Barriers to Innovation Activities from the Perspective of Non-Innovative Enterprises in The European Union Countries

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Abstract

The identification of barriers to innovation activities is of significant importance in the proper climate development for innovation. In the course of this process, it should be remembered that the perception of factors hampering or preventing the implementation of innovation activities depends on the characteristics of enterprises. The heterogeneity of perception is influenced by, e.g., enterprise size, the history of its operations, development strategy, the entrepreneur's country of origin, the degree of innovation as well as the division into innovative and non-innovative entities. The latter should remain the subject of special interest, because the identified barriers determine their resignation from innovation activities. Therefore, the adopted research goals focused on identifying the key barriers to innovation activities among non-innovative enterprises in the European Union, the classification of countries regarding the similarities of factors determining the resignation from such activities and determining correlations between the indications to these factors and innovation activities in individual countries. This study was focused on verifying the hypothesis adopting that the perception of significant barriers to innovative activity by a wide range of non-innovative enterprises translates into the low intensity of innovative processes. The research results from the Community Innovation Survey (2016) and the European Innovation Scoreboard 2017 served as the information basis for the conducted analyses. The multi-dimensional statistical analysis methods, including data classification methods were used in the research.

Keywords: Innovation Activities, Non-Innovative Enterprises, Barriers to Innovation Processes.

Introduction

Recognizing barriers to innovation activities is of significant importance. Their identification and in-depth analysis allows determining the nature of factors which either hamper or prevent undertaking actions aimed at the implementation of new or significantly improved solutions. Acquiring knowledge about the essence of barriers to innovations helps in defining the group of actions which eliminate or reduce the extent of their impact. Chen and Hove (2011) have adopted that by identifying specific barriers to innovations one can simultaneously learn about the ways to overcome them, however, the potential difficulties have to be recognized in due time in order to increase the chances for solving the occurring problems (Hueske, Endrikat and Guenther 2015).

The activities focused on eliminating or reducing factors preventing or hampering innovation processes should be undertaken by the enterprises and entities responsible for developing the appropriate climate for innovations. This postulate results from the division of barriers – for new or significantly improved solutions – into internal and external ones (Hadjimanolis 1999; Mohnen and Rosa 2002; Tourigny and Le 2004; Duarte, Madeira, Moura, Carvalho and Moreira 2017). The first of them remain within the enterprises themselves and require undertaking appropriate corrective or improving actions (e.g. organisational rigidities within the enterprise: attitude of personnel towards change, attitude of managers towards change). The situation is different in the case of external barriers. Enterprises are not capable of solving problems related to e.g. lack of external finance – credit or private equity, lack of infrastructure or the weakness of property rights. It also happens that joint actions (of enterprises and entities from

their environment) turn out indispensable to overcome certain barriers (e.g. lack qualified personnel: within the enterprise, in the labour market). It should also be remembered that many barriers are of complementary nature (Mohnen and Roller 2005; Galia and Legros 2004). It means that their influence is simultaneous (e.g., insufficiently qualified enterprise staff and internal resistance to change; Mohnen and Rosa 2002), whereas their impact power is not a simple sum, but a synergy of negative factors (Shiang and Nagaraj 2011). In such circumstances, eliminating or reducing individual barriers seems pointless. Systemic actions are required (Mohnen and Roller 2005), because it is only them that can create a favorable climate for innovations. It is also worth highlighting that irrespective of the barrier type, the actual process of their impact elimination or reduction begins with the identification of factors hampering or preventing innovative processes. The experience gained by enterprises remains an invaluable source of information in this respect.

The perception of barriers is correlated – as many studies show – with enterprise characteristics. Among the factors influencing this perception the following, among others, are listed and analyzed:

- enterprise size; e.g. Hyytinen and Toivanen (2005) found that small businesses indicate cost barriers more often than large enterprises; the contrary findings in this regard were presented by Tourigny and Lee (2004) and Iammarino, Sanna-Randaccio and Savona (2007). Their research shows that along with the enterprise size the feeling of financial constraints declines;
- the history of business activity; e.g. Schneider and Veugelers (2008) showed that the enterprises featuring a short history of business activity are more likely to encounter financial barriers than the ones with a longer market presence,
- development strategy; e.g. the companies involved in internal research and development work focused on radical technological innovations usually experience cost barriers which do not pose significant limitations to innovation activities in the case of export-oriented enterprises (Galia and Legros 2004),
- the entrepreneur's country of origin; e.g. Immmarino, Sanna-Randaccio and Savona (2007) noted that foreign corporations (operating in Italy), unlike the Italian ones, are more aware of the encountered barriers,
- the degree of company innovation; e.g. Pihkala, Ylinenpaa and Vesalainen (2002) observed that the companies presenting high innovation level consider market conditions a significant barrier to innovation activity, whereas the companies characterised by low innovation activity point to barriers taking the form of internal knowledge and access to information.

Heterogeneous perception of barriers to innovations – as noted by Hölzl, Janger, Stadler, Reinstaller, Unterlass, Daimer and Stehnken (2010) – is observed among the innovative enterprises, disregarding the non-innovative ones in the research as well as the factors they identify as preventing them from implementing innovative activities. This approach does not seem justified. The need to distinguish between innovative and non-innovative enterprises is highlighted by many authors (Arundel 1997; Baldwin and Lin 2002; Galia and Legros 2004; Hoffman, Parejo and Bessant 1998; Keizer, Dijkstra and Halman 2002; Radas and Božič 2009; Szczepańska-Woszczyna 2014), because the first of them attribute larger importance to the factors hampering innovation activity, whereas the latter show a greater tendency towards pointing to the complementarity of individual impediments (Shiang and Nagaraj, 2011).

These observations seem natural, because overcoming the revealed barriers – as opposed to the deterrents[1]– results in obtaining full knowledge about their nature and impact. It does not mean, however, that the research should focus on the innovative enterprises, which empirically verify the importance of obstacles to innovation. Among them, only the barriers hampering innovation processes can be found, whereas full recognition of the impediments to innovations is also associated with the need to identify factors preventing innovation activities. In other words, among the innovators, the factors impeding success are analyzed, while in the environment of non-innovators, the factors determining failure are investigated. It is also worth remembering that in the future the enterprises and countries capable of breaking conventional solutions will be successful (Lesáková, Gundová, Kráľ, Ondrušová 2017). Therefore, it is necessary to transform the non-innovative enterprises into innovative[2] ones, which cannot be done without identifying factors determining the resignation from innovation activities. The presented

article constitutes a part of this research, focused on identifying the key barriers to innovation activities among non-innovative enterprises in the European Union countries, classifying countries regarding the similarities of factors determining the resignation from innovation activities and identifying correlations between indications to these factors and the innovation activities in individual countries. Two questions were raised within the framework of the aforementioned research goals:

− are the most important barriers to innovation activities, experienced by the non-innovative enterprises, the same or similar in the EU countries or are they diversified (e.g. in some countries the most significant barriers are ingrained in the factors related to knowledge, whereas in others to the market)?
− is there any correlation between the high percentage of non-innovative enterprises' indications to barriers of innovation activities and the actual innovation activities implemented in the analysed countries?

In the light of these questions, a hypothesis was put forward that the perception of significant barriers to innovative activity by a wide range of non-innovative enterprises translates into the low intensity of innovative processes.

Barriers to enterprise innovation activities in the EU countries

Data and Research Method

In the conducted research:

− the statistical data from the latest edition of the Community Innovation Survey (2016) were used, the results of which were provided as part of the official statistics (Eurostat 2019; retrieved on November 29, 2019) as well as the statistical information from the European Innovation Scoreboard 2017 (The European Innovation Scoreboard 2017 provides statistical information covering 2016),
− these European Union countries were included for which either complete or possible to supplement data – using a stepwise regression method – are available in terms of barriers to innovation activities,
− the most important barriers to innovation activities were taken into account (the percentage of enterprises indicating "high" importance of a given barrier in the four-level scale of assessments determining the importance of individual barriers as: 1 - high, 2 - medium, 3 - low, 4 - irrelevant),
− non-innovative enterprises and the potential barriers to their innovation activities identified under CIS and presented in EUROSTAT were taken into consideration, i.e.:
  ▪ cost factors:
    C_1 – lack of internal finance (% of non-innovative enterprises),
    C_2 – lack of external finance – credit or private equity (% of non-innovative enterprises),
    C_3 – high costs (% of non-innovative enterprises),
    C_4 – difficulties in obtaining public grants or subsidies (% of non-innovative enterprises),
  ▪ knowledge-related factors:
    K_1 – lack of qualified employees within enterprise (% of non-innovative enterprises),
    K_2 – lack of collaboration partners (% of non-innovative enterprises),
  ▪ market factors:
    M_1 – uncertain market demand (% of non-innovative enterprises),
    M_2 – high competition (% of non-innovative enterprises),
    M_3 – low market demand (% of non-innovative enterprises),
    M_4 – little market competition (% of non-innovative enterprises),
  ▪ factors related to other reasons for failures in implementing innovation processes:
    O_1 – lack of good ideas (% of non-innovative enterprises),
    O_2 – previous innovations (% of non-innovative enterprises).

The study covered 21 European Union countries. Belgium, Denmark, Ireland, United Kingdom, Netherlands, Spain and Finland were not included due to the total unavailability of data. Statistical information

about France and the Czech Republic was only partly unavailable. In this case, information gaps were filled in using the stepwise regression method.

The following research procedure was used in the study:

1. Selection of the key barriers discouraging or preventing innovation activities of non-innovative enterprises in the individual EU countries. The identified key deterring factors from innovation activities were considered the first three positions with the highest percentage of indications by non-innovative enterprises.
2. Graphic analysis and presentation of the indications' value distribution of non-innovative enterprises regarding barriers to innovation activities.
3. Identification of outliers among the EU countries, based on atypical indications of non-innovative enterprises to barriers deterring innovation activities using box plot.
4. Identification of relatively homogeneous classes of the EU countries in terms of the similar importance of individual barriers deterring enterprises from innovation activities using cluster analysis methods. The classification methods were addressed by, e.g., Ward (1963), Johnson (1967), Anderberg (1973), Hartigan (1975), Sneath, Sokal (1973), Aldefender Blashfield (1984), Basiura, Sokołowski (2007).

   The classification of the EU countries was carried out following the below research steps:
   - classical standardization of variables (barriers C_1- C_4, K_1-K_2, M_1-M_4, O_1-O_2);
   - determining the distance between countries resulting from barriers to innovation activities indicated by enterprises as important, using squared Euclidean distance;
   - separate classification of the EU countries using the hierarchical Ward's method, allowing homogeneity within the identified classes and heterogeneity between classes. The final number of classes was determined using the criterion of the first significant increase in agglomeration distance. For this purpose, the dendrogram of connections, integration distances and classification stages were analysed.
5. Characteristics and presentation of the identified classes of countries using average values of enterprises' indications to barriers acting as deterrents to innovation activities.
6. Defining the profiles of obtained classes for the EU countries. To achieve this goal, the Summary Innovation Index (SII) and the indicators representing all innovation dimensions specified in the European Innovation Scoreboard 2017 (European ..., 2017) were analysed.

Results of Empirical Research

Barriers to innovation process identified by non-innovative enterprises should be perceived in the category of deterrents to the activities aimed at the implementation of new or significantly improved solutions, or factors preventing this activity.

Table 1 lists the deterring barriers – resulting in the resignation from innovation activity even before commencing it – indicated by the largest part of enterprises (three fist positions in terms of the highest percentage of indications) in at least two EU countries.

Table 1: Key factors preventing enterprise innovation activities in the individual EU countries indicated by the non-innovative enterprises

No.	Countries	Barriers (C_1, C_2, …, O_2) and their ranking position (L = 1,2,3) including the percentage of indications by non-innovative enterprises (%)									
		C_1		C_3		M_3		O_1		O_2	
		L	%	L	%	L	%	L	%	L	%
1.	Bulgaria	3	8,4	2	9,4	1	12,0	-	-	-	-
2.	Czechia	1	17,3	3	13,1	2	15,4	-	-	-	-
3.	Germany	-	-	2	12,6	1	17,1	-	-	3	9,1
4.	Estonia	-	-	3	9,4	1	12,7	-	-	2	9,6
5.	Greece	2	17,0	-	-	1	21,1	-	-	-	-
6.	France	1	14,3	2	13,8	3	12,8	-	-	-	-
7.	Croatia	2	9,1	2	8,1	1	9,4	-	-	-	-
8.	Italy	2	14,5	-	-	1	17,5	-	-	-	-
9.	Cyprus	-	-	-	-	1	37,6	-	-	2	30,0
10.	Latvia	-	-	-	-	1	13,6	3	10,4	2	12,3
11.	Lithuania	-	-	-	-	-	-	-	-	1	22,7
12.	Luxembourg	-	-	-	-	1	17,2	3	5,0	2	9,6
13.	Hungary	-	-	3	7,3	1	18,2	-	-	2	7,6
14.	Malta	-	-	3	2,0	1	7,5	-	-	2	5,5
15.	Austria	-	-	-	-	1	17,1	3	7,5	2	12,1
16.	Poland	3	7,0	2	8,0	-	-	1	8,9	-	-
17.	Portugal	-	-	3	9,2	1	13,5	-	-	2	12,7
18.	Romania	-	-	3	6,5	1	9,9	-	-	2	7,7
19.	Slovenia	3	8,0	-	-	1	14,7	-	-	2	9,1
20.	Slovakia	1	14,4	3	12,8	2	12,9	-	-	-	-
21.	Sweden	3	8,1	-	-	1	11,6	-	-	2	10,5

Source: authors' compilation based on the Eurostat database.

Low market demand is the key deterrent barrier to innovation activity. Non-innovative enterprises from 16 EU countries ranked this factor as first among barriers to innovations, in the next three countries it was ranked the second (Czechia, Slovakia) or third (France) in terms of the highest percentage of indications (Tab. 1). Previous innovations were recognized as another significant limitation to the innovation activity. Enterprises from 13 countries identified them as the reason for giving up actions to implement new or significantly improved solutions (2nd place in terms of the highest percentage of indications in 11 EU countries; 1st place – Lithuania; 3rd place – Germany). The list of key deterrents to innovation activities is closed by economic factors – high costs and lack of internal finance, indicated by the enterprises from 12 and 10 countries, respectively. Surprisingly, they are not the top ranked barriers (usually 3rd or 2nd position in terms of the percentage of the total number of enterprises).

The distribution of indications made by non-innovative enterprises into individual barriers to innovation activities of a deterrent nature seems to show a fairly positive picture (Fig. 1). High – [18,8; 28,2) – or very high – [28,2; 36,7] – percentage of the total number of enterprises is grouped by a few factors in individual countries. Usually, a small fraction of non-innovative production or service entities (low percentage of responses) recognize deterrent barriers. Low market demand is the only barrier that clearly stands out from the picture. This factor is indicated by 9,4% up to 18,8% enterprises from 16 countries.
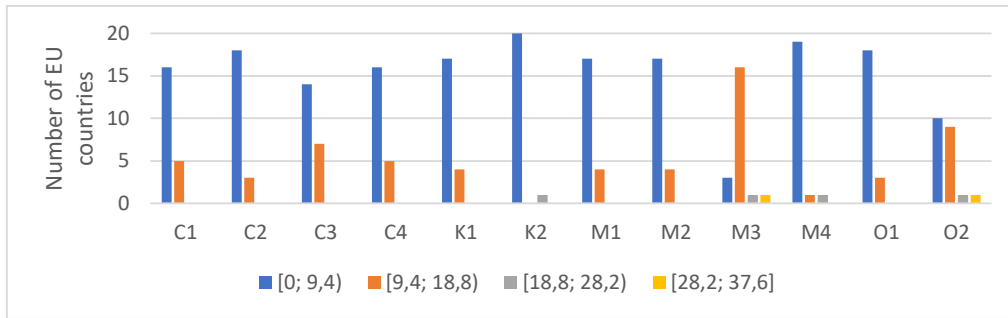
Fig. 1: The histograms of non-innovative enterprises' indications identifying significant barriers to innovation activities in the European Union countries

Source: authors' compilation based on the Eurostat database.

Fig. 2 presents the characteristics of individual indicators determining the percentage of non-innovative enterprises' indications to individual barriers hampering innovation processes. Atypically high indications of barriers deterring innovation activities were recorded in the case of Lithuania and Cyprus. Almost 20% of non-innovative enterprises in Lithuania identified the lack of collaboration partners as the barrier to innovations (K_2). The median of indications to this factor, among the analysed EU countries, was only 3,2%, and the minimum value recorded by Luxembourg enterprises was 0,4%. The enterprises from Cyprus pointed, with an unusually high frequency (24%), to the barrier little market competition (M_4). The median of indications to this market factor in the analysed countries is as low as 4,8%, whereas the minimum value is 1,7% (Malta).
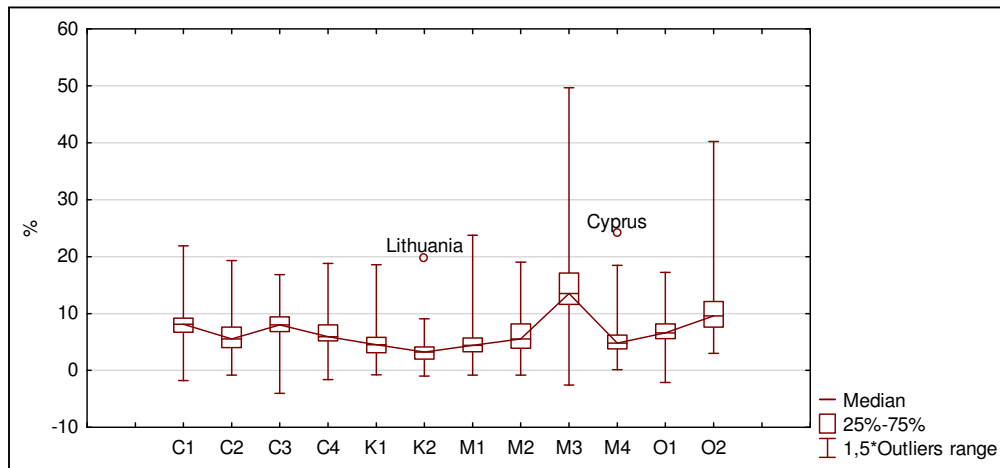

Fig. 2: Box plot for barriers preventing or deterring innovation activities (% of indications to a given barrier by non-innovative enterprises)

Source: authors' compilation based on the Eurostat database.

The next step of the research procedure was the classification of the EU countries using Ward's method. Fig. 3 illustrates the results of the hierarchical classification covering 21 EU countries using spanning trees and integration distance diagrams with regard to classification stages. Based on his analysis, the decision was made to separate five relatively homogeneous classes of the EU countries in terms of 12 deterrents to innovation activities, indicated by the non-innovative enterprises.
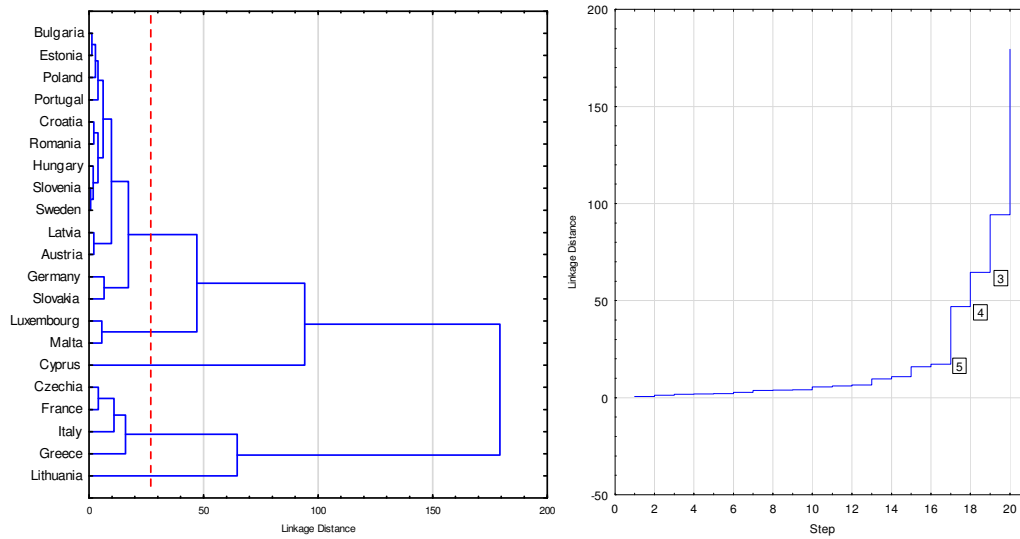
Fig. 3: Dendrogram of connections, integration distances and classification stages using Ward method for EU countries

Source: authors compilation based on Eurostat data by applying STATISTICA 13.1 statistical package

Fig. 4 presents the average values of non-innovative enterprises' indications as barriers to innovation activities in the identified classes of countries constituting the basis for their detailed analysis.

Fig. 5 presents the profiles of classes for the EU countries identified based on the average class values of the Summary Innovation Index and the indicators describing the dimensions of innovations in accordance with EIS 2017.

Table 2, which presents the results of the EU countries' classification, as well as the characteristics and profiles of the received classes, summarizes the conducted research and performed analyses.
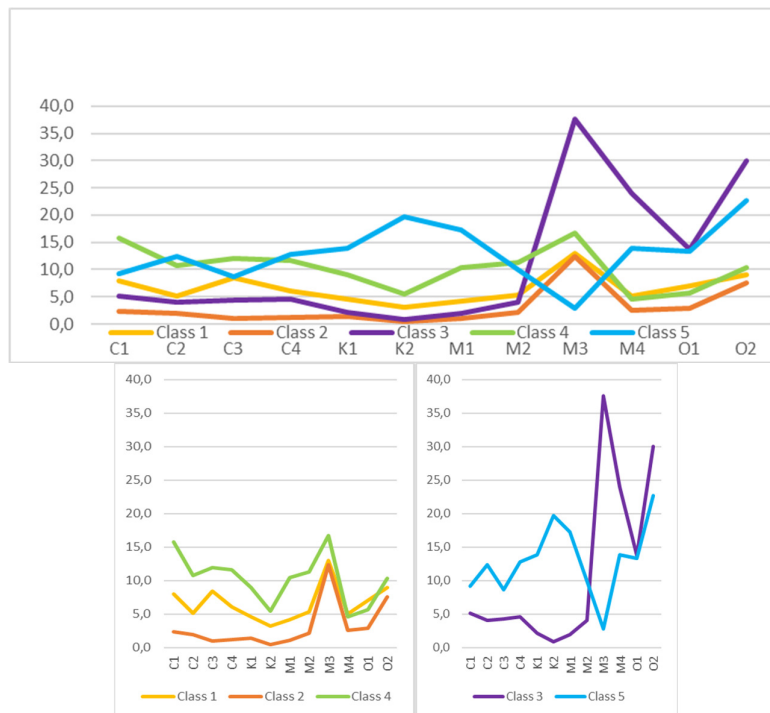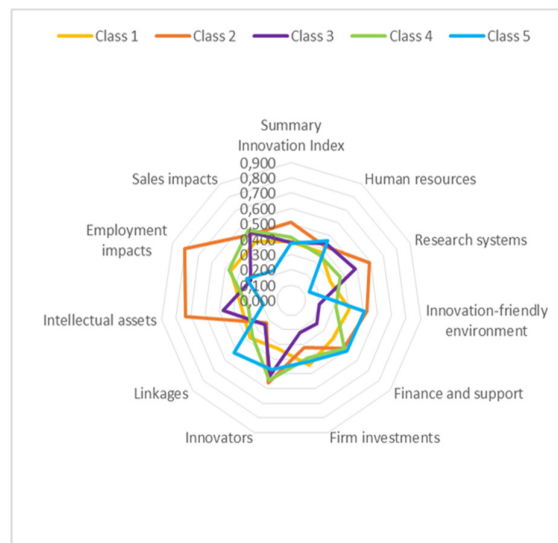
Fig. 4: **Average values of non-innovative enterprises' indications to barriers of innovation activities in the individual classes of European Union countries**

Source: authors' compilation based on the Eurostat database
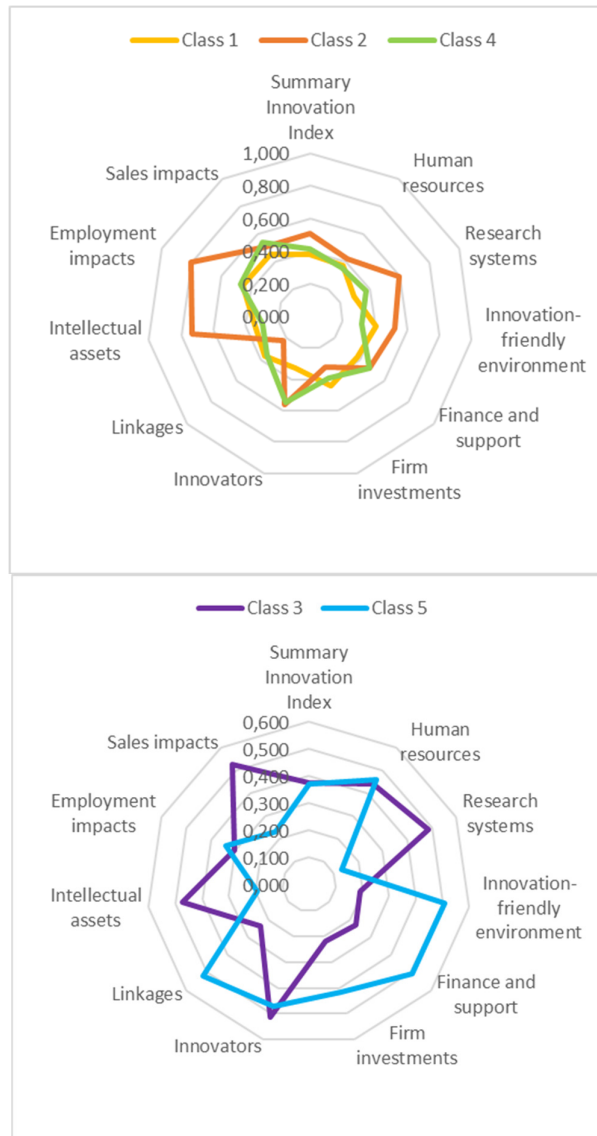
Fig. 5: Class profiles of the EU countries according to the Summary Innovation Index and the innovation dimensions in line with EIS 2017 (average values in individual classes of the European Union countries).

Source: authors' compilation based on the Eurostat database

Table 2: Classification of the European Union countries in terms of the intensity of barriers deterring innovation activities and class profiles according to the Summary Innovation Index and the dimensions of innovation

Class number	Class characteristics (intensity of barriers deterring innovation activities)	Class composition	Class profile
1.	Average	Bulgaria, Germany, Estonia, Croatia, Latvia, Hungary, Austria, Poland, Portugal, Romania Slovenia, Slovakia, Sweden	Maximum value in the dimension of Firm investments and minimum value in the dimension of Innovators
2.	Low	Luxembourg, Malta,	Maximum value of the Summary Innovation Index (SII) and Research system, Innovation-friendly environment, Innovators, Intellectual Assets and Employment impact
3.	Very low in terms of cost and knowledge-related barriers, and very high regarding low market demand (M_3) and previous innovations (O_2)	Cyprus	Minimum values in the following dimensions: Innovation-friendly environment, Finance and support, Firm investments and Employment impact
4.	High	Czechia, Greece, France, Italy,	The lowest values in Human resources and the highest in Sales impacts
5.	Very high in terms of knowledge-related, high competition (M_2) and previous innovations (O_2) barriers	Lithuania	Minimum values of the Summary Innovation Index (SII) and Research system, Intellectual Assets and Sales impact, and simultaneously maximum values in Human Resources, Innovation-friendly environment and Linkages

Source: authors compilation based on Eurostat data

The intensity of barriers deterring innovation activities – measured by the percentage of non-innovative enterprises' indications to factors discouraging or preventing the activities aimed at implementing innovations – results in identifying three relatively homogeneous classes of countries and two outliers – one-element classes (classes 3 and 5; Tab. 2, Fig. 4). Luxembourg and Malta, co-creating the second class, group the non-innovative enterprises which rarely see barriers to innovation activities of a deterrent nature (except M_3 – the lowest value in Lithuania). This leadership is justified by the highest average value of the Summary Innovation Index (SII), as well as its components in terms of the research system, innovation-friendly environment, innovators, intellectual assets and employment impact (Fig. 5). Class 4 (Czechia, Greece, France, Italy) is at the opposite end. It shows – apart from one-element classes – the highest average values of non-innovative enterprises' indications to barriers hampering innovation activity (except: M_4, O_1; the highest values in class 1), as well as the lowest value referring to human resources and the highest one in sales impacts (SII components). Class 1is characterised by the average intensity of barriers deterring innovation activities (Bulgaria, Germany, Estonia, Croatia, Latvia, Hungary, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Sweden; Fig. 4). In this case, the average of indications to individual deterrents remains below 10% (except: M_3). In addition, it is distinguished by the maximum value referring to

investment companies and the minimum one in the dimension of innovators (SII components). Cyprus and Lithuania form unusual, one-element classes. The specificity of Cyprus (class 3) is manifested in a very low percentage of indications of non-innovative enterprises to cost and knowledge-related factors (class 2 is the only one with a lower percentage), and also in the highest perception of low market demand and previous innovations as deterrent barriers, comparing to other classes. These observations are surprising against the background of this class profile (e.g. minimum values in the dimensions: innovation-friendly environment and finance and support). Lithuania (class 5), unlike Cyprus and other classes, is characterised by very high indications of knowledge barriers, and also high competition and previous innovations. Some of these barriers seem to be perfectly combined with the profile of this class (Tab. 2).

Discussion and conclusions

The conducted research allows concluding as follows:

- key factors discouraging or preventing innovation activities in the EU countries, identified based on the percentage of indications made by the non-innovative enterprises pointing to high importance of the specific barriers (top 3 positions), include low market demand (first place), previous innovations (second place) and economic factors (high costs and lack of internal finance; third place),
- high – [18,8; 28,2] – or very high – [28,2; 36,7] – percentage of the total number of enterprises are grouped by few deterring barriers in individual countries,
- the lowest frequency of barriers deterring innovation activities, measured by the percentage of non-innovative enterprises' indications to factors either discouraging or preventing actions aimed at implementing innovations, is recorded in Luxembourg and Malta (the class of countries presenting the highest average value of the Summary Innovation Index).
- the majority of the EU countries is characterised by an average intensity of the deterring barriers occurrence, which hamper innovation activities (Bulgaria, Germany, Estonia, Croatia, Latvia, Hungary, Austria, Poland, Portugal, Romania Slovenia, Slovakia, Sweden).

The results of the conducted research prove that the perception of significant barriers to innovative activity by a wide group of non-innovative enterprises translates into the low intensity of innovative processes (Lithuania, Czechia, Greece, France, Italy; Tab. 2).

Summarising the results of the conducted research, it should be highlighted that the vast majority of non-innovative enterprises either do not notice or ignore the barriers to innovation activities (low percentage of indications to highly important deterrents), which may result from their lack of experience. Many factors hampering the efforts aimed at implementing new or significantly improved solutions are detected only in the course of innovation processes. Overcoming them results in gaining full knowledge about various obstacles to innovations. In addition, the experience of running an innovative business can change the approach to the importance of individual barriers. For example, it can be expected that cost barriers will be recognized as the leading ones, and lower weight will be assigned to such factors as low market demand or previous innovations. However, these observations do not undermine the validity of conducting the research focused on identifying barriers to innovation activities among the non-innovative enterprises, because – as it has already been emphasized – among innovators the factors hindering success are investigated, whereas in the environment of non-innovators the factors which determine the failure.

Acknowledgements

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[1] Deterring barriers, unlike the revealed ones, determine refraining from undertaking innovation activities (D'Este, Iammarino, Savona and Tunzelmann 2012).

[2] This process is very difficult, because innovation oriented activities are always associated with risk, high costs and no guarantee of the incurred expenditure recover (Koellinger 2008; Ceccagnoli 2009).