Application of correspondence analysis to the identification of the determinants of the economic condition of the e-services sector enterprises in Podlaskie region

Katarzyna Dębkowska

Bialystok University of Technology, Faculty of Management
e-mail: k.debkowska@pb.edu.pl

Jarosław Kilon

Bialystok University of Technology, Faculty of Management
e-mail: j.kilon@pb.edu.pl

Abstract

Correspondence analysis (CA) is a descriptive, exploratory technique of multivariate statistical analysis, allowing to define the nature and structure of the relationship between qualitative variables, measured in nominal and ordinal scales. This technique, on the cost of losing some of the information, leads to an increase in the transparency of data and simplifies their interpretation. In this paper the results of the classical correspondence analysis of the selected data collected within CAWI/CATI survey are presented. The survey was carried out on a sample of 60 small and medium enterprises (SMEs) representing both e-commerce and e-services located in Podlaskie region. The application of correspondence analysis allowed the authors to identify some relations between the economic situation of companies in the e-services sector and the factors hampering their activities. In addition, CA technique allowed to indicate the relationship between the economic situation and the factors enabling firms to effectively compete in the market. It has been observed that companies with good economic situation often indicate the quality of services and quality of customers service as the main sources of their competitiveness.

Keywords

correspondence analysis, e-services, e-commerce

Introduction

Electronic commerce (e-commerce) includes all transactions carried out by the IP-based network, and other computer networks as well. Although goods and services are ordered by the network, the payment for the ordered goods or services and their ultimate delivery can be made virtually or outside the network. The 'e-commerce' term covers all the transactions made between enterprises, individuals, government institutions and other private and public organizations. Orders received by telephone, fax or e-mail messages are not e-commerce transactions (http://www.stat.gov.pl/gus/definicje).

In accordance with the Polish law on electronic services, the term e-services should be understood as 'the execution of a service provided without the simultaneous presence of the parties (in the distance) through the transmission of data on individual request of a recipient, transmitted and received by the means of electronic equipment for the digital processing, including digital compression, and storage of data that is wholly send, received or transmitted via the telecommunication network' (Ustawa o świadczeniu…).

The electronic service is also similarly defined by the Polish Agency for Enterprise Development (PARP). In accordance to the Agency, the electronic service is a service provided in an automated manner through the use of information technology, using information and communication systems of public telecommunication networks at the individual request of a recipient, without the simultaneous physical presence of the transaction parties. E-service is then distinguished from the services in the traditional sense by no human intervention during the process and by the distance serving.

In summary e-service is a service that fulfils the following conditions (Śliwiński, 2008):

- it is served in a partially or fully automated process, with the use of information technology;
- it is provided on the Internet and via the Internet;
- it is individualized in relation to the customer's needs or decisions (personalized);
- service providers and users are located in different locations (distant service).

The enormous economic potential of the Internet is widely recognized by the entrepreneurs who increasingly locate their business on the web. The number of consumers who decide to purchase goods and services via Internet, also steadily grows.

According to the recent estimates of Internet Standard portal (http://www.inter-netstandard.pl), there are about 16 000 web-based businesses (established under its own domain) in Poland (in comparison to 7000 in the year 2009). Most of them perceive e-commerce as an opportunity to generate or increase profits. On the other hand, the customers are more and more familiar, and satisfied from on-line shopping. The most important benefits of such a form of buying goods and services are convenience, time savings, 24/7 availability of the offer in any place where the Internet access is available and of course economic factors such as saving money by searching for the lowest prices. Therefore, in the last few years, a rapid development of the e-commerce and e-services segment can be observed. At this point it should be noted that this development starts from a very low level. When the importance of e-commerce market to the economy is concerned, it seems that not the real value of electronic trades should be taken into consideration (11% of total sales revenue in 2011 amounted to PLN 32.5 billion) but the development potential of the market. Currently, the most of goods and services can be found and purchased on-line, and in the case of some certain goods it is much more easier to purchase them on the web.

Electronic business (e-business) can be defined as a use of the Internet to link (connect) and facilitate the running of businesses, commerce, communication, and collaboration within the company and with its customers, suppliers and other business partners. E-business companies widely use of the Internet, intranet, extranet, and other networks to support their business processes (trade), (Combe, 2006). The dynamic development of electronic commerce and e-services sector makes e-business venture an attractive opportunity for the company in the broad sense. It is often characterized by relatively low costs and the prospect of rapidly increasing revenues. In this context it seems reasonable to examine the determinants of the economic situation of companies operating in the e-services sector. In this paper the factors that hinder the activities of companies and enabling them to effectively compete in the market were analysed. The influence of the selected factors on the economic situation of companies has been studied using one of the methods of multivariate statistical analysis – the correspondence analysis.

1. Correspondence analysis as a method of qualitative data analysis

Correspondence analysis (CA) is a descriptive, exploratory technique of multivariate statistical analysis, allowing to define the nature and structure of the relationship between qualitative variables, measured in nominal and ordinal scales (Stanisz, 2007). CA belongs to the group of incomplete taxonomic methods (Górniak, 2001).

This technique, as well as multidimensional scaling, principal component analysis of factor analysis, on the cost of losing some of the information leads to an increase in the transparency of data and simplifies their interpretation. The use of statistics and charts specific for that method allows the researcher for easy, intuitive reasoning on the relationships between the analyzed categories of variables (Panek, 2009). In general, the correspondence analysis could be considered as a method to decompose the overall chi-square statistics by defining a system with a small number of dimensions, in which the deviations from the expected values are presented. CA is a multi-step procedure, that starts from the arrangement of the data in the contingency table. CA technique includes the following steps (Gatnar i Walesiak, 2004):

- Determination of the correspondence matrix, row and column profiles and masses[1];
- Calculation of the distances between the rows (columns) using the chi-squared metric;
- Presentation of row (column) profiles in the space generated by the columns (rows) correspondence matrix;
- Determination of the average row and column profiles;
- Reducing the dimension of space;
- Plotting the correspondence map, as a common row and column profiles chart (bi-plot).

The main aim of plotting the correspondence map is to reduce the number of analysed space dimensions by choosing such a low-dimensional subspace in which the chi-square distances between points are shown with the best accuracy (Greencare, Hastie 1987, p. 437). In this process, the SVD (singular value decomposition) algorithm of the matrix decomposition with respect to specific values is used (Press et al. 2007, p. 63). Interpretation of the correspondence map allows the researcher to find the diversity within the analyzed variables profiles, as well as the co-occurrence of different categories.

In this paper the results of the classical correspondence analysis of the selected data collected within CAWI/CATI survey is presented. The survey was carried out on a sample of 60 small and medium enterprises (SME's) representing both e-commerce and e-services located in Podlaskie region. The study was a partial survey. Selection of the sample was not random, as the size and structure of the population was unknown. The survey covered the entities from the business activities in the areas of e-commerce and e-services. The research was conducted in 2012 on the need

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[1] The 'mass' term in CA is used to determine the 'size' of records in the table of relative frequencies. Since the sum of all the values of relative frequency equals 1, the table shows the relative frequencies as one 'mass' unit is distributed in the cells of the table.

of Labour Market and Economic Forecasting Observatory of Regional Labour Office in Bialystok. The main aim of the survey was an in-depth analysis of e-services and e-commerce sector as an important area of growth and innovation of Podlaskie province (Widelska at al., 2012).

2. Economic condition of e-services and e-commerce enterprises in Podlaskie region: the research results

The companies operating within the e-commerce and e-services sector in Podlaskie province participating in the survey were asked to assess their general economic condition. According to the research results, in the opinion of almost half of the respondents the economic condition of the surveyed enterprises was at the middle level (Fig. 1). According to 32% of the companies participating in the study their economic condition was good and only 10% of respondents answered the question by indicating a very good level.
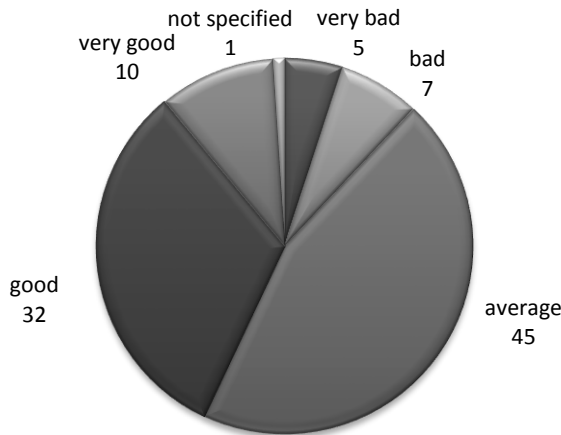

Fig. 1. Economic condition of the surveyed enterprises [%]
Source: own study (N=60).

According to 32% of the respondents the economic situation of companies in the sector of electronic commerce and e-services has deteriorated in the past two years.

The economic condition of 22% companies was constant and did not change signif-icantly (Fig. 2) in the same period, while 20% of respondents noticed a positive change.
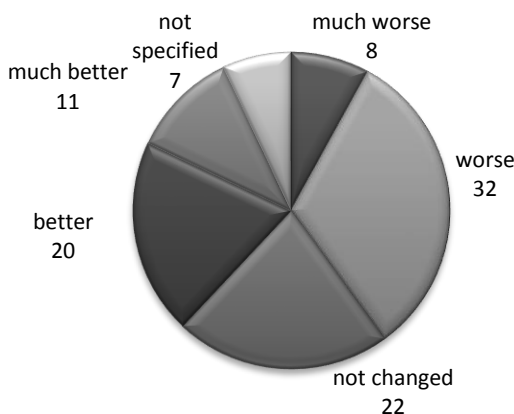

Fig. 2. Change of economic condition of the surveyed enterprises in the last two years [%]
Source: own study (N=60).

Entities participating in the survey were also asked to assess the change in the level of revenue generated during the last year. Approximately ¼ of the surveyed companies stated that their incomes did not changed in 2012. In addition, 27% of respondents answered that they had lower incomes than in the previous year and 29% claimed that their incomes strongly decreased (Fig. 3).
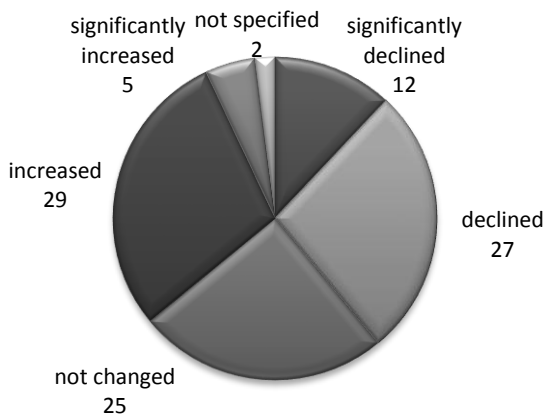

Fig. 3. Change of total revenues of the surveyed enterprises in the last year [%]
Source: own study (N=60).

What is interesting, at the same time about 35% of the companies taking part in the survey took the view that their economic condition will improve in the next three years. Nearly a quarter of the respondents could not clearly assess their future situation (Fig. 4). In addition, 23% of the surveyed companies said that the economic situation in their company over the next three years will not change. The other respondents expressed a negative assessment. All in all the results here results looks optimistic, which proves the high growth potential of the sector.
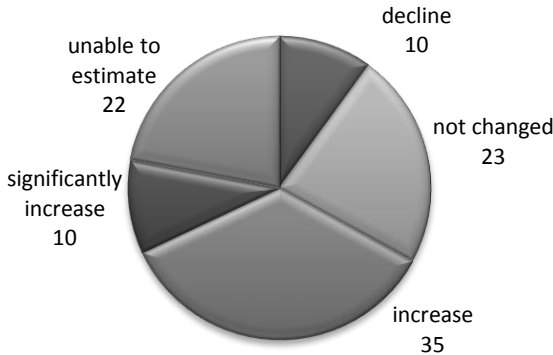

Fig. 4. Estimated economic condition of the surveyed enterprises in three years perspective [%]
Source: own study (N=60).

The improvement of the economic condition of enterprises operating in the analyzed sector is often determined by the internal aspects. Many of the surveyed companies had difficult financial situation, but the entities that provide simple electronic services to the needs of the local economy seemed to be the most disadvantaged. Companies that focus their activities on offering the innovative services adjusted to the needs of the domestic and international markets were in a much better financial condition. The most successful companies of the sector were the enterprises based on an unique business model or an unique innovative idea. The creativity of managers and ability to utilize the innovative ideas seems to be particularly important in this sector, as they are often the factors that most likely decide on the level of economic benefits.

As a part of the study the managers and owners of the companies were asked for quantitative evaluation of groups of factors affecting the development of their businesses. Respondents had to evaluate each group of factors on a scale of 0 to 5, where 0 indicated no effects, 1 – very weak, and 5 – very strong influence. According to the companies' representatives opinions, the greatest impact on the development of

the e-services and e-commerce sector are economic and social factors (average of 3.3). The technical factors and demographics were listed subsequently. The political factors were assessed as having the least impact on the development of the analyzed sector (average of 1.6), (Tab. 1).

Tab. 1. Quantitative evaluation of groups of factors affecting the development of e-services companies

Factors	Influence						
	0	1	2	3	4	5	Average
Economic	7%	12%	13%	12%	28%	28%	3,3
Social	3%	5%	12%	35%	30%	15%	3,3
Technical	18%	5%	13%	20%	18%	25%	2,9
Demographic	17%	10%	17%	25%	17%	15%	2,6
Political	27%	30%	15%	13%	13%	2%	1,6

1 – very weak influence; 5 – very strong influence; 0 – no influence

Source: own study (N=60).

Furthermore the respondents assessed the impact of the factors hindering both the activities of their companies and the development of the sector. According to the results of the survey, the most impeding factor in this area is high taxes (average impact on the level of 4.12). Subsequently the respondents pointed such factors as: rising labour costs, not transparent and unstable legislation, the high prices of fuel and energy, problems with payment, competition of domestic firms, low demand and the development of shadow economy – with the average assessment of these factors at the 3 to 4 level (Tab. 2). Factors such as stronger bargaining position of customers, shortage of skilled workers, instability of exchange rates or increasing concentration and consolidation of the industry were assessed as having less influence. For these factors, the average scores were lower than 3. Among the other factors that hinder the development of the sector some cases of unfair competition were listed.

Tab. 2. Estimated impact of factors hindering activities of e-services companies

Factor	Impact						Aver-age
	0	1	2	3	4	5	
High taxes	3%	2%	5%	22%	20%	48%	4,12
Increasing labour costs	12%	5%	12%	10%	25%	37%	3,87
Not transparent and unstable legislation	8%	8%	3%	20%	28%	32%	3,78
High prices of fuel and energy	7%	12%	15%	17%	23%	27%	3,41

cont. Tab. 2.

Problems with payments and liquidity	10%	13%	18%	7%	22%	30%	3,41
Competition of domestic firms	5%	13%	10%	20%	37%	15%	3,32
Low demand	3%	12%	23%	10%	30%	22%	3,28
Failure of institutions (eg. tax offices)	12%	17%	18%	13%	22%	18%	3,08
Development of shadow economy	25%	13%	17%	12%	18%	15%	3,07
Stronger bargaining position of customers	5%	18%	18%	30%	13%	15%	2,88
Shortage of skilled workers	15%	20%	17%	22%	10%	17%	2,84
Difficulties in obtaining financing	10%	17%	25%	20%	13%	15%	2,83
Instability of exchange rates	22%	22%	20%	15%	10%	12%	2,62
Increasing concentration and consolidation of the sector	7%	20%	33%	18%	10%	12%	2,57
Competition of international firms	18%	30%	17%	15%	15%	5%	2,37

1 – very weak influence; 5 – very strong influence; 0 – no opinion

Source: own study (N=60).

The results of the study confirmed that among the other aspects competition in the sector is an important attribute that strongly influences the market activity of the surveyed companies. Competition in the e-services and e-commerce was assessed (87%) as a strong and very strong by the majority of companies (Fig. 5). The high degree of business fragmentation (particularly in e-commerce) is also an indirect confirmation of this fact. On the other hand, strong competition does not affect the companies that offer specialized or unique services (from the perspective of the needs target markets).
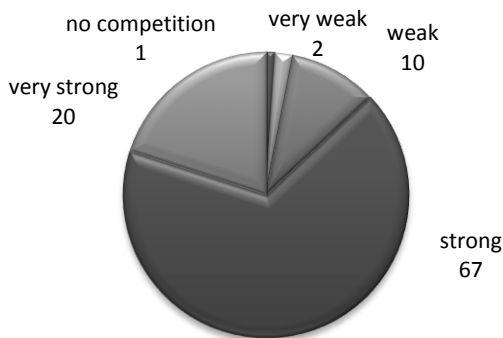

Fig. 5. The competition level in e-services sector [%]
Source: own study (N=60).

Tab. 3. Factors enabling effective competition of the surveyed enterprises

Factor	Influence						Average
	0	1	2	3	4	5	
High quality of services	3%	0%	2%	10%	23%	62%	4,5
High quality of customer service	3%	0%	5%	3%	37%	52%	4,4
Time of service	7%	0%	8%	18%	32%	35%	4,0
Effective promotion/marketing system	3%	8%	5%	23%	33%	27%	3,7
Wide range of offer	3%	5%	12%	27%	23%	30%	3,6
Highly innovative offer	5%	5%	20%	22%	22%	27%	3,5
Human resources	20%	3%	13%	25%	22%	17%	3,4
Lower prices	5%	13%	15%	25%	17%	25%	3,3

1 – very weak influence; 5 – very strong influence; 0 – no opinion

Source: own study (N=60).

As a part of the research the representatives of the surveyed companies were also asked to point out the factors essential to compete effectively in the sector. According to the entrepreneurs participating in the study, the high quality of services is a factor that has the greatest impact on effective competition on the market. The high quality of customer service, assessed as a second best, is almost as much important in their opinion. The results of the survey, when the competitiveness is concerned, the time of service has also an important influence (Tab. 3). An effective system of promotion, a wide range of the offer, the level of innovation, quality of human resources, and lower prices proved to have a weaker impact. Among the other factors the company's reputation and its market experience were listed. Quantitative studies indicated that non-price instruments of competition are the key competing methods for the participating companies, which is characteristic of today's businesses. Lower prices as a major competitive factor was indicated by only ¼ companies.

Furthermore, the relationship between the impact of factors hindering the activities of the company and its economic situation was tested. The correspondence analysis was used for this purpose, which allowed authors to indicate some links between the variables. Factors hindering the company's operations were evaluated on a scale of 1 to 5, where 1 meant no hindering and 5 very high hindering, while the economic situation was assessed as follows: very good, good, average, bad or very bad. The correspondence analysis technique was made on the data covering assessment of each factor (see Tab. 2) and the economic situation of the company. The most interesting correspondence maps, representing co-occurence of the respondent's opinions, are presented below.
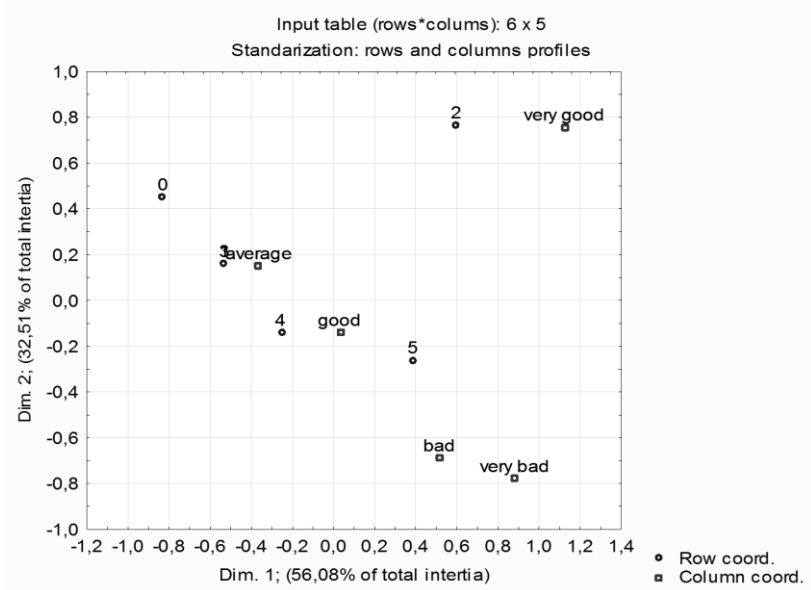
Fig. 6. The correspondence map for the economic condition of a company and increasing labour costs
Source: own calculation using STATISTICA PL.

The analysis of the correspondence between factor: rising labour costs and the assessment of the economic situation of the company (Fig. 6) proves that companies that found their economic condition as bad or very bad often indicate that rising labour costs make their business operations very difficult (score 5). On the other hand, the companies that found their economic condition as very good more often indicated that labour costs does not significantly affect their situation (score 2). Therefore it can be concluded that rising labour costs are a powerful determinant of the economic situation of the companies in the sector.
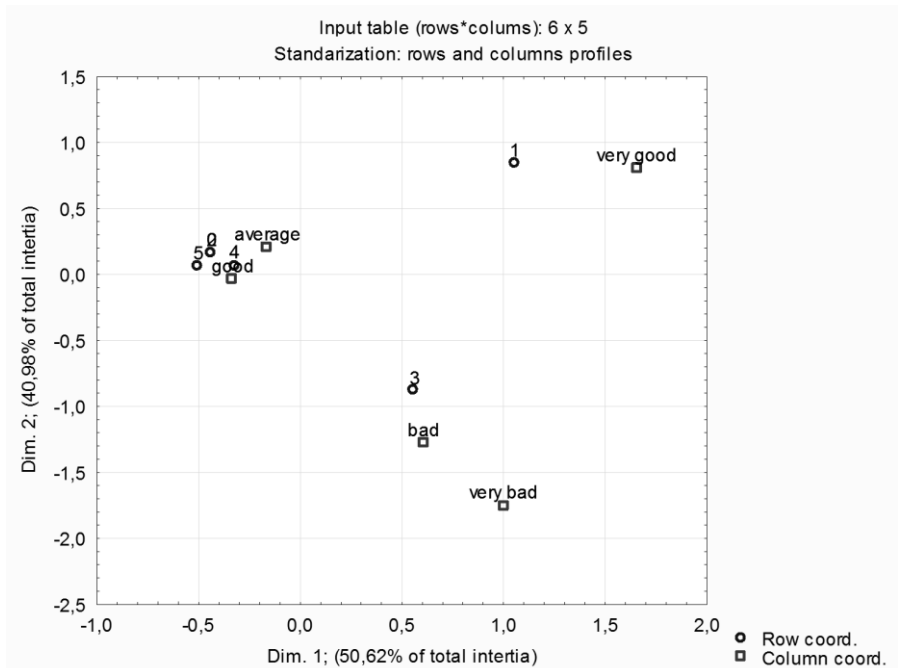
Fig. 7. The correspondence map for the economic condition of a company and the competition of international companies

Source: own calculation using STATISTICA PL.

When the relationship between the assessment of competition from international companies and the economic situation of the company is concerned, it can be concluded that if the competition from international firms was not a factor impeding the activities of a company it usually was in the best economic situation (Fig. 7). That relation proved some former conclusions, meaning that an innovative or unique e-services can successfully compete domestically or internationally.
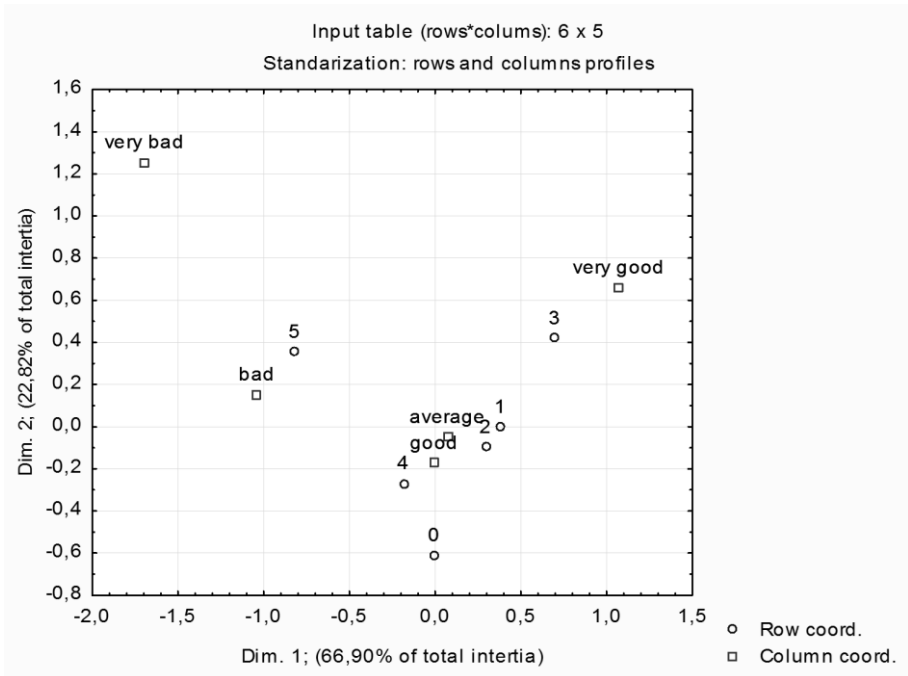
Input table (rows*colums): 6 x 5

Standarization: rows and columns profiles

Fig. 8. The correspondence map for the economic condition of a company and the difficulties in obtaining financing

Source: own calculation using STATISTICA PL.

The link between the difficulty in obtaining financing of business activities and the economic situation of the company was the another investigated relationship (Fig. 8). According to the study, businesses in worse economic situation often indicated that the difficulty in obtaining financing was an influential problem diminishing their activities. This factor much less hinders the activities of companies in a very good economic situation.

The relationship between the economic situation of companies and some selected factors of effective competition in the sector were also investigated using correspondence analysis. The list of factors that allow companies to compete effectively was presented in Tab. 3.
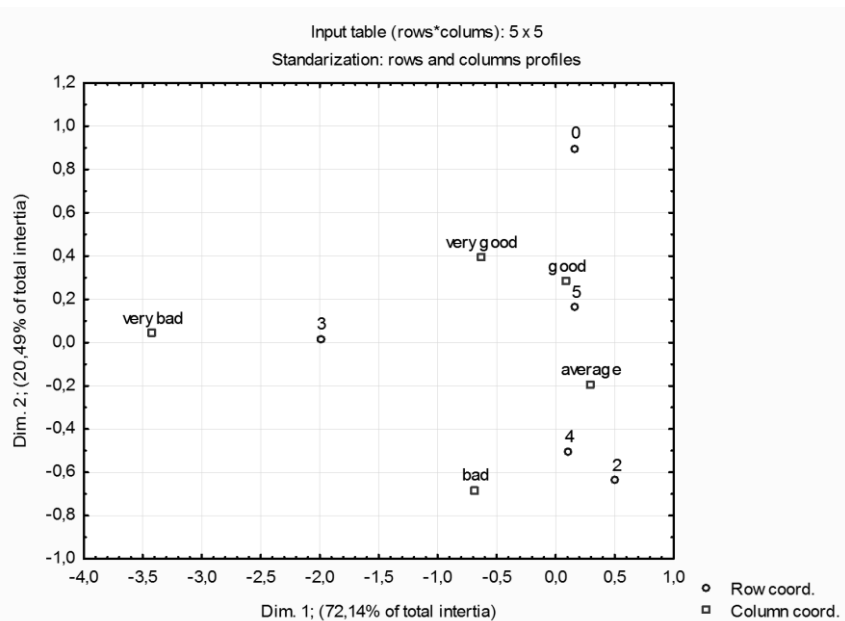
Fig. 9. The correspondence map for the economic condition of a company and the high quality of services

Source: own calculation using STATISTICA PL.

The analysis proved that, in general, the companies in good financial condition evaluate the quality of services as a factor strongly influencing the effective competition on the market (Fig. 9). Similarly, when the high-quality customer service is concerned, the companies in a very good economic situation were more likely to indicate it as a factor that strongly influences market competitiveness (Fig. 10). To sum up, it can be concluded that the financial success of a company operating in e-services sector is strongly dependent on the quality of services and the quality of customer service as well.
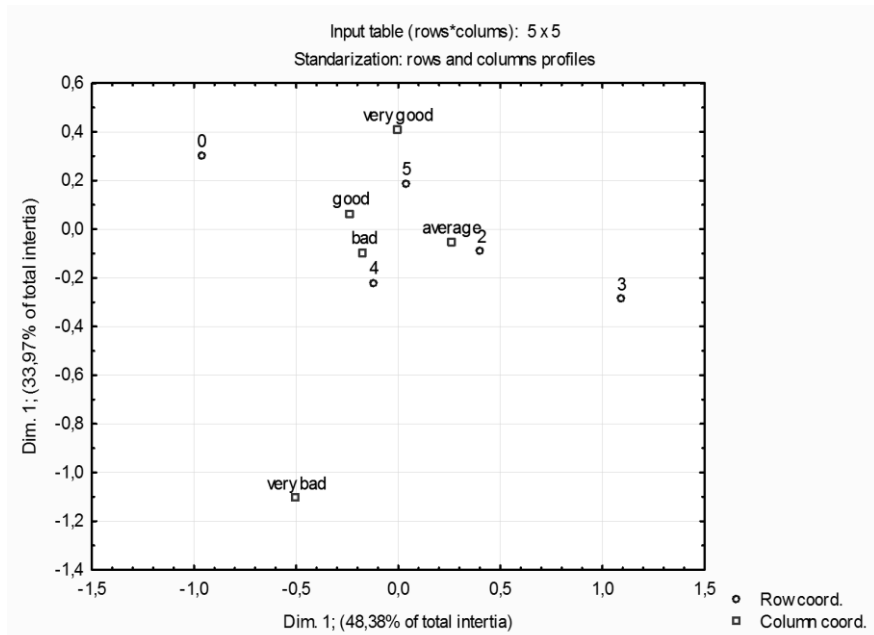
Fig. 10. The correspondence map for the economic condition of a company and the high quality of customers service

Source: own calculation using STATISTICA PL.

In addition, the relations between the factors hampering the company's operations and the factors enabling effective competition on the market were investigated using Spearman's rank correlation coefficient. The analysis proved that statistically significant correlations exist between the stronger bargaining position of customers and time of service. This relationship is also confirmed by the analysis carried out with CA technique (Fig. 11). In general, the entrepreneurs who found bargaining power of buyers as a factor that strongly influences activity of the company more often indicated that the time of service is a factor that significantly affects the effective competition on the market.
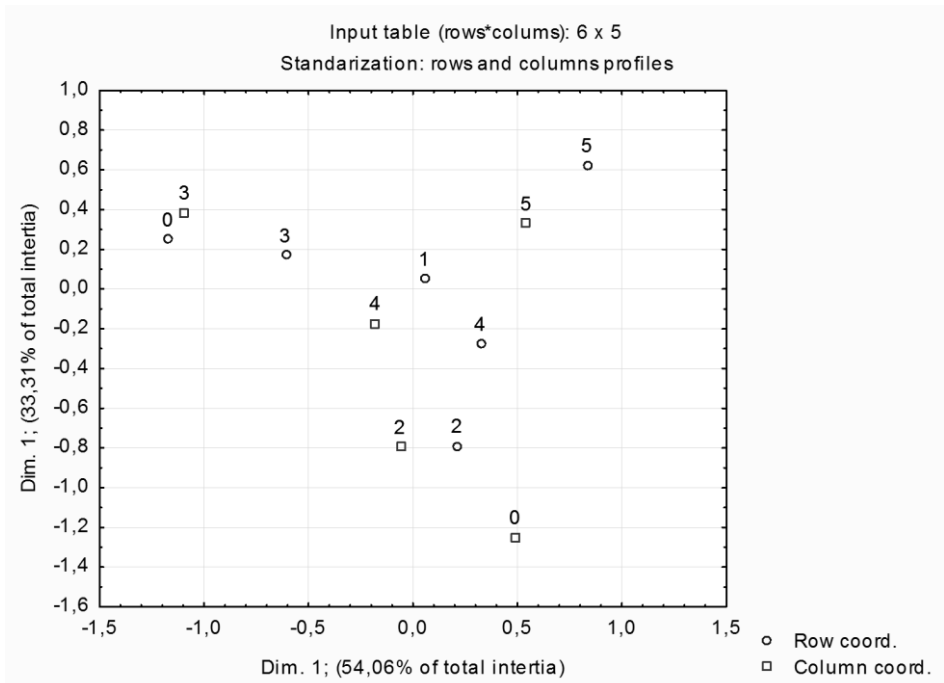
Fig. 11. The correspondence map for the common assessment of factors: the increasing bargaining position of customers and time of service

Source: own calculation using STATISTICA PL.

A statistically significant relationship was also found between competition from international companies and company's human resources. Companies evaluating competition from international companies as a factor strongly affecting their business often indicated that human resources are an important factor to effectively compete in the market (Fig. 12).
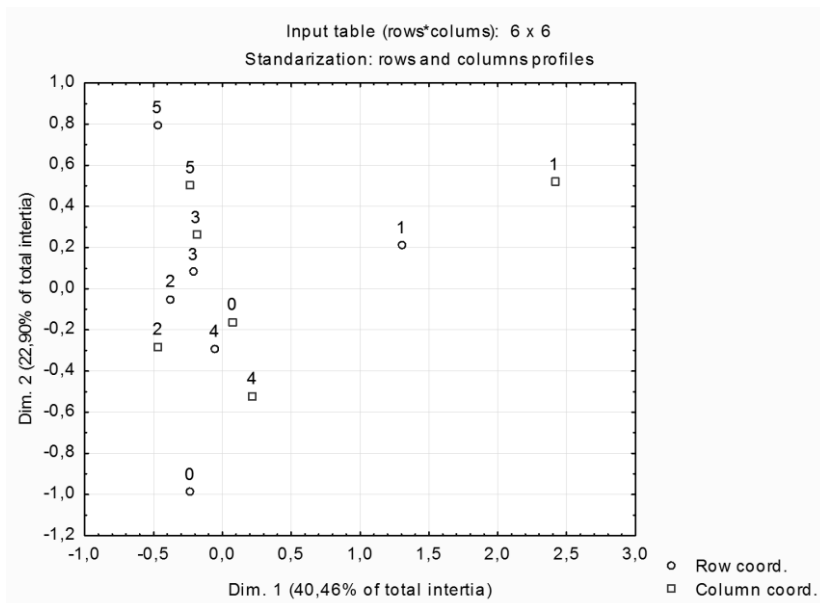
Fig. 12. The correspondence map for the common assessment of factors: the level of competition of international companies and human resources of enterprise

Source: own calculation using STATISTICA PL.

Conclusions

Correspondence analysis presented in this paper is a technique that allows for a relatively rapid, cross-sectional analysis of various qualitative data. Graphical presentation of the initial results of the survey allows to find the relationship between the analyzed variables, which is a good starting point for an in-depth interpretation of the results. This technique significantly simplifies the interpretation of the results of the surveys, in which a vast majority of the obtained data is described by qualitative variables.

The application of correspondence analysis on the data obtained from a CAWI survey being discussed allowed authors for the identification of some relations between the economic situation of companies of e-services sector and the factors impeding their activities. Among these factors the rising labour costs, competition of international companies and the difficulty in obtaining financing were identified. It should be emphasized that these factors much more influenced the activities of companies that are in a worse economic situation. In addition, CA technique allowed to

indicate the relationship between the economic situation and the factors contributing to effectively compete in the market. It has been observed that companies with good economic situation often indicate the quality of services and quality of customers service as sources of their competitiveness.

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Wykorzystanie analizy korespondencji w badaniu uwarunkowań kondycji ekonomicznej przedsiębiorstw sektora e-usług województwa podlaskiego

Streszczenie

Analiza korespondencji należy do grupy opisowych, eksploracyjnych technik wielowymiarowej analizy statystycznej. Umożliwia ona określenie charakteru i struktury relacji między zmiennymi jakościowymi, mierzonymi w skalach nominalnych i porządkowych. Technika ta, kosztem utraty części informacji, prowadzi do zwiększenia przejrzystości danych oraz upraszcza ich interpretację. W artykule przedstawiono przykład zastosowania klasycznej analizy korespondencji w odniesieniu do wybranych danych zgromadzonych w ramach badania CAWI/CATI, które zostało przeprowadzone na próbie 60 małych i średnich przedsiębiorstw zlokalizowanych w województwie podlaskim, reprezentujących sektor e-usług i e-handlu. Zastosowanie analizy korespondencji umożliwiło identyfikację wybranych zależności pomiędzy kondycją ekonomiczną badanych przedsiębiorstw a czynnikami utrudniającymi ich działalność. W dalszej części opracowania zidentyfikowano również zależność między kondycją ekonomiczną a czynnikami umożliwiającymi skuteczne konkurowanie na rynku. Badania dowiodły, że firmy w najlepszej kondycji ekonomicznej za główne źródła swej konkurencyjności uważają jakość świadczonych usług oraz jakość obsługi klientów.

Słowa kluczowe

analiza korespondencji, e-handel, e-usługi

Author information

Katarzyna Dębkowska
Bialystok University of Technology
Wiejska 45a, 15-351 Białystok, Poland
e-mail: k.debkowska@pb.edu.pl

Jarosław Kilon
Bialystok University of Technology
Wiejska 45a, 15-351 Białystok, Poland
e-mail: j.kilon@pb.edu.pl