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Innovation activity in European Union service sector: Similarities or differences?

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ABSTRACT

Objective: The article aimed to identify and assess the degree of homogeneity and differentiation of European Union countries regarding innovation activity in individual sections of the service sector.

Research Design & Methods: I developed the research objective using three specific objectives formulated as auxiliary questions. I designed the research in three stages directly correlated with the particular objectives. The research hypothesis assumed that we might group EU countries into internally homogeneous clusters and, simultaneously, externally different in terms of innovation activity in the service sector industries. Firstly, I verified whether innovation activity is homogeneous in individual service sector industries (Levene's test). I considered homogeneous service industries, demonstrating homogeneity in at least eight indicators. In the second step, I identified homogeneous clusters of EU countries in each service industry (cluster analysis). In the last step, I differentiated between clusters of countries (the T-student test). I used the analysis and logical construction method with its inherent analysis and synthesis.

Findings: In the scope of service sector industries, we may group EU countries into clusters that are internally homogeneous and, at the same time, externally diversified in terms of innovation activity. I identified clusters of internally homogeneous countries in four out of five analysed service sections (except for the transportation and storage industry). The highest degree of homogeneity (100%) was characteristic of innovative activity conducted by enterprises in the scientific and technical activities section. The most significant differentiation between the identified clusters of countries was the characteristic of wholesale and retail trade, as well as the repair of motor vehicles and motorcycles industry (G). Regarding innovation activity in each industry, the defined groups of countries were much more internally homogeneous than significantly differentiated. In industry G, both of the phenomena were at an almost identical level.

Implications & Recommendations: Based on the presented research results, it is possible to develop uniform tools and instruments of pro-innovation policy dedicated to countries aggregated within a specific, internally homogeneous cluster of countries. On the one hand, this policy would be universal for countries aggregated in a given cluster. On the other hand, it could contain instruments and tools specific to a given industry. Such a diversified form of pro-innovation policy would contribute, firstly, to increasing coherence in the scope of the implemented assumptions of the EU innovation policy. Secondly, it would ensure that the instruments used in its scope would be targeted and dedicated to specific groups of enterprises. Therefore, the study may constitute a set of information that policy-makers could use. Moreover, the research results and analyses constitute a source for deepening knowledge on the construction of independent strategies by individual countries as part of innovation activities carried out at the level of various service industries.

Contribution & Value Added: The study is consistent with the currently applicable scientific paradigms and strategic assumptions of the EU countries regarding the cohesion of its members, as well as development based on innovation and related activities. To characterise the issue of innovativeness, I used a methodological approach that integrates extensive tools in the field of research methods.

Article type: research article

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INTRODUCTION

The study addresses important issues related to innovation activities and integrates them with the services sector, which is no less important from the perspective of the EU economy. The most visible effects of innovation activity are technological and non-technological innovations appearing on the market due to enterprise activities. According to the EU report on innovation policy (Polluveer, 2023), innovations arising from dynamic changes at the international level, although they have been permanently recognised as determinants determining the economic development of countries, have recently become even more important. Importance and role not only in the economy but also in the area of health (in 2020, the COVID-19 pandemic) or the arms industry (apart from the armed conflicts that have occurred so far, in 2022, there was an escalation of the Russian-Ukrainian war).

The political and socio-economic situation in the world forced the intensification or initiation of innovation activities not only by industrial entities, but also, and perhaps above all, service entities. Numerous studies indicate that the service sector industries have suffered the most from the COVID-19 pandemic. On the other hand, innovation activity provides the potential and opportunities for development and survival in new, dynamically changing, complicated, and complex conditions (Huang *et al*., 2020; Ramelli & Wagner, 2020; Gopinath, 2020).

The literature on the subject identifies the key reasons for the destabilization of the economic situation of service entities from the perspective of recent years, which include, among others, collapse on the demand side, interruption of global supply chains, accumulation of product inventories and decline in real incomes. Moreover, factors that negatively impact the situation in service sections include limited opportunities to finance projects for new solutions, regulatory barriers, including self-isolation and social distancing (Serbulova *et al.*, 2020). The new realities of functioning on the market, including, *e.g.,* restrictions on movement, posed a threat in the case of activities related to the provision of catering, hotels (Huang *et al.,* 2020) or transport services, in which the pandemic did not have a negative impact. The negative phenomenon of the pandemic had a beneficial effect, for example, in the activities of Emirates Airlines. The COVID-19 crisis forced the use of an innovative approach to running a business, which resulted in the implementation of the so-called reactive innovations, *i.e.,* in response to the situation resulting from the environment and not entirely dependent on the enterprises themselves. Gopalakrishnan and Kovoor-Misra (2021) In the example, in the above-mentioned Emirates Airlines were used, among others: innovative onboarding procedures, considering passengers maintaining a safe distance (business process innovation). Moreover, the airlines transformed passenger aircrafts into units intended to transport goods – SkyCargo – a product innovation (De Mey, 2020). Thus, the COVID-19 crisis caused a collapse on the demand side in many of the above-mentioned service industries. Still, at the same time, it became an opportunity to diversify activities, expand the range of services and cause a disproportionate increase in demand in other service sections.

The pandemic has naturally created new markets for many services, *e.g.,* those focused on ICT activities. Examples include video streaming and video conferencing companies (Koeze & Popper, 2020). The period of health crisis has become an opportunity for the development and creation of innovative solutions in the field of so-called proactive innovations, not only in the ICT market but also in service industries related to insurance activities or the e-commerce market, *e.g.,* online shopping services (Alan & Köker, 2021). The creation of the mentioned proactive innovations is justified when there is a demand for new products and services on the market, and such a phenomenon occurred during the COVID-19 crisis (Gopalakrishnan & Kovoor-Misra, 2021).

The 'Europe 2020' strategy by the European Commission (EC) demonstrated the importance of the topics discussed in the study. The strategy bases on three priorities with goals:

- intelligent development of the economy – based on knowledge and innovation,
- sustainable development – related to supporting an economy that uses resources efficiently,
- inclusive development – involves supporting an economy that ensures economic, social and territorial cohesion.

Highly diversified levels of effectiveness characterised the Community countries in achieving the goals in terms of the presented priorities. The countries with the highest degree of strategy implementation belonged mainly to the 'old' EU countries, *e.g.,* Sweden, Finland, Denmark, and Austria, as well as new ones, *e.g.,* Slovenia, Czech Republic, Estonia, and Poland. Very bad results in this respect concerned southern Europe, including Greece, Spain, Italy, Romania, and Bulgaria (Kasprzyk & Wojnar 2021).

Currently, in the face of insufficient fulfilment of the provisions of the Europe 2020 strategy and the context of cohesion policy in the field of research and innovation, it seems that there is a need to reformulate the level of requirements and/or the level of their implementation to a lower than international level. In this regard, it is worth considering the objectives, as well as assistance at the EU sectoral level, guided by the strategies adopted for the coming years, including:

- in the field of cohesion policy, investing in a smarter, greener, better connected and more social Europe (2021-2027),
- EU research and innovation policy,
- single market strategy,
- digital single market strategy.

It seems that the above-mentioned innovation activity support strategies have a greater impact on innovation activities in the services field than the Europe 2020 strategy, constituting the second premise for undertaking research.

The aggregation of countries, which is the result of achieving the objective of this study, constitutes potential guidelines and indications that can be used in determining the assumptions of subsequent strategies developed in this area, as well as the innovation policies of individual groups of countries. The work in the scope of this study allowed me to identify the internal homogeneity and cluster of countries differentiation identified in the service sections, considered in terms of innovation activity. Thus, the strategic assumptions, including goals and instruments supporting the achievement of the assumptions of the new EU strategy, can be adapted to the specificity of each service section and extend their application in countries identified as similar in terms of innovativeness.

The third and last indication of the key importance of the issues discussed in the study was that it covered the services sector of EU countries and practically illustrated the level of innovativeness of enterprises providing services representing individual countries. According to the literature, over the last 30 years, the service sector has significantly influenced the world economy (Manohar *et al.*, 2023). Hausman and Johnston (2014) indicate the essence of the service sector in the economy and the growing importance of innovation as determinants of the socio-economic development of countries and regions. Innovativeness has become a key factor in creating a new economic model in developed countries where achieving population and consumption growth is difficult (Churski *et al.*, 2018).

Noteworthy, growth dynamics characterise the service sector, and additionally, in the economies of developed countries, it has a priority because its share in creating economic indicators is high (Guevara-Rosero *et al.*, 2023; Alan & Köker, 2021). The strong position of the service sector is not only the result of technological progress but also plays a key role in consumer needs regarding, *e.g.,* quality, lifestyle and growing customer expectations, including understanding how consumers perceive service innovations, as well as their growing purchasing power (Nair, 2018; Habel *et al.*, 2016; Hsieh & Yuan, 2019).

The World Bank mentions the importance of the services sector (Buckley & Majumdar, 2018) in a report, which notes that the process of transforming the world economy from agricultural to productive has lasted for centuries and is still ongoing in some economies. However, as indicated in the cited source, the service sector is developing more dynamically than the production sector, and the world is undergoing radical changes. Many authors also point to the importance of the service sector in the economy. The studies by Wosiek (2018) and Buckley and Majumdar (2018), presented in 2018, compiling the basic economic values generated by the service and production sectors, clearly indicate the dominant economic importance of the service industries. The cited authors prove that this sector displays a growing trend in the services share in generating GDP (69% in 2016). This is particularly visible in low- and middle-income countries, where in 2015 it was 57%, while in high-income countries it was as much as 67%. Employment level was another measure proving the growing importance of

the service sector. In 2017, over 70% of the workforce was employed in services in most world economies, including the Organization for Economic Co-operation and Development (OECD) countries, and over 80% in high-income countries. Another proof of the key role of the services sector in the development of the economies of countries around the world may be the value of exported services, which in the period 2006-2016 increased by 39.36%, to 4 751 billion USD. At the same time, the production sector saw an increase in the value of exports that was approximately 12 percentage points (percentage points) smaller (27.05%) in 2016, equal to 11 557 billion USD (World Trade Statistical, 2017). The sector data came from before 2018 to illustrate the situation compatible with the period of data analysed in the study, which came from 2018-2020 (data current at the time of writing the text). Moreover, as previously shown, based on numerous studies, the increasing importance of the service sector has been progressing for decades and is a growing trend.

To sum up, innovation activity and innovativeness are extremely important issues in the perspective of overcoming the economic crisis caused by the global problem of COVID-19. The post-pandemic period and the need to stabilise the economic and health situation of the global economy, including the EU, is an appropriate moment to develop updated, sustainable, uniform and common, and at the same time specific and tailored to individual groups of countries, strategy assumptions, and innovation policy. The key issue in this respect may be the establishment of instruments or tools supporting innovation activities, especially for the service sector, which may be facilitated by the results of the analyses conducted in this study. The need to support the service sector relates to its role and significant impact on the economy of individual countries.

The novelty and originality of the issues addressed in the study resulted from seven premises (Alan & Köker, 2021; Osiadacz, 2012):

- for a long time, scholars perceived the service sector as insensitive to innovation and technical progress, therefore it was not an interesting research area,
- innovations in services until 2005 (3rd edition of the Oslo Manual – OM3), were not included in the category of product innovations and were therefore not included in the research on innovation activity,
- there are difficulties in measuring innovativeness in the service sector, because they often result in immeasurable changes of a qualitative (non-technological) nature that are difficult to quantify,
- there is a problem with open access to reliable data/innovativeness indicators characterizing services,
- low level of interest in innovations in the service sector, as they are rarely related to technological progress,
- previous works in the area of the discussed issues are mainly case studies of individual service industries, *e.g.,* works by Sarmah *et al.* (2017), Khan *et al.* (2020) on innovation in hotel services and their co-creation by customers as part of, for example, the concept of user-driven innovation (Wahyudi *et al.*, 2023; Szymańska, 2017), less often concern specific business entities, such as Mercadona (Albors-Garrigos & de Miguel Molina, 2023),
- the study uses a methodology based mainly on quantitative methods – cluster analysis, Ward's agglomerative method at the macroeconomic level, Levene's statistical test, and Student's t-test.

The presented premises regarding the importance of the topic and the degree of novelty allowed for the identification of a research gap. It occurred at the level of innovativeness research, in which the service sector is often omitted. Due to the presented research gap, the aim of the research described in the study was to identify and assess the degree of homogeneity and differentiation of EU countries in terms of innovation activity in individual sections of the service sector. Within the scope of the objective, I defined specific objectives constructed in the form of research questions, which were also the next research stages:

RQ1: Do individual sectors of the service sector of EU countries exhibit homogeneity in terms of the innovation activity of enterprises?

RQ2: Is it possible to identify homogeneous clusters of EU countries in individual service industries, taking the level of innovation activity as a criterion?

RQ3: Were there any significant differences identified between the clusters of countries that occurred in the individual industries?

The study consists of an introduction, which, apart from indicating the significance of the discussed issues from a cognitive point of view, also includes a fragment of the methodology concerning the objectives. The next part will be largely theoretical in nature. It will focus on presenting international literature and justifying the research hypothesis.

The part of the study regarding research methodology presents a sequential approach to the research assumptions along with the methods, tools and research techniques used at each of the three stages. This chapter also presents a set of analysed indicators of innovation activity and defines criteria for assessing the level of homogeneity and significant differentiation.

The rest of the study presents the results of the conducted research analyses. This part also includes a discussion relating to previous research results and conclusions. Conclusions and references support the work's structure.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The literature on the subject contains a multitude of concepts related to the issue of broadly understood innovativeness, as well as various ways of interpreting it. We should consider subsequent editions of the Oslo Manual as the basic source of information in this aspect. The fourth version of this manual from 2018 is currently in force. This source is a collection of all necessary information used for issues related to innovativeness. Moreover, the Oslo Manual contains methodological guidelines for conducting all research conducted at the international level, *e.g.,* by Eurostat, or at the national level, *e.g.,* reports on the innovation activities of enterprises in Poland prepared by the Central Statistical Office – GUS (Oslo Manual, 2018).

At the microeconomic level, innovativeness constitutes an enterprise's tendency to implement innovations and accept new ideas. It may manifest itself in a processual manner, as it is a source of encouraging, experimenting, and supporting changes that may ultimately generate new products, services or technological processes (Imran *et al.*, 2018; Chavez *et al.*, 2020). From the perspective of innovation management, we may define innovativeness as part of an organizational culture with a specific structure, open to new ideas, which functions as a source of solving organizational problems (Jahanshahi *et al.*, 2019).

Due to its specificity, innovativeness is a difficult area for empirical considerations. We may estimate it at the macroeconomic level in the national context. However, it also has a meso- and microeconomic dimension. To define it internationally, we use the summary innovation index (SII), which I will discuss in detail later in this chapter. Moreover, from a macroeconomic perspective, we may also define innovativeness based on various indicators regardless of the SII, *e.g.,* the impact of the number of innovative companies and employment in knowledge-adoptive sectors on GDP, foreign direct investment, the rate of unemployment, the establishment of new companies export and market share (Bazhal, 2017; Zervas *et al.*, 2017).

From the perspective of this study, the methods of measuring innovativeness at the microeconomic level are interesting as they determine the innovativeness advancement of economic sectors. Estimation of innovativeness in this industry sense may come down to the analysis of the innovation activity of enterprises, and the selection of indicators describing this phenomenon depends on the specificity of the empirical research conducted and its scope. The most common areas of research are those related to the innovative potential and/or effects related to the degree of its use at the enterprise level. Scholars may conduct research on these levels separately or integrally (Lin *et al.*, 2020; Mendoza-Silva, 2021; Sandvik *et al.*, 2014). We may describe the innovative potential using quantitative data regarding, for example, expenditure (R&D) the number of patents obtained or applications submitted in this area (Baranskaitė *et al.,* 2022). We can measure the effects of business activities that indicate the level of innovativeness of entities by the number of implemented innovations, the degree of their newness in geographical, market or conceptual terms, and also the length of the innovation life cycle.

Regarding innovation taxonomy, it is essential to indicate the latest edition of the Oslo Manual from 2018 (OM4), which constitutes the methodological basis for research on innovativeness and also informed the methodology used in this study. In OM4, we divided innovations into two categories. Firstly, product innovations, understood as new/significantly improved products or services in terms of one or more properties compared to those previously offered. The second group of innovations consolidates the changes that were made in the OM3 edition, which were of a process, organizational, and marketing nature. Currently, we collectively refer to them as business process innovation and they may be the result of one or more of the six so-called 'business functions,' including production of goods and services, distribution and logistics, development of products and business processes (in OM3 these were process innovations), information and communication systems (ICT), administration and management (in OM3 these were are organizational innovations), marketing, sales and after-sales service – formerly marketing innovations (Oslo Manual, 2018; Oslo Manual, 2005).

The considerations presented so far inspired the development of three premises that formed the basis for the construction of research assumptions, especially the research hypothesis, which assumed that:

H1: EU countries can be grouped into clusters that are internally homogeneous and, at the same time, externally different in terms of innovation activity in the service sector industries.

The factors influencing the research construction were under the influence of three conditions:

- two research trends in terms of patterns of innovation activity,
- estimation of the innovativeness level conducted based on SII, presented in the annual edition of the European Innovation Scoreboard (EIS) 2023 and developed by the European Commission,
- continuation and the need to expand existing research on innovativeness in both the service sector and its sections, treated as specific case studies.

Detailing the presented premises, we should note the two antagonistic research directions used in the field of innovativeness. The first one is based on research on homogeneity in innovative behaviour. It focuses on examining the homogeneity of innovative behaviour of enterprises in various – from the perspective of innovative strategies used – areas of production activity, as well as in the service sector, *e.g.,* on the financial market (Urbankova & Krizek, 2020; Jakimowicz & Rzeczkowski, 2019; Srholec & Verspagen, 2008; Llerena & Oltra, 2002). The second trend of research conducted on innovation activity assumes differences in the innovativeness of enterprises with a wide range of technological advancement defined at high, medium, and low levels (Hirsch-Kreisen *et al.*, 2008).

Another premise justifying the construct of the research hypothesis and the purpose of the research related to the results of the EIS report on the level of innovativeness in EU countries. This document contains basic guidelines containing and defining areas requiring improvement at the level of individual countries. The aim of this report is to strengthen the innovative position of individual countries in the EU and in the world (European Innovation Scoreboard, 2023). On their basis, the EU countries are aggregated into groups with a similar level of innovativeness. The classification is based on SII, which is a constellation of 32 indicators grouped into four sets (framework conditions, investments, innovation activities, impacts) and defining 12 areas. This ranking defines four groups of countries, differentiated by their innovativeness level. Two of them are above and two below the average EU SII, which is 100% as a reference point. In 2023, the largest group of countries (10) represented the so-called 'moderate innovators,' whose SII was in the range of 75-108% of the EU value. Noteworthy, in 2016-2023 in these countries there was identified higher growth of SII than in EU. The highest growth dynamics of SII was observed in the following countries: Estonia (29.3% points), Greece (22.2% points), the Czech Republic (21.0% points), Lithuania (16.7% points) and Italy – 15.6% points (European, 2023). Apart from these countries, the 'moderate innovators' included Slovenia, the Czech Republic, Spain, Malta, Portugal, Lithuania, and Hungary. The smallest group of countries in terms of quantity were the so-called 'innovation leaders,' *i.e.,* countries with the highest innovativeness level. This includes, among others, Denmark, Sweden, Finland and the Benelux countries, where the SII index was above 135% (European Innovation Scoreboard, 2023). Research on innovativeness at the international level is very popular in the literature on the subject, but at the industry level, it is still paucity (Dworak, 2022).

Based on the EIS, the ranking and classification of countries made within its scope (in the scope of the EIS) aggregates EU countries into clusters with similar values of innovativeness indicators. From a cognitive point of view and in the perspective of the data included in the EIS, it is worth considering whether it is possible to conduct a similar study and group countries according to, *e.g.,* the level of innovation activity of individual sections of the service sector, the significant importance of which I demonstrated in the previous part of the study?

The last factor that determined the research assumptions was the need to continue and specify the existing research in the field of innovation activities, both in the service sector in general and at the level of its individual industries. An example is the work of Bielińska-Duszak and Hamerska (2021), in which the authors aggregate industries classified according to NACE (the Statistical Classification of Economic Activities in the European Community into homogeneous ones, in terms of innovation activity clusters. In the above-mentioned studies in the case of service entities, they noted that the best quality of division was achieved when three clusters were created due to the participation of enterprises implementing product or business process innovations. Moreover, they indicate the possibility of further analyses provided by the process of grouping service sections into endogenously similar clusters.

Another excellent example of research that proves the possibility of classifying EU countries into clusters that are homogeneous in terms of innovation activity is the empirical work by Kasprzyk and Wojnar (2021), which covers EU countries. The authors consider homogeneity according to the effectiveness in implementing the assumptions of the Europe 2020 strategy achieved by the Community countries, using, among others, cluster analysis with Ward's agglomeration method.

Based on the considerations presented, we can conclude that the issues discussed in this study, together with the hypothesis, goals and methodology for achieving them, constitute a logical continuation of the research considerations of other authors, draw on the existing scientific achievements, and naturally fits into the gap research.

RESEARCH METHODOLOGY

Considering the theoretical and empirical background of the issues discussed in the previous part of the text, I formulated a research objective, which was to identify and assess the degree of homogeneity and differentiation of EU countries in terms of the innovative activity of individual industries of the service sector. I developed the main goal with specific goals formulated in the form of research questions presented in the introduction. In the context of the presented assumptions, I verified the research hypothesis, which assumed that:

H2: We may group EU countries into clusters that are internally homogeneous and, at the same time, externally different in terms of innovation activity in the service sector industries.

I verified the hypothesis and implemented the main goal using the method of analysis and logical construction designed in four stages/phases, at which time I used a number of supporting methods, techniques, and research tools (Table 1).

The first stage of the described research was the identification of potential homogeneity in the service industries of EU countries in terms of innovation activity, which was characterised using the indicator method. In this phase of the research was used Levene's test, which assumed that the variances in different groups are the same (homogeneous). This is the most powerful test of homogeneity of variance. All indicators in individual service industries were tested. For the purposes of further analyses, I considered homogeneous sections as those in which at least eight indicators showed homogeneity. Based on stage 1, I achieved detailed objective 1.

In the second stage, I used cluster analysis to connect the examined objects and determine the distance between them. One can conduct it using the so-called single or full bond or centre of gravity of clusters. The most important point in cluster analysis was the creation of a matrix of distances between the examined objects. I used the Euclidean distance as a measure of this distance in the research (Decyk, 2024). At this stage, I used Ward's agglomerative method of grouping objects. Its effectiveness is appreciated, especially in economic research. This is due to the fact that among the

available grouping methods, it is the most effective in reproducing the actual structure of economic data (Steinley & Brusco, 2007). This method involves consolidating objects into groups based on the principle of minimizing intra-class variance and combining objects into clusters that guarantee the minimum sum of the squares of the distance from the so-called centre of gravity of the newly created cluster that they create (Łukiewska, 2019). The cut-off point (in this elaboration), which specified the number of clusters, was marked by a straight line, symbolizing the level at which there were relatively large changes in the value of increases in agglomeration distances in the process of combining classes between individual levels of consolidation. The research approach used in the first stage enabled the implementation of the first specific objective.

Table 1. Research procedure

Research stage		Applied research approach	Degree of implementation of methodological assumptions	
1	The identification of the potential homogeneity of service industries in terms of innovation activity	- Levene's homogeneity of variance test (analysis of variation test), - indicator method	first specific goal	main research goal and verification of the hypothesis
2	The identification of clusters of EU countries in the field of service industries, taking the level of innovation activity as the criterion	- cluster analysis with Euclidean distance as a measure of the distance between the examined objects, - Ward's agglomerative clustering method, - dendrogram – graphical interpretation of the results	second specific goal	
3	The identification of significant differences between defined clusters of countries in a given industry	- categorised normality plots – normal distribution of the variable, - Student's t-test – identification of statistically significant differences between clusters	third specific objective	

Source: own study.

In the next step, I analysed the degree of differentiation between the identified clusters. For this purpose, I used Student's t-test, which I proceeded with the verification of the normal distribution of the dependent variable based on categorised normality plots. I tested independent and unrelated variables with a statistical H_0, stating that there were no statistically significant differences in innovation activities between the clusters identified in stage 1. The alternative hypothesis assumed that there were statistically significant differences in the studied phenomenon. I considered groups of countries with statistically significant differences to be those in which at least one indicator differed statistically significantly between two selected pairs of clusters. In accordance with the presented methodological approach, I obtained the answer in the scope of the third specific objective.

As part of the summary of the results obtained in the earlier stages of the research, I estimated the degree of homogeneity of innovation activity in the identified clusters of EU countries and the level of differentiation between them. I determined the homogeneity degree in the scope of individual clusters of countries based on an indicator calculated as the ratio of the number of indicators considered homogeneous (Levene's test) to the total number of indicators – 15. The level of differentiation was expressed as a percentage indicator as the ratio of significantly different pairs of clusters to all possible configurations that could be created by clusters in a given service industry. I performed all analyses and statistical tests using the Statistica 13 program with a significance level of p=0.05.

In addition to quantitative methods, I developed both the theoretical part of the work and the methodological assumptions using analysis and criticism of international literature. It allowed me to systematise the existing knowledge on innovativeness.

I expressed the obtained data in the form of 15 percentage indicators, which were the ratio of enterprises (implementing an innovation project/innovation, introducing innovation/a specific type of innovation/innovation with a specific scale of novelty) to all surveyed entities in a given section.

I determined the choice of meters by the ineffectiveness of using popular metrics in service industries used to measure the level of innovativeness, such as the intensity of research and development (R&D) or the number of patents. Research in the area of the service sector requires more specific and adjusted indicators (Williams & van Triest (2021). The mentioned group of 15 indicators was the subject of research and, at the same time, research material, which included data from 2018-2020 and published by Euroatst (Table 2). I used the latest, available, and comprehensive quantitative data on innovation activity from all EU countries.

Table 2. Summary of the indicators of innovation activity used in the research in the service sector section in the EU countries in 2018-2020

Group of indicators	The specific type of indicator*
Innovation activity index	1. Enterprise innovative efficiency index (IEI). 2. Innovation activity efficiency index (IAEI).
Type of innovations	3. Enterprises which introduced product innovations (PI). 4. Enterprises which introduced business process innovations (PrI).
Types of product innovation	5. Enterprises which introduced product innovations in the form of goods (GIEI). 6. Enterprises which introduced product innovations in the form of services (SIEI). 7. Enterprises which introduced product innovations that were new from the market perspective (MNIEI). 8. Enterprises which introduced product innovations that were new only from the perspective of a given firm (FNIEI).
Types of business process innovation	9. New or improved methods for producing goods or providing services (MPGPS). 10. Logistics (LI). 11. New business practices for organizing procedures or external relations (BPER). 12. New methods of organizing work responsibility, decision making or human resource management (OWHR). 13. New or improved methods for information processing or communication (IPC). 14. New methods for accounting or other administrative operations (AAO). 15. New marketing methods for promotion, packaging, pricing, product placement or aftersales services (MM).

Note: '*' the indicators are expressed as percentages, reflecting the ratio of enterprises conducting innovation activities in a given scope to all enterprises surveyed in a given section.
Source: own study based on Eurostat data.

The subject of the described research was innovative enterprises representing industries in the service sector in individual EU countries and, more precisely, their innovation activities in the broad sense. I analysed all sections of the services sector where data from at least half of the EU countries were available (14 out of 27). Due to the presented limitations and incomplete information, the study included five out of eight industries in the service sector. They included the following industries: G – wholesale and retail trade; repair of motor vehicles and motorcycles; H – transportation and storage; J – information and communication; K – financial and insurance activities; and M – professional, scientific, and technical activities.

RESULTS AND DISCUSSION

Homogeneity of Countries in Terms of Innovation Activities of Individual Branches of the Service Sector

The application of Levene's variance estimation test enabled the use of indicators in a range that begins in the analysed service industries (Table 3). Values of $p \geq 0.05$ indicated that there were no grounds to reject H_0, which states that the variances in the examined objects were homogeneous.

Based on Levene's test, it was possible to identify not only similarity in service sections, but also the indicators in which this occurred. Based on the results, it should be concluded that the most homogeneous innovative activity was identified in section M, where similarity was observed in all 15 analysed indicators. In the case of the remaining service sections examined, the similarities were

slightly lower but also higher. The second equally homogeneous industry was financial and insurance activities – K. I observed internal similarity in 14 indicators. Thus, clusters of countries with a similar level of innovation activity concentrated there. Only in the case of one indicator like enterprises which introduced product innovations that were new only from the perspective of a given company – FNIEI (p=0.0069) – was not significantly homogeneous. The J – information and communication industry was characterised by a slightly lower similarity level, in which the results of Levene's test showed a lack of homogeneity of variance only in the case of 2 out of 15 indicators. These were the percentage of enterprises which introduced product innovations in the form of goods – GIEI (p=0.0186) and FNIEI (p=0.0021). Industry G was characterised by lower significant homogeneity than in the above-mentioned sections, although still high homogeneity, in which I identified similarity in terms of 12 measures. I also identified dissimilarities in new or improved methods for producing goods or providing services – MPGPS (p=0.0024) and new marketing methods for promotion, packaging, pricing, product placement or aftersales services – MM (p=0.0417). I recorded the lowest level of homogeneity in section H. I diagnosed it only in seven tested indicators. Due to the methodology adopted in the study, which assumed that service sections in which at least eight indicators were homogeneous would be considered homogeneous, I omitted industry H in further analyses.

Table 3. Internal homogeneity of the service sector sections in all EU countries in terms of individual indicators of innovation activity in 2018-2020

No.	Type of indicator	Levene's test probability value in the service sector				
		G	H	J	K	M
1	Enterprise innovative efficiency index (IEI)	0.3640	0.1516	0.4257	0.3761	0.2711
2	Innovation activity efficiency index (IAEI)	0.3648	0.0000*	0.3417	0.4668	0.6023
3	Enterprises which introduced product innovations (PI)	0.4285	0.0171*	0.4180	0.3851	0.2864
4	Enterprises which introduced business process innovations (PrI)	0.0209*	0.0603	0.0725	0.2777	0.1463
5	Enterprises which introduced product innovations in the form of goods (GIEI)	0.0453	0.0066*	0.0186*	0.2273	0.3386
6	Enterprises which introduced product innovations in the form of services (SIEI)	0.1123	0.0360*	0.0712	0.0732	0.6447
7	Enterprises which introduced product innovations that were new from the market perspective (MNIEI)	0.2469	0.0001*	0.3804	0.3621	0.6638
8	Enterprises which introduced product innovations that were new only from the perspective of a given firm (FNIEI)	0.3026	0.0872	0.0021*	0.0069*	0.2973
9	New or improved methods for producing goods or providing services (MPGPS)	0.0024*	0.0869	0.6770	0.6132	0.6114
10	Logistics (LI)	0.4080	0.2249	0.5469	0.4345	0.0650
11	New business practices for organizing procedures or external relations (BPER)	0.1042	0.0313*	0.3701	0.1663	0.9549
12	New methods of organizing work responsibility, decision making or human resource management (OWHR)	0.4875	0.2936	0.4887	0.0896	0.2711
13	New or improved methods for information processing or communication (IPC)	0.1561	0.0013*	0.4870	0.4256	0.6023
14	New methods for accounting or other administrative operations (AAO)	0.4807	0.0002*	0.3085	0.4000	0.2864
15	New marketing methods for promotion, packaging, pricing, product placement or aftersales services (MM)	0.0417*	0.4243	0.1762	0.0472	0.1463

Note. '*' statistically significant results at p<0.05 significance level'.
Source: own study based on Eurostat data and Statistica 13 program.

The analysis of Levene's test results allowed me to conclude that individual sections of the service sector in the EU countries were significantly homogeneous in terms of innovation activity. At a later stage of the research procedure, it was interesting to ask whether, in connection with the potentially

demonstrated homogeneity, it is possible to aggregate the EU countries into smaller internally homogeneous clusters, in which it would be possible to apply the same (universal) innovation policy towards members of this cluster and at the same time specific to a given industry.

Therefore, in the next stage of the research procedure, I identified the homogeneity of the innovation activity of the countries within each of the analysed service industries. For this purpose, I used cluster analysis with Euclidean distance, supported by Ward's agglomeration method. Table 4 presents the results of this part of the research process in the synthetic way. This ensured the refinement of the identified homogeneity and allowed for the continuation of the analyses in accordance with the presented research methodology.

Table 4. Clusters of EU countries in which internally homogeneous innovation activity was identified, conducted in 2018-2020, with a distinction made between industries of the services sector

Type of service section	Cluster no	Countries
G	1	Croatia, Czechia, Portugal
	2	Denmark, France, Hungary, Italy, Luxembourg, Sweden
	3	Malta, Poland, Slovakia
	4	Spain, Romania
H	1	Belgium, Netherlands
	2	Bulgaria, Denmark, Hungary, Latvia, Poland, Slovakia, Spain
	3	Austria, Czechia, Finland, France, Germany, Ireland, Italy, Lithuania, Luxembourg, Malta, Portugal
	4	Cyprus, Greece
	5	Slovenia, Sweden
	6	Estonia
	7	Croatia
	8	Romania
J	1	Austria, Belgium, Czechia, Finland, Germany, Greece, Netherlands, Portugal
	2	Denmark, Estonia, France, Italy, Lithuania, Slovenia, Sweden
	3	Croatia
	4	Cyprus
	5	Bulgaria, Hungary, Ireland, Latvia, Luxembourg, Malta, Poland, Slovakia, Spain
	6	Romania
K	1	Belgium, Cyprus, Czechia, Greece, Germany, Portugal, Italy, Austria
	2	Bulgaria, Netherlands, Hungary
	3	Lithuania, Malta, France, Finland, Latvia, Spain, Luxembourg, Poland, Estonia, Sweden, Slovakia, Denmark, Slovenia, Ireland
	4	Croatia
	5	Romania
M	1	Czechia, Portugal, Croatia, Sweden, Italy
	2	Denmark, France
	3	Malta, Poland, Hungary, Luxembourg, Slovakia, Spain
	4	Romania

Source: own study based on Eurostat data and cluster analysis performed using Statistica 13 program.

Based on the cluster analysis, I identified a different number of homogeneous clusters in terms of innovation activity in the surveyed industries, in section G – 4, H – 8, J – 6, K – 5, and M – 4. The research included clusters that constituted one country, for example, in the J industry, such as Croatia, Cyprus, or Romania. Based on the presented analysis results, firstly, we may conclude that in industries where a larger amount of data was available, I identified a greater fragmentation in terms of clusters. For example, in industries G and M. Secondly, the presented results allowed for a preliminary conclusion that the countries forming the single-element groups were not similar in terms of the analysed indicators to any of the other clusters enough to create a homogeneous group with them. A particular lack of homogeneity in relation to other EU countries was visible in Romania, which, in the case of each

industry (except G), formed a separate single-element cluster. This may indicate a significantly different level of innovation activity in the service industries of this country. However, at this research stage, it was not possible to determine whether the level was significantly different. Based on the values of the analysed indicators of the Romanian service industries, we may assess that they were mostly at the lowest or one of the lower levels in the entire EU. One of the reasons for this situation in Romania was undoubtedly the fact that the corporate sector conducted only 29% of research, and the entire Romanian innovation system is based, in general, on the public sector. Moreover, this country was characterised by the second lowest intensity in the implementation of R&D activities – efficiency at the level of 25% of the assumed goal for 2020, which was set at 2% of GDP (Maier & Maier, 2018).

In general, the classification of countries according to the innovation activity of the service sector was similar to the groups of countries defined on the basis of SII (European, 2023). Therefore, we may conclude that, apart from defining the level of innovativeness at the macroeconomic level, SII also reflects the general distribution of innovativeness in the service sector. This phenomenon was most visible in the case of the J industry.

The result of the cluster analysis allows for two-way conclusions. Firstly, the identified clusters of countries were internally homogeneous in terms of innovation activity, which the results of the analyses presented so far have confirmed. The second direction is not clearly defined, although it can potentially be assumed that the clusters of EU countries were externally different. However, at this research stage, it was not possible to make an unambiguous diagnosis, estimate, or draw conclusions about the significance of differences between individual clusters of countries at the level of individual service industries. However, I ensured it with the implementation of the next stage specified in the research approach.

Differences in Countries in Terms of Innovation Activities Carried out in Individual Branches of the Service Sector

To comprehensively implement the main research assumptions, apart from the discussed results regarding the internal homogeneity of country clusters, it was also necessary to define potentially occurring differences between them. I defined these differences within individual industries of the sector by comparing clusters of countries in a peer-to-peer configuration (for example, in G industry, I identified four clusters, so differences could potentially occur in the following six cluster configurations: 1-2, 1-3, 1-4, 2-3, 2-4, and 3-4. Generally, I noted that statistically significant differences between clusters of countries occurred in the vast majority of cases in each section of the service sector examined. However, I observed a diversified level of this differentiation (Table 5).

Table 5. Clusters of EU countries between which statistically significant differences in innovation activity were defined in individual service industries

Service sector section		G	M	K	J
Pairs of clusters between which statistically significant differences were defined	The number of statistically significantly different pairs	6	6	9	12
	% of clusters that are statistically significantly different in the number of all possible cluster configurations	6/6=100	6/6=100	9/10=90	12/15=80

Source: own study.

Based on the presented results, we can conclude that in industries G and M there was the greatest statistically significant difference between the defined clusters of countries. Differences between all examined cluster configurations in the wholesale and retail trade sections; repair of motor vehicles and motorcycles were statistically significant in at least one of the examined indicators. Based on the adopted methodology, 1 out of 2, 3, 4 and 2 out of 3, 4 were considered to be significantly different pairs of clusters – 8/15 indicators that were statistically different (Table 6).

Based on the presented data, we can conclude that cluster 1 (Croatia, Czechia, Portugal) was the most externally diversified in section G. The level of innovation activity in this industry in the above-mentioned countries was the highest. The evidence for it was the highest average values (compared

to the other clusters) of all tested measures. The average values of indicators in Croatia, Czechia, and Portugal were higher than in the countries from clusters three and four at least twice, *e.g.,* PrI indicator, respectively: 50.3% (cluster 1); 25.6% (cluster 3) and 12.5% (cluster 4) or FNIEI, respectively: 28.4%; 8.2%; 8.6%. These data confirmed the existence of significant differences between the mentioned clusters and, therefore, within the industry. Thus, the pro-innovation policy addressed to G industry enterprises should be clearly differentiated in the case of countries representing clusters 1, 3 and 4, and at the same time, as indicated by Levene's test, homogeneous within the clusters of these countries. In the professional, scientific and technical activities industry, similarly to G, I observed that in all compared pairs of clusters, there were statistically significantly different indicators – 100% (Table 5). In this respect, this industry did not differ from G. However, significant differences in the level of innovation activity in M industry were on a relatively smaller scale. Two configurations were considered significantly different clusters: 1 and 3 and 1 and 4 (Table 7).

Table 6. Statistically significant differences in innovation activity between clusters of EU countries in G industry (in the number of indicators studied in the period 2018-2020)

Cluster no.	1	2	3	4
1	X	**9**	**14**	**14**
2	**9**	X	**9**	**14**
3	**14**	**9**	X	3
4	**14**	**14**	3	X

Source: own study based on the results of the Student's t-test and the Statistica 13 program.

Table 7. Statistically significant differences in innovation activity between clusters of EU countries in M industry (in the number of indicators studied in the period 2018-2020)

Cluster no.	1	2	3	4
1	X	3	**14**	**12**
2	3	X	7	2
3	**14**	7	X	3
4	**12**	2	3	X

Source: own study based on the results of the Student's t-test and the Statistica 13 program.

As in the case of the previously analysed industry, the results of the Student's t-test were consistent with the calculations of the average value for individual indicators. Cluster 1 (Czechia, Croatia, Italy, Portugal, Sweden) differed significantly from Romania – cluster 4 (12 significantly different indicators) or group 3 (14 indicators). A significantly higher level of innovativeness (at least 2 times up to 6 times) characterised countries from cluster 1 compared to, for example, 4. I identified the greatest differences in relation to the so-called indicators of innovation activity, *e.g.,* PI (51.8% to 8.6% in Romania), IEI or IAEI. In the configurations between the remaining clusters, I identified no eight or more statistically significant indicators, and therefore, in accordance with the methodology used in the study, I could not classify pairs of these clusters into significantly different ones. In view of the above information, it is justified to design assumptions of a pro-innovation policy that is diversified depending on the cluster of countries and, at the same time, homogeneous within its internal framework.

The level of statistically significant differentiation in the field of innovation activities, identified in the financial and insurance activities section, was lower than in the previously discussed industries. It defined nine pairs of clusters (90%) in which at least one indicator was statistically significantly different (Table 5). Analyzing the results of the Student's t-test, it should be noted that I observed no significant differentiation in the pair of clusters 4 and 5 (Table 8).

Based on the statistics, we can conclude that in K, I observed the greatest disproportions in relation to the other clusters in the countries belonging to group 1 – Greece, Cyprus, Portugal, Czechia, Germany, Belgium, Italy, Austria, which varied significantly in the range of 11 up to 13 indicators. Comparing clusters 1 with 5 (Romania), I observed no significant disproportions in the case of the four tested

measures. Considering in detail the average values of all indicators in clusters 1 and 5, they were characterised by diametrically different levels of innovation activity. Based on the estimated indicators, the countries aggregated in cluster 1 were characterised, on average, by approximately four times higher levels of innovation activity than in Romania. At the same time, group 1 was most significantly differentiated in relation to cluster 3 in the case of 86.7% of the examined indicators. In K industry, I identified a pair of clusters that differed in terms of eight indicators, and this occurred between groups of countries 3 with an average level of innovation activity and 5. As a result of the analysis of data from K industry, we should conclude that the innovation policy applied to countries from clusters 4 and 5 could have a universal character due to the lack of significant differentiation between them. On the other hand, countries from cluster 1 definitely require different strategic assumptions regarding innovativeness, different from other groups of countries. The last industry analysed was information and communication. Based on the data, this was the least diversified industry in terms of innovation activities because it identified the smallest percentage of cluster pairs with statistically significant differences – 80% (Table 5). Furthermore, in industry J, I diagnosed seven cluster configurations and considered them significant from the perspective of the methodology adopted in the study (Table 9).

Table 8. Statistically significant differences in innovation activity between clusters of EU countries in K industry (in the number of indicators studied in the period 2018-2020)

Cluster no.	1	2	3	4	5
1	X	**12**	**13**	2	**11**
2	**12**	X	7	6	3
3	**13**	7	X	7	**8**
4	2	6	7	X	0
5	**11**	3	**8**	0	X

Source: own study based on the results of the Student's t-test and the Statistica 13 program.

Table 9. Statistically significant differences in innovation activity between clusters of EU countries in J industry (in the number of indicators studied in the period 2018-2020)

Cluster no.	1	2	3	4	5	6
1	X	2	5	3	**12**	**13**
2	2	X	**8**	**9**	7	**12**
3	5	**8**	X	0	**8**	0
4	3	**9**	0	X	**8**	0
5	**12**	7	**8**	**8**	X	7
6	**13**	**12**	0	0	7	X

Source: own study based on the results of the Student's t-test and the Statistica 13 program.

In the information and communication section, it is difficult to clearly indicate a cluster that is significantly different from the others. The greatest disproportions occurred in the case of cluster 1 (Czechia, Belgium, Netherlands, etc.). Analyzing this cluster, we should conclude that it was the most diversified compared to clusters 5 and 6 – Romania, which we should consider definitely less innovative, respectively: approximately 0.5 times and even 8 times in the case of Romania and the SIEI indicator. It is worth adding that in the literature on the subject, Maier (2018) notes that J industry in Romania is considered one of the most innovative service industries in terms of the share of innovative enterprises in their total number – 26.0%. Based on the research that is the subject of this study, the most innovative industry in the Romanian service sector, in terms of the mentioned measure, was section J. The difference in this indicator identified in the research between Romania (17.9%) and, for example, Cyprus (79.6%) was over four times higher.

I identified the largest number of significantly different pairs in cluster 5 (Bulgaria, Hungary, Spain, Poland, Slovakia, etc.). Apart from the fact that cluster 5 was significantly differentiated in relation to cluster 1, it also showed differentiation in relation to clusters 3 (Croatia) and 4 (Cyprus). Between

groups 5 and 3 and 4, I diagnosed eight statistically significantly different measures. Analyzing the average values of individual indicators, the significant difference between these groups resulted mainly from the significant disproportion in the indicators relating to individual types of business process innovations (in Table 2, no. 9-15), which were significantly lower in group 5. At the same time, in J industry, group 3, *i.e.,* Croatia, was the most innovative, while slightly worse results emerged for cluster 1, consolidating eight countries. To sum up the analysis concerning section J, the countries aggregated in clusters 3, 4, and 6 were not significantly differentiated from each other. Therefore, the assumptions of the innovation policy towards them could be of a universal nature and similar in scope.

To assess the degree of internal homogeneity of country clusters and the level of differentiation between them, one needs to consider the following in parallel within the service sections studied:

- analyses conducted on the degree of internal homogeneity of clusters of countries,
- the scale of significant differences occurring between defined clusters of countries.

The conducted research proved that the sections of the skateboard of services showcased a much higher degree of internal homogeneity within the defined clusters than by external differentiation between them, as presented in Table 10.

Table 10. Level of similarity of innovation activity within clusters of EU countries (in % of indicators from the 2018-2020 period) and differentiation between them (in % of possible comparisons between clusters in the scope of service industries)

Homogeneity/Diversity	industry G	industry J	industry K	industry M
Homogeneity within clusters (in %)	12/15=80	13/15=86.7	14/15=93.3	15/15=100
Pairs of clusters between which significant differences have been defined	5/6=83.3	7/15=46.7	4/10=40	2/6=33.3

Source: own study based on Table 4 and Tables 6-9.

The professional, scientific and technical activities (M) industry was the most internally homogeneous. At the same time, it displayed the lowest differentiation level – 33.3% (Table 10). As the second sector in this classification, we can consider the K industry, which groups companies active in the field of finance and insurance. Companies from sections J and G demonstrated homogeneity of innovation activity at the level of 86.7% and 80%, respectively.

We recorded the lowest similarity index (46.7%) in H industry. Therefore, it was not the subject of further consideration (Table 3). In this industry, the calculated significant differentiation index was also the lowest – 28.6%. In industry J, significant differences were observed in 7 configurations of country pairs, but this constituted less than half of the potentially possible comparisons (46.7%). Diversity rates for the remaining sections were even lower.

Considering endogenous homogeneity and exogenous diversity simultaneously, we can conclude that the most similar scales of these phenomena regarded G industry. A similarity of 80% meant that as many as 12/15 of the examined indicators of innovation activity were similar to each other in the defined clusters. In this industry, I also identified the greatest differentiation considered significant. It occurred in as many as 83.3% of possible pairs of clusters.

CONCLUSIONS

Based on the presented research material and analyses, I achieved the research goal, which was to identify and assess the degree of homogeneity and diversity of EU countries in terms of innovation activity in sections of the service sector. In this respect, the assumptions of the next three specific objectives were fulfilled. As a consequence of the research procedure used and the results obtained, I drew the following conclusions:

- EU countries' service sectors are characterised by internal homogeneity in terms of innovation activity – objective 1,
- I observed the highest degree of homogeneity in industries M, K, J, G and H.

- we can aggregate the EU countries in terms of individual service sections into homogeneous clusters in terms of innovation activity (countries belonging to them and their numbers are different) – objective 2,
- as a result, it is possible to develop universal assumptions for individual groups of pro-innovation policy supporting the activities of enterprises operating in individual sections of the service sector,
- the greater the data availability, the more fragmented clusters I identified (H, J, K industries),
- clusters of EU countries were generally statistically significantly different – objective 3,
- the most significantly differentiated clusters of countries were those identified in industry G, where I observed the largest number of significantly different cluster pairs,
- I identified the differences between clusters of countries, which allowed me to conclude that the developed innovation policy assumptions may be specific to different clusters of countries in terms of different service industries,
- defined clusters of countries were characterised to a greater extent by the phenomenon of internal homogeneity than by significant differentiation in terms of innovation activity. This may prove a strong concentration of innovativeness indicators at a similar level in the identified clusters of countries,
- I identified similarity and significant differentiation of innovation activity at a similar level in section G, 80% of similar indicators and 83.3% of significantly different pairs of clusters, respectively.

The implementation of the auxiliary objectives ensured the fulfilment of the assumptions of the main objective, which, together with the proposed research approach, enabled a positive verification of the research hypothesis formulated in the study. In the EU there are clusters of similar countries (in terms of service sector innovation activity), which can be combined into internally homogeneous clusters and, at the same time, externally different. Therefore, there were homogeneous countries in which we can group the EU countries into clusters that are internally homogeneous and, at the same time, externally different in terms of innovation activity. The presented results can constitute guidelines for policy-makers in the development of instruments and tools to support innovation activities of a universal nature, common in individual clusters of countries. Such a situation may occur in virtually every of the analysed industries of the service sector due to high homogeneity indicators, with the exception of the H industry. On the other hand, innovation policy instruments may have a specific character due to the fact that they will be directly 'dedicated,' to adapted and dependent on the operating conditions of economic entities in a given industry of the service sector.

From the perspective of the discussed issues, it seems that interesting and future research may aim at developing this issue by:

- developing assumptions of pro-innovation policy in relation to service sector enterprises for individual clusters of countries,
- estimating the level of innovation activity in individual industries of the service sector within defined clusters or regardless of this division,
- an attempt to identify and analyse indicators differentiating the innovation activities of individual clusters of countries in selected service industries,
- identification of similarities and differences between EU countries carried out for each service industry separately, then there will be a possibility of detailed interpretation of individual indicators of innovation activity, and the choice of industry for research may be determined by, for example, the specificity of the development of smart specializations in EU countries, the regional level of a given industry, the date of country's accession Member State to the Community etc.

The presented considerations are subject to certain limitations. These include the fact that the validity of the data used for analyses depends strictly on the date of publication by Eurostat. The second limiting factor is their incompleteness. A research limitation may also be the determination of the cut-off point at the level of the so-called 'significant difference in bonding distance,' which may seem somewhat subjective and which is visualised on the agglomeration graph.

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Use of Artificial Intelligence

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