation in the neighbouring countries. Under these circumstances, a decisive factor for company's development was the mobility of its owner and staff as well as their ability to adjust the range and location of their activities to the rapidly evolving and changing market conditions. Innovativeness, which is the fundamental factor in the wheel of retailing theory, was not so important. It should be noted, however, that many commercial firms and enterprises operated, in part, in accordance with the assumptions of the first phase of the wheel of retailing theory since they entered the market and competed with already existing stores by setting low prices and by adjusting the assortment structure to the needs of foreign customers. It must also be observed that new business entities, which operate most frequently in marketplaces and bazaars, were charged with lower trading activity dues, which also made them more competitive as compared to the "mature" stores. Some of the "new" trading firms operating in cross-border areas, despite the absence of an element of innovation during the first phase of their development, expanded their activities by widening the range of services, by modernizing the look of the site of their activities, and, sometimes, by moving an existing business to a new location within the same locality, which allowed them to achieve the phase of maturity. The fact that many firms abandoned their activities was caused by the decreasing demand and not by the factor of competitiveness on the part of new enterprises. To sum up, the wheel of retailing theory does not explain all the implications of the development of trade, specifically in view of the pace and complexity of changes occurring in the border zone areas during the past two decades.

The enterprise life-cycle theory (ELC) based on the product life-cycle theory was put forward in the 1970s, when there was a remarkable increase in the number of various trading companies and a growing tendency towards the organizational concentration and formation of large-scale trade formats. With regard to commercial enterprises four phases of development were distinguished: start-up phase, growth phase, maturity phase and decline phase [Grzesiuk 2010]. This theory, like the wheel of retailing theory, explains, to a certain extent only, the processes of the development of retail trade in border regions.

Phase I, i.e. the start-up, assumes innovativeness, absence of competition and relatively small financial benefits. When we apply the aforesaid statement to the border zone areas in Poland, it is worth noting that the operation mode of most enterprises did not include an element of innovativeness; on the contrary, a certain spontaneity and primitive character of trade was noted, specifically as regards marketplace and bazaar sellers. High demand on goods on the part of cross-border shoppers coming to Poland from neighbouring countries caused the sellers to enter, without the need to conduct innovation activities, quite rapidly and smoothly into the phase II (growth phase) which is characterized by quantity development. In many cases, phase I (i.e. start-up market entry), and phase II (development) became joined together, thus enabling a given entity to achieve maturity. According to the life-cycle theory of trading enterprises, during the maturity phase (phase III) there appear many competitors in the market, so that the rate of growth in turnover and the profitability of the entity decrease. In Poland's border regions, the decline of profitability and revenues from commercial activity was an outcome of the decreasing number of cross-border shoppers from the neighbouring countries and not of the increasing number of competitors. In phase IV, referred to as the decline phase, the volume of the company's turnover and profits decrease and the successive new retailers appear in the market. In the border zone areas of Poland the phase of decline in turnover and profits was the result of gradually decreasing differences in prices and in the standards of living in the neighbouring countries on the one hand, and, on the other hand, of a large-scale introduction of new retail format stores, including department stores, large-surface stores, specialist stores etc.

To sum up, we can say that despite certain points of convergence between the tendencies set out by the life-cycle theory and observed in the development of retail trade in the border zone areas of Poland, this theory does not really help us explain the character and specificity of the process of development of retail trade in the border zone areas, since the trade life-cycle theory takes into consideration factors different from those affecting the retail trade in Poland's border regions. In the model of trade life-cycle innovativeness and competition play the most important part, and in the conditions of border zone areas the development of retail trade is influenced by unstable market which is dependent on external factors, spontaneity, mobility and the ability of rapid adjustment of the range and site of conducted activity to changing conditions.

Changes of organizational forms over time are illustrated by **Tordjman's concept** [Czubała 2001]. This approach made it possible to distinguish four phases of retail trade development: traditional, intermediate, advanced and highly advanced. Phase I is marked by low levels of concentration, prevalence of small family-owned firms operating independently of one another, and the entry of large-surface stores into the market. During the phase II there is still a dominance of small retailers, however this is the beginning of the processes of concentration and integration, specifically in food products trade. During the phase III, the number of trading enterprises decreases and, at the same time, the surface area of the stores increases. The process of cooperation and internationalization of trade can be observed in this phase. The phase IV of the development of retail trade, according to Tordjman's concept, is a modern trade with professional staff, high labour productivity, a very high level of concentration, integration, internationalization and with the use of modern solutions in various areas of the operation of enterprises. When we discuss the

processes of retail trade taking place in the border zone areas in Poland with reference to the concept presented above, we may say that this trade is undergoing the phase I of its development.

The fundamental assumption of the **theory of retail trade evolution** is the process of natural selection, and the survival of a commercial entity depends on its adapting abilities. Therefore, the greatest successes are achieved by those entities and firms that are characterized by flexibility in operation and the ability to adapt to changes in the surrounding environment. This theory is also called the theory of adaptive behaviours. The theory says that changes in retail trade may occur under the influence of various factors, including such important issues as changes in the structure of purchasers, technological advancement and the changing nature of competition. All in all, the development of cross-border retail trade is consistent with the evolutionary theory since commercial enterprises, operating in dynamically changing economic, political, organizational and legislative conditions, were forced to constantly adjust the range and form of their activities to ongoing changes. However, we must strive to obtain a model approach which, in addition to a general outline, will enable us to present the specificity and stages of the development of retail trade in border regions.

THE DEVELOPMENT OF RETAIL TRADE IN BORDER AREAS ACCORDING TO THE CONCEPT OF SELF-ORGANIZATION

The theoretical approaches presented above may be applied to stabilized market conditions in which the development of commercial entities is the result of the activities and measures undertaken by the enterprise. However, commercial firms in border zone areas in Poland had to operate under the conditions requiring rapid and frequent adjustment to changes occurring in the market, and in this situation trade was both legal and illegal, registered and unregistered, formal and informal.

Therefore, in order to present the development of retail trade in Poland's border regions during the transformation period it has been suggested to use a model that is appropriate for the characteristics of the phenomena marked by great spontaneity and imbalance. According to the author of this study, it would be appropriate to approach the subject using the concept of self-organization[1], which should be widely applied to the analysis of the socio-economic phenomena and processes during transformation years [Domański 2005]. Over the past twenty years, retail trade in Poland's border zone areas has met the following assumptions of the above-mentioned model: (1) systems are open to the flow of energy and matter; (2) they are characterized by non-linearity; and (3) they are far from being in a state of equilibrium. Poland's sudden shift from the central planning model to the free market economy resulted in the occurrence of the non-linear phenomena in many

---

[1] The self-organization theory, which was worked out on the basis of thermodynamics, can be applied to the behaviour of physical systems; it presents the mode in which complex systems pass from one structure to another, from one order to another [Prigogine 1967]. This approach has also been adopted in chemistry and biology. In 1977, the author of this theory was awarded the Nobel Prize in Physics.

areas of social and economic life (including trade). The full opening of the frontiers and the fact that Polish citizens were allowed to travel freely across borders permitted a flow of energy and matter, and the appearance of numerous spontaneous phenomena brought about a trade imbalance. Border zone areas were faced with certain chaotic activities in the realm of socio-economic behaviours, and the basic principle of self-organization proved right, namely "let everyone take care of himself as much as he can".

A sudden perturbation gives rise to the process of self-organization. For retail trade in the border regions this perturbation was caused by a sudden increase in the number of customers due to the introduction of the free crossing of national frontiers. This caused increased fluctuations, which were manifested in the intensified movement of cross-border shoppers. In response, there was an emergence of a large number of stores and small shops located within easy access to border crossing points, albeit unadjusted to the buying and selling activity; those were mainly marketplaces and bazaars where freehand, peddling and itinerant (door-to-door) trade dominated. It was, for the most part, an unregistered and unrecorded activity. The reinforcement of fluctuation led to the emergence of macroscopic movements. This was an outcome of a large-scale (often organized, for example organized coach group tours) movement of persons across borders for trading purposes. Commercial function has come to be an important socio-economic function in the border zone areas. One could observe increased supplies of goods sold in the border zone shops and stores and a partial clean-up of marketplaces and trade squares. Foreign buyers travelled for trading purposes farther beyond the range of border areas; that is why commercial activities, similar to those undertaken in border areas, were conducted in almost all localities in Poland, most frequently in areas with good transport access. This led to the rise of a new order and new structure sustained by the exchange of energy with the surrounding environment. In a new organizational structure of retail trade there was a co-existence of the various formats of shops and stores in border zone areas: in addition to the hitherto dominant small shops, new large-surface stores were established. The importance of traditional trade was enhanced by new associations and unions of merchants and traders. Diminishing differences in prices of similar goods in the neighbouring countries caused the number of cross-border shoppers to decrease. As a result, the incomes of the vendors declined; however, new organizational changes introduced at a local level increase the revenues of territorial self-government units. This enabled the people to conduct activities which were directed towards the creation of a new structure accomplishing more and more complex functions. In particular, this was carried out through the expansion in the realm of operation of retail trade. In many shops and stores located in border regions, in addition to the re-distribution of goods, services were also offered, and trade performed a number of social and economic functions, including those pertaining to the process of local development. The implementation and enforcement of new laws regulating the flow of persons across borders and the differentiated pace of social and economic processes in the neighbouring countries as well as increasing unemployment resulted in changes in the intensity of retail trade in border zone areas. That is why, new structures functioned at a certain distance from the state of equilibrium, which entailed the limitation of business activity, and sometimes even liquidation of many shops and stores in the border zone areas. At the same time, an increased scope of informal activities was observed again. Despite the difficulties, benefits flowing from the commercial function

stimulated other social and economic functions. This caused a given unit of territorial self-government to shift in the hierarchical system. The increase in the revenues from retail trade sales contributed to the raising of living standards of the population and yielded higher revenues on a local scale, which caused a given administrative unit to expand the range of realized social and economic functions (including educational, health care and health-related, production, social and other functions). The increased range of realized functions contributed to the improvement of the ability of absorption and diffusion of innovations, which translates into the acceleration of the pace of socio-economic development. There has been an inflow of highly qualified specialists, increase of human and social potential and the formation of distinct trading centres in border regions (such as, for example, Słubice and Przemyśl). This resulted in the growing attractiveness of space. Trading activity caused the increase in the well-being of society and of the units of territorial self-government and the growing attractiveness of the given area, which contributed to the flow of investment (in trade and other sectors of social and economic activity). The appearance of these shocking phenomena affecting the retail trade is viewed as successive perturbations and fluctuations. They lead to the emergence of increasingly complex structures in which retail trade takes part by adjusting itself to the changing situation.

CONCLUSIONS

The study shows that the existing theories of the retail trade development do not fully explain the process of the development of retail trade in the border zone areas in Poland during the period of transformation. This is mainly due to the fact that the existing models can be applied to stabilized conditions and the range of activities of the commercial entity depends on its entrepreneurship, innovative activity and investment opportunities. However, during the period of transformation entrepreneurs undertaking trading activities in the border regions in Poland operated in very difficult conditions which required rapid and frequent adjustments to ongoing and multiple changes. Therefore, in order to present the development of the retail trade in Poland's border regions during the period of transformation the concept of self-organization was applied; this allowed the author to demonstrate the complex, multi-faceted and multi-stage character of the phenomenon.

REFERENCES

Ayers R.W., 1988. Self-organization in biology and economics. IIASA, RR-88-1, Laxenburg.

Borusiak B., 2008. Modele wzrostu przedsiębiorstw handlu detalicznego (Models of growth of retail businesses). Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań [in Polish].

Czubała A., 2001. Dystrybucja produktów (Distribution of products). Polskie Wydawnictwo Ekonomiczne, Warszawa [in Polish].

Domański R., 2005. Geografia ekonomiczna: ujęcie dynamiczne (Economic Geography: a dynamic approach). Wydawnictwo Naukowe PWN, Warszawa [in Polish].

Grzesiuk A., 2010. Handel detaliczny jako pracodawca we współczesnej gospodarce (Retailing as employer in modern economy). Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań [in Polish].

Nicolis G., Prigogine I., 1977. Self-organization in nonequilibrium systems. Wiley & Sons, New York – London – Sydney – Toronto.

Powęska H., 1995. Development of trade and services in the eastern borderland of Poland – Problems and prospects [in:] Polish eastern border. Past and present problems. Conference Papers No 22. IGiPZ PAN, Warszawa, 83–96 [in Polish].

Powęska H., 2008a. Cross-border shopping in Poland in the early 21st century. Acta Scientiarum Polonorum, Oeconomia 7 (1), 111–122.

Powęska H., 2008b. The character and conditions for development of cross-border shopping in Poland in the period of transformation. Electronic Journal of Polish Agricultural Universities – Economics 11 (4). http://www.ejpau.media.pl/volume11/issue4/abs-09.html.

Prigogine I., 1967. Introduction to the thermodynamics of irreversible processes. Interscience, New York.

Sławińska M., 2008. Kompendium wiedzy o handlu (Compendium of knowledge about trade). Wydawnictwo Naukowe PWN, Warszawa [in Polish].

ROZWÓJ HANDLU DETALICZNEGO W OBSZARACH PRZYGRANICZNYCH W POLSCE W ŚWIETLE WYBRANYCH UJĘĆ TEORETYCZNYCH

Streszczenie. Handel detaliczny w obszarach przygranicznych Polski w okresie ostatnich 20 lat charakteryzował się dużą dynamiką zmian, głównie za sprawą transgranicznej nierejestrowanej wymiany handlowej. W niniejszym artykule proces ten przedstawiono w świetle teoretycznych ujęć problemu. Jednakże istniejące modele odnoszą się do warunków gospodarczych, w których zakres działalności podmiotu handlowego zależy głównie od jego przedsiębiorczości, innowacji i możliwości inwestycyjnych. Warunki prowadzenia działalności handlowej w obszarach przygranicznych Polski w analizowanym okresie były mało stabilne, wymagające szybkiego dostosowania się przedsiębiorców do zachodzących zmian. Dlatego dla pełnego ukazania specyfiki rozwoju handlu przygranicznego, jego złożoności, wieloaspektowości i wieloetapowości zastosowano koncepcję samoorganizacji, którą szeroko stosuje się do analizy zjawisk i procesów społeczno-gospodarczych w okresie transformacji.

Słowa kluczowe: handel detaliczny, handel przygraniczny, obszary przygraniczne, Polska

CONTENTS
SPIS TREŚCI

General and technical requirements for the elaboration of papers:

1. **Size of the research paper** including tables, figures and photographs should not exceed 12 pages of A-4 format.
2. **Materials to be published** in *Acta Scientiarum Polonorum* should be prepared in accordance with the rules of the publishing process binding at the publishing office of a given series of the Journal.
3. **Style of documents** – the text of the paper should be typed with Times New Roman font 12 points, 11 of space between the lines, setting parts of the text in special typeface is allowed, e.g. italic or bold, but without underlining letters, words and sentences.
4. **Size of tables and figures** cannot exceed B-5 format (12.5 cm × 19.5 cm); descriptions of tables should be typed with Times New Roman 9 points, content of tables 8 points, single space, if possible without vertical lines, table format – doc. or rtf.

The following paper setting is binding:

1. **Title of the article** in Polish (or in English if the whole paper is in English; the same refers to the summary and key words).
2. **First name and surname** of the author (-s).
3. **Paper abstract** (from 600 to 1000 characters).
4. **Key words** – 6 words useful when indexing and searching.
5. **The main text of the research paper** should include: introduction with the aim and research hypothesis, material and methods, results, discussion, conclusions (or summary) and references.
6. **Title, abstract** (600–1000 characters) as a translation of the summary and **key words** in English.
7. **Address** of the author's (authors') place of work – post and e-mail address.
8. **Titles of tables** and their content, and captions of figures and legends must be provided in Polish and in English, while the numbers of tables and figures – with Arabic numerals.

Units and spelling – the international SI system is binding, e.g. $g \times dm^{-3}$ (and not g/dm^3).

References – when referring to the publications of other authors in the text of the paper, a surname and a year should be provided in brackets [Kowalski and Lewandowski 2000, Lewandowski 2001, Zalewski et al. 2001] or … according to Kowalski [2000]...

The list of references should be presented in the alphabetical order in the following way: author's (authors') surname, initials of first names; year of publishing if there is more than one paper of the same author published in a given year, after the year it is necessary to mark particular items a, b, c, etc.; title of the paper, bibliographical abbreviation of the publishing house and place of publishing, No of volume, book and numbers of pages, e.g.:

Chełkowski Z., 1966. Introdukcja troci do rzeki Gowienicy. Gospod. Ryb. 1 (2), 18–19.

Greń J., Kowalski Z., 1972. Statystyka matematyczna. PWN, Warszawa.

Turski W., 1972. Projektowanie oprogramowania systemów liczących. Mat. Konf. Projektowanie maszyn i systemów cyfrowych. Warszawa 2–5 czerwca 1971. PWN, Warszawa, 132–139.

The author sends the text of the paper in 2 copies to the editorial office. After he/she receives a review, the Author sends an editorial copy to the editorial office including the reviewer's comments, a corrected copy of the paper including an electronic carrier (diskette, CD or e-mail) and a response to the reviewer's and editor's comments. The main part of the publication (abstract, the text of the article proper and references) should be saved in one file. The editorial office reserves a right to make cuts and corrections, and to suggest changes and substantive supplementations agreed with the author. The graphic material (figures, diagrams, charts) should be prepared and sent as a separate electronic file (source files) in programs working in Windows environment (e.g. in Excel, Corel Draw, Photoshop etc.).

The author of the paper published is obliged to transfer his/her copyright to the publisher and submit a declaration that the paper has not been published in another journal.

The authors of the papers participate in the costs of their publishing. Information about fees and additional information for authors are available at the website

www.acta.media.pl

1644 0757