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Implementation of new technologies in accounting and financial processes: An effectiveness assessment

Rafał Szmajser, Marcin Kędzior, Mariusz Andrzejewski, Katarzyna Świetla

ABSTRACT

Objective: The aim of this paper is to explore accountants' views on the usage of Robotic Process Automation technology (RPA) which brings efficiency increase.

Research Design & Methods: An online survey has been addressed to over 500 respondents from international companies, where 160+ complete answers were received from the most important types of organizations in the business services industry. The non-parametric rho Spearman correlation coefficient and the non-parametric Kruskal-Wallis test and business case for the RPA implementation efficiency were used.

Findings: Based on the research results obtained, it should be emphasized that robotization technologies which raise the efficiency of financial and accounting services make an important impact on the efficiency of modern business services sector. Application of RPA assumes replacing work of an existing employee with the use of dedicated software (software robots) to support activities, primarily repeated and uncomplicated, characterized by a low number of exceptions.

Implications & Recommendations: RPA application is commonly used in modern business services, particularly in the areas of Finance, Accounting, IT and Human Resources Management. By utilizing RPA technology, the effectiveness of operations increases while reducing workload, minimizing possible errors in the process. The greatest efficiency resulting from the RPA implementation was observed in the Accounts Payable department, to a lesser extent in the General Ledger department and in the Tax section. The assessment of managers in terms of the effects of RPA implementation is unequal, while for Business, IT Process Outsourcing companies (BPO / ITO), Shared Service Centers (SSC), Consulting / Advisory companies and their customers no significant differences were found.

Contribution & Value Added: The article presents an assessment of the effectiveness of the use of Robotic Process Automation in Process Outsourcing companies (BPO / ITO) and Shared Service Centers (SSC) operating in Poland. It is one of the first studies of this type for enterprises operating in Poland. The article uses a relatively large number of responses (160+) from the respondents. In the previous studies in the literature, the answers obtained came from a much smaller number of respondents and were conducted in the form of direct interviews. In the article, the group of respondents consists not only of managers of outsourcing companies, but also auditing companies and clients of outsourcing companies. The article also presents a financial simulation of the effectiveness of BPO / ITO and SSC using Robotic Process Automation, which additionally validates the responses obtained in the questionnaire.

Article type:	research article
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INTRODUCTION

Employees from financial and accounting departments curry out financial processes during unprecedented technological changes that take place in the profession (Borrego *et al*., 2020). Specialists working in financial departments have long been subjected to the process of accelerated computerization, and more and more advanced information technologies are also used to an increasing extent (Borrego *et al*., 2020). The implementation of high-quality financial services also necessitates the digitization of accounting processes. This phenomenon intensified especially during the pandemic (Kaka, 2020). The use of more and more advanced technologies is, on the one hand, becoming a necessity, on the other hand, it facilitates the work of financial services, increases the quality of accounting information and its credibility (Özdoğan, 2017). The growing need to dematerialize accounting and tax processes, as well as the more and more common use of accounting applications necessitate the development of a greater use of information technology in financial processes (Gulin *et al*., 2019). In economic practice, technologies such as Internet of Everything, blockchain, Big Data may be used, but most of all in the financial services sector – automation of accounting processes and artificial intelligence and (Rîndașu, 2017).

Given the recent technological advancement, an increasing range of services rendered by enterprises and institutions alike is provided in digital format (Andrzejewski & Dunal, 2021; Sieja & Wach, 2019). It is largely possible thanks to the automation of corporate business and operational processes (Osman, 2019; Ribeiro *et al*., 2021). The modern view on automation of business processes is a solution designed to help optimize human activities during the performance of tasks. Using the latest technologies, an increase in effectiveness of the operations takes place while reducing workload and errors. It should also be noted that digitization as a continuous process of convergence between the real and the virtual worlds is becoming a major drive of innovation and change in most sectors of the economy.

Regardless of how the use of modern information technology is assessed, there are also some doubts as to whether it should replace human activities. The use of RPA in the creation of state-of-the-art services may reduce the need for human labor, making it possible to limit the costs of labor in a highly effective way (Kaya *et al*., 2019). This study provides a perspective on this issue.

Robotic automation processes are a technology consisting of software agents, so-called "bots", which imitate human work through a series of applications when performing specific activities in business practice (Syed *et al*., 2020). RPA provides a class of software for automating business processes. It assumes replacing an existing employee with the use of dedicated software (software robots) to support activities, primarily repeated and uncomplicated, characterized by a low number of exceptions. The operation of robots consists in imitation of human activities within a specific process. RPA can act as another employee in the organization, who does not require holidays or breaks. RPA allows an employee to focus on more complex, discretionary processes, which bring greater added value to the organization. RPA is one of the latest technological solutions. RPA is actually becoming a must when it comes to doing business for many enterprises across the world. It creates added value for companies (Madakam *et al*., 2019).

The aim of this paper is to explore accountants' views on usage of Robotic process automation technology which brings efficiency increase. The key advantage of using RPA in handling processes previously carried out by human beings has become fast implementation while reducing errors and no need for large financial investments. By using RPA, a rapid flow of information is introduced throughout the company internal network along with its external and internal customers, which allows for proper analysis of the surrounding economic environment. The application of this class of solutions usually does not require modifications to the already existing IT systems of the company. This is because RPA tools operate at the level of the Graphical User Interface (GUI), i.e. in the same way as human operators do. The business logic is embedded within automated applications, which solves the problem of its restoration which occurs in the traditional systems integration model. In addition, different than in the case of IT transformation using Enterprise Resource Planning (ERP), the use of RPA does not require significant investments made by organizations or substantial interference with existing systems. RPA can be deployed in organizations in a relatively short time, as it requires relatively low cost of investment.

We believe that our study contributes to the body of literature mainly because we investigate a large sample of finance and accountant experts in a relatively unexplored area. We plan to continue our research to assess the impact of automation on the area of risk and security of financial processes as well as the impact on the change of the desired skills of accountants. In addition, most of the research projects addressing the issue in question make use of direct interviews while our study involved a questionnaire-based survey.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

RPA can be applied in a great many branches of the economy (Madakam *et al*., 2019). The application of RPA is particularly widespread in the areas of Finance, Accounting and Human Resources Management. This is largely due to the high repeatability of processes and the relatively low number of exceptions. Due to the fact that robotization is becoming more and more popular and common, organizations are beginning to use increasingly mature knowledge-based automation methods, which, thanks to the constantly expanded database of cases and exceptions from the standard process, allow to use automation also in those processes with much more exceptions. Typical examples of knowledge-based automation are Customer Service processes, where robots analyze and categorize types of queries from individual customers. By identifying key words, they search for the right information in the various IT systems of the company. Then, based on the response templates they provide specific information in the form of e-mail messages (e.g. if and when an invoice with a specified number was paid).

RPA is most useful in situations of an increase in the volume of error-free transactions and when it comes to monitoring such transactions. Operations proven to be particularly ineffective so far can become profitable again, and experts in a particular field can focus on operations which are the most strategic and important for the client (Kaya *et al*., 2019). Companies should continuously monitor their process in order to identify and optimise those that would benefit from RPA. High-volume tasks and low-complexity tasks are the most RPA-adaptable (Ribeiro *et al*., 2021).

Another important feature of RPA technology is the lack of need to implement new advanced and costly IT tools, as automation is most often carried out on platforms already used by business entities.

Gotthardt *et al*. (2020) highlight the potential of time and financial savings to be made thanks to the implementation of RPA. But there are also many limitations and potential problems related to the quality of data fed into and coming from the system. A gradual implementation of RPA in many accounting and auditing firms seems to be a good idea. Companies should adopt RPA as a tool that can support and be useful to their employees. It should not be considered a complete replacement of human resources (Madakam *et al*., 2019).

Extensive research on the automation of tasks was conducted by Engberg and Sordal (2012), who stressed that it has aroused interest for more than a century. RPA is regarded as key, as it allows taking over repetitive, monotonous tasks previously performed by humans. RPA promotes the use of technology reducing costs while increasing the competitiveness of the beneficiary entity. In their study, conducted research involved 11 respondents, where characteristics of their positions were analyzed according to their: skill variety, task identity, task significance, autonomy, and feedback. The result of the study was an indication that employees perceived the impact of the application of RPA on all the features of their job positions except feedback (Engberg & Sordal, 2012).

A similar theme was taken up by Szmajser *et al*. (2019), who also noted that RPA is increasingly being used in financial service entities, performing certain tasks previously assigned to people and thus replacing employees. The activities of robots consist in imitation of activities hitherto assigned to humans during certain processes. According to the authors, RPA robots, thanks to appropriate programming, perform activities of a certain level of complexity in an autonomous manner. These activities are predominantly characterized by repeatability as well as a certain number of exceptions to the rule used in the algorithm. An example of this is, when robots log on to data handling programs from which they retrieve information that is then processed and afterwards they store the results in specific databases or systems. As pointed out by the authors, the use of robots happens where the integration of many systems is too time-consuming and expensive, and all the possible functionality of the systems has already been used.

Thanks to this use of the latest technology, it is possible to significantly increase the profitability of the processes assigned to the robots, as the cost ratio of an robot/worker can be as high as 1/9. Among the benefits, the infallibility of the robot (provided, of course, that it is properly programmed), the lack of stress and the possibility of continuous operation should be noted (Szmajser *et al*., 2019). The positive impact of the application of RPA on profitability was also proven by Seasongood (2016).

Research on the automation of accounting processes was also conducted by Fernandez and Aman (2018). The results were used to understand the impact of RPA on the development of global accounting services. The research was based on a comprehensive analysis of one of the largest global institutions providing accounting services, and the published findings indicate that RPA has a key impact on organizations changes happening in them. At the very outset it causes reductions of tasks performed by humans, thus reducing employment. The authors also noticed a certain way in which people "can't compete" with robots. This was particularly the case with regard to disciplinary problems, staff productivity, human resources shortage, and wage growth expectations (Fernandez & Aman, 2018).

Eikebrokk *et al*. (2020) conducted 24 interviews with individuals engaged professionally with such industries as production, finance, and mining. They noticed that in the case of industries offering standardized products, characterized by little differentiation, the greatest advantages of the use of RPA are effectiveness and reduced labor costs. The phenomenon is typical of industries where cost leadership is a significant success factor.

Van Looy (2020) stresses that companies make use of robotization of business processes to an increasing extent. Based on 48 interviews, the authors of the study notice that most employees, mainly those highly skilled and highly qualified, speak positively of the performance of robot – including robots with advanced cognitive abilities. Employees tend to say that they are ready to accept working with robots if their work is supervised accordingly. Managers tend to accept working with robots to a greater degree if their work involves carrying out simple, repeatable tasks, which are often labor-intensive. The general preference is to leave the more demanding, complex, difficult tasks, which require creativity and interpersonal interaction, to humans.

Apart from the obvious benefits of RPA implementation, some challenges or difficulties in this respect deserve to be distinguished. Accountants believe that the level of their knowledge of the practical application of information technologies is at most average (Rîndașu, 2017). A large part of accountants is also unaware of the time savings resulting from the use of advanced technological solutions, such as, for example, RPA (Zenuni *et al*., 2014).

In economic practice, there are often inappropriate business models in enterprises, which make it difficult to implement RPA technologies. Only in enterprises that focus on innovative investments, are flexible and open to changes, the implementation of modern technological solutions is possible (Soni *et al*., 2019). Employees of accounting firms are aware of technological barriers that are not easy to overcome. Hence, there may be a natural reluctance to implement advanced technologies (Brooks *et al*., 2020). Many accounting firms do not attach much importance to innovation in the accounting profession, despite the fact that advanced technologies allow to a large extent to improve the management efficiency of accounting firms. It may be necessary to develop an appropriate organizational culture based on technologies and innovation (Lee et. al., 2019).

Cooper *et al*. (2019) draw attention to the actual difficulties and coordination of RPA implementation responsibilities between accountants and specialists from the IT department. The question that needs to be answered is whether bots should be programmed by accountants or IT specialists. Each of the solutions has both positive and negative aspects. In the opinion of Kokin and Blanchette (2019), the wider introduction of RPA in accounting departments is rather implemented in a small or medium scope. As a result of RPA implementation, new problems may arise related to the realization of internal control, as well as new types of risk. Enterprises must determine to what extent bots will be responsible for the recording of processes and to what extent accountants. Appropriate segregation of duties can redefine the accounting profession. Often also the complexity of individual accounting processes can be a significant barrier to RPA implementation. In addition, there are objective technical problems in the RPA implementation process, necessitating very high involvement of IT departments, which in

turn is costly and labor-intensive. The authors also point out that numerous processes are not easy to standardize, which can significantly reduce the profitability of RPA

Regardless of how the use of modern information technology is assessed, there are also some doubts as to whether we should replace human activities in the implementation of the automation in business processes. The financial benefits associated with the implementation of RPA may in fact vary significantly. As calculated by Szmajser *et al*. (2019), apparently similar business processes performed in different geographical locations may in fact require the programming of completely different, independent robots. The authors also point out that another often overlooked aspect of mass automation is that the implementation of a robot in the financial process "freezes" the possibility of modifying the process from the point of view of its simplification. This makes further standardization of the automated processes more difficult, as any change in the way the process is performed requires modification of the robot's performance.

The reactions of employees to the implementation of RPA could be described quite often as full of concern and uncertainty, including fear of becoming redundant. But the more recent studies reveal a slightly different sentiment among employees (Asatiani *et al*., 2020). The authors decided to conduct a study to verify the reaction of employees of accounting firms to the adoption of RPA. Their response was surprisingly positive. Some employees appeared to be really enthusiastic about and interested in a new technology. Therefore, the potential escalation of concern among employees was uneven, highly diversified. The authors conclude that the adoption of RPA may even have a positive impact on the atmosphere at work (Asatiani *et al*., 2020). It seems reasonable to stress that robots performing simple, repeatable operations in finance-accounting departments relieve employees from the need to handle these unpleasant and unambitious obligations. This way, they actually improve the atmosphere at work and the quality of life of employees (Madakam *et al*., 2019). Thus, it seems very important to promote the positive image of RPA when it is to be implemented (Madakam *et al*., 2019).

Different opinions about the processes related to RPA are a matter raised also by Cooper *et al*. (2021). The authors conducted 14 interviews with representatives of the Big 4 auditors – with both top managers and lower-rank employees. The survey focused on the impact of RPA on the performed work, on the level of job satisfaction, and on the opportunities of development. It was proven that there is a difference as to how the benefits resulting from the implementation of RPA are perceived by managers and lower-rank employees. Both groups of respondents agree that RPA has a positive impact on the work of an accountant, but lower-rank employees did not report any significant impact of RPA on the level of their job satisfaction – unlike managers. This may stem from the fact that lower-rank employees still work within the same time frames and the same number of hours despite the time savings made thanks to RPA.

Others authors believe that the adoption of RPA in private companies is accompanied by layoffs, or at least suspended recruitment of new employees (Eikebrokk & Olsen, 2020). The implementation of new RPA technologies makes it necessary for accountants to expand their competences in the field of information technology (Stancheva-Todorova, 2018). Therefore, the improvement of the effectiveness of economic processes carried out by companies from BPO / ITO will result in the necessity to expand professional competences among employees of accounting departments. Accountants who will not be able to do this may be more exposed to potential problems in the labor market. The phenomenon concerns also qualified employees, whose work is based on knowledge. The situation is different in the public sector, where a greater emphasis is put not on making savings through staff reductions, but on the quality of the public services provided, of the recorded data, on effective migration of data between systems, etc. To facilitate the above process, employers should conduct advanced training in the use of advanced technologies in the work of BPO / ITO centers (Shaffer *et al*., 2020). Often the accountants themselves are not aware of the benefits of using advanced RPA technologies (Zel & Kongar, 2020). RPA implementation will be easier if it is accepted by the accountants themselves. The role of an accountant is changing, who will not only be responsible for the records of repetitive operations, but will rather create value or manage strategic finances of the company. However extensive cooperation between accountants and specialists from the IT department seems also indispensable here.

Considering the different points of view, the authors put forward the following main hypothesis and two sub-hypotheses:

H: The proper implementation of RPA in the sector of modern business services increases the operational efficiency of organizations.

H1: There is a relationship between the job position and the perception of the impact of RPA on individual benefits of organizations.

H2: There is a relationship between the type of company in the business services industry and the perception of the impact of RPA on individual benefits of organizations.

RESEARCH METHODOLOGY

Survey

An online survey has been addressed to over 500 respondents from international companies, where 160+ complete answers were received from the most important types of organizations in the business services industry, i.e. Business and/or IT Process Outsourcing (BPO/ITO), Shared Service Centers (SSC), Consulting/Advisory and their customers. Survey results were provided by representatives of the positions in their organizations: Members of the Board, Directors, Managers and Experts/Specialists. The non-parametric rho Spearman correlation coefficient and the non-parametric Kruskal-Wallis test and business case for the RPA implementation efficiency were used.

The introduction of automation of financial processes increases the efficiency of Business, IT Process Outsourcing (BPO / ITO), Shared Service Centers (SSC). It is worth noting, however, that it is the highest for relatively simple, repeatable processes carried out in the accounts payable section, lower efficiency was observed for the general ledger, the lowest and the least predictable for tax services. Moreover, there are some differences in opinions on the potential efficiency resulting from the automation of processes among employees holding various positions in the company (Executive Board, Director, Senior Manager, Expert / Specialist). There were no significant differences in the perception of the effectiveness of the implementation of accounting process automation in various entities operating in the financial services sector (Business, IT Process Outsourcing (BPO / ITO), Shared Service Centers (SSC), Consulting / Advisory and their customers).

Due to the fact that the survey was addressed to respondents of international companies located both in Europe and on other continents, the authors decided to conduct the survey using CAWI (Computer Assisted Web Interviews). The survey was conducted using SurveyMonkey, a professional survey tool which has extensive mechanisms for defining questions, the way they are answered, their analysis and visualization of results. The survey was addressed to the international group of LinkedIn participants, mainly from the modern business services industry or being their current or potential customers.

As a result of a personalized online survey addressed individually to over 500 respondents from international companies, 162 complete answers were received from the most important types of organizations in the modern business services industry, i.e. BPO/ITO, SSCs, consulting/advisory and their clients. Answers were provided by representatives of diverse roles in their organizations: board members, directors, managers and experts/specialists. In addition, the survey was further supplemented by an in-depth interview, where respondents were invited to supplement their position with additional comments and observations.

Statistical Tools

The statistical analysis used is the IBM SPSS Statistics software. The non-parametric rho Spearman correlation coefficient and the non-parametric Kruskal-Wallis test were used. The Spearman rho correlation coefficient was used to determine whether for variables measured at the level order (ranks) a statistically significant correlation occurs. Three levels of statistical significance were assumed: $p < 0.001$, which was determined ***, $p < 0.01$, which was determined ** and $p < 0.05$, which was determined *. If the correlation is at least at the level of $p < 0.05$, then the rho correlation coefficient shown in the table should be interpreted as statistically significant. Negative values mean that as the value of one variable increases,

the value of the other variable decreases. Positive values, on the other hand, indicate that the value of one variable increases with the value of the other. The coefficient indicates the existence of a linear correlation but does not indicate which variable is the effect and which one is the cause.

The Kruskal-Wallis test is used to determine whether the values obtained in two or more groups differ statistically significantly. In the tables, the following designations are used: M – the arithmetic mean, Me – the median, SD – the standard deviation, H – the Kruskal-Wallis test statistics, "p" – the significance of the Kruskal-Wallis test. Three levels of statistical significance were assumed: $p < 0.001$, which was determined ***, $p < 0.01$, which was determined ** and $p < 0.05$, which was determined *. In each of these three cases, the discrepancy between at least two groups can be defined as statistically significant. In the case of this test, it is also necessary to establish exactly which groups differ from each other significantly. It occurs when the test shows a significant difference of at least $p < 0.05$.

RESULTS AND DISCUSSION

Empirical Findings

The analysis included the responses of 162 respondents from various types of organizations: BPO/ITO – 31, SSCs – 52, consulting/advisory – 41, client of a company providing BPO/SSC services – 9, others - 29 and those performing various roles in their organizations: management board – 47, director – 36, senior manager – 53, expert/specialist – 26. The respondents were asked to assess the impact of benefits related to the implementation of RPA on particular benefits. Each benefit was evaluated on a 5-point scale, where 1 is low, 2 is moderate, 3 means medium, 4 is high, and 5 is very high. On this basis, the mean (M), the median (Me) and standard deviations (SD) for the different advantages were calculated. The higher the average and the median on a scale of 1-5, the higher the assessment of the impact of the benefits associated with RPA implementation on individual benefits of organizations. Table 1 compares the responses from different organizations and the respondents' respective roles therein in terms of answers to individual questions.

Table 1. Comparison of the opinions of respondents with different roles in the organization in terms of assessing the impact of benefits associated with the implementation of RPA

Rank the impact of the following benefits behind RPA on implementation on:	Position in the organization												Kruskal-Wallis Test	
	Executive Board			Director			Senior Manager			Expert/ Specialist				
	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	H	p
Productivity improvements	3.83	4	1.03	3.92	4	0.97	3.85	4	0.82	3.88	4	0.65	0.430	0.934
Reduction of operating costs	3.21	3	1.04	3.39	4	0.99	3.57	4	0.93	3.23	3	0.99	4.036	0.258
Increased compliance with standards and procedures	3.51	4	1.08	3.33	3.5	1.07	3.79	4	0.97	3.35	3	1.06	6.059	0.109
Increase in customer satisfaction	3.17	3	1.09	3.06	3	1.15	3.30	3	0.89	3.23	3	0.91	0.669	0.880
Revenues growth	2.47	3	1.12	*2.31*	2	1.24	2.91	3	1.06	3.04	3	1.04	10.568	0,014*
Decrease in the number of errors	3.98	4	87	3.69	4	1.04	3.89	4	0.91	4.12	4	0.95	3.779	0.286
Process acceleration	4.02	4	92	4.00	4	0.89	4.08	4	0.94	4.31	4	0.68	1.800	0.615

1 – low, 2 - moderate, 3 – medium, 4 – high, 5 – very high

Source: own study based on the survey questionnaire (n = 162).

The Kruskal-Wallis test showed statistically significant differences between respondents depending on their role in the organization in terms of assessing the significance of RPA implementation for revenue growth. Managers and senior managers assessed it as more important for the growth of revenue than directors did. Among other groups, there were no statistically significant differences. There were also no statistically significant or close differences regarding other benefits. Thus, the hypothesis that there is a correlation between the job position and the perception of the impact of RPA on individual benefits of organizations in relation to revenues growth was confirmed.

In the next question, the respondents were asked to specify the level of benefits they expected from the implementation of RPA for particular financial processes. Each process was evaluated on a 5-point scale, where 1 means no or low (0-10%), 2 is moderate (11-25%), 3 implies medium (26-50%), 4 is high (51-75%), and 5 is very high (76-100%). On this basis, M, Me and SD were calculated for the expected level of benefit in relation to a given financial process, as shown in Table 2. The higher the average and the median on a scale of 1-5, the greater the expected benefit of implementing RPA for financial processes.

Table 2. Comparison of the opinions of respondents with different roles in the organization in terms of the expected level of benefits associated with the implementation of RPA on individual financial processes

The expected level of benefits associated with the implementation of RPA on financial processes	Position in the organization												Kruskal-Wallis Test	
	Executive Board			Headmaster			Senior Manager			Expert/Specialist				
	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	H	P
Accounts payable	3.28	3	1.15	3.86	4	0.91	3.87	4	0.86	3.88	4	0.82	9.025	0.029*
Accounts receivable	3.26	3	1.06	3.54	4	0.95	3.42	4	0.82	3.69	4	0.93	3.792	0.285
Travel and expenses	3.13	3	1.20	3.53	4	0.86	3.35	3	0.99	3.62	4	0.75	3.376	0.337
Intercompany GL	3.11	3	1.11	3.38	3	1.10	3.45	3	1.05	3.35	3	0.80	2.404	0.493
General ledger	2.73	3	0.96	2.88	3	1.15	3.10	3	0.88	3.54	4	0.86	13.042	0.005**
Cash flow management	2.49	3	1.06	2.65	3	1.10	2.78	3	0.90	3.15	3	0.92	6.468	0.091
Management accounting	2.67	3	1.11	2.71	3	0.94	2.86	3	0.87	3.12	3	1.11	2.979	0.395
Taxes	2.31	2	1.04	2.49	2	1.09	2.76	3	0.93	2.77	3	1.03	5.974	0.113

1 – low, 2 – moderate, 3 – medium, 4 – high, 5 – very high

Source: own study based on the survey questionnaire (n = 162).

The Kruskal-Wallis test showed statistically significant differences between respondents depending on their role in the organization in terms of assessing the significance of RPA for accounts payable and the general ledger (table 2). Significantly higher expectations for the benefits of accounts receivable were expressed by managers and senior managers than members of the board. Among other groups, there were no statistically significant differences. In turn, experts and specialists have significantly higher expectations of benefits related to general ledgers than board members and directors. Among other groups, there were no statistically significant differences. In addition, the difference close to statistical significance refers to the expectations related to cash flow management. Clearly higher expectations in this regard were expressed by experts and specialists than board members. No statistically significant or close differences were noted regarding the other expectations.

Table 3. Comparison of the opinions of respondents from different types of organizations in terms of assessing the impact of benefits from RPA implementation

Rank the impact of the following benefits behind RPA on implementation on:	Organization type:															Kruskal-Wallis Test	
	I			II			III			IV			V				
	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	H	p
PI	3.93	4	0.80	3.74	4	1.00	3.77	4	0.96	3.98	4	0.82	4.11	4	0.60	1.905	0.753
ROC	3.31	3	1.07	3.16	3	0.97	3.50	4	0.94	3.37	3	1.07	3.56	3	0.73	2.446	0.654
ICSP	3.48	4	0.95	3.26	3	1.18	3.56	4	1.06	3.68	4	1.04	3.89	4	0.78	4.686	0.321
ICS	3.14	3	1.09	3.13	3	1.09	3.27	3	1.07	3.10	3	0.80	3.67	4	1.00	3.128	0.537
RG	2.76	3	1.18	2.58	3	1.09	2.60	3	1.21	2.73	3	1.14	2.78	3	0.97	0.509	0.973
DNE	3.69	4	0.85	3.81	4	1.19	3.98	4	0.90	3.98	4	0.82	4.22	4	0.97	4.586	0.332
PA	3.93	4	1.07	3.94	4	1.03	4.21	4	0.82	4.15	4	0.69	4.00	4	0.87	2.130	0.712

PI- productivity improvements; ROC- reduction of operating costs; ICSP- improving compliance with standards and procedures; ICS- increase in customer satisfaction; RG - revenues growth; DNE- decrease in the number of errors; PA- process acceleration; I-Other, II- BPO/ITO, III- SSC, IV-consulting/advisory, V-BPO/SSC customer; 1 – low, 2 – moderate, 3 – medium, 4 – high, 5 – very high

Source: own study based on the survey questionnaire (n = 162).

The Kruskal-Wallis test showed no differences between respondents' opinions from different organizations in terms of assessing the impact of benefits from RPA implementation (Table 3). Partial hypothesis (H2) that: There is a relationship between the type of company in the business services industry and the perception of the impact of RPA on individual benefits of organizations, was thus not confirmed.

In the next step, a comparison of responses from different types of organizations was performed in terms of the expected level of benefits associated with the implementation of RPA on individual financial processes as shown in Table 4.

The Kruskal-Wallis test showed statistically significant differences between respondents from various organizations regarding the expected level of benefits coming from intercompany settlements. Significantly higher expectations for these settlements were expressed by respondents from other organizations than those from BPOs/ITOs. Among other groups, there were no statistically significant differences. In addition, the difference close to statistical significance refers to the expectations related to the general ledger. Clearly higher expectations in this regard were expressed by respondents from organizations that are customers of companies providing BPO/SSC services than respondents from BPOs/ITOs. No statistically significant or close differences in the expectations of others were noted.

Table 4. Comparison of the opinions of respondents from different types of organizations in terms of the expected level of benefits associated with the implementation of RPA on individual financial processes

The expected level of benefits associated with the implementation of RPA on a financial process	Organization type:															Kruskal-Wallis Test	
	I			II			III			IV			V			p	
	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	M	Me	SD	H	p
AP	3.68	4	0.90	3.71	4	0.97	3.66	4	1.10	3.68	4	0.93	4.00	4	1.00	1.047	0.903
AR	3.46	4	0.84	3.19	3	0.98	3.52	4	1.01	3.56	4	0.90	3.33	3	1.00	3.335	0.503
ABT	3.25	3	0.80	3.45	3	0.96	3.16	3	1.07	3.65	4	1.10	3.33	3	0.71	7.328	0.120
IS	3.61	4	0.92	3.00	3	1.03	3.53	3	1.04	3.05	3	1.12	3.56	4	0.53	10.011	0,040*
GL	3.14	3	0.89	2.68	3	0.75	2.94	3	1.11	3.21	3	1.08	3.44	4	0.73	8.551	0.073
CFM	2.89	3	0.96	2.42	2	1.06	2.73	3	1.09	2.87	3	0.95	2.67	3	0.71	4.538	0.338
MA	3.29	3	1.05	2.65	3	1.14	2.78	3	0.96	2.72	3	0.92	2.56	3	0.53	7.715	0.103
TX	2.86	3	1.04	2.39	2	1.05	2.42	2	1.03	2.69	3	1.03	2.67	3	0.71	4.528	0.339

AP-Accounts payable; AR- Accounts receivable; ABT-Accounting for business trips;IS- Intercompany settlements; GL-General Ledger; CFM- Cash flow management; MA-Management accounting; TX-Taxes; I-Other, II- BPO/ITO, III- SSC, IV-consulting/advisory, V-BPO/SSC customer; 1 – low, 2 – moderate, 3 – medium, 4 – high, 5 – very high
Source: own study based on the survey questionnaire (n = 162).

During the study, respondents identified the expected level of process automation (calculated in %) depending on the type of financial process. To verify that the expected level of automation provided a positive return on investment (ROI) and check the level of savings after 12 months of implementation, financial simulation was carried out. During the simulation, the following assumptions were adopted:

- Three financial processes in the area of accounts payable, general ledger and taxes were selected, where the level of expected percentage of automation is different.
- For the group of processes adopted, an automation compartment indicated by the largest share of respondents was adopted (range underlined in Table 5). The simulation was performed for both the smallest and the largest level of automation in the selected processes in Table 5.

For the purposes of simulation, next assumptions were indicated below:

- The level of complexity of the robot implementation (low, medium and complex) directly affects the programming time of the robot.
- Time-consumption: it was assumed that each of the selected processes is performed by four employees with 2-3 years of experience in the workplace.
- Personnel costs for each job are shown in Table 6 on the basis of the average monthly cost per employee.

Table 5. Automation compartment indicated by the largest share of respondents

Process	None or low (0-10%)		Moderate eng. Moderate (11-25%)		Aver. eng. Moderate (26-50%)		High eng. High (51-75%)		Very high eng. very high (above 75%)		Number of respon.
	%	N	%	N	%	N	%	N	%	N	
AP	0.68	1	13.61	20	19.05	28	45.58	67	21.09	31	147
AR	1.36	2	17.01	25	25.85	38	44.90	66	10.88	16	147
TE	2.76	4	15.86	23	33.10	48	35.86	52	12.41	18	145
I	2.78	4	17.36	25	37.50	54	26.39	38	15.97	23	144
GL	4.90	7	23.08	33	39.86	57	25.17	36	6.99	10	143
Tr	11.81	17	29.17	42	34.03	49	21.53	31	3.47	5	144
MA	9.03	13	29.86	43	34.72	50	22.22	32	4.17	6	144
Tx	14.48	21	35.86	52	29.66	43	16.5	24	3.45%	5	145

AP- Accounts payable; AR- Accounts receivable; TE- Travel and expenses; I- Intercompany; GL- General Leder; Tr- Treasury; MA- Management accounting; Tx- Taxes; % - % of responses; N - number of responses
Source: own study.

Table 6. Personnel costs per job position

Position	Average monthly cost per employee		
	Min	Avg.	Max
Personnel costs per employee handling processes from the Payables; Accountant 2-3 years of experience	1 092	1 310	1 528
Personnel costs of employee supporting processes in the GL group (incl., taxes, ledger); Accountant 2-3 years' experience	1 310	1 474	1 638
Personnel costs: IT specialist	983	1 168	1 354
Personnel costs: IT senior specialist	1 092	1 441	1 790
Personnel costs: IT expert	1 747	2 402	3 057
Personnel costs of developer	1 965	2 838	3 712

Source: own study.

On the basis of data received from the IT and finance departments, it was established that the cost of 1 robot includes the following components:

1. Cost of making the robot (one-time): cost analysis of the process, the cost of robot design, robot programming costs, the costs of collection and transfer of robot for use.
2. Cost of robot maintenance (monthly): software license costs, IT maintenance costs and infrastructure costs.
3. The cost of UiPath license is equal to 2696 EUR per year. One licence can operate 4 boots.

Furthermore, an important element is IT maintenance costs emerging in the values indicated in Table 7. Additionally, the costs of designing and software together with the costs of process analysis, collection and transfer for use are provided in Table 8.

It was assumed that the costs of IT infrastructure are at the level of EUR 75,000 a year and they can handle up to 100 robots. The cost of infrastructure per robot is therefore EUR 750/year/robot (EUR 75,000/year for 100 robots).

The value of savings was determined by:

$$Value\ of\ savings = Personnel\ cost\ reduction - \\ - onetime\ cost\ of\ robot\ implementation - \text{monthly IT support costs} - \\ - \text{monthly license cost} \quad (1)$$

Based on the major assumptions, calculation was made concerning the period of ROI in months and the value of savings after 12 months, as shown in Table 9.

Table 7. IT maintenance costs + RPA license costs

Position	Cost per boot (employee) in EUR	Quantity	Unit of Measurement Definition	Annual cost in EUR	Method of calculating the fee
RPA license cost (robot per virtual machine)	2 695,65	25	License	6 7391,30	Yearly
IT specialist (standard queries)	1 168,12	2	1 employee	2 336,24	Monthly
IT senior specialist (medium complexity queries)	1 441,05	2	1 employee	2 882,10	Monthly
IT expert (complex queries)	2 401,75	2	1 employee	4 803,49	Monthly
IT infrastructure costs	750,00	100	BOT	75 000,00	Monthly
Total				152 413,13	Cost per 100 robots
No. of robots				100	No. of pieces
Monthly cost per 1 robot				127,01	EUR/m

Source: own study.

Table 8. Costs of design and software per robot together with the costs of process analysis, collection and transfer for use

The components of the cost of robot designing and software	The level of complexity of the robot		
	Simple	Medium	Complex
The time needed to create a robot: analysis, development, testing, documentation (workdays)	20,00	30,00	40,00
Average labor cost EUR/day	98,00	142,00	186,00
The cost of building 1 robot	1 965,00	4 258,00	7 424,00

Source: own study.

Table 9. Period of ROI in months and the value of savings after 12 months

Financial process	Accounts Payable		General Ledger		Taxes	
Number of employees involved in the process (currently)	4		4		4	
The expected level of time reduction associated with the implementation of the robot (min/max)	51%	75%	26%	50%	11%	25%
The level of complexity of the robot	**Medium**		**Complex**		**Complex**	
Number of employees involved in the process (target)	1.96	1	2.96	2	3.56	3
The level of reduction in time consumption (number of people)	2.04	3	1.04	2	0.44	1
Monthly personnel costs per employee	1 310	1 310	1 474	1 474	1 474	1 474
Costs of the design and development of single robot	4 258	4 258	7 424	7 424	7 424	7 424
The number of robots to handle	4	4	4	4	4	4
Monthly IT support costs/robot	508	508	508	508	508	508
Monthly license cost/robot in EUR	449	449	449	449	449	449
The payback period per robot (months)	3.00	2.00	13.00	4.0	-	22.00
The value of savings after 12 months	16 324	31 416	-518	16 460	-11 130	-3 191

Source: own study.

As the calculations show, the payback period is diametrically different ranging from two months for the accounts payable process with 75% savings (in this case value of savings after one year at 31,416 EUR) and in the extreme case for the process taxes implementation and maintenance costs exceed the savings resulting from the use of the robot.

DISCUSSION

Similar research results were obtained by Cooper *et al*. (2019). Research participants (large audit companies) confirmed that the implementation of accounting processes based on RPA causes a very significant increase in the efficiency of accounting companies. Bots can work full-time, reduce the time of a given process by about 30-40%, and also provide continuous work for clients. The authors also emphasize that the implementation of RPA for tax services is the most difficult; consulting and assurance services are slightly closer to practical implementation. Employing accountants with basic accounting knowledge may be limited in the future. On the other hand, the robotization of accounting processes may result in a greater balance in professional work and private life. Similar results were obtained by Kokina and Blanchette (2019). However, the authors believe that only some of the processes that are properly prepared for RPA, moreover, are repeatable and rules-based can be implemented by bots. This is in line with the Task-Technology Fit and Technology-to-Performance Chain. RPA will be most effective if the processes are time-consuming, large-scale, digitized, and used by a variety of systems. In this situation, RPA provides cost savings, a more effective flow of documentation, accounting errors are reduced, processes are valued more reliably, and financial reporting is improved.

CONCLUSIONS

In summary, the results of the statistical analyses carried out with regard to revenue growth confirmed the correctness of the hypothesis that there is a correlation between job position and the perception of the impact of RPA implementation on individual benefits of organizations. Its importance for revenue growth was rated in a statistically significantly greater manner by managers and senior managers than directors. The differences between respondents on the other job positions were not so significant. This may be due to the greater practical knowledge of managers who, due to the nature of their work, have closer contact with operational issues than directors and are able to control the impact of RPA implementation on the generation of additional sources of income on an ongoing basis.

Against this, the authors claim that the partial hypothesis (H1) that there is a correlation between the job position and the perception of the impact of RPA on individual benefits of organizations in relation to revenues was confirmed. It was different in the case of the partial hypothesis (H2) that there is a correlation between the type of company in the modern business services sector and the perception of the impact of RPA implementation on individual benefits of organizations. In this case, no statistically significant differences or any close to the statistical significance were noted between respondents from different organizations. Thus, the adopted partial hypothesis (H2) could not be confirmed. Thus, it was not possible to unequivocally confirm the main hypothesis H0 in its wording: Proper implementation of RPA in the sector of modern business services increases the operational efficiency of organizations. This does not, however, complete the research conducted at this stage. Due to the fact that during the response to the survey, the participants were able to add comments on other benefits resulting from the implementation of RPA, the issues raised in this article will be analyzed in further research.

Two further areas that the authors intend to verify during the research will be directed to seek answers to questions about the limitations and barriers associated with the implementation of robotization and the impact of RPA implementation on changing work characteristics and employee competencies. This will enable RPA implementation not only in the area of finance and accounting but will also foster a holistic approach to the functioning of a business entity in all its areas.

The introduction of automation of financial processes increases the effectiveness of Business, IT Process Outsourcing (BPO/ITO), Shared Service Centers (SSC). It is worth noting, however, that it is the highest for relatively uncomplicated, repeatable processes realized in the accounts payable section, lower efficiency was observed for general ledger, the lowest and least predictable for tax services. Moreover, there are some differences in the potential efficiency resulting from automation of accounting processes among employees holding various positions in the company (Executive Board, Director,

Senior Manager, Expert/ Specialist). No significant differences were observed in the perceived effectiveness of implementing accounting process automation among various entities operating in the financial services sector (Business, IT Process Outsourcing (BPO/ITO), Shared Service Centers (SSC), Consulting/Advisory companies and their customers).

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Conflict of Interest

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Entrepreneurship and SMEs under COVID-19 crisis: A literature review

Fatemeh Gorji Zadeh

ABSTRACT

Objective: The article aims to summarize the impact of the COVID-19 crisis on SMEs, considering both its positive and negative effects. Also, the study seeks to summarize the response approaches usable for SMEs to face a crisis.

Research Design & Methods: This article uses a critical literature review to summarize the international literature developed on the COVID-19 crisis topic. It considers scientific papers published from 2017 to February 2022 with a focus on specific keywords, English language, from the open access sources on (i) Emerald, (ii) JSTOR, (iii) ScienceDirect, and (iv) Springer, (v) IER, and (vi) EBER.

Findings: The paper sheds light on how the uncertainty caused by the COVID-19 crisis can impact SMEs. The paper tries to summarize the literature on how SMEs can reverse the uncertainty caused by a crisis and benefit from it. Also, the paper reviews the fact that some SMEs cannot cope quickly enough with the changes in the environment and forcibly shut down their business. The most damaging impact of the COVID-19 crisis is also reviewed in this paper which is the business closure due to lack of resources or disconnection of SMEs from their partners.

Implications & Recommendations: This study provides an overview of the positive and negative effects that the COVID-19 crisis had on SMEs. Three approaches were reviewed, uncertainty, resilience, and opportunity, which the decision-makers can use to plan their strategies more effectively and face impending crises more efficiently. This paper also introduces gaps such as the lack of evidence of how COVID-19 affects the entrepreneurship phenomena, which is worth being studied.

Contribution & Value Added: This study summarizes the three approaches mentioned in various research papers that SMEs can take during crises and presents gaps worth researching. While many other studies study entrepreneurship at macro levels, the approach in this study is unique as it considers a particular piece of entrepreneurship area and looks at it in terms of small and medium-sized enterprises, describes why COVID-19 is a crisis to the business environment and contributes to the literature to explain how entrepreneurship and SMEs are influenced by COVID-19 situation. I summarized some of the issues SMEs face during a crisis and mentioned the approaches to be taken by business owners during such times using articles conducted in the last five years.

Article type: research article

Keywords: entrepreneurship; SMEs; covid-19; crisis; literature review; uncertainty; resilience

JEL codes: L26, H12

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INTRODUCTION

Entrepreneurship can be worthy for the economy as it creates jobs (Kraus *et al.*, 2018). Therefore, even though the financial system is impacted by crises, which are sometimes considered as accelerators for economic growth due to their role as a source of innovation and activity creation (Voda & Florea, 2019). So, analyzing how SMEs and business individuals battle adversity matters to understand how crises should be managed. As the COVID-19 concern is a global, immediate and unexpected matter the future determines the various outcomes it has (Moghimi Esfandabadi, 2017). The

coronavirus outbreak impacted the world in many ways, such as economic, political, and environmental. When this manuscript was being prepared, the data I found as of May 2020 suggested that 33.5 million jobs have been eliminated in the United States (Lambert, 2020). Stocks worldwide have lost around 25% of their value thus far. According to Goldman Sachs, the Gross Domestic Product in the US has fallen by 24% in the second quarter of 2020, with the reduced local demand for items that are not categorized as food, lower overseas demand for US products exports, supply-chain disruptions, and facilities closing their operations (Reinicke, 2020). Governments across the globe responded to this crisis by releasing enormous stimulus packages. The US has already authorized USD 2 trillion in stimulus measures to address the recession (Emma & Scholtes, 2020), while EU finance ministers agreed to Euro 500 billion (Riley, 2020).

SMEs that develop creative solutions to challenges in their communities will be significant drivers of change (US Small Business Administration 2019). SMEs, which account for more than 99 percent of all businesses, play a unique role in the macro-environment when charting a course ahead (Eggers, 2020).

The COVID-19 impacted the economic condition of nations, mainly by slowing economic growth and significantly influencing employment and welfare levels. Because of these adverse effects on social welfare, policymakers have attempted to implement measures that, on one hand, address the health problem that causes COVID (via vaccine development) and on the other hand, halt the decline in economic growth and reactivate the economy as soon as possible to pre-COVID levels (Galindo *et al.,* 2021*)*.

The main aim of this paper is to summarize the impact of the COVID-19 crisis on SMEs by looking into a number of research done in this area. Many of the current studies regarding entrepreneurship and SMEs focus on the macro-level such as studies that focus on how governments are involved with SMEs (Xiang *et al*., 2022; Veronica *et al*., 2020; Minh *et al*., 2021) or studies that focus on how SMEs contribute to the overall economy of a country (Smallbone *et al*., 2022; Lestantri *et al*., 2022; Luthra *et al*., 2022). However, I focused on a specific piece of entrepreneurship in this paper, the SMEs. SMEs have several traits that might aid them in a crisis. Because of their diminutive stature, they are more adaptable to opportunities and hazards in their surroundings. Therefore, studying SMEs can drive innovative solutions and agile decision-making if another crisis occurs.

Furthermore, in SMEs, the decision-makers are closer to their stakeholders (Eggers *et al*., 2012). As a result, they will have access to vital market data that can aid them in responding to crises. I also tried to summarize the positive and negative influences that COVID-19 had on SMEs. Another aim is to learn about the approaches applied by SMEs to face the COVID-19 crisis. This study is critical as it summarizes the major trends in SMEs, entrepreneurship, and COVID-19 and, at the same time, answers the two research questions:

RQ1: What were the positive and negative effects of COVID-19 on SMEs?

RQ2: What approaches did SMEs take to respond to the COVID-19 crisis?

This study outlines three primary ways stated in several research publications that SMEs might use during. While many other studies discuss entrepreneurship at a macro level, the approach taken in this study is unique as it examines entrepreneurship in terms of small and medium-sized enterprises, mentions why COVID-19 is a business environment crisis and contributes to the literature by summarizing how COVID-19 influenced SMEs.

This article employs a critical literature review technique to assess the existing worldwide literature in research. Going forward, the literature on SMEs under the COVID-19 crisis is discussed, and then, the findings and implications of the study, its limitations and suggestions for further research are presented.

MATERIALS AND METHODS

Deepening knowledge based on prior research and relating it to the existing state of knowledge is the basis of all research activities in the academic environment, regardless of the discipline. A valuable literature review is crucial for any research or conceptual article. The usefulness of a literary review, like all research, is determined by what was done, what was discovered, and the clarity with which it was reported (Moher *et al.*, 2009). The researcher can employ a variety of methodologies, standards,

and guidelines designed specifically for performing a literature review, depending on the goal of the review (Snyder, 2019). Wach (2020) differentiates seven primary forms of literature reviews: (i) narrative reviews, (ii) descriptive reviews, (iii) scoping reviews, (iv) systematic reviews, (v) umbrella reviews, (vi) realist reviews, and (vii) critical reviews which some of them are summarized below (Table 1).

Table 1. Approaches to literature review

Approach	Purpose	Questions	Type of papers	Analysis and evaluation
Narrative	To summarize and synthesize publication on a topic	The questions are detailed and narrow	Usually, qualitative research	The authors analyze and summarize the published papers supporting their ideas.
Descriptive	To identify patterns and gaps in the literature	The questions are narrow, pointing the opening of the literature out	Descriptive/quantitative or qualitative	The author evaluates the preexisting papers and theories to fill in a literature gap.
Scoping	To group or categorize existing literature on a topic	The questions are case-based and general	Qualitative or quantitative	Data evaluation could lead to a logical diagram or any descriptive form that fits the research's scope and aim.
Umbrella	Usually, compile pre-existing evidence on a topic to prepare a high-level review.	The questions are general and broad.	systematic and meta-analyses/Qualitative mainly	It aims to determine what is known about a topic and what is unknown and make recommendations for what needs more investigation.
Realist	To support or extend pre-existing literature	The questions are specific about the topic and its evidence	Quantitative/qualitative	Reviewing the content can be aggregative or interpretive.
Critical	To describe the author's hypothesis based on literature about a topic.	Questions are specific and detailed	Quantitative/qualitative	Presenting the idea and discussing the critical points, and including the evidence to describe a hypothesis suggested by the author
Integrative	Mainly to synthesize and be critical of a topic.	Questions can be specific or, when needed, general and broad	Books and published texts as well as research papers	Classification, theoretical model, and framework as well as taxonomies

Source: own elaboration based on Wach (2020) and Grant & Booth (2009).

In this study, I implemented a critical literature review. The primary research technique was a study of the literature and its constructive criticism. Critical literature aims to show that the author has done deep research into a topic and managed to assess the quality of the existing literature with a critical approach. The following are the grounds for selecting this form of literature review (Saunders & Lewis, 2012):

- While a critical literature review finds and contains the most relevant research, it does not cover all material that may be relevant to a particular issue.
- This approach examines and assesses a specific issue but does not summarize or detail the study.
- In this approach evaluation finds recognized writers, researchers, and specialists on a particular issue.
- This approach contextualizes and validates research questions for a specific issue before considering and debating research that supports or contradicts the research concept.

The starting point for the critical literature review is the selection of appropriate and reliable literary sources. I decided to choose international databases of recognized publishers of scientific research materials: (i) Emerald, (ii) JSTOR, (iii) ScienceDirect, and (iv) Springer, (v) IER, and (vi) EBER. The keywords below were used in the search for articles: "SMEs, Entrepreneurship, COVID," "Entrepreneurship, COVID," and "SMEs, COVID." I focused on the papers published from 2017 to this day (February 2022). The number of articles published in the reviewed databases is as follows (Table 2).

Table 2. The quantitative analysis of publications on COVID-19 and entrepreneurship

Database	Keywords	Number of publications	Scientific Papers	Book Chapters
Emerald	"SMEs," "Entrepreneurship," "COVID"	447	406	41
	"Entrepreneurship," "COVID"	2000	1682	318
	"SMEs," "COVID"	703	647	56
JSTOR	"SMEs," "Entrepreneurship," "COVID"	25	25	-
	"Entrepreneurship," "COVID"	282	256	26
	"SMEs," "COVID"	104	103	1
Science Direct	"SMEs," "Entrepreneurship," "COVID"	208	200	8
	"Entrepreneurship," "COVID"	926	923	31
	"SMEs," "COVID"	853	826	27
Springer Link	"SMEs," "Entrepreneurship," "COVID"	698	235	463
	"Entrepreneurship," "COVID"	3001	1774	1227
	"SMEs," "COVID"	925	635	290

Source: own elaboration based on Emerald, JSTOR, Science Direct, and Springer.

I found 10,172 publications containing the above keyword. Almost 24% of the publications are book chapters, and the rest are published in the form of scientific papers such as case studies, articles, conference proceedings, etc. Most of the publications are in innovation and entrepreneurship, management, crisis management, and economics.

As studying all I found was not feasible, the number of reviewed articles has been reduced by applying criteria as presented below (Figure 1).

LITERATURE REVIEW AND THEORY DEVELOPMENT

Multidimensionality of Entrepreneurship

Entrepreneurship is a scientific process that begins with cognitive conditions and ends with social situations, founded on a reflexive approach. Also, the new ideas which come with it add value to businesses and society (Shane & Venkataraman, 2000; Fisher *et al*., 2020). Entrepreneurship is a well-known term with roots in various scientific fields (Gumbau Albert, 2017; Guerrero *et al*., 2020). The narrow definition of entrepreneurship links it with starting or operating one's firm, but the broad definition associates it with exploring and exploiting market possibilities, implementing innovations, or taking risks (i.e., Ferreira *et al*., 2017; Markowska *et al*., 2019).

There are several levels of entrepreneurship analysis: person, group, team, organization, industry, and society (Low & MacMillan, 1998) but overall, it always contributes to economic growth and reduction of unemployment. (Loan *et al*., 2021). Some research argue that entrepreneurs own and operate their interactions (i.e., Hopp &Martin, 2017; Larsson & Thulin, 2019; Jovanovic, 2019). Most studies on crisis management focus on managing firms throughout an epidemic (e.g., Krishnan *et al*., 2022; Miguel *et al*., 2022), natural disasters (e.g., Hamani & Boudjema, 2013), and economic and financial crises (Pham, 2022) therefore, there is still a lack of research on the impact of new and emerging crises on micro-enterprises. It is postulated that micro-enterprises in less developed areas are exposed to more significant challenges than larger enterprises or urban areas, especially during a crisis (Fabeil *et al*., 2020). This study's approach deals with entrepreneurship in micro dimensions and micro-enterprises; thus, I study entrepreneurship in terms of SMEs.

There are many definitions and taxonomies of SMEs in the literature based on various criteria. According to the European Commission, the average European enterprise that employs no more than six employees is classified as an SME. It also adds, "The *category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and an annual balance sheet total not exceeding EUR 43 million*." (European Commission, COM/2016/3).

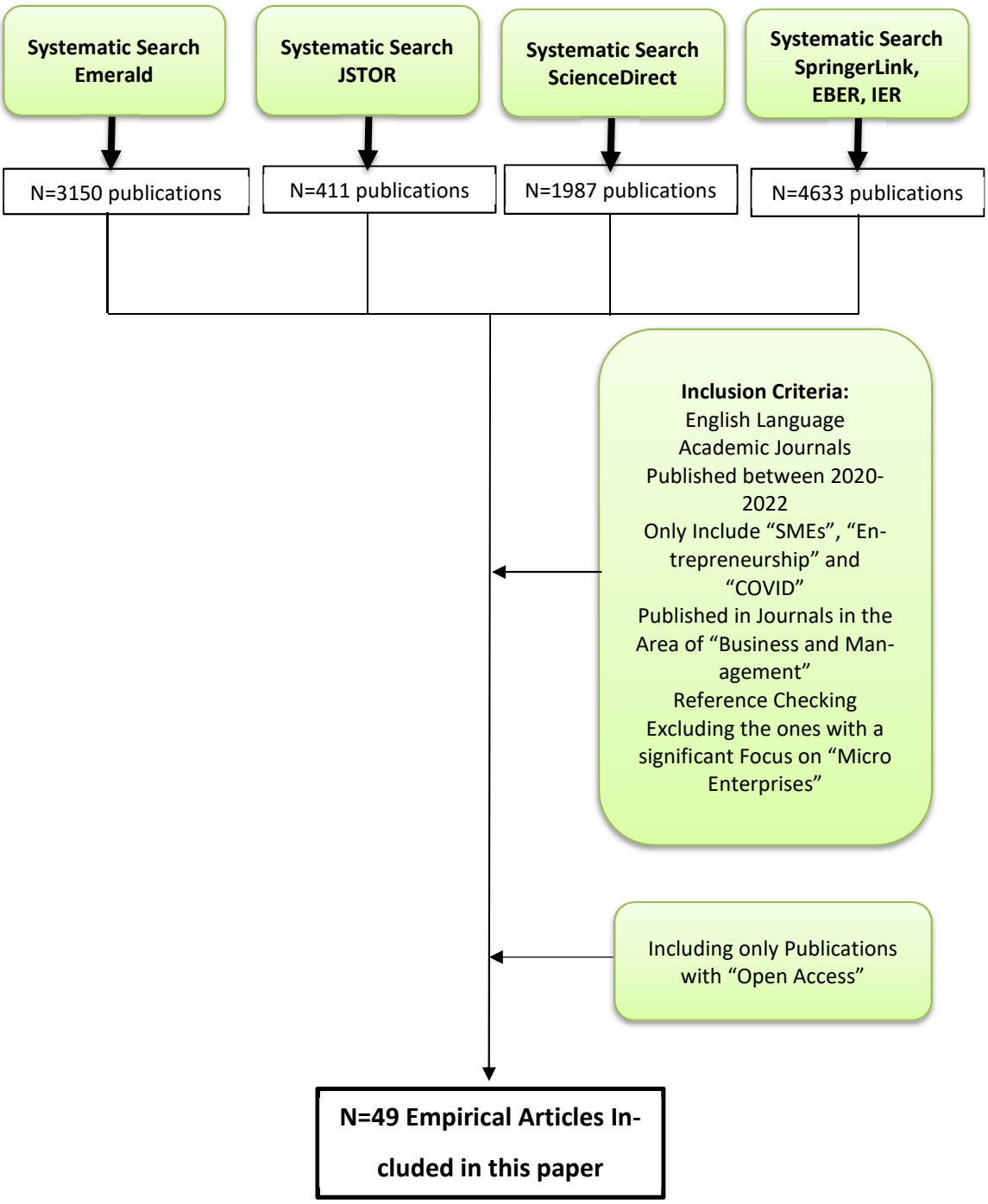

Figure 1. Steps in the selection of the final sample
Source: own elaboration.

According to Chesbrough (2020), the COVID-19 crisis changed society, which is why finding a critical way of understanding how entrepreneurship and in my area of focus, SMEs kept up with this sudden change. Countries had to put in force the social distancing, border closures, mask mandates, and other measures which wasn't anticipated by many businesses and caused many issues in their logistics and activities and forced some of them to close their businesses, including many of the SMEs throughout the world (OECD,2020). Voda and Florea (2019) believed that even though SMEs suffered because of the COVID-19 crisis, they also played an essential role in bringing back economic growth resulting from

entrepreneurial activity and innovation. The mentioned points brought out an important topic, how entrepreneurs could overcome the crisis.

Entrepreneurship and Crisis

It is critical to grasp the concept of crisis before focusing on the impact and ways to mitigate the damage. According to Booth (1993), a crisis is a circumstance that an individual, group, or organization cannot deal with using typical routine methods. Crises have been classified into two types: sudden and smoldering (Irvine, 1997). The gradual threat, periodic danger, and sudden threat are the three forms of crises (Booth, 1993). The COVID-19 crisis is a ”sudden threat,” as it arose out of nowhere and has affected the entire organization and entire sections of the economy. A crisis is both a threat and an opportunity for small and medium-sized businesses. It varies in the scope of change (spatial, temporal, *etc.*) and onset (predictability and suddenness) as an external enabler or disabler, which dictates how external changes affect the roles and consequences of a crisis through diverse mechanisms (Bendell *et al.*, 2020). Natural catastrophes or terrorist strikes are two examples of sudden crises. Smoldering crises begin as minor internal difficulties within a company, become public at some point, and then increase because of managerial inattention. Scandals, bribery, and sexual harassment are among examples of smoldering crises. The COVID-19 crisis is an unexpected, immediate, global disaster (Davidsson *et al*., 2021). It is a “sudden crisis” as it occurs quickly and impacts whole organizations and entire sectors of the economy. The impact of the COVID-19 pandemic on the global socio-economic system can be severe, and recovery is critical for existing in a new usual way of life. It is argued that in the post-COVID-19 era, the motivations for becoming an entrepreneur are influenced negatively due to a high level of uncertainty (González-Tejero *et al*., 2022). Considering this, it will be interesting to know the many obstacles small businesses face and how they adapt during and after an outbreak (Fabeil *et al.*, 2020). This is because if the motivation for becoming an entrepreneur is less than before, then, what about the motivations and efforts for entrepreneurs with already established SMEs? How should they react to the sudden change in the business environment?

The crises make entrepreneurs demonstrate their ability to innovate by implementing survival mechanisms to mitigate its effects, such as marketing innovation through alternative promotion or pricing (Naidoo, 2010) and low-cost and effective online campaigns (Bourletidis & Triantafyllopoulos, 2014). Based on Fabeil (2020), many SMEs and micro-organizations had to take initiatives to plan strategies and continue their business and supply chain operations, as the COVID-19 disrupted the traditional ways they used to utilize. In times of crisis, the entrepreneur must be more dynamic and innovative (Ratten, 2020). They accomplish this through defined skills such as proactivity, opportunity identification, innovation, risk management, and resilience (Branicki *et al.*, 2018; Portuguez Castro *et al.*, 2020). One of the interesting trends which happened when the COVID-19 crisis started, was the major shift in the management style (Montenero & Cazorzi, 2022).

Entrepreneurship Under the COVID-19 Pandemic

Entrepreneurship adds value to the economy through job creation (Kraus *et al.*, 2018). Since SMEs are a part of entrepreneurship, it is essential to understand how SMEs managed to survive the risk that COVID-19 caused to the business environment. In the literature reviewed for this paper, three main perspectives were identified. First, the pandemic induced significant levels of uncertainty beyond those experienced by most businesses, and scholarly research attempts to quantify this. Second, resilience is proposed as an essential trait for entrepreneurs to combat the negative consequences of increased uncertainty caused by the pandemic. Academic literature seeks to discover the variables that enable entrepreneurs to develop such resilience. Third, the delay caused by a crisis should not be considered a negative factor; on the contrary, it might be a good opportunity for some businesses to try out novel solutions and innovative services, products, and ideas.

The ongoing COVID-19 pandemic has impacted SMEs in the world for instance, a study states the impact of COVID-19 on over 4 800 Chinese SMEs (Lu *et al.*, 2020). In one of the studies included in the literature sample, Hossain *et al*. (2022) elaborate that two of the limitations that the COVID-19 pandemic caused for SMEs are the limited cash flow and the disruption the SMEs faced their supply chain

and organization. Due to a lack of resources, companies have been forced to close because of the COVID-19 crisis (Bartik *et al.*, 2020). Commercial enterprises have also revealed the negative consequences of COVID-19 on the business environment (Seetharaman, 2020). Forcible and involuntary business closures and operational constraints hurt small and medium-sized firms (Fairlie, 2020). There are many academic efforts done to identify the situation caused by the COVID-19 crisis and how it influenced the business environment; however, even though all this valuable academic work is done, it remains unclear how much precisely the COVID-19 crisis changed and influenced the world of SMEs and entrepreneurship as a whole. Some of the available research focuses only on part of the big picture. For instance, Sun *et al*. (2022) focused on SMEs in China, Ratten *et al*. (2020) focused on entrepreneurship education during the COVID-19 pandemic, and Neumeyer *et al*. (2020) dedicated their research to resource and waste management SMEs and how the COVID-19 crisis influenced them.

Proposition* 1*: The impact of COVID-19 on SMEs should be considered from an uncertainty perspective.

Hossain *et al*. (2022) elaborate that two of the limitations that the COVID-19 pandemic caused for SMEs are limited cash flow and the disruption of the supply chain. This means that SMEs are being financially pressured while they must meet and adapt to the consumer's needs. Financial instability is a crucial element, as evidenced by surveys of entrepreneurs seeking their perspectives on the crisis' progression (Cepel *et al.,* 2020). Also, human resource uncertainty appeared because of decreased hiring, retaining workers got more noticeable and the overall economic uncertainty hurt the job market. Other types of uncertainty caused by the pandemic, are the social uncertainty and informational uncertainty (Sharma *et al*., 2020). The ambiguity caused by uncertainties, raises the risk of non-development, which means that activities deemed necessary to build the business cannot be made, and the venture's very existence may be jeopardized (Kuckertz *et al.,* 2020).

Proposition* 2*: The impact of COVID-19 on SMEs should be considered from a resilience perspective.

According to Sun *et al*. (2022), the main reasons for the financial issues SMEs faced during the COVID-19 crisis are lower demand in the market, limitations in logistics, and postponed work resumption. Researchers have investigated what entrepreneurs may do to combat the consequences of crisis-induced uncertainty. One solution advocated is adopting the idea of resilience, which characterizes an organization's ability to undergo continual reconstruction. The empirical literature on the COVID-19 crisis and entrepreneurship shows that resilience may be approached in three ways. Its first goal is to shed light on the conditions that lead to resilience. Second, it shows which types of entrepreneurs are resilient (and which are not), and last, it discusses legislative approaches to help entrepreneurs and their businesses become more resilient. Resilience has a positive impact on business success (Ignat & Constantin, 2020) and is primarily the result of financial strength and initiative-taking recovery measures. Similarly, Sun *et al*. (2022) suggest that resilience saved many SMEs in China during the COVID-19 crisis. It is later explained that the companies which managed to quickly shift to being involved in a digital transformation or doing their business online and providing the services and products using innovative solutions to solve the difficulty they had in their logistics, were successful throughout the pandemic and even experienced a growth (Sun *et al.,* 2022). A study by Xia *et al.* (2022) suggests that organizations which were utilizing digital finance were more resilient during the pandemic and managed to mitigate the financing risks they were facing.

Proposition* 3*: The impact of COVID-19 on SMEs should be considered from an opportunity perspective.

Some authors like Sun *et al*. (2022) believe that being resilient and shifting to online solutions can be helpful in times of crisis. Some authors, such as Zhang *et al*. (2021), stated that the only approach to survive a crisis is to be innovative. In general, uncertainty arises in any crisis because of fresh challenges that characterize the problem, and because of such an exogenous shock, novel and creative solutions become necessary and attainable (Ebersberger & Kuckertz, 2021). Eggers (2020) suggests that SMEs which use the crisis as an opportunity and go beyond the customer expectations by creating innovative solutions, are the ones likely to survive, and Turkyilmaz *et al*. (2021) add to this by elaborating how Industry 4.0 can be one of the most significant opportunities which SMEs can use to survive and grow while facing a crisis. A study by Hossain *et al*. (2022) argues that a crisis stimulates the opportunities to learn

new approaches such as making the business digitalized. The crisis impacts the opportunity and how entrepreneurship is handled, for example, by increasing the emphasis on teamwork (Haneberg, 2020).

RESULTS AND DISCUSSION

While the crisis' real-world consequences are undeniably severe and are likely to be a generation's defining moment (Gates, 2020), we are still far from observing a fundamental shift and revolution in research. Instead, essential entrepreneurship concepts like the opportunity perspective have shown to be both fruitful and powerful explanatory tools.

As a result of the COVID-19 epidemic, the analyzed studies show significant environmental changes in entrepreneurs' company settings. Increased uncertainty results from such ecological shifts, and it sheds light on entrepreneurs' resilience in times of crisis. Corbaz-Kurth *et al*. (2022) studied the organizational resilience during the pandemic and concluded that "job crafting" can be an outcome of resilience which helps the firm in times of crises. Bendell *et al.* (2020) propose a broad distinction between disruptive events such as crises (e.g., airline crashes), disasters (e.g., hurricanes), and approaching mega-catastrophes (e.g., climate change) based on the duration, severity, and impact of the event for the first operation. As a result, more research may be conducted to see how entrepreneurial reactions differ depending on the sort of disruptive event.

Eggers (2020) explains that SMEs get severely struck by the COVID-19 crisis due to their specifics which are the liability of smallness and not having a resource to defend them against these sudden changes. That said, it be observed in minority entrepreneurship, such as female, LGBTQ, or disabled entrepreneurs that they are hurt, more than the other types of firms (Beland *et al.,* 2020; Maheshwari & Maheshwari, 2021). Therefore, future research could focus on the fact that in different uncertainties caused by the problems and in different types of firms, resilience could look different, categorize these grounds, and find out what mechanisms entrepreneurs can use to turn uncertainty into opportunities by being more resilient.

CONCLUSIONS

This paper has reviewed a sample of articles related to the COVID-19 pandemic and how it influenced SMEs. The impact of the COVID-19 outbreak on the world's economy is specific and well mentioned in other research (See Kritikos & Thurik, 2022; Engidaw, 2022; Fabeil & Langgat, 2020). The study answers the research questions regarding the effects of the COVID-19 crisis on SMEs and the possible approaches taken by SMEs' to face the change in the business environment. An argument is given by discussing how the uncertainty created by the COVID-19 problem might affect SMEs' resilience. The crises might have a beneficial effect since some SMEs turn uncertainty caused by it into opportunity. In contrast, others cannot deal quickly enough with changes in the environment and are forced to close their doors. This research also states some of the most significant consequences of the COVID-19 problem: business closure due to a lack of resources or severance from their partners. This study summarizes three main approaches: uncertainty, resilience, and opportunity. Reviewing these approaches helps us understand that even though the COVID-19 problem changed the environment and made it difficult for many SMEs to continue operating due to their disconnection to the networks and resources, it brought opportunities to some of the firms.

The study mentioned that SMEs might be able to turn the uncertainty caused by the crisis into an opportunity to become more innovative and flexible and gain new capabilities. Although a few trends were identified in the literature and discussed, there are still gaps in the literature that must be filled with more research. As mentioned earlier, all businesses are not affected equally by the COVID-19 disruptions. Some were deemed necessary to keep operating, while others were forced to close. For instance, I reviewed the three perspectives in COVID literature and SMEs, but it remains unclear if the COVID crisis made more of an opportunity for SMEs or a threat. So, studying this in a case study sample could be very enlightening for this topic. Also, the strategies to take during an emergency to turn it into a chance are worth researching as in the literature mentioned in this paper, only three approaches were reviewed.

This manuscript will help the decision-makers review three main approaches, namely, resilience, uncertainty, and opportunity, when facing a crisis. This could build a basis for quick decision-making, plan strategies ahead of time, and implement crisis management plans throughout the firm. The value added in this paper can be described as an overview of the connection between entrepreneurship, SMEs, and how crises influence these topics. It can also open a way for new research as knowing the crises can have positive and negative effects, how would they influence the global economy as a whole. Another idea for further research is a case study as also mentioned by Pelle and Tabajdi (2021), to see if the pandemic really led to growth, innovation, and operational changes in the firms or not. However, this study faces limitations: Firstly, it cannot be generalized to all the firms in various markets and industries because I focus on a specific part of entrepreneurship and only discuss the approaches discussed regarding SMEs. Court and Arikekpar (2022) mention that there are many actors and factors in the entrepreneurship phenomena so it will be an interesting area of research, to focus on other parts of entrepreneurship (such as startups or non-profit SMEs) and study the effect of the pandemic on them. Finally, an important limitation of this study, is the criteria applied to choose the research I reviewed which narrowed down a large number of articles to 49. It is a good idea to explore articles that are not openly accessible, which are published in other languages or in any way, do not fall into the exclusion criteria presented in this paper. Also, it is good to use different techniques such as conducting a systematic literature review to shed light on the topics and areas which remain undiscovered in this manuscript.

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Forecasting the development of renewable energy sources in the Visegrad Group countries against the background of the European Union

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ABSTRACT

Objective: The aim of the article was to forecast the necessary pace of changes in the share of RES in the V4 countries resulting from the EU's renewable energy sources directive compared to other European Union countries.

Research Design & Methods: The research area included all EU Member States, and in particular the Visegrad Group countries. Forecasts of future RES share values were based on two models: Holt-Winters and the autoregressive (AR) model based on EUROSTAT statistical data.

Findings: The potential failure to meet the recommendations of the RES share in gross final energy consumption for 2022 concerns 19 of the 27 Member States, of which 2 countries belong to the Visegrad Group.

Implications & Recommendations: The research has implications mainly to raise awareness of the direction of RES development in the European Union countries.

Contribution & Value Added: The study contributes to the estimation of the future value of the share of renewable energy sources in the V4 countries compared to other countries European Union on the basis of the current activities of these Member States. The forecast makes it possible to initially determine the possibility of meeting the specific target regarding the share of renewable energy sources in the final energy consumption set out in the European Union directive.

Article type: research article

Keywords: prediction of green energy development; RES in the European Union; Holt-Winters model; economic analysis; autoregressive model

JEL codes: O13, P48

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INTRODUCTION

The global energy transition requires a gradual transformation from a fossil energy system to a low carbon energy system and ultimately to a sustainable energy path based on renewable energy (Dizdaroglu, 2017). Effective implementation of the idea of sustainable energy and the need to counteract the negative consequences of global warming requires a gradual reconstruction of the global energy infrastructure based on oil, coal, natural gases, hydropower and nuclear energy (Singh, 2008). On the one hand, concern for the well-being of the environment requires increasing energy efficiency and reducing greenhouse gas emissions, and on the other hand there is the need to meet the growing energy demands.(Kaygusuz 2012; Keles & Bilgen, 2012; Li *et al*., 2022). Renewable energy sources including wind, solar, hydroelectric, geothermal, biomass and biofuels are seen as alternatives to fossil fuels and contribute to reducing greenhouse gas emissions, diversifying energy supply and reducing dependence on uncertain and volatile fossil fuel markets, especially oil and gas (European Parliament,

2021), whose reserves are limited and subject to price fluctuations (Owusu & Asumadu-Sarkodie, 2016) resulting, for example, from international politics, or the situation in global financial markets (Hsiao *et al*., 2019). The substitutive character of renewable energy and crude oil has a significant impact on shaping the demand for these goods. Oil price fluctuations determine the costs of its use, which in turn shapes consumers' interest in clean energy (Hu & Ding, 2016). Increasing energy security through the use of renewable energy sources has been noticed in many European countries (Angheluta *et al*., 2019), which are taking a number of measures to move towards a sustainable and more efficient energy system (European Parliament, 2021). The progress in the area of renewable energy sources is related to the principle of sustainable energy use, which significantly shapes environmental, social and economic development, which is reflected in better availability of clean, affordable and efficient energy, as well as provides a foundation for meeting many environmental, economic and developmental needs (Hess, 2014). The progress in the use of renewable energy sources supports economic development (Bhattacharya *et al*., 2016), economic growth and employment (Lehr & Ulrich, 2017), shapes economic competitiveness and more efficient use of resources (Falkner, 2014).

The aim of the article was to forecast the necessary pace of changes in the share of RES in the V4 countries resulting from the EU's renewable energy sources directive compared to other European Union countries. The long-term vision strategy adopted by the EU was of interest to the authors of the article, who adopted the following research hypothesise:

H1: In the following years, the growth of the RES share in the energy mix will be maintained, averaging 1% per year for the EU.

The study considers a maximum forecasting period of 4 years from the last known statistical value. In the scope of the study, two models were used: the Holt-Winters' model and the autoregressive model (AR). The specific study design is justified by the number of model inputs, whose statistical values for each EU Member State are 17 years (period: 2004-2020 based on EUROSTAT).

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Energy Policy of the European Union in the Area of Renewable Energy Sources

Along with the global development of renewable energy sources, there is a need for an energy policy aimed at their support (Edenhofer *et al*., 2013), as exemplified by actions taken within the European Union. The energy policy of the European Union is characterized by a comprehensive approach to the aspects of energy security, satisfaction of social needs, competitiveness of the economy, as well as environmental and climate protection. The Europeanization of energy policy supports the creation of an environment shaping the development of the energy industry and energy companies in the European Union. It determines the convergence of macroeconomic systems among the member states and the convergence of industries and sector policies, with particular emphasis on energy policy. Due to the sectoral nature of the energy policy, energy policy belongs to the common competences of the European Union and its member states (Wach *et al*., 2021).

In 2018 the European Union adopted a revised Renewable Energy Directive (Directive (EU) 2018/2001) (European Parliament, 2018a). It establishes a new target that at least 32% of final energy consumed in the European Union should be obtained from renewable sources by 2030 and includes a clause to increase this target by 2023 (European Parliament, 2021). A significant change occurred in relation to the 2009 Directive, as the target indicated is binding only for the EU as a whole, and not for individual Member States (Monti & Martinez, 2020). The EU Member States were required to propose national energy targets and establish 10 year National Energy and Climate Plans under the programme 'Horizon 2030' (European Commission, 2021a) and will then submit progress reports every two years. It will remain for the European Commission to assess these plans, as well as to possibly take measures at the EU level to ensure that they are consistent with the overall objectives of the European Union (European Parliament, 2021).

Another of the objectives of the European Union's energy policy until 2050 is to achieve climate neutrality within the European Green Deal, which will result in the elimination of fossil fuels as energy

sources (Brodny *et al*., 2021). In 2021 the European Commission presented a new legislative package on energy entitled 'Ready for 55: meeting the EU's 2030 climate target on the road to climate neutrality' (COM(2021)0550) (European Commission, 2021b). The new revision of the Renewable Energy Directive (COM(2021)0557) (European Parliament, 2018b) proposed to increase the mandatory target for the share of renewable energy in the European Union's energy mix to 40% by 2030, as well as new targets at national level (European Parliament, 2021).

Energy Sources in the Visegrad Group Countries in the Light of the EU Energy Policy

The Czech Republic, Hungary, Poland and Slovakia, which are members of the Visegrad Group, are former socialist countries undergoing economic transformation since the early 1990s. (Godawska & Wyrobek, 2021). The similarity of the economies of the Visegrad Group countries resulted from the departure from central planning, although certain differences were visible in the national, ethnic and cultural areas (Pach-Gurgul & Ulbrych, 2019). Political instability in the Central and Eastern European region gave rise to the Visegrad countries in 1991, followed by the break-up of Czechoslovakia in 1993, which led to the formation of the Visegrad Group (V4) (Kumar *et al*., 2021). Initially, the main goal of this informal association was the full integration of cooperation in the political and economic dimensions (Latawski, 1993). The Visegrad Group countries are an example of countries with mutual interests that should transcend borders to develop emerging energy sectors (Kumar *et al*., 2021). The possibility of close economic cooperation of the Visegrad Group countries resulting from geographic proximity enables the reduction of costs resulting from the transmission of energy between countries (Sulich & Sołoducho-Pelc, 2021).

The energy production in Central and Eastern Europe is traditionally based on non-renewable energy sources (Sulich & Sołoducho-Pelc, 2021). The energy production in the Visegrad countries is based to a large extent (the Czech Republic, Hungary, Slovakia) or very much (Poland) on the exploitation of fossil fuels (Godawska & Wyrobek, 2021). It is worth noting that the group of countries mentioned above includes one of the largest coal producers – Poland, which has the ninth largest deposits of this raw material in the world (Sulich & Sołoducho-Pelc, 2021).

Undoubtedly, a particularly important factor determining the shape of the energy sector in this part of Europe is the historical background, among which the dependence on the supply of fossil fuels from Russia (Center for European Policy Analysis, 2016), combined with an active mining lobby, promotes a cautious approach to the policy of transformation of the community. On the one hand, the decreasing profitability of coal based energy and on the other, the growing attractiveness of renewable energy sources favors the former. In the economic reality, this situation is exacerbating the differences between the energy policies of these countries and causing significant internal shocks. An example is the timing of the departure from coal as an energy source in individual countries. Slovakia has announced the cessation of coal use for electricity production by the end of 2023, and Hungary has announced its withdrawal by 2030 (Heilmann *et al*., 2020; Księżopolski *et al*., 2020). In the Czech Republic, on the other hand, it will be 2033 (300gospodarka, 2022), and in Poland it will be 2049 at the latest (300gospodarka, 2021).

The energy transformation of the countries in question makes it necessary to invest in gas or nuclear solutions, as well as in renewable energy sources. In the case of the development of the latter, the key role in the nearest financial perspective will be played by the European funds, which constitute as much as 40-60% of national public investments in the Visegrad countries (Heilmann *et al*., 2020). In addition to the above mentioned financial support, the geographical location and environmental conditions are important assets of the Visegrad countries, which favor the development of renewable energy sources (Kotulewicz-Wisińska, 2018).

The natural conditions for investing in renewable energy sources in the Visegrad countries are generally moderately positive, although some regional differences can be observed (e.g. Slovakia has favorable conditions for the development of hydropower, while Hungary for the development of geothermal energy) (Godawska & Wyrobek, 2021). The contrasts can also be seen in the diversity of technologies used to achieve the targets in the area of renewable energy sources (Kozar, 2019). The propensity of individual Visegrad countries to develop renewable energy sources is also different due to

the possibility of obtaining nuclear energy. In the case of Slovakia (Kratochvíl & Mišík, 2020), the Czech Republic and Hungary, obtaining energy from the atom may limit the interest in obtaining energy from renewable sources (Księżopolski *et al*., 2020). Whereas Poland assumes construction and commissioning of 2 nuclear power plants with 3 reactors each. Construction of the first reactor is to start in 2026 and its commissioning in 2033 (Ministry of Climate, 2020). The energy transformation of these countries makes it necessary to invest both in gas or nuclear solutions and in renewable energy sources. In the case of the development of the latter, the key role in the upcoming financial perspective will be played by the European funds, which constitute as much as 40-60% of national public investments in the Visegrad countries (Heilmann *et al*., 2020). In addition to the financial support mentioned above, the geographical location and environmental conditions are important assets of the Visegrad countries that favor the development of renewable energy sources (Kotulewicz-Wisińska, 2018).

Differences can also be observed in the area of inhabitants' environmental awareness and willingness to undertake pro-environmental investments. An upward trend in these aspects is observed in Hungary and the Czech Republic. In the case of Poland and Slovakia, on the other hand, this trend is less noticeable despite huge campaigns and outlays on education (Magda *et al*., 2019).

All Visegrad countries (as well as other European Union Member States) have submitted National Energy and Climate Plans for 2021-2030, which include climate and energy targets for 2030 (Ministry of Industry and Trade, 2019; Ministry of Innovation and Technology, 2019; Ministry of National Assets, 2019; Slovak Ministry of Economy, 2019). The share of RES in gross final energy consumption (in %) in 2020 and the targets for 2025 and 2030 vary from country to country (Figure 1.).

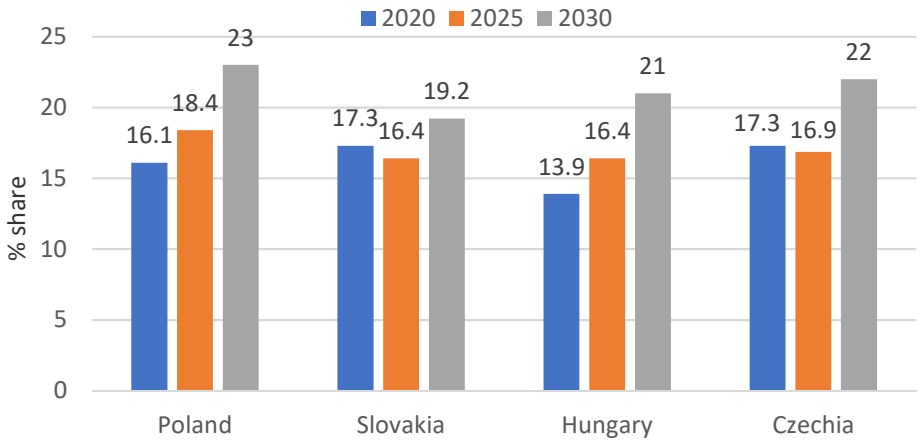

Figure 1. Share of energy from renewable sources in final gross consumption of energy in V4 Countries National Energy and Climate Plans and future expectations by 2025 and 2030

Source: own studies based on: (Ministry of Industry and Trade, 2019; Ministry of Innovation and Technology, 2019; Ministry of National Assets, 2019; Slovak Ministry of Economy, 2019)

Forecasting the development of renewable energy sources makes it possible to assess the chances of achieving the targets set out in the European Union documents and provides a basis for their possible modification. In the literature, there are studies on forecasting the development of renewable energy sources, which were carried out for selected areas using different econometric methods. Among studies covering the selected EU member states (and others), one can point to forecasts of: the level of renewable energy consumption in Belgium, the Czech Republic, France, the Netherlands, Poland and the UK by 2030 (Manowska, 2021); energy production from renewable sources in Poland by 2025 (Brodny *et al*., 2020); renewable energy consumption in France, Germany, Italy, Spain, Turkey and the UK by 2030 (Utkucan, 2021). The multifaceted projections of the development of renewable energy sources in member and associated countries of the International Energy Agency (including the selected countries belonging to the European Union) until 2026 are included in the latest report of this institution (International Energy Agency, 2021).

RESEARCH METHODOLOGY

Model Characteristics

In the scope of the study consisting in forecasting the development of RES, in particular its share in gross final energy consumption, two models were used: the Holt-Winters' model and the autoregressive model (AR). The first one allows for forecasting variables with seasonal fluctuations in the scope of complete time series, while the second model concerns higher order autoregression. The aim of the study is to predict the development of renewable energy sources in the European Union Member States. The study was based on EUROSTAT resources concerning the share of energy from renewable sources in gross final energy consumption falling on the years 2004-2020. When carrying out the study with the Holt-Winters' model, calculations can be based on two variants: additive and multiplicative. The additive variant is described by the following equations (Szumksta-Zawadzka & Zawadzki, 2014):

$$m_t = \alpha(Y_t - C_{t-m}) + (1-\alpha)m_{t-1} \quad (1)$$

$$S_t = \beta(m_t - m_{t-1}) + (1-\beta)S_{t-1} \quad (2)$$

$$C_t = \gamma(Y_t - m_t) + (1-\gamma)C_{t-p} \quad (3)$$

The multiplicative variant is described by the equations:

$$m_t = \frac{\alpha Y_t}{C_{t-m}} + (1-\alpha)(m_{t-1} + S_{t-1}) \quad (4)$$

$$S_t = \beta(m_t - m_{t-1}) + (1-\beta)S_{t-1} \quad (5)$$

$$C_t = \frac{\gamma Y_t}{m_t} + (1-\gamma)C_{t-m} \quad (6)$$

where:

m_t - assessment of average value;
S_t - the directional parameter of the trend (trend growth);
C_t - assessment of seasonality;
p - the length of the period of periodic fluctuation;
α, β, γ - the volatility and trend smoothing constants, take values in the range [0,1].

The predictor based on the additive model is expressed by the formula:

$$Y_t = m_{t_0} + S_{t_0}h + C_{t_{0-m+h}} \quad (7)$$

For the multiplicative model, we describe the predictor as follows:

$$Y_t = (m_{t_0} + S_{t_0}h)C_{t_{0-m+h}} \quad (8)$$

We take the following equations as the initial values of the forecast variable:

$$m_1 = \frac{1}{r}\sum_{i=1}^{r} y_i \quad (9)$$

$$S_1 = \frac{1}{r}\sum_{i=r}^{2r} y_i - \frac{1}{r}\sum_{i=1}^{r} y_i \quad (10)$$

For the additive model:

$$C_m = y_m - \bar{y} \quad (11)$$

For the multiplicative model:

$$C_m = \frac{y_m}{\bar{y}} \quad (12)$$

For the AR predictive model, the equation is defined by the following form (Autoregressive models, 2021):

$$X_n = \alpha_0 + \alpha_1 X_{n-1} + \alpha_2 X_{n-2} + \cdots + \alpha_k X_{n-k} + \varepsilon \quad (13)$$

where:

X_n - the value of the time series;
$\alpha_0, \alpha_1, \ldots, \alpha_k$, - coefficients;
ε - white noise;
k - row of autoregression.

RESULTS AND DISCUSSION

Intended Targets and RES Achievements in the European Union

Due to the large differences in RES share in the EU Member States, resulting from spatial and financial aspects, the Directive stipulated national targets, which could differ from the EU target, and the way to achieve them was to be presented in a detailed RES policy action plan. At the time of this study, all Member States had presented their national RES share in gross final energy consumption, allowing for an assessment of the targets.

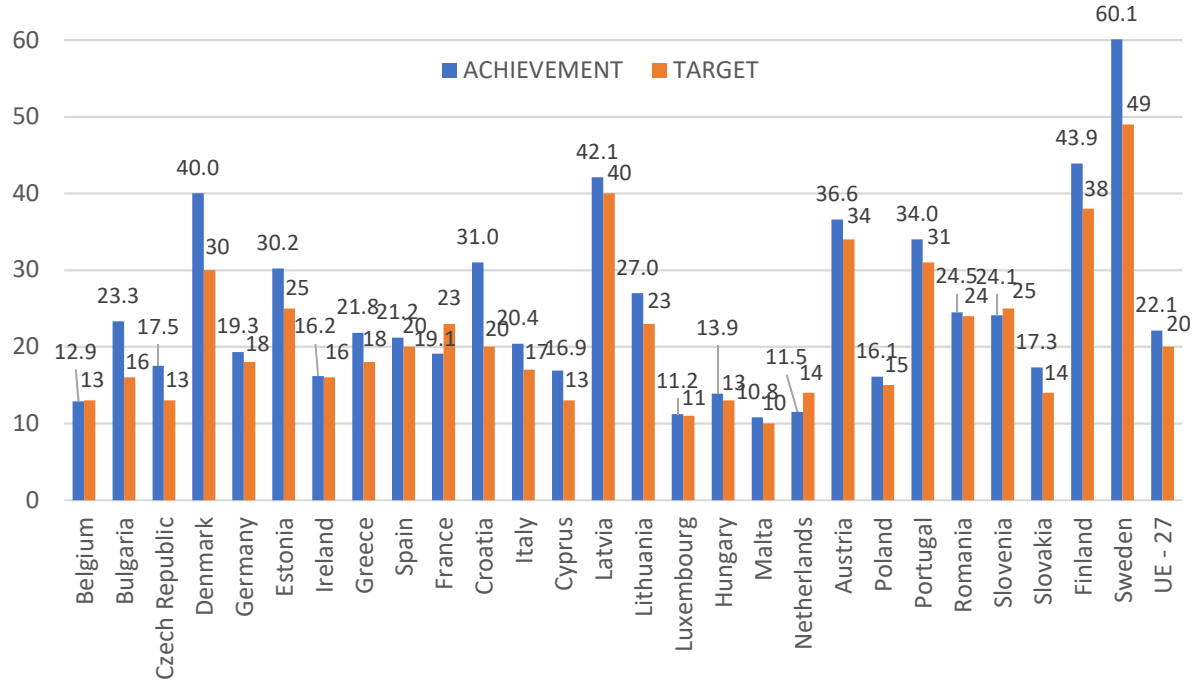

Figure 2. Summary of the adopted target and the actual share of RES (2020) in gross final energy consumption in the EU Member States
Source: own study based on EUROSTAT data.

The EU target of a 20% RES share by 2020 has been overachieved by 2%. Unfortunately, not all the EU member states have fully achieved their national targets, we are referring to: Belgium, France, the Netherlands and Slovenia. The effectiveness of the national targets within the EU as a whole was 85%. The results are worse if we assume that each EU Member State should achieve the expected 20% RES share in 2020. It turns out, therefore, that less than 15 countries can boast of exceeding such a value, which translates into the effectiveness of 56%. At the next stage, the European Commission proposed that the share of RES in the EU energy mix should reach 40% by 2030 (Ciucci, 2021). In the implementation of the European Green Deal, such a move would be a kind of a 'milestone' towards achieving climate neutrality by 2050 (European Parliament, 2009). In order to achieve this target, a minimum increase of 1% per year within the EU should be adopted (as a reminder, in 2020 the value was 22.10%).

Table 1 presents a summary of the results for the use of the two forecasting models, the values of which often differ from each other. The most divergent forecast models are visible for countries such as: the Netherlands, Cyprus or Estonia, where the values of the difference oscillate even within 10%. This may be due to the fact that in these countries a linear increase in RES share has been observed in recent years. The aforementioned linearity of the growth trend, combined with the dynamic difference in the share over 2019 and 2020, may have influenced the final values of the model coefficients and thus the direction of the forecast. Therefore, assuming that the forecast can be considered most plausible when both models have similar values and the difference between them does not differ by more than 1 pp, then: Greece, France and Finland, which will meet the above requirements in terms of 4-

year prognosis. Greece will have the highest dynamics of change (for the above mentioned countries) with the value of ≈ 1.4%, while Finland will approach the share of RES in final energy consumption to ~49% already in 2024. The closest forecasts of the models used are for 2021 and 2022, where 14 out of 28 surveyed entities (50%) achieved a difference of less than 1 pp, while the following years are characterized by progressive divergence.

Table 1. Forecast values of RES energy share in gross final energy consumption for 2021-2024, according to Holt-Winters' (H-W) and autoregressive (AR) model [data in %]

COUNTRY	YEAR								$\overline{x}$	
	2021		2022		2023		2024			
	H-W	AR	H-W	AR	H-W	AR	H-W	AR	H-W	AR
Belgium	13.53	13.58	14.55	14.25	15.84	14.08	18.77	15.03	1.75	0.48
Bulgaria	24.71	23.89	26.40	24.40	27.60	25.11	29.19	25.69	1.49	0.60
the Czech Republic	18.52	18.25	20.20	18.47	22.12	18.47	23.12	18.65	1.53	0.13
Denmark	41.01	40.04	42.52	42.95	45.53	44.47	47.59	44.83	2.19	1.60
Germany	18.85	20.81	19.79	22.60	21.63	24.92	22.90	27.43	1.35	2.20
Estonia	28.32	30.75	24.98	30.35	24.15	31.49	22.45	31.46	-1.96	0.24
Ireland	18.32	18.27	20.51	20.35	23.49	27.05	27.61	32.55	3.10	4.76
Greece	22.90	23.51	24.45	24.97	26.50	26.28	27.19	27.74	1.43	1.41
Spain	21.95	21.46	23.37	19.40	25.67	19.49	28.63	22.24	2.22	0.26
France	19.50	18.98	19.98	19.54	20.98	20.42	22.46	21.60	0.99	0.87
Croatia	32.53	31.41	32.56	31.75	33.08	31.63	35.10	31.74	0.86	0.11
Italy	19.83	20.54	20.11	19.71	22.15	19.95	23.22	20.98	1.13	0.15
Cyprus	18.02	12.71	19.99	21.48	21.93	13.06	23.56	32.47	1.85	6.59
Latvia	43.87	42.57	43.77	43.31	43.84	44.03	45.64	44.65	0.59	0.69
Lithuania	28.43	27.52	29.18	27.59	31.24	27.81	32.74	28.25	1.44	0.24
Luxembourg	11.28	10.17	13.48	13.85	12.60	14.08	15.98	17.72	1.57	2.52
Hungary	12.60	14.20	11.38	14.44	12.35	14.36	13.38	14.28	0.26	0.03
Malta	11.32	12.45	12.20	14.32	12.98	16.12	14.75	18.26	1.14	1.94
the Netherlands	12.83	15.61	14.69	22.80	17.22	34.80	19.55	54.88	2.24	13.09
Austria	35.29	33.93	35.88	36.09	37.47	33.93	39.56	36.22	1.42	0.76
Poland	17.03	15.44	17.96	16.34	18.87	17.11	19.79	18.10	0.92	0.88
Portugal	34.28	36.23	36.65	36.90	39.81	35.97	42.59	35.90	2.77	-0.11
Romania	24.10	24.81	23.55	24.71	24.07	24.71	24.23	24.74	0.04	-0.02
Slovenia	25.27	23.79	24.95	23.35	26.24	22.35	27.05	22.56	0.59	-0.41
Slovakia	18.44	15.30	20.19	16.89	22.93	19.26	23.47	19.12	1.68	1.37
Finland	44.69	45.50	47.08	46.37	47.87	47.81	48.66	48.89	1.32	1.13
Sweden	59.98	59.37	61.00	60.56	64.33	62.31	66.82	63.01	2.28	1.21
UE-27	22.27	23.06	23.38	23.51	25.29	23.99	26.75	24.81	1.49	0.58

$\overline{x}$ – average annual growth forecast

Source: own study based on EUROSTAT data.

Referring to Table 1 and to hypothesis 1 (H1), where an average annual RES growth dynamics of 1% within the community of the EU Member States was determined, it can be stated that on the basis of the study, the AR model did not confirm such growth within the next 4 years. The perspective of introducing by the European Commission a 40% share of RES by 2030 with unchanged achievements in its development, together with a sustained growth trend of 1.49% (Holt-Winters' model) and 0.58% (AR model) may not be achieved. Assuming that the target set in the current directive (32%) remains unchanged, it is very likely to be met. Based on the Holt-Winters' model this is almost certain, while based on the AR model it is not necessarily so. However, using the average growth dynamics received on the basis of these two models we obtain a value of ≈ 1.04%, which also confirms the aforementioned assumption of meeting the target. On this basis, the authors of the study are inclined to confirm the truth of hypothesis 1 (H1).

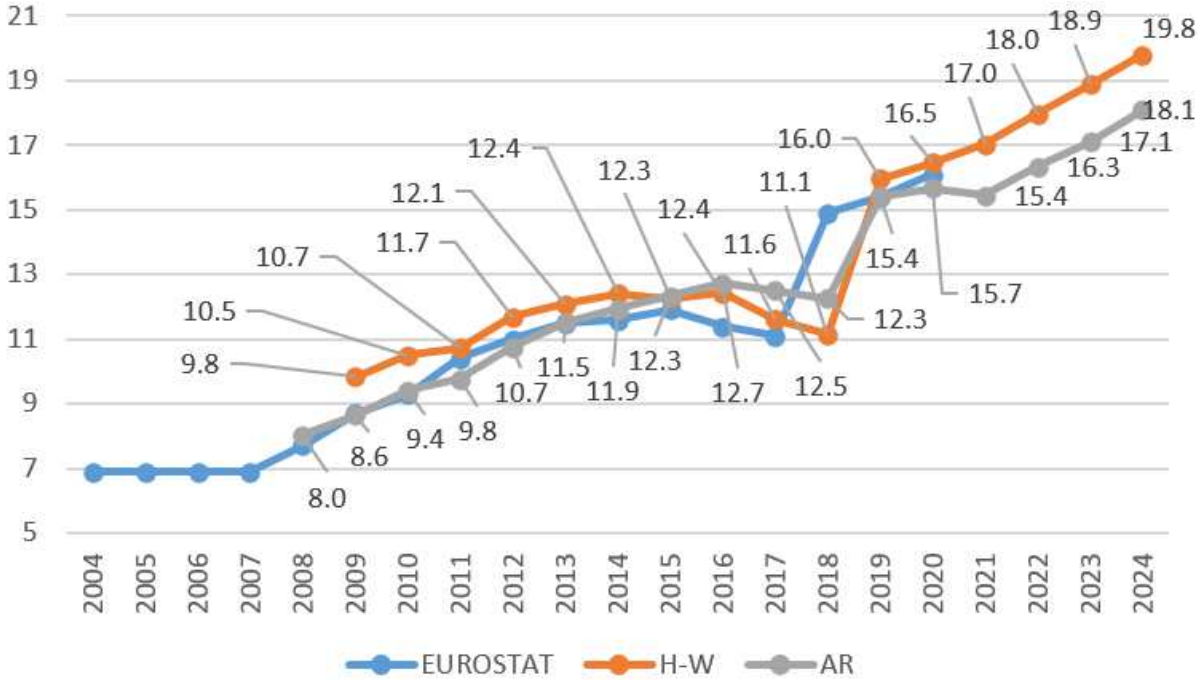

Figure 3. Actual (EUROSTAT) and projected (H-W, AR) share of RES in gross energy consumption [%] – projection for Poland
Source: own study based on EUROSTAT data.

Referring to the obtained forecasts for Poland (figure 3), further development of RES can be expected in the coming years without major disturbances. However, there are some difficulties in the area of RES implementation related to the geographical conditions which is reflected in the degree of insolation in the case of photovoltaic panels (Buriak, 2014). Another problem is the size of investment outlays that have to be borne by the investor in order to launch such a system. Despite the complicated situation, a systematic increase in the share of RES is visible, in particular due to the subsidies granted for its development and the possibility to finalize such an investment with foreign capital (preferential investment loans) (Instytut Energii Odnawialnej, 2019; Ministerstwo Klimatu i Środowiska, 2022). Implementation of support mechanisms for prosumers and renewable energy sources must be carried out with simultaneous efforts to maintain the profitability of the mining sector (Księżopolski *et al*., 2020).

A. Manowska (2021), while forecasting the share of RES in the selected EU countries, presented that the forecasting model for Poland showed a share of about 15% for 2025 and about 17% for 2030. As in the case of this article, the forecasting was carried out using the AR model, but the results differ from those obtained in Table 1. Such differences are related to a smaller amount of input data (data until 2018), which translated, among others, into the forecast of Poland's inability to meet the 2020 target, which was eventually met. Similar results were obtained by another team of researchers, who predicted Poland's inability to meet its 2020 target for the share of RES in gross final energy consumption (Brodny, 2020). In this case, the model was also based on statistical data falling to 2018. It should be noted that in the case of the cited research work and the present study, the EUROSTAT statistical database was used, where there is some irregularity in the data for 2018. In the cited research, the value for Poland for 2018 was determined at the level of approximately 11.5%, while at the moment (February 2022) the statistical base defines the share at the level of 14.9%. Probably there was an update of EUROSTAT statistical data, which significantly affected the level of forecasts and for this reason the mentioned discrepancies in research results could occur.

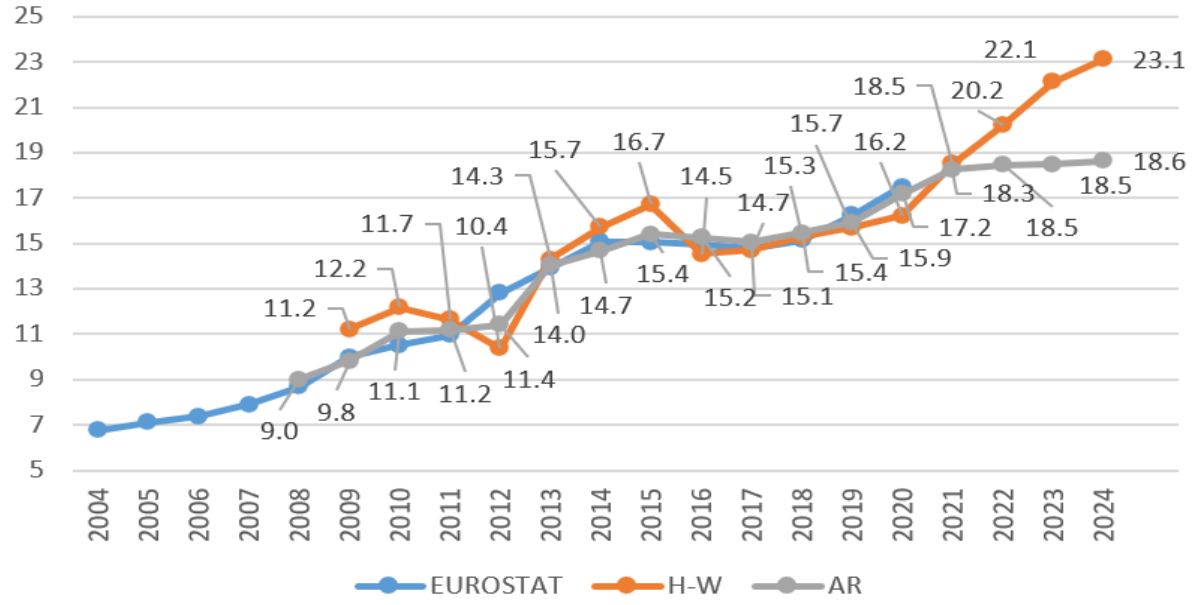

Figure 4. Actual (EUROSTAT) and projected (H-W, AR) share of RES in gross energy consumption [%] – projection for Poland
Source: own study based on EUROSTAT data.

In the case of the Czech Republic, further development of RES is also expected based on the results of both forecasting models (figure 4). In the case of the Holt-Winters' model, forecasts similar to those obtained by A. Manowska (2021) were achieved. The Czech Republic predicts that in 2025 it will reach 16.87% and in 2030 22% share of RES in gross energy consumption. The models indicate that the planned value level is realistic to achieve especially for 2025. Assuming that the average annual value of the growth dynamics for the country is 1.53% (Holt – Winters' model) and 0.13% (AR model), it can be determined that there is a probability of meeting also the forecast for 2030. The level of fear of the inhabitants about the negative effects of wind power plants on the environment and their quality of life, which was one of the barriers to the development of renewable energy in the Czech Republic, has decreased (Cetkovský *et al.*, 2009).

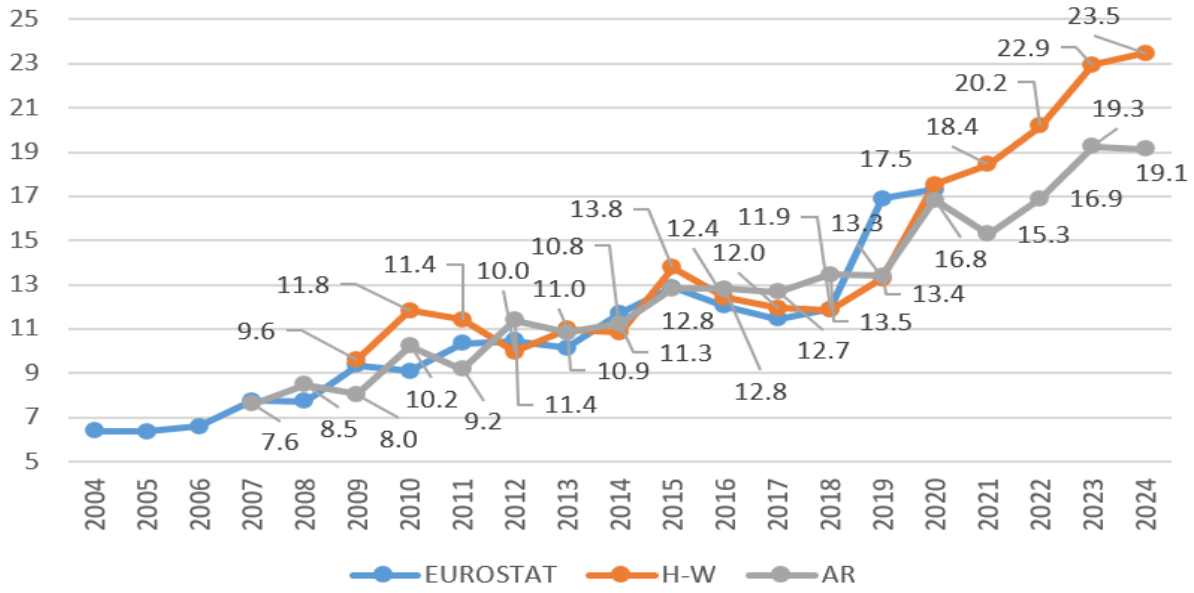

Figure 5. Actual (EUROSTAT) and projected (H-W, AR) share of RES in gross energy consumption [%] – projection for Slovakia
Source: own study based on EUROSTAT data.

In the case of Slovakia (figure 5), the Holt-Winters' model showed the highest growth dynamics in the aspect of the whole Visegrad Group and the RES share was determined at the level of 1.68% per year. The growth dynamics is close to the average value obtained for the Czech Republic, and the graphical visualization of the share in the presented period is very similar to each other. This may be related to similar GDP growth for these countries with some advantage for Slovakia (Brożyna *et al.*, 2020). The RES share target for this country is 16.4% for 2025 and 19.2% for 2030 (figure 1). The predicted forecast values of the different models clearly indicate that Slovakia will definitely increase the share of green energy in the coming years. The forecast may be true due to the planned allocation of 220 million EUR for the implementation of RES projects in the coming years (Hudec, 2021).

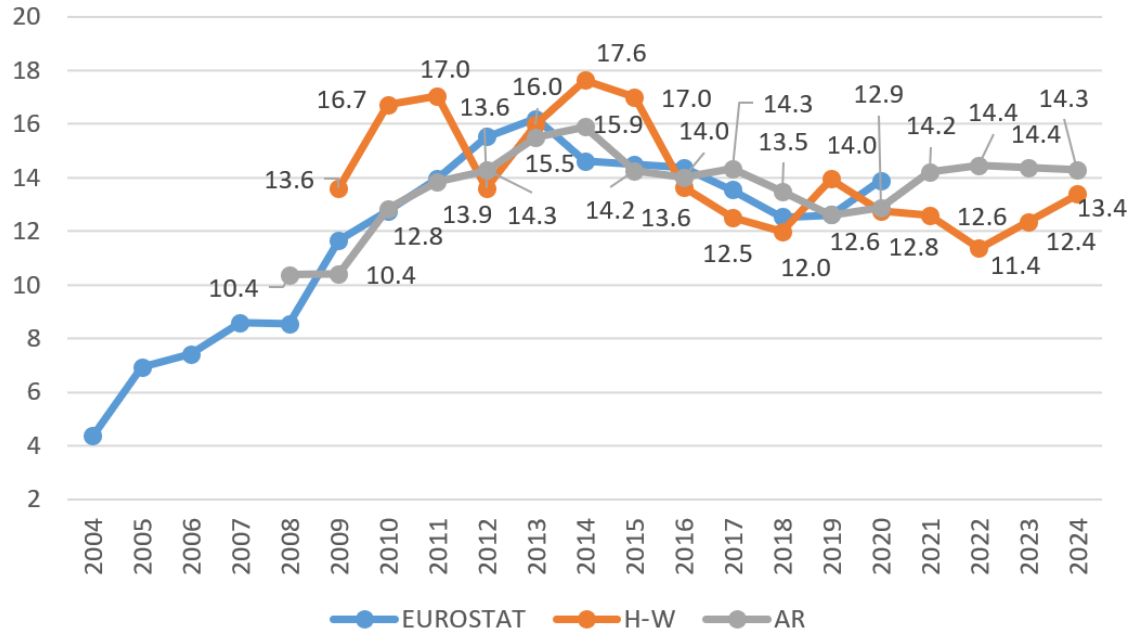

Figure 6. Actual (EUROSTAT) and projected (H-W, AR) RES share in gross energy consumption [%] – projection for Hungary
Source: own study based on EUROSTAT data.

As for Hungary, the forecast showed an average annual growth rate of around 0.26%. The value shown is obviously less optimistic than for the other Visegrad countries. This is mainly due to the fact that a decrease in the share of RES in gross final energy consumption was noticeable in the period 2013-2019 (fig.6). Despite a slight decrease in the RES share since 2013, Hungary reflects the highest potential in terms of solar radiation among the four V4 countries (Kumar *et al.*, 2021), which translated into a significant increase in solar energy production from 2019 onwards by more than 59% (Renewables Now, 2019b). The increase in the number of photovoltaic power plants in recent years is due to the possibility of subsidies from 2019 for this type of investment (Simon & Deák, 2022). Hungarians have set as a target of RES share in gross energy consumption values of 16.4% in 2025 and 21% in 2030. In the actual actions in this regard, the forecasting models did not make it possible to state that such values will be achieved, however, further growth in the importance of solar energy in this country may change them.

Reading the Regulation of the European Parliament and of the EU Council of 11 December 2018 (Chapter 2, Article 4) we will encounter the following provision (European Parliament, 2018c):

> *„(…) By 2022, the indicative trajectory shall reach a reference point of at least 18 % of the total increase in the share of energy from renewable sources between that Member State's binding 2020 national target, and its contribution to the 2030 target. (…) "*

Figure 7. The map of the member countries showing potential compliance with RES share requirements in gross final energy consumption for 2022. The countries are marked in green

Legend: *B – Belgium; BG – Bulgaria; CZ – Czech Republic; DK – Denmark; D – Germany; EST – Estonia; IRL – Ireland; GR – Greece; E – Spain; F – France; HR – Croatia; I – Italy; CY – Cyprus; LV – Latvia; LT – Lithuania; L – Luxembourg; H – Hungary; M – Malta; NL – Netherlands; A – Austria; PL – Poland; P – Portugal; RO – Romania; SLO – Slovenia; SK – Slovakia; FIN – Finland; S – Sweden.*

Source: own study based on EUROSTAT data.

The quoted fragment sets out guidelines for the EU Member States regarding the minimum incremental share of RES in final energy use for 2022. Figure 7 shows those countries, which as a result of the conducted forecast will exceed the aforementioned increase (green colour) using at least one model. Referring to the results of the study, 19 out of 27 EU countries will meet the targets set in the regulation, which translates into an effectiveness of 70%. For the EU as a whole, the increase is 18%, which, despite the limit value, allows us to conclude that the RES increase targets for 2022 can be met.

The authors of the study emphasize that the models used did not take into account the financial outlays for the development of RES, which was characteristic and noticeable in recent years of green energy development and could have affected the forecast results. In the case of Poland, high RES growth dynamics was achieved, among others, due to the introduction of the so called green certificates (Pająk & Mazurkiewicz, 2014). The dynamic growth of RES share in the case of the Netherlands has a basis in technological aspects. In recent years, the installed capacity of offshore wind turbines has been increased and new ones have been put into operation, which has allowed to increase the capacity from 4500 MW (2019) to 6600 MW (at the end of 2020) (International Trade Administration, 2020). According to the Estonian Energy Development Plan, the RES share by 2030 is assumed at the level of 50% (Renewables Now, 2019a), the combination of this target with the results of forecasts determining the continuation of dynamic development, allows us to state that the assumed values are realistic to achieve. A study by

Utkucan (2021) presented a dynamic growth of RES share in Spain, among others, where the forecast for 2024 was similar to the values obtained using the AR model and amounted to about 22.5%.

There may be many reasons for RES development, the most important of which is counteracting climatic changes manifested by temperature increase, melting of glaciers, etc. (Kundewicz & Juda-Rezler, 2010). Maintaining the dynamic development of RES also has an economic justification, related to the constantly increasing prices of CO2 emission allowances.

CONCLUSIONS

The development of renewable energy sources is an important challenge in the process of energy transformation in the Visegrad Group countries, which is implemented, among others, on the basis of the energy policy of the European Union. The perspectives for the use of renewable energy sources are differentiated due to the specific conditions of individual economies. The European Union, as well as the Czech Republic, Hungary, Poland and Slovakia, are aware of the potential of investments in the renewable energy sector, which in the long term perspective will translate measurably into a reduction in greenhouse gas emissions, increased energy efficiency and improved energy security.

The research contained in this paper contributes to the body of literature on the subject in several dimensions. Firstly, a review of the latest theoretical and empirical research provides a basis for a discussion on the prospects for the development of renewable energy sources in the Visegrad Group countries against the background of the European Union. Secondly, based on the empirical research, the following conclusions can be drawn:

1. The target for the share of renewable energy sources in gross final energy consumption in the European Union member states in 2020 has only been met at the community wide level, as several countries have not met the targets at the national level.
2. The projected average growth rate of the share of renewable energy sources in gross final energy consumption for the period 2021-2024 in the European Union is just over 1%. The prospects for achieving the target in this area by 2030 in the European Union are therefore good.
3. The European Union's objective of increasing the share of renewable energy sources in final consumption to a minimum of 18% in 2022 is achievable only at community level.
4. Forecasts of the growth of the share of renewable energy sources in the Visegrad Group countries for 2022 vary, but unfortunately are often insufficient to meet the requirements set by the European Union in this regard. Among the Visegrad Group countries, only the Czech Republic and Poland are up to the challenge.
5. Divergent results in the area of forecasting the share of renewable energy sources in consumption in the Visegrad Group countries may result from a number of reasons. For example, the different technologies used to meet the renewable targets or the stage of development of the country.

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Creative entrepreneurial intention of students in Indonesia: Implementation the theory of planned behaviour

Jarosław Korpysa, Waluyohadi

ABSTRACT

Objective: Entrepreneurship has a very important role in developing countries. Universities, especially in Indonesia, organize some entrepreneurship programs to encourage students' intentions. But, there is no assessment that shows the significance of the influence of university programs on developing entrepreneurial intentions. The objective of this article is to assess the entrepreneurial intention among university students in Indonesia, especially the significant influence of university programs as a subjective norm, compared with the other determinants such as attitude and perceived behavioural control. This research was conducted in 2022, so that at the same time, it could be seen how the pandemic affected the intention.

Research Design & Methods: The study uses a quantitative approach that applies the theory of planned behaviour (TPB) and is analyzed by the SEM PLS method. The questionnaire technique is used and delivered to 272 Indonesian students.

Findings: The digital technology and social media content, believed to be rich and giving, inspire students as a subjective norm, playing a bigger part in entrepreneurial intention than their attitude, university program, or university environment. Furthermore, attitude has little bearing on entrepreneurial intention.

Implications & Recommendations: It is recommended that the universities have to engage more with the trends of digital technology especially social media to promote entrepreneurship. The related topic that is relevant to be shared on social media such as readiness to start the business, risk taking, and giving as a positive motivation.

Contribution & Value Added: In term of theory development, the study contribute to fill the gap in science, especially research of a creative entrepreneur intention, after the pandemic, and take place in Indonesia as an added value. In practical terms, for universities, the research recommendation can be used as a reference in developing entrepreneurship programs at universities, especially in the creative field.

Article type: research article

Keywords: creative; entrepreneurship; intention; Indonesia; pandemic; TPB; SEM PLS

JEL codes: F23, L20, L26

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INTRODUCTION

Entrepreneurship is becoming a global issue (Lopes *et al.*, 2018; Mei *et al.*, 2020). The role of entrepreneurship in improving the quality of life is recognized in the context of the Sustainable Development Goals (SDGs) 2030. In terms of the SDGs under consideration in 2019, entrepreneurship is associated with SDGs 4 and 8. SDGs objective 4.4 aspires to significantly expand the number of young people and adults with relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship. Simultaneously, SDG target 8.3 aims to promote development-oriented policies that encourage productive activities, decent job creation, entrepreneurship, creativity, and innovation, as well as the formalization and growth of micro, small, and medium-sized enterprises (MSMEs).

MSMEs play an important role in inclusive development as both agents and recipients. MSMEs are one of the most effective vehicles for addressing the problem of creating 600 million new jobs by 2030, particularly for young people (Carpentier & Braun, 2020).

In order to understand how to create jobs, it is also important to know how to establish a business called entrepreneurship and the person who set up the business called entrepreneur. By definition, Schumpeter implies that invention and creativity are critical factors in economic progress, and this is referred to as "entrepreneurship" (Szmrecsányi, 2009). From the management point of view, Drucker characterized entrepreneurship as one of the characteristics of management, stating that the manager must always administrate. He must manage and improve on what currently exists and is known. However, he must also be an "entrepreneur"(Drucker, 2014).

Entrepreneurs, in the current era, are developing into a new term called "startup". One of the fairly common definitions of startup is the definition according to Salamzadeh. Startups are business startups that have just been established and are in a period of struggle (Salamzadeh & Kawamorita Kesim, 2015), although there are other definitions of startups in certain fields, especially in digital business. With this definition, the term "startup" cannot be separated from entrepreneurship. On the other hand, entrepreneurship is a spirit for creating new businesses, so entrepreneurship cannot be separated from creativity (Gammell & Kolb, 2020).

In academic, entrepreneurship education has embraced a design thinking viewpoint. In recent years, design thinking, which is defined as "the collection of tools, methods, and mindsets that designers use to solve issues," has been progressively included in the business school course curriculum (Sarooghi *et al.*, 2019). The new thing that is different from the previous method of learning to establish the new business is the Business Model Canvas (BMC), which is a method for visually mapping a business plan on a piece of paper (Osterwalder & Pigneur, 2013).

Recent research on entrepreneurship also mentions serial entrepreneurship (Dabić *et al.*, 2021). That is, someone who has an entrepreneurial spirit, when he can find a pattern of doing business, will tend not to focus on one business field but on various businesses. This is a positive thing because he will open up new jobs quickly, but a negative thing because if he doesn't have good support, his business will lose focus.

Entrepreneurship research is not all about technical ways to build a business, such as finance, marketing, operations, but also about mindset (Nielsen *et al.*, 2021). Therefore, research on entrepreneurship is also related to factors that influence people's desire to start a business, such as self-motivation in starting a business (Liñán *et al.*, 2011), environmental factors that influence decisions (Ajzen, 1991), and control variables or other aspects that affect business decisions (North, 1990). In another study, it was also stated that growth in colleagues is a reason that influences entrepreneurial intention (Birley *et al.*, 1991). On the other hand, the nature of entrepreneurship is also influenced by attitudes or innate nature (Damke *et al.*, 2018). All the research on intention is summarized into the Theory of planned behaviour (TPB) (Ajzen, 1991; Bird, 1988; Boyd & Vizikis, 1994; Fini *et al.*, 2012). After that, the study of entrepreneurship was also strengthened by research on the habits of entrepreneurs, which resulted in an empirical study that showed every successful person has a habit that can be learned (Duhigg, 2012). Especially in entrepreneurship, this research has developed into an entrepreneur's behaviour (Hashimoto & Nassif, 2014).

Entrepreneurship is being developed in a lot of countries, especially Indonesia. In the last 15 years, along with the creative economy trend, the trend of entrepreneurship has shifted from establishing manufacturing-based small medium enterprises (SMEs) to creative one. The term creative industry, as an emerging business and contribution (Dewi *et al.*, 2018; Saksono, 2012; Setiadi & Inderadi, 2021; Sumiati *et al.*, 2017), is considered a solution for entrepreneurs who start with small capital. Therefore, the government promotes creative entrepreneurship. One of the creative business sub-sectors considered to have a large contribution to the economy today is culinary, fashion, and craft sectors (Rasyid, 2018). In an effort to develop the existing businesses, the government initially funded production engineering training programs. However, along with the trend of creative sectors, the training is directed at product design, branding, packaging, and also a festival held to attract tourists (Nugra, 2019). Not only for existing businesses, but startups also need training or education to leverage their

knowledge based on their particular conditions. The government's role in policymaking and support mechanisms also needs to be well designed by involving entrepreneurs.

To develop entrepreneurship, Indonesia carries out various programs, including collaborating with universities (Dewi *et al.*, 2018). As a center of excellence, the university contributes in the form of training and consulting. In addition, in the community, the government has created clustering programs (Tambunan, 2005). Clustering is an effort to unite businesses in one area with the same product and build networks with other clusters to synergize with each other. Another study on entrepreneurship in Indonesia is about gender (Tambunan, 2007). From this research, it was revealed that in Indonesia there is no gender discrimination, especially regarding herbal producers. The clusters are mostly in the family environment, namely working on homemade products, so the role of women, or housewives, is very important in business operations. They take care of the household while producing.

Among existing studies, there is also research on learning from the failure of government programs (Bezerra *et al.*, 2017; Galloway & Brown, 2002). This study explains that the entrepreneurship program has so far not been in accordance with the desired number of targets, so more research is needed from various fields to fill the existing gaps, especially regarding critical success factors (Handoyo *et al.*, 2021). One of the latest studies in Indonesia that needs to be used as a reference is about entrepreneurship intention (Kristiansen & Indarti, 2004). This research is still general; there is no specificity in one particular field. The new thing that has not been developed is how the impact of the COVID-19 pandemic on entrepreneurship intentions, especially regarding creative entrepreneurship, is considered as a field that is easier to develop because it does not require large capital.

In general, the purpose of this research is to explore students' intentions in starting a business by including the pandemic factor as one of the variables. This is necessary considering that the process of extracting intentions is expected to have two advantages, both as a practical solution to existing problems and as a contribution to science. Practically, this research is expected to provide direction for the creation of entrepreneurship education programs, while for science the results of this research are expected to fill the research gap on entrepreneurship with case studies of creative entrepreneurship in Indonesia, and the implementation of theories of planned behaviour into post-pandemic case studies.

LITERATURE REVIEW

In order to accelerate entrepreneurship, there needs to be a planned system in education (Lopes & Lussuamo, 2020). Some research also discusses how to build entrepreneurship-based academic learning but is not limited to formalities (Lamine *et al.*, 2014). More specifically, entrepreneurship science is also researched, especially in formal education (Miller *et al.*, 2016). In higher education there is an entrepreneurial university concept that entrepreneurship knowledge needs to be given to students before entering the world of work. Based on the definitions proposed by Etzkowitz *et al.* (2000), this meaning is defined as a university that has the ability to innovate, recognize and create opportunities, work in teams, take risks, and respond to challenges on its own, seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. In other words, it is a natural incubator that provides support structures for teachers and students to initiate new ventures: intellectual, commercial, and conjoint. The outcome of an entrepreneurial university produces some macro and microeconomic factors that can be influenced, positively and negatively, during the process of creation and development of this kind of university. In building an entrepreneurial university, universities also teach business skills as knowledge that is being taught in the university. Some of the skills that must be taught at universities include the development of behavioural, social, and technical skills; real projects and networks for students (Hasan & Nisa, 2021).

From the pedagogy point of view, transforming existing formal education into an entrepreneurial matter has to consider the entrepreneur or employer's insight. For that purpose, based on some literature reviews, universities must implement more than 5 factors to develop an entrepreneurial concept in the future, such as tacit knowledge, mentorship, peer review learning, combining digital tools, and andragogy. Tacit knowledge is highly personal knowledge. It is hard to formalize and, therefore, difficult to communicate with others. Tacit knowledge is also deeply rooted in action and an individual's

commitment to a specific context—a craft or profession, a particular technology or product market, or the activities of a workgroup or team (Nonaka, 1998).

On the other hand, universities should also apply for a mentorship program. Mentorship is the influence, guidance, or direction given by a mentor. Mentorship is off-line help from one person to another in making a significant transition in knowledge, work, or thinking. A mentor is someone who teaches or gives help and advice to a less experienced and often younger person. A mentor is someone who helps another person become what that person aspires to be (Sabrina & Sihombing, 2018). In an organizational setting, a mentor influences the personal and professional growth of a mentee. Most traditional mentorships involve senior employees mentoring more junior employees, but mentors do not necessarily have to be more senior than the people they mentor. What matters is that mentors have experience that others can learn from. The literature also suggested future research work on 1.) authentic learning, or a real-world case, facts, and examples are used; and 2.) active learning to explore students' problems and develop their answers. Universities, therefore, need to plan for blended learning environments that are characterized by combining digital tools with teacher support to promote interactive learning among the students in and beyond their classrooms (Ashour, 2019).

Another McNelly study suggested that entrepreneurship course syllabi be designed in an andragogical manner. According to a sample of 113 social entrepreneurship curricula from institutions all across the world, Through descriptive statistics analysis, it may be concluded that there has been a shift in teaching philosophies from instructor-centered (Pedagogy) to learner-centered (Andragogy) (McNally *et al.*, 2019). The entrepreneurial spirit can be trained with habit, so Duhig said in his book, The Power of Habit, that it is a reference to the habits of successful entrepreneurs that prospective entrepreneurs can imitate for personality improvement (Duhigg, 2012). Habits or behaviours can be planned by understanding the theory of planned behaviour (TPB) (Ajzen, 1985).

This TPB explains that human actions are caused by previous intentions (I). Besides, attitude (A), subjective norm (SN), and perceived behavioural control (PBC) all influence I. SN is the environment or factors outside of oneself that affects I, which can be other people or the surrounding environment, whereas behavioural control is a belief about the existence of factors that will facilitate or hinder the performance of behaviour and the perceived strength of these factors. Overall, these 3 factors shape intentions and, subsequently, shape behaviour (B). This theory is the foundation for the perspective of beliefs that are able to influence someone to take specific actions. An intention is a decision that is triggered by consciousness or the unconscious. This theory is appropriate for studying behaviour that requires planning, as well as for planning an intention and behaviour to be formed.

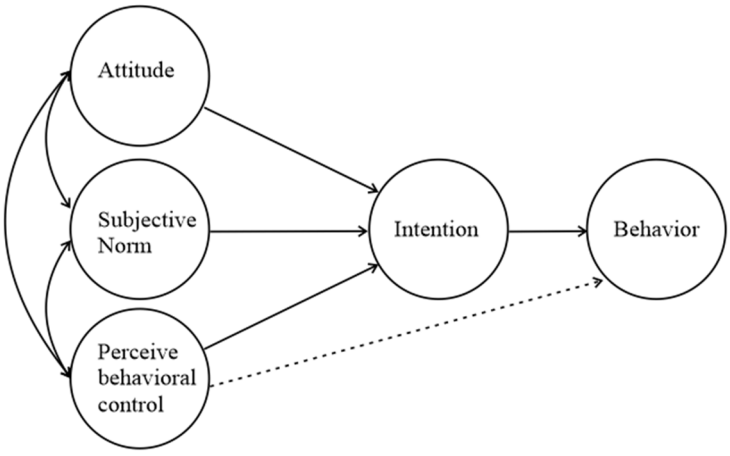

Figure 1. The Theory of Planned Behaviour
Source: Ajzen, 1985.

TPB is an update of Reasoned Action Theory (RAT). It explained that the I to carry out certain actions is caused by two reasons, namely SN and A towards B. Then, in 1988 Ajzen added one factor,

namely PBC. According to Ajzen, A that influences B are important things that can plan actions. However, it is also necessary to consider external factors and behaviour that has become a habit. If there is a plan and support from the environment that makes it easier to behave, this will further support a person's intention to behave. Attitude is the sum of one's feelings about accepting or rejecting a B and is measured by an evaluative scale, for example, strongly agree or strongly disagree (Hill *et al.*, 1977). Attitude is an internal state that affects the choice of individual actions towards certain objects, people, or events (Ajzen, 2002).

The latest entrepreneurial intention research in Indonesia is about the effect of perceived university support, entrepreneurial self-efficacy, and proactive personality in promoting entrepreneurial intention (Dwi *et al.*, 2022). Despite the Indonesian government's institutional support, entrepreneurship is not regarded as a promising alternative career path. As a result, the study investigates the impact of university institutional support and personal trait variables on the entrepreneurial intention of Indonesian students. According to the findings of this study, perceived educational support has a direct impact on entrepreneurial intention. While perceived concept development support and perceived business development support positively shape self-efficacy, which leads to entrepreneurial intent. This study also confirms the role of self-efficacy and proactive personality in predicting entrepreneurial intention. It suggests the future research of the university's support factors to examine the influence of the social environment such as social support and family support. This research suggestion is the baseline to do the research that is reported in this article.

To achieve the goal this research framework is adapted from the Theory of planned behaviour (TPB). Previous research on students' perceptions of business skills, business growth skills, strategy, and successful business are key factors that students consider in their entrepreneurial orientation. In the case of Indonesian students, research conducted by Ambara showed that attitude and perceived control behaviour have a significant role in entrepreneurial intention in Indonesian students. In addition, subjective norms play no role in entrepreneurial intention (Ambara *et al.*, 2019). According to previous research, the modified TPB is a common framework to determine the hypothesis. Therefore, below is the hypothesis and framework for the following research:

H1: There is a strong and positive relationship between attitude and students' entrepreneurial intention.

H2: There is a strong and positive relationship between subjective norm and students' entrepreneurial intention.

H3: There is a strong and positive relationship between perceived behaviour control and students' entrepreneurial intention.

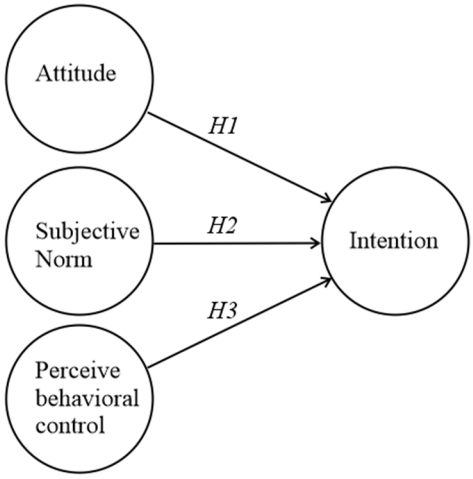

Figure 2. Research Framework and Hypothesis
Source: own elaboration.

RESEARCH METHODOLOGY

Different to the previous studies on education that use qualitative methods (Hlady-Rispal & Jouison-Laffitte, 2014), this research is arranged in a quantitative method that analayze the relationship between a student's A, SN, PBC, and entrepreneurial I in accordance with the TPB. Respondents as research objects are students in the Product Design Department of the Sepuluh Nopember Institute of Technology (ITS). This is in accordance with the target population where they are students who study product design as part of the creative industry and get subject design management and technopreneurship. In addition, ITS is among the top 6 universities in Indonesia based on the World Class University Rank 2022. ITS is located in East Java province, where this province has the largest number of SMEs with the largest contribution in Indonesia. As a comparison, the number of SMEs in East Java is 92,031, while the total number of SMEs in Indonesia is 253,068 (Badan Pusat Statistik, 2022). According to this explanation, ITS students are the target group of responses.

To analyze it, this research uses the Structural Equation Model-Partial Least Square (SEM-PLS) method using SMARTPLS software. This method is the most recent method compared to the previous method, namely SPSS. With SMART PLS, it is possible to use a small number of respondents. This study supports three hypotheses about entrepreneurial intention. The findings of this study have a number of important implications for future practice such as to conduct and evaluate entrepreneurial programs at universities.

The Questionnaire Development

This questionnaire is made up of 4 parts, namely: research overview, identity, demographics, and questions. The research overview is explained through a video recording uploaded on Youtube with a duration of 3.28 minutes. This is to make it easier for respondents to understand the research in a concise and interesting manner, and can draw in respondents from the YouTube viewer itself. The overview also explains that the data collected will be confidential. The identity was collected from respondents in the form of e-mail address, name, telephone number, sex, age, major, university, and years.

There are 14 questionnaire questions, which are grouped into four items based on the TPB model. These questions have been tested and taken from previous studies. These questions are translated into Indonesian to avoid misunderstandings and back-translated by using ImTranslator v 16.21 to maintain accuracy. The questionnaire is measured on a five-point Likert scale, which means strongly disagreeing (1) to strongly agreeing (5). The questions are divided into four categories including A, SN, PBC, dan I. In the A category, the topic being measured and the questions such as passion in entrepreneurship (Al Issa, 2021; Bhansing *et al.*, 2018), life skill, open minded (Al Issa, 2021) and management skill (Campo-Ternera *et al.*, 2022). The SN category is represented by COVID19 pandemic factor (Liguori & Winkler, 2020; Meahjohn & Persad, 2020) internet role (Olanrewaju *et al.*, 2020), government program (Al Mamun *et al.*, 2016; Idris, 2017), campus ecosystem (Bazan *et al.*, 2020), and family support (Al Mamun *et al.*, 2016). The PBC category includes readiness (Zulfiqar *et al.*, 2017), risk taking (Al Issa, 2021), and the spirit of giving (Rehan *et al.*, 2019). At last, the two topics to measure the I are optimism (Bernoster *et al.*, 2018) and opportunity (Hassan *et al.*, 2020).

Data collection

After the questionnaire is made, collecting and analyzing quantitative data is carried out (Walliman, 2006). The targets targeted in this research are all undergraduate students of the ITS Product Design Department. According to ITS data, the total number of students in the 1st, 2nd, 3rd, and 4th grades is 365 persons. Their average age was 18-24 years, and there was no gender restriction. This questionnaire is created online in Google Form and then the URL is distributed using WhatsApp Messenger to students directly one-by-one or through WhatsApp Groups. To make it easier to coordinate lectures, lecturers, supervisors, and staff also help. In addition, the form is also uploaded on the YouTube Channel for easy access directly. The questionnaire was distributed at the beginning of the even semester of 2022, which is early February 2022. Out of 365 students, only 272 filled it out.

Because it uses SEM-PLS, this number is considered valid because the lowest limit according to SEM-PLS is 150 respondents (Bagozzi & Yi, 1988).

The important thing that needs to be considered in accelerating filling out the questionnaire is waiting for students to fill out the form. From this experience, when students are asked to fill it in without waiting, they will delay filling it in and even forget. To coordinate all students at a fast pace, ask the lecturer for time during online classes using the Zoom platform. It only takes 10-15 minutes to be filled by 90% of students. This is the advantage of online lectures, where students are easy to coordinate quickly. Unlike before, by entrusting or sending one by one, for a week, only 10% filled out the form. It's also difficult because you have to remind them one by one every day.

RESULTS AND DISCUSSION

Based on the questionnaire, it was found that the majority of the gender were 179 female students and the remaining 93 male students. Their age is almost the same but the higher the level the fewer the number between 18 – 23 years with details 18 years – 65 students, 19 years – 77 students, 20 years – 74 students, 21 years – 40 students, 22 years – 13 students, 23 year – 3 students. Based on the number of levels, the majority who filled out the questionnaire were first year students, which were 106 students, followed by 80 second year students, 60 third year students and 26 fourth year students. The following is the demographic table of the respondents:

Table 1. Questionnaire result

Description	Frequency	%
Sex		
M	93	34.2
F	179	65.8
Age		
18	65	23.9
19	77	28.3
20	74	27.2
21	40	14.7
22	13	4.7
23	3	1.1
Years		
I	106	39
II	80	29.4
III	60	22
IV	26	9.6
Total:	**272**	**100**

Source: own study.

Once the data is collected, it is continued by making a model based on TPB. As with the SEM-PLS system, it is necessary to determine the code that represents the latent variables and their indicators. The latent variable attitude is represented by code A, subjective norm is represented by code SN, perceived behaviour control is represented by code BC, and intention is represented by code I. The indicators are the questions asked and are represented by numbers, so that a combination of letters is formed, representing the latent variable and numbers that represent indicators. Here is the code arrangement of latent variables, indicators and its questions:

After getting the data results in the form of excel then the data is entered into the Smart PLS software system. The data obtained from the Google Form is still in the form of data without code so it is necessary to replace it with the indicator code as well as change the file format to 'csv' so that it can be detected by Smart PLS. After being imported into SmartPLS, the missing value marker information

will appear: none, meaning the data is ready for analysis. After that, create a framework by determining the latent variables and indicators and then link them according to the TPB framework. Here are the results of the framework:

Table 2. Indicator codes

Code	Questions
Instrument to measure A	
A1	My interest is doing business
A2	I have a good life skill
A3	I am an open minded person, to do business need to learn more
A4	I have a good capability in management to build business
Instrument to measure SN	
SN1	Pandemic COVID 19 condition push me to become entrepreneur
SN2	Technology, internet, and social media influence me to become entrepreneur
SN3	I am aware that the government has programs to assist entrepreneurs and that is why I plan to become an entrepreneur
SN4	My campus ecosystem is support me in becoming and entrepreneur
SN5	My family hopes that I will become an entrepreneur
Instrument to measure BC	
BC1	I am ready to become an entrepreneur
BC2	I like to take a risk and business is a challenging me
BC3	I like giving, I need to be rich, businessman is a rich person
Instrument to measure entrepreneurial I	
I1	I am ready (optimist) to start a business now
I2	If I have the opportunity, I will start to become an entrepreneur

Source: own study.

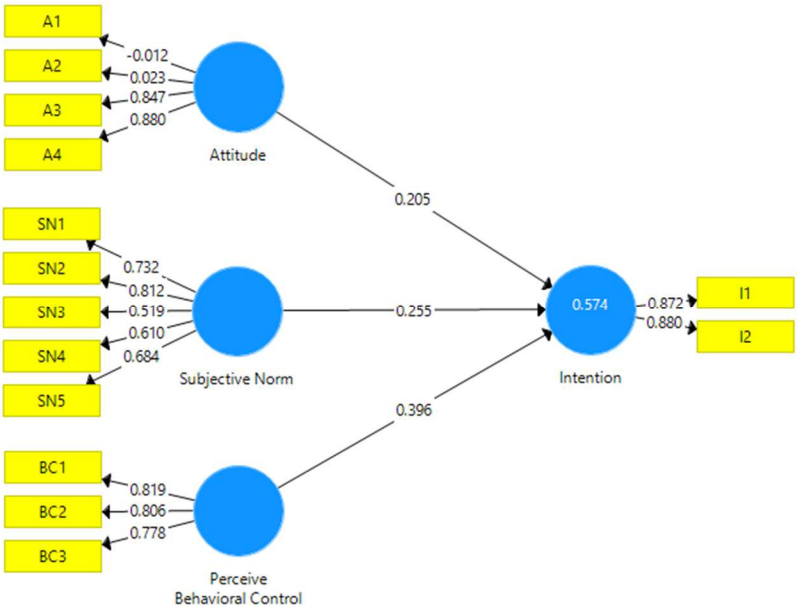

Figure 3. Initial framework before measuring its validity
Source: own elaboration.

It is necessary to re-analyze the measurement model after seeing the results of the framework. This measurement is called Convergent Validity. It consists of two tests, namely loading factor and Average Variance Extracted (AVE). To analyze it, it is necessary to look at the loading factor. An acceptable loading factor is one whose value is above 0.7. However, this value can still be tolerated up

to 0.5 by adjusting the indicator conditions (Hair *et al.*, 2010). If it uses 0.7, then the indicator will run out, then use a lower value up to 0.5. In this case, it is known that A1, A2, SN3, and SN4 have values below 0.5, so they need to be removed. The following are the results of the framework after re-calculating the loading factor. It produces a loading factor value above 0.7, all of which means that the indicator is considered valid. Below is the result framework after being loading factor's recalculated:

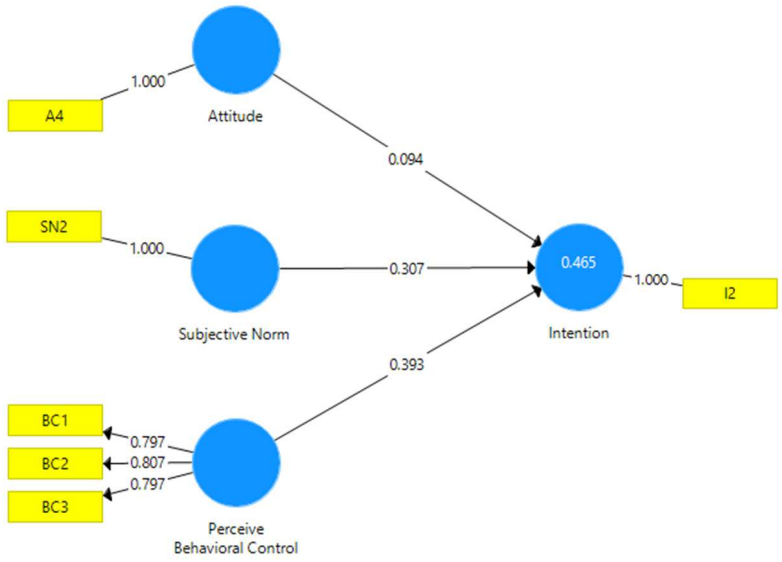

Figure 4. Recalculating loading factor result
Source: own elaboration.

In contrast to the loading factor, which is useful for testing the indicator, the AVE is useful for testing the variable. After the AVE test is carried out through construct validity and reliability. The AVE test requires the removal of new indicators, namely A3, SN1, and I1, this is to adjust the AVE parameters to be above 0.7. The values with the framework adjustments appear as follows:

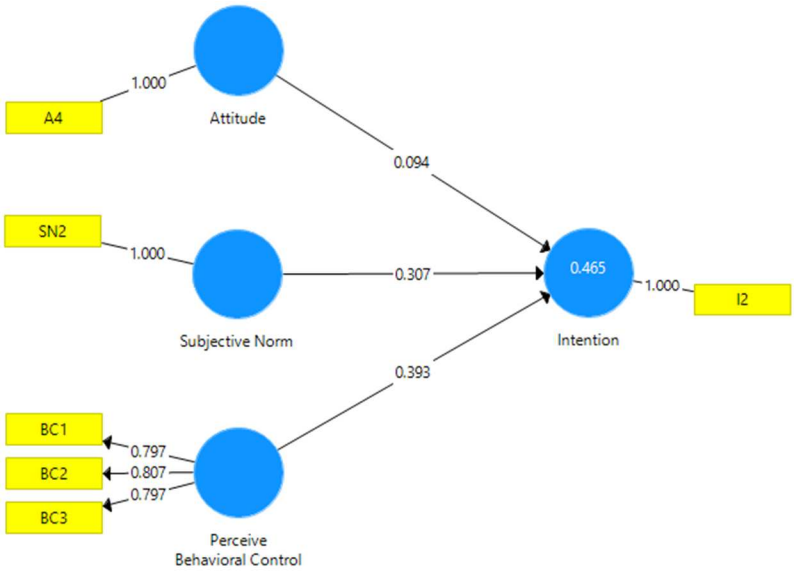

Figure 5. AVE test result
Source: own elaboration.

After performing these two tests, it was found that the remaining indicators were A4, SN2, BC1, BC2, BC2 and I2. By referring to the topic of the previous question, it can be understood that indicator A with measuring tools of passion, open-mindedness, and mastery of life skills is considered insignifi-

cant to determine A. The only significant factor determining A is managerial ability. In addition, to determine SN indicators for pandemics COVID 19, government programs, campus ecosystems and family's expectations do not meet, while the SN values are met by indicators of the influence of technology, internet, and social media. Compared to others, indicators of readiness, risk taking, and spirit of giving can meet the criteria for measuring the BC variable. In variable I, the optimism indicator cannot fulfil while opportunity is more fulfilling.

With these predetermined indicators, the process of measuring the significance of each relationship between exogenous and endogenous variables is then carried out. The exogenous variables are A, SN, and BC while the endogenous variables are I. This measurement is the final process in determining the hypothesis. To know the significance of the correlation, it uses the bootstrapping test. The results of the bootstrap show that the T-Statistic results in A > I 1.550 (H1), BC > I 5.276 (H2), and SN > I 4.399 (H3). This assessment shows a significant relationship if the value is above 1.96. The value of 1.96 or nearly 2 is convenient to take this point as a limit in judging whether a deviation is to be considered significant. It means that the relationship between A and I is not significant. Meanwhile, BC and SN are thought to be important. The bootstrapping stage is the last stage of the SEM-PLS analysis process. The results of the hypothesis have been tested. The result of the bootstrapping are as follows:

Table 3. Bootstrapping result

Path	Original Sample (0)	Standard Deviation (STDEV)	T Statistics (O/STDEV)
Attitude > Intention	0.094	0.061	1.550
Perceived Behaviour Control > Intention	0.393	0.074	5.276
Subjective Norm > Intention	0.307	0.070	4.399

Source: own study.

CONCLUSIONS

Based on the analysis that has been carried out, the conclusion obtained is that entrepreneurship has become a global issue and it is important to carry out continuous studies. There are many studies on entrepreneurship, but they need to be developed by finding research gaps. One of the gaps is the entrepreneurial intention of students in the creative industry. Research on this case with Indonesian case studies is also rare, so this research takes case studies of students from the Department of Industrial Design, Institute of Technology Sepuluh November (ITS). Because the study is about intention, the theory used to study it is The Theory of Planned Behavior (TPB) using the Structural Equation Modeling – Partial Least Squares (SEM-PLS) analysis.

The data used for analysis is 272 data points. Hypothesis H1 investigates the effect of attitude (A) on entrepreneurship intention (I), Hypothesis H2 investigates the effect of subjective norms (SN) on entrepreneurship I, and Hypothesis H3 investigates the effect of perceived behavioral control (BC) on entrepreneurship I. The analysis of the measurement model resulted in the decision to remove two indicators, namely the variables A1, A2, and SN3. In the evaluation of the model, it is found that the five indicators that must be eliminated are A3, SN1, SN4, SN5, and I1. Based on the bootstrapping test on respondent data, the results obtained by the intention variable are positively and significantly influenced by the SN and BC variables. It means that the relationship between A and I is not significant. Meanwhile, BC and SN are thought to be significant.

Related to the topic, it can be interpreted that creative entrepreneurship intention is not influenced by student's Attitudes such as entrepreneurship as a passion, having life skills, and an open-minded spirit. However, entrepreneurship intention is influenced by Subjective Norms such as technology, the internet, social media, and Perceived Behavioural Control such as risk taking, readiness, spirit of giving. In case of pandemic COVID 19 influence, as a part of indicator at subjective norm but it has been eliminated due to AVE test. It means that students' intention to start a business is not affected by a pandemic situation. As for the implications and recommendations, according to the findings of this study, colleges should get more involved with digital technology trends, particularly social

media, in order to stimulate entrepreneurship. The appropriate topic should be discussed on social media, such as readiness to start a business, risk taking, and giving as a good motivation.

As a comparison, based on a previous study on the effects of the pandemic, Eric Ligouri's research in 2020 raised two problems regarding online learning on entrepreneurship education (Liguori & Winkler, 2020). First, students must be trained to adjust to market situations, remain nimble, and innovate, which presents a significant challenge for the lecturer to put what we preach into reality. Second, it serves as a sobering reminder that lecturers have yet to acquire the tools and capacity required to effectively teach what they do in an online manner. The research is only conducted from the lecturer point of view. However, by evaluating student intention using TPB, this research found the opposite. Even though the pandemic and online learning did not affect the students' intention to start a business.

Another research on creative entrepreneurs was also conducted by Bhansing PV in 2018. According to research conducted at the Creative Business Center in the Netherlands, it was found that there is a link between localized passion and inspiration (Bhansing *et al.*, 2018). Furthermore, passion has a favorable and significant impact on inspiration. A three-path mediation model is used in this interaction. First, the entrepreneur's sense of enthusiasm in the environment has a favorable impact on other entrepreneurs' perceptions of passion at the place. Second, how deeply involved an entrepreneur is with his or her own creative work is influenced by the perceived passion of other entrepreneurs. Finally, the more enthusiastically an entrepreneur engages in professional activities, the more motivated he or she will become. This means that the more passionate a location is as a whole (localized passion), the more individual entrepreneurs are driven to turn it into a creative business. This is also contrary to the research discussed in this article where passion as part of the attitude indicator is not a significant factor influencing entrepreneurial intention.

The theoretical contribution of the study is to fill the gap in entrepreneurial research field, especially research of intention that is applied in a creative entrepreneur after the pandemic, and implemented in Indonesia as a case study. In practical use, the results of this research, such as using social media as a strategy and motivational topic, can be used as a reference to support entrepreneurship programs at universities. The social media that is trending now are YouTube, TikTok, Instagram, and Facebook. Universities have to manage the content on such media intensely. They also have to invest on equipment, human capital, and advertisement specifically in this project. The contents, based on the study, recommend sharing motivational topics, for example, readiness to start a business, risk taking behaviour, and giving as motivation to be an entrepreneur.

Despite the fact that this study was successful, these results need to be interpreted with limitation. First, this method was tested for the case of industrial design students. If it is to be applied to other fields in the creative industry, there needs to be further studies with different variables. Second, the contemporary issue while this research is going on is a pandemic that pushes students in digital transformation or study from off-line to on-line, so the pandemic and campus ecosystem is not to influence the entrepreneurial intention. However, in fact, there is another effect of the pandemic that hasn't been captured yet in this study such as economic conditions. Third, the indicators, especially on variable A and SN are limited, therefore two latent variables are loaded by just one item each. The future research is recommended to apply more reliable indicators. In terms of translation, the questionnaires are important to be shown in dual language e.g English and Indonesian in order to avoid misinterpretation. Since one of the findings states that social media is the most important influence to gain creative entrepreneurial intention, the future research suggests to do in-depth study on social media to promote creative entrepreneurship including how to find the role model, to start, to manage, to create educational contents, to optimize, and to evaluate.

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The impact of information and communication technology on services exports: Evidence from developed and developing economies

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ABSTRACT

Objective: The objective of the article is to examine direct and indirect channels through which information and communication technology affects exports of services.

Research Design & Methods: In this study a linear fixed effects panel regression model with country-specific fixed effects and with Driscoll and Kraay standard errors is fit to the data over the period 2000-2019. The samples cover the data sets for 80 countries, and separately for 44 high-income and 36 low and middle-income economies.

Findings: The findings show that the access to traditional and broadband digital connectivity has a positive impact on services exports, revealing a slightly stronger influence of the latter for the advanced economies. Additionally, exports and imports of the ICT goods appear to be complementary to services exports.

Implications & Recommendations: The detected dependencies indicate that in a digital era, connectivity infrastructure, as well as international flows of the ICT goods bring about significant effects for services exports. Both findings raise important implications for export-led growth policy that should account for new interdependencies between goods and services, and for further investments in digital infrastructure.

Contribution & Value Added: This study contributes to the relevant literature by extending the traditional factor-endowment approach used to explain the impact of information and communication technology on the exports of services. Besides specifying the exports of services as a function of internet market penetration, both a traditional and a broadband one, we consider the exports and the imports of ICT goods as the potential determinants of services exports.

Article type:	research article
Keywords:	services exports; digital trade; broadband connectivity; international trade; ICT; trade in services
JEL codes:	F10, F14, C23

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INTRODUCTION

The rise of services trade is one of the most distinctive features of international trade in the 21st century. In the first two decades of a new millennium, the growth of services exports outstripped the growth of goods trade. From 2000 to 2019, the volume of global services exports almost tripled, whereas goods exports doubled over this time. Developing countries became the main actors of rapidly expanding international trade, as the pace of their exports, of both goods and services, clearly exceeded that of developed economies. Although developing economies have successfully expanded their shares in global trade, the prevailing position of high-income countries have remained strong, especially in services exports. In 2000, high-income countries provided about 84% of the world services exports, and in 2019 their shares only slightly decreased to around 80%. In goods trade, the asymmetry between developed

and developing countries has weakened to a larger extend, as low and middle-income economies shifted their shares of global goods exports from 18% in 2000 to 34% in 2019 (WDI database).

This study takes a close look at information and communication technology (ICT), seeking to explain how it affects the exports of services. While most of researchers focus on the role of digital infrastructure, including internet or mobile phone connectivity, our study extends this traditional factor-endowment approach. Thus, besides specifying the exports of services as a function of internet market penetration, both a traditional and a broadband one, we include the exports and the imports of ICT goods as the potential determinants of services exports. We contribute to the existing literature, accounting for the relationships between ICT goods trade and services exports that allow covering different international channels through which digital technology may affect trade in services. We expect that digitalization not only creates new types of services, but also gives rise to new interlinkages between goods and services. Thus, we hypothesize that digitalization affects services exports, both directly and indirectly. The existence of a complementarity between trade in ICT goods and the exports of services would imply important recommendations for trade policy-makers.

The rest of the paper is organized as follows. First, we briefly overview main tendencies in services trade over the last two decades. Then, we discuss the relevant literature on services exports, pointing to the different categories of tradable services and their determinants. Next section describes the variables, data sources, and methodology that we apply to the empirical analysis. The results and the discussion are presented in the next part. Eventually, in concluding remarks we present the implications of our findings for trade policy and point to the fields of further relevant studies.

LITERATURE REVIEW

Service exports was growing intensively worldwide during the recent decades, reaching in 2019, i.e. in a year before the Covid-19 pandemic, 25% of the volume of global trade in goods and services. Two crises, the Global Financial Crisis (GFC) and Covid-19 pandemic, have interrupted a steady growth of services exports. In 2009, the volume of global service exports collapsed by around 11%, both in high-income, and in low and middle-income economies. After rebounding in 2010, global exports of services reached their pre-crisis level, however, in 2015 when world economy slowed down services exports lost their momentum (Fig. 1).

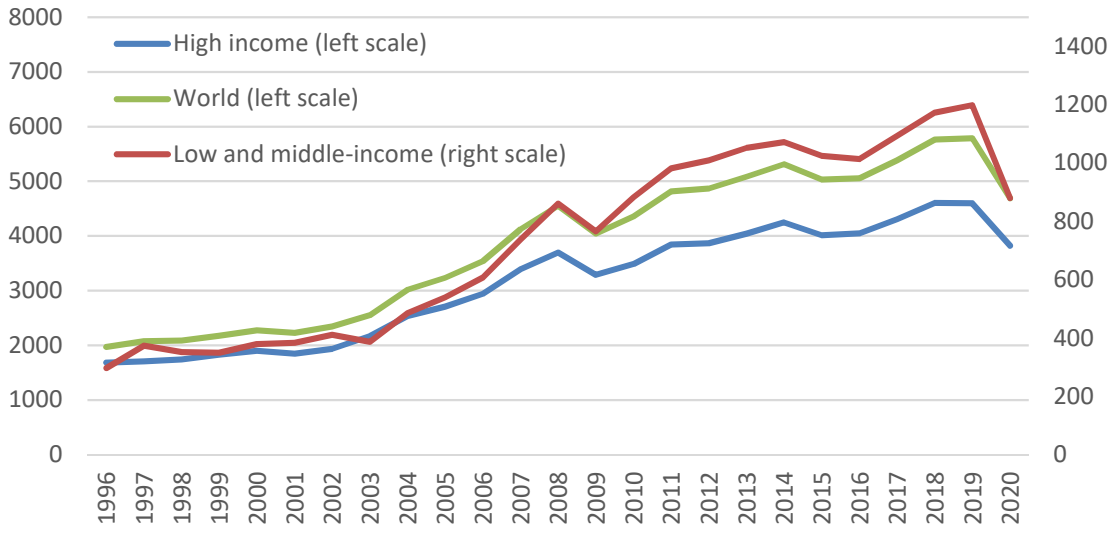

Figure 1. Exports of services from different income-group countries (in bln of USD, deflated by the GDP deflator)
Source: own elaboration based on the data from WDI database.

In 2020, the Covid-19 pandemic restrictions such as social distance and lockdowns, particularly adversely affected services, whether supplied to domestic or international markets. In the first year of the

pandemic, the volume of the worldwide services exports fell by nearly 20%. This time, the collapse of services exports was much more severe in low and middle-income countries (-26%) than in developed economies (-17%). Apparently, the difference was due to the fact that the Covid-19 pandemic-driven shock mainly reduced exports of traditional services, like transport and travel, which account for a larger share of exports from developing, rather than from developed countries. For instance, in the year preceding the outbreak of the Covid-19 pandemic the share of travel in developing economies services exports amounted, on average, to 33%, whereas in developed countries the relevant average shares were below 20%. In particular, developing countries in Latin America and the Caribbean, North Africa and South-East Asia rely on travel services. The average shares of this category in total services exports from these regions, amounted in 2019 to 50%, 45%, and 35%, respectively. Given that in 2020 the decline in exports of travel services was by 70%, the economic impact of Covid-19 pandemic was extremely severe in these regions. It is worth noting that the exports of certain types of modern services, for instance, telecommunication, computer and information services, were steadily increasing in the Covid-19 pandemic times (Fig. 2). This was a natural consequence of adapting to the pandemic restrictions through the use of digital technologies in daily life. The intensification of online communication for work, study, commerce, and leisure contributed to the growth of international trade in ICT services.

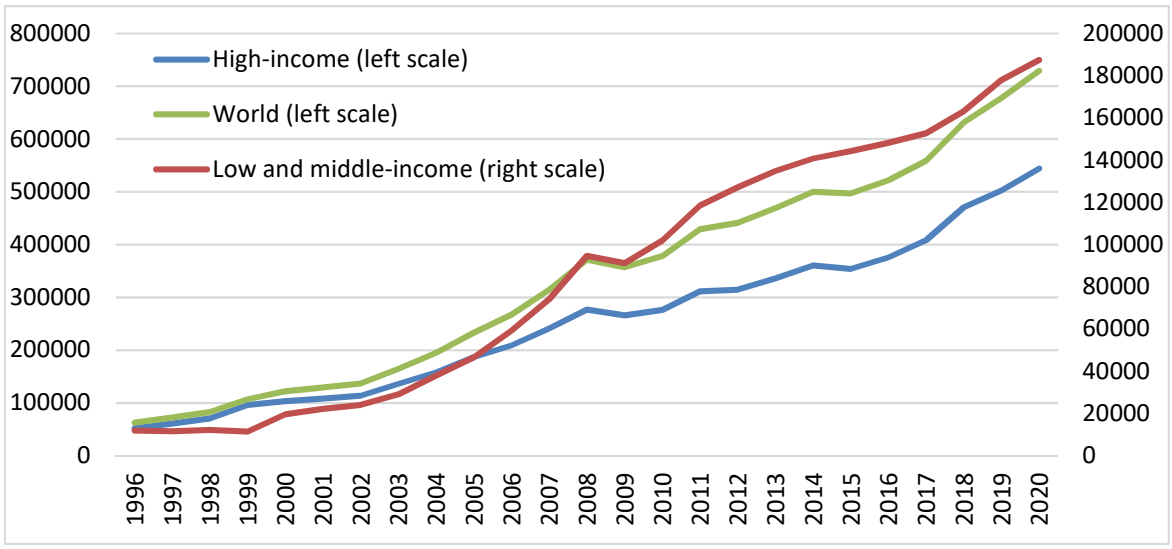

Figure 2. Exports of ICT services from different income-group countries (in mln of USD, deflated by the GDP deflator)

Source: own elaboration based on the data from WDI database.

Figures 1 and 2 show that since 2008 the growth of services exports has been faster in low and middle-income countries than in high-income economies. It should be noted, however, that despite this dynamic development, the shares of low and middle-income countries in the world services exports remain about four times smaller than those of high-income countries. This asymmetry is readily apparent in Figure 2 when considering that the scales on the right and left axes are different.

Apparently, the substantial predominance of developed economies in the global services exports reflects the differences in the GDP structure of high-income, and low and middle-income economies. In the former, services contributed in 2019 about 70% to GDP, whereas in the latter, the value added of services amounted to around 54% (Fig. 3). Thus, as the share of services in GDP increases along with economic growth, it is very likely that catching-up countries will increase their comparative advantages in trade of services. In the era of digitalization, when services become more tradable, the question arises about the distribution of gains from the expanding service exports between developed and developing countries.

The studies on services exports have been gaining in popularity as the share of services in global trade has grown. The research questions on services trade determinants have varied from the role of service trade liberalization policy (Evenett & Fritz, 2021; Gupta *et al*., 2022) through the innovative channels of services delivery, and the new types of tradable services, relating to such phenomena as

servicification (Bombińska, 2019), off-shoring and global value chains (Kordalska & Olczyk, 2021), or industrial revolution 4.0. Undoubtedly, the latter one, which includes the development of information and communication technology, has created a lot of opportunities for services trade, overturning the assumption, used for instance in the Balassa-Samuelson model, that services are not tradable.

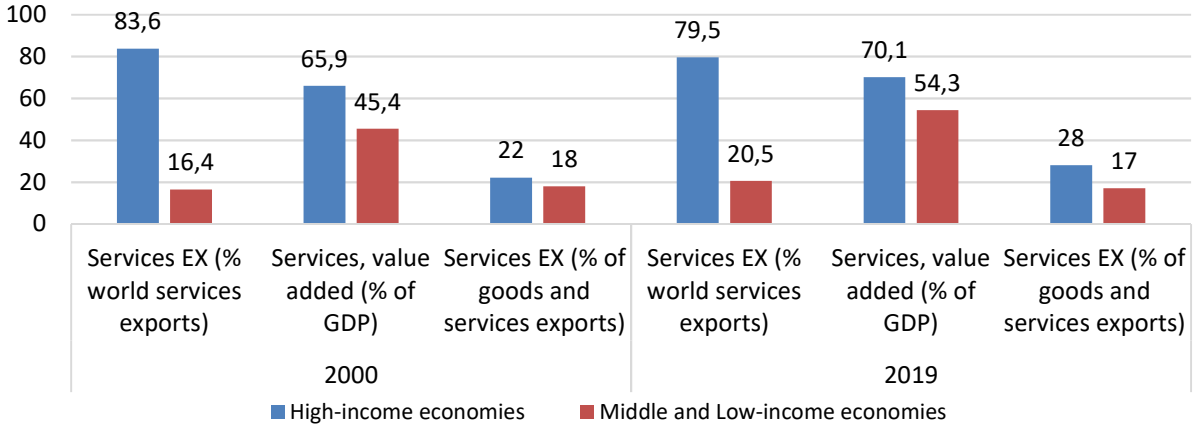

Figure 3. Services exports as a percentage of countries' exports of goods and services, world services exports, and the value added by services to GDP
Source: own elaboration based on the data from WDI database.

Many studies have confirmed that digital technology has played a pivotal role in supporting services trade, both in developed, and developing economies. For example, Nasir and Kalirajan (2014) using a stochastic frontier gravity model examine services exports performance of Asian emerging and developed countries. The authors show that labour skills and the ICT infrastructure are key factors fostering modern services exports. They also point to the role of services trade liberalization, which enhances trade in modern services, such as computer and information, business and professional, and telecommunication.

Eichengreen and Gupta (2013) examine determinants of modern services exports using country-level data for 60 developed and developing economies, and taking a close look at India, which performance in modern services has been exceptional, especially in the sector of information and telecommunication. The authors show that besides factor endowments, like communication infrastructure, access to foreign technology, availability of highly-skilled English-speaking labour, as well as the overall economic development, and goods trade have significant and positive impact on services exports. Introducing exports of goods as an explanatory variable into the services trade model, the authors accounted for network effects, as well as, complementarities between tradable goods and services. When, instead of goods exports, the authors incorporated goods imports and total goods trade into the model, the panel regression results showed that these variables also positively affected services exports. The identified linkages appear to be associated with supply-side factors used by the producers of services.

Similarly to the Eichengreen and Gupta's study (2013), Sahoo and Dash (2014) also examine an impact of goods exports on services exports, which allows capturing the network effects. Using the ARDL cointegration model, Sahoo and Dash (2014) identify for India's economy a positive and significant long-term relationship running from goods exports to modern services exports such as software and communication, and insurance and finance. Their findings imply that the existing trade networks in merchandise market are likely to support foreign sale of services. The authors also found that human capital, tele-density, foreign direct investments and exchange rates are important drivers of modern services exports.

While Sahoo and Dash (2014) point to goods exports as a determinant of services exports, López-González and Ferencz (2018) identify imports as the channel through which goods affect services exports. According to the authors such approach allows exploring complementarities emerging between

tradable goods and services in the digital era. They construct a new variable which captures the combined importance of digital connectivity and ICT devices. As the latter often derive from imports, it has been calculated as a product of the ICT goods imports and the density of digital connectivity. After having introduced it as an explanatory variable into the gravity model of trade, the results confirmed positive linkages between this new measure and exports of services. The identified relationship implies that imports of ICT goods contribute to the factor endowments, including digital infrastructure, which is used by producers and exporters of services. According to the authors, their finding suggests that digitalization not only affects services exports (especially digitally deliverable ones) directly, but also indirectly through the ICT-related goods.

An interesting empirical study on the role of ICT on exports, imports and total trade of different types of services is by Nath and Liu (2017). They construct the ICT development index, which captures three aspects of information and communication technology, such as access, use, and skills. Additionally, they employ real GDP per capita and population as control variables. Using the GMM method and estimating the models with data for 49 countries over the period 2000-2013, Nath and Liu (2017) identify a positive and significant effects of the ICT on total service trade, and also on exports or imports, separately. Their results show that the development of information and communication technology has contributed significantly to trade in the majority of the services, including telecommunication, business, financial, and insurance, which are classified as the ICT-enabled services. Moreover, real per capita GDP revealed to have a positive and statistically significant effect on exports, imports and total trade in more types of modern services. This finding explains the predominant position of advanced economies in international trade of ICT services.

More recent studies highlight the role of services in global value chains (GVC). This area of services performance attracts a lot of attention from both academics and policymakers (Mayer, 2018; Bombińska, 2019; Kordalska & Olczyk, 2021). The ongoing discussion concerns not only functional but also methodological issues of measuring and distribution of value added in trade. Since many services have been bundled with goods and sold as inputs, their evidence as separate trade flows became complex. A couple of new initiatives have been launched to deal with this methodological issue. For instance, the OECD released Trade in Value Added (TiVA) database, which delivers evidence on imports of foreign inputs to produce goods and services for exports, and also data on domestically produced inputs, which are then exported and used by foreign producers. Such statistics capture, respectively, backward and forward links of domestic entities with foreign partners that allows for better estimation of real contribution of services into the exports. According to TiVA evidence, services bring about 50% of the value added in exports, whereas Miroudot and Cadestin (2017) claim that this share may amount to about two-third. According to the authors, service activities provided within manufacturing firms, either as substitutes or complements to merchandises, may increase this contribution.

The importance of the strength of linkages between services and manufactures is confirmed by Kordalska and Olczyk (2021). They examine the role of goods and services bundling in the domestic markets on fostering trade by participation of domestic agents in GVC. The authors analyse backward and forward linkages between manufactures and different categories of tradable services, including: financial and insurance; business and management consulting; legal and accounting; and computer programming in seven Central and Eastern European economies. They found that positive intersectoral relationships between manufactures and services at the countries' level enforce comparative advantages and foreign trade of intermediary services used in international production chains. This result allows them to conclude that the role of complementarity between services and goods is more than just inputs. The mechanisms that bundle up manufactures and services, enhancing foreign trade, are also described by Bombińska (2019), who points to the various patterns and channels of international servicification. The author shows, that besides offshoring, also capital mobility, for example in the form of foreign affiliates, triggers international servicification and trade in services. These international channels, that link services to the production and the sale of goods are particularly important in integrated economies, e.g. the EU, where a common market ensures the free movement of goods, services, capital, and labour.

The literature review and prior empirical results allowed to assume the following research hypotheses:

H1: There is a positive relation between internet connectivity and services exports.

H2: Export of ICT goods is positively related to services exports.

H3: Import of ICT goods enhances services exports.

RESEARCH METHODOLOGY

The annual country-level data that we used in our research come from the World Bank database (WDI). The size and period of the sample are dictated by the availability of the data on trade in ICT goods. Using three data sets, i.e. for 80 countries and separately for 44 high-income and 36 low and middle-income economies over the period 2000-2019, we run panel regressions of services exports on ICT goods exports, ICT goods imports, and internet connectivity, both traditional and broadband. These four types of the ICT-related data used as the explanatory variables, allow capturing different channels through which ICT can affect exports of services.

In addition, estimating the models for the whole sample and then for the two sub-samples, selected by income per capita, provided a comparative perspective. A classification of countries by income-group is according to the World Bank that defines high-income economies as those in which GNI (Gross National Income) per capita in 2020 exceeded USD 12,695. Middle-income economies are those in which 2020 GNI per capita was between USD 1,046 and USD 12,695. And, if GNI per capita was USD 1,045 or less in 2020, the countries have been classified as low-income.

The services exports model is specified in equation (1):

$$\ln EXS_{jt} = a_{j0} + a_1 \ln GDP_t + a_2 \ln ICT_{jt} + a_3 \ln INT_{jt} + a_4 \ln REER_{jt} + \varepsilon_{jt} \quad (1)$$

where *j* stands for a country and *t* refers to the year. Exports of services (EXS), which is our dependent variable, include different types of services defined as economic output of intangible commodities that may be produced, transferred, and consumed at the same time (WDI database). Taken in the US dollars, they were then deflated with the GDP deflator for the US economy. The variable ICT1 stands for imports (in model 1 and 3) and ICT2 for exports (in model 2 and 4) of the ICT goods, depending on the models. Each of these variables may affect services exports, accounting for the different channels of international diffusion of technology. Thus, we consider, alternatively, imports and exports of the ICT goods that are given, respectively, as a percentage of country's imports and exports of total goods. According to the WDI data definition, the ICT goods include computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods. The other explanatory variable, denoted as INT captures the access to the traditional (INT1) and modern internet network (INT2). In models 1 and 2, the INT1 gauges individuals using the internet as a percentage of population, whereas in models 3 and 4, the INT2 covers the access to the broadband connectivity and it is given as a number of fixed broadband subscriptions per 100 people.

Following the literature, we have also introduced demand-side and cost-related factors as variables that traditionally explain services exports. They are proxied with the world GDP (GDP) and the real exchange rates (REER). The former is given in constant US dollars, whereas the latter measures the value of domestic currency against a weighted average of foreign currencies of the main trading partners, divided by a price deflator or index of costs.

Panel data are characterized by time series observations for a set of countries. This kind of data typically displays both contemporaneous correlation across countries (cross-sectional dependence), country level heteroscedasticity and serial correlation making inference from standard errors produced by ordinary least squares suboptimal. Panel-corrected standard errors or "robust" standard errors help to account for these issues and allow for better inference. Different standard errors estimators are preferred in one or the other branch of applied econometrics. For moderately-sized panel time series in macroeconomics Driscoll and Kraay (DK) "robust" standard errors (Driscoll & Kraay, 1998) are usually recommended. In this study a linear fixed effects panel regression model with country-specific fixed effects and with DK standard errors was fit to the data (Driscoll & Kraay, 1998).

RESULTS AND DISCUSSION

Tables 1-4 show the results for each of our four models of services exports, accounting for different gauges of digital connectivity and two flows (exports and imports) of ICT goods trade as potential determinants of services exports. Tables 1 and 2 present the results for models including traditional internet, whereas tables 3 and 4 show the estimates for models with broadband connectivity as a proxy for digital communication infrastructure. The results estimated for all countries in our panel data, and also for two panel sub-sets selected by countries' income per capita, are presented in columns. Our findings imply, that the access to digital connectivity network, as well as trade in ICT goods are important drivers of services exports. Moreover, foreign demand proxied by the world GDP positively affects services exports, taking the highest values of the regression coefficients (ranging from 1.40 to 1.79, depending on the model). These findings have been confirmed when the models were estimated for a sample of all countries, and for the samples, selected by income-group countries.

Table 1. Model 1 estimation results for services exports

Independent variables	Sample (1) All countries	Sample (2) High-income countries	Sample (3) Low and middle-income countries
World demand for services GDP	1.56***	1.55***	1.40***
	(0.19/0.0000)	(0.17/0.0000)	(0.24/0.0000)
Internet connectivity INT1	0.13***	0.14***	0.14***
	(0.02/0.0000)	(0.03/0.0000)	(0.03/0.0000)
REER	0.55***	0.31***	0.68***
	(0.06/0.0000)	(0.08/0.0001)	(0.07/0.0000)
ICT1	0.08***	0.11***	0.06**
	(0.02/0.0002)	(0.03/0.0013)	(0.03/0.0186)
R^2	0.988	0.985	0.985
Countries/Observations/Years	80/1513/12-20	44/842/13-20	36/671/12-20

Notes: Asterisks denote statistical significance at ***: 0.01, **:0.05, *: 0.10 level. Driscoll-Kraay robust standard errors and p-values are in parentheses.
Source: own calculations in R.

Table 2. Model 2 estimation results for services exports

Independent variables	Sample (1) All countries	Sample (2) High-income countries	Sample (3) Low and middle-income countries
World demand for services GDP	1.55***	1.55***	1.41***
	(0.19/0.0000)	(0.19/0.0000)	(0.24/0.0000)
Internet connectivity INT1	0.15***	0.16***	0.16***
	(0.02/0.0000)	(0.03/0.0000)	(0.02/0.0000)
REER	0.63***	0.42***	0.73***
	(0.06/0.0000)	(0.11/0.0001)	(0.07/0.0000)
ICT2	0.01**	0.03**	0.01
	(0.00/0.0245)	(0.01/0.0107)	(0.01/0.4562)
R^2	0.988	0.985	0.985
Countries/Observations/Years	80/1506/12-20	44/842/13-20	36/665/12-20

Notes: Asterisks denote statistical significance at ***: 0.01, **:0.05, *: 0.10 level. Driscoll-Kraay robust standard errors and p-values are in parentheses.
Source: own calculations in R.

The coefficients of traditional internet connectivity, as expected, have positive signs. They are statistically significant at 1 percent level in all of the models. As tables 1 and 2 show, the values of coefficients of internet access range from 0.13 to 0.16 (depending on the model), whereas those of the broadband connectivity amount to 0.04-0.06 (table 3 and 4). Thus, the traditional internet connectivity (INT1) appears to have a greater impact on services exports than the broadband connectivity (INT2). This property was identified for high, as well as for low and middle-income economies. When compar-

ing our findings to other relevant studies, we noted that the results obtained by López-González and Ferencz (2018) indicated that traditional internet infrastructure has a positive impact on service exports, with the strength of the impact varying for different types of services. For instance, the model of post and telecommunication services gives the coefficient of 0.335, for computer and related services the coefficient amounted to 0.323, and for hotels and restaurants the coefficient was 0.175. When the authors tested the influence of internet connectivity on the overall exports of digitally enabled services, the average coefficient was 0.222., implying that a 1 percent increase in internet connectivity (proxied by a number of internet users) enhances, on average, the exports of digitally enabled services by 0.222 percent. The sample, tested by López-González and Ferencz (2018), covered both developed and developing economies. It is worth to note, that the authors also examined the impact of internet access on goods trade in each group of countries separately. They found a stronger relationship of the impact of internet infrastructure on exports in developed countries (the coefficient of 0.509) than in developing ones (the coefficient of 0.012).

Table 3. Model 3 estimation results for services exports

Independent variables	Sample (1) All countries	Sample (2) High-income countries	Sample (3) Low and middle-income countries
World demand for services GDP	1.57***	1.51***	1.77***
	(0.15/0.0000)	(0.18/0.0000)	(0.11/0.0000)
Broadband digital connectivity INT2	0.05***	0.05***	0.04***
	(0.01/0.0000)	(0.02/0.0004)	(0.01/0.0000)
REER	0.43***	0.24**	0.56***
	(0.07/0.0000)	(0.11/0.0323)	(0.07/0.0000)
ICT1	0.09***	0.10***	0.07***
	(0.02/0.0000)	(0.03/0.0009)	(0.03/0.0043)
R^2	0.988	0.984	0.985
Countries/Observations/Years	80/1464/13-20	44/833/15-20	36/631/13-20

Notes: Asterisks denote statistical significance at ***: 0.01, **:0.05, *: 0.10 level. Driscoll-Kraay robust standard errors and p-values are in parentheses.
Source: own calculations in R.

Table 4. Model 4 estimation results for services exports

Independent variables	Sample (1) All countries	Sample (2) High-income countries	Sample (3) Low and middle-income countries
World demand for services GDP	1.57***	1.53***	1.79***
	(0.15/0.0000)	(0.20/0.0000)	(0.12/0.0000)
Broadband digital connectivity INT2	0.06***	0.06***	0.05***
	(0.01/0.0000)	(0.02/0.0011)	(0.01/0.0000)
REER	0.49***	0.30**	0.61***
	(0.07/0.0000)	(0.14/0.0304)	(0.06/0.0000)
ICT2	0.02***	0.04***	0.02***
	(0.00/0.0000)	(0.01/0.0001)	(0.00/0.0000)
R^2	0.988	0.984	0.985
Countries/Observations/Years	80/1459/13-20	44/833/15-20	36/627/13-20

Notes: Asterisks denote statistical significance at ***: 0.01, **:0.05, *: 0.10 level. Driscoll-Kraay robust standard errors and p-values are in parentheses.
Source: own calculations in R.

Our findings also identified complementarities existing between exports of services and trade in ICT goods. On the one hand, services exports are higher when ICT goods imports increase. The strength of these relationships varies for the income-groups samples. Tables 1 and 3 demonstrate that high-income economies reveal stronger positive relationships between exports of services and imports of ICT goods (the coefficients 0.1-0.11) than developing countries (the coefficients 0.06-0.07). On the other hand, services exports appear to be complementary with exports of ICT goods, implying intersectoral dependencies operating by goods-related services or bundled services. These relationships

also turn out to be stronger for developed than for developing countries. It is worth adding, that the coefficients of ICT goods exports take lower values than those of the ICT goods imports, ranging from 0.02 to 0.03 for low and middle-income countries, and from 0.03 to 0.04 for high-income economies. The finding that imports of ICT goods positively affect services exports is in line with the results by López-González and Ferencz (2018), who identified complementarities between imports of ICT goods and exports of digitally deliverable services. The coefficient of 0.009, obtained by the authors, was also relatively small, however, it should be underlined, that they proxied the ICT goods imports by a new combined measure of internet penetration and imported ICT devices.

Our results on price-related factors, included in the explanatory variable as the real effective exchange rate, imply that an appreciation of the domestic currency is associated with an increase in exports of services. This positive relationship may be due to an increase in demand for the domestic currency, used as the invoicing currency of service exports payments. The coincidence in the short term of capital inflows that cause exchange rate appreciation with the export of services is characteristic for services requiring direct contact between supplier and consumer., e.g. travel, tourism, or transport services. This interpretation has been apparently confirmed by the values of the coefficients for REER, which are higher in middle-income countries recording higher shares of traditional services in total services exports, than in high-income countries. Depending on the model, the values of REER coefficients range from 0.56 to 0.73 for low and middle-income countries, and from 0.24 to 0.42 for high-income countries.

Our results have important and far-reaching implications on trade and growth policies. The first implication is that export-led growth focusing on services exports requires digital infrastructure capabilities, supporting production and exchange of services. Since traditional internet has already reached 90% of the market penetration in high-income economies, more scope for investments in this area is left in low and middle-income countries, whose 50% of population has access to traditional internet infrastructure. Therefore, investment in information and communication infrastructure should be at the centre of developing countries' growth strategies. Given rapid advances in digital technology, development of broadband connectivity network should be a first priority. There is much to be done in this area, both in high- and in low and middle-income countries, as the broadband penetration of their markets is relatively low. On average, the number of fixed broadband subscriptions per 100 people amounts to 35 in high-income and only to 15 in low and middle-income countries. Accounting for more advanced digital products that require high speed of data transmission, a development of the broadband internet infrastructure appears to play a key role in digital-led growth policy. Additionally, the increasing number of internet users, both producers and consumers, need high-speed bandwidth connectivity enabling upstream and downstream data-carrying capacity. This kind of supply-side factors seems especially relevant for supporting the development of modern services exports that can be digitally delivered.

The second policy implication stems from our finding that services are complementary to ICT goods, both imported and exported ones. On the one hand, the ICT imported goods contribute to digital factor endowments, providing technology-advanced devices used by the producers and exporters of services. Our study shows, that imports of ICT goods are positively related to exports of all services, not only in the ICT sector. Thus, the imported technology in the form of ICT goods can both directly and indirectly support the provision of services abroad. For example, exports of ICT services such as software-related services, data-processing services, or the broadcast or transmission of sound, images, are directly supported by ICT goods, whereas the export of traditional services use ICT goods rather in indirect way. The latter may involve supporting the transport services with satellite navigation or transit payment applications, and backing the travel services by digital accommodation databases, online travel tickets, currency exchange applications, etc.

Moreover, since the imports of ICT goods worsen trade balance, countries with structural external deficits may resort to protectionism. As protectionist behaviour intensified in the aftermath of the Covid-19 crisis and many economies began to insulate their domestic markets, from foreign competition, the awareness that imports of ICT goods support exports of services should temper the inclination to implement trade restrictions. Hence, liberal trade policies, as well as regulations governing trade in ICT goods and related intangible assets, should be a key element of export-driven strategies of growth.

In other words, trade policy-makers should account for new opportunities for enhancing exports, which emerged from the interlinkages between ICT goods and services. It should also be emphasised, that a liberal trade policy towards imports of ICT goods may be not sufficient to achieve the benefits of high-tech tangible assets. The experience of successful ICT service exporting countries, including India or Ireland, shows that human capital also plays a pivotal role in modern service exports.

On the other hand, the exported ICT goods also drive services exports either directly, for instance by enhancing post-sale services, such as maintenance and repair, or indirectly, for example, through network effects. The observation that complementarities between ICT goods trade and services exports appeared stronger in advanced rather than in developing economies, can be explained by the fact that the former build their comparative advantages in modern services such as financial or ICT, which according to López-González and Ferencz (2018), are more digitally-relayed.

CONCLUSIONS

This study examined the key drivers of services exports performed in high-income and low and middle-income economies. Seeking to explore the role of the factors related to the information and communication sector, we took a close look at the connectivity infrastructure and international trade in the ICT goods as potential determinants of services exports. This two-fold approach allowed capturing direct and indirect channels through which digital technology can affect exports of services. Moreover, running panel regressions for different data sets selected by the countries' income per capita, we shed light on the differences in the determinants of services exports between high-income and low and middle-income economies.

In sum, the detected dependencies indicate that in a digital era, not only connectivity infrastructure, but also international flows of the ICT goods bring about significant effects for services exports. In other words, the ICT, operating either directly, through infrastructure endowments, or indirectly, through the ICT goods trade, may enhance exports of services. Our findings showed a slightly stronger influence of broadband connectivity on services exports in advanced economies rather than in low and middle-income economies. Additionally, exports and imports of the ICT goods appeared to be complementary to services exports in both of the countries' groups. The strength of these relationships also appeared greater in the models tested for high-income than for low and middle-income countries. Since our dependent variable captures total services exports, including traditional, such as transport, travel, or construction, as well as the modern ones, such as financial, software-related services or data-processing services, the results we obtained suggest that exports of both types of services are driven by the ICT goods, both exported and imported.

Given the continued development of the ICT and its positive influence on services exports, our study provides useful implications for economic policymakers. Firstly, export-led growth focusing on services exports requires digital infrastructure, thus further investment, especially in high-speed internet connectivity is required. Secondly, the detected complementarities between ICT goods trade and services exports imply that trade regulations imposed on both exports and imports of ICT goods should account for their impact on services exports. This conclusion seems extremely important when in the aftermath of the GFC and the Covid-19 pandemic, many countries have imposed trade barriers, aiming at reducing their vulnerabilities to external shocks.

Further research on services exports focusing on cross-sectoral approach could reveal additional channels and mechanisms behind the interdependencies of goods and services. In the digital era, a particular field for further research, covers global value chains of services, including data chains. Data collection and data processing are two pivotal activities within global data chains. As almost all internet users are involved in global data chains, but there are relatively few service providers, e.g. the owners of digital platforms, the major issue that digitalisation raises for global economy is the distribution of the benefits of international trade. Moreover, digital trade raises the security issues, therefore international regulation of the protection of intangible assets, the protection of personal data and the security of digital payments, should be on the agenda. To conclude, the biggest challenge for modern international trade

appears to be the adjustment of existing regulations to new products, services and the relationships emerged between them in digital era, without reducing the level of trade liberalisation.

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Conflict of Interest

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The effects of participation in European competitions on the domestic competitiveness of Polish football clubs

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ABSTRACT

Objective: The objective of this study was to establish whether participation in European football competitions affects the sports performance of Polish football clubs in the domestic league. Accordingly, negative short-term effects and positive medium-term effects were hypothesized.

Research Design & Methods: Based on the case of Polish Ekstraklasa, observations covering a 10-year competition period (seasons 2011/12 to 2020/21) were tested in regression models that included the league points and positions in the table as dependent variables and participation in the European UEFA competition and promotion to the group stage as explanatory variables.

Findings: The results revealed that if a Polish football club competes in European competitions, there are neither negative consequences for its domestic competitiveness in the short run nor positive consequences in the medium-term period.

Implications & Recommendations: Every season, football teams throughout Europe make an effort to internationalize themselves through UEFA competitions. This study demonstrates to sports managers that, contrary to common belief, engaging limited resources of football clubs outside the top leagues to compete in two competitions simultaneously has neutral effect.

Contribution & Value Added: To date, researchers have been interested in determining the influence of international competitions on the level of competitive balance. This is the first study on the impact of participation in European UEFA competitions on sports performance in domestic leagues outside Western Europe.

Article type: research article

Keywords: competitive imbalance; financial fair-play (FFP); resource-based view (RBV); sport performance; sports clubs; UEFA

JEL codes: F23, Z21

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INTRODUCTION

The format of European football club competitions has evolved over the years. The general direction of these changes is to open access for more units from the richest and highly competitive leagues, especially the so-called 'Big Five' (English *Premier League*, French *Ligue 1*, German *Bundesliga*, Italian *Serie A*, and Spanish *La Liga*), to compete at the cost of limiting the number of poorer, weaker, and less recognizable global clubs from eastern Europe (Bullough, 2018). Meanwhile, the prizes for participation in both UEFA tournaments, the Champions League (UCL) and the Europa League (EL), have been growing constantly (UEFA, 2021). According to Késenne (2015), these two tendencies have deepened international imbalances in European football in terms of both the financial and sporting situations of clubs in different countries.

Currently, the Big Five leagues are responsible for 60% of the revenue in the entire professional football industry, and their shares in the market have been continuously growing. At the opposite end

of the spectrum, leagues outside the top 10 leagues make up 15% of the revenue of European football clubs (UEFA, 2022). Among all the clubs that played in the UCL between 2003/04 and 2016/17, less than one in four represented leagues outside the top 10 (Bullough, 2018). Consequently, when football clubs from leading leagues compete in such competitions, most of the representatives from leagues outside the top ten face challenges of being promoted to the group stage of UCL and EL. Taking into account their budgets, the starting fees paid by the UEFA for group stage participation may be seen as a significant financial injection that will improve club sports performance in the near future.

In Poland, which suffers from the divergence of wealth in the global football industry, there is a common belief that clubs that take part in UEFA competitions show decreased sports performance in the domestic league (see, for instance, Iwankiewicz, 2021). In line with the resource-based view (RBV), we can indeed assume that clubs representing less competitive leagues, drained from most productive players (Dimitropoulos & Scafarto, 2021), lack the quantity and quality of human resources to be able to play in two competitions simultaneously (Barney, 1991).

Therefore, it can be hypothesized that, on the one hand, the use of limited resources for international competitions makes football clubs less competitive in the domestic league during a given season (H1). On the other hand, however, it is expected that promotion to international competition in one year positively affects a club's sports performance in the following season (H2). To test the given hypotheses, this study aimed to establish whether participation in European football competitions (UCL and EL) affects the sports performance of Polish clubs in the domestic league.

It is hoped that this research will contribute to a deeper understanding of the link between domestic and international competitions. To date, we have evidence that the growing asymmetry of revenues in European football, partially resulting from the participation in UEFA competitions, leads to an improvement in the competitive imbalance within the Big Five in favor of the biggest clubs (Dietl *et al.*, 2008; Pawlowski *et al.*, 2010). However, the question remains as to how competing in UEFA tournaments affects the competitive position of clubs outside the top leagues in a given season and subsequent seasons. In this paper, we focus on the case of Polish football clubs by investigating a 10-year period of sports performance in ECL, EL and Ekstraklasa (the domestic league in Poland). This study aims to answer this question and provide relevant implications for the governance bodies of football clubs.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

According to RBV, which assumes that an organization is a set of resources and competencies that builds a competitive advantage (Barney, 1991), the success of a football club depends on its access to physical (including financial revenue), organizational, and human resources (Omondi-Ochieng, 2019). However, the distribution of these resources among clubs is highly uneven, leading to a high variation in sports levels between European football competitions (Késenne, 2000). The literature on this topic thoroughly describes the factors that have driven European football into a progressive competitive imbalance since the mid-1990s.

First, the Bosman ruling in 1995 eliminated the legal restrictions on the player transfer market (Frick, 2009), allowing players to exercise their freedom in the labor market after the expiration of their contract with the current club. Equally important was the elimination of the 'three plus one' rule. The limit on foreign players in EU leagues no longer exists and, consequently, barriers to the supply of players from less developed markets on a massive scale have disappeared. Currently, in each of the Big Five leagues, non-nationals accounted for more than 50% of the total minutes played in the 2020/21 season (UEFA, 2022).

Second, the new format of European competitions, especially the UCL, closed the door to clubs representing less affluent leagues and exceeded the payments for those clubs participating in the UCL. One of the most relevant modifications was made in the 1999/2000 season when the number of participants was increased from 24 to 32 teams; the payments for the clubs participating in the UCL have been rising significantly since then (Pawlowski *et al.*, 2010). The competitions originally dedicated to national league champions have been transformed into championships in which the most competitive leagues have four slots to fill, while some leagues notoriously do not have a representative in the group

stage, as they are not promoted from the qualifying phase. These processes were accompanied by an increase in the internationalization of European football, mainly through the increased availability of sports broadcasts in various parts of the world (Andreff & Bourg, 2006). Therefore, fees obtained from the UEFA grew alongside the interest of investors willing to invest money in football clubs, not for profits but to gain prestige from and satisfaction with their successes (Lang *et al.*, 2011).

The presence of such investors has strengthened the win maximization orientation in European football instead of the profit-maximization model that is dominant in US sports (Késenne, 2000; Sloane, 1971). Therefore, the largest clubs operate in soft budget-constrained conditions and overinvest the resources available on the market beyond what the clubs can cover from self-generated revenues (Andreff, 2007). In such conditions, the role of financial resources in sports competitions has increased and depends on the spending power of club owners (Franck, 2010; Franck & Lang, 2014).

The Financial Fair Play (FFP) regulation, introduced by UEFA in 2009, aimed to restrict that practice through the rule of no overdue payables and the break-even rule (Peeters & Szymanski, 2014). The financial effects of the introduction of FFP are highly debated in the literature. Ahtiainen and Jarva (2022) provided evidence that FFP improved the profitability of Spanish football clubs and, to a lesser extent, English and German football clubs. On the other hand, such positive outcomes were not found for French, Spanish or Italian clubs (Ahtiainen & Jarva, 2022; Ghio *et al.*, 2019). Francois *et al.* (2021) supported these outcomes by showing the increased profitability of English football clubs compared to French clubs. However, this pattern only applies to entities that are not participating in UEFA internation competition. In general, FFP outputs vary between countries. According to Rohde and Breuer (2018), the ownership structure is what differentiates football clubs in this regard, as FFP has increased the efficiency with which the resources of football clubs owned by private majority investors are managed.

However, in the context of this study, the influence on international competitive balance is a more important consequence of the FFP regulation. Peeters and Szymanski (2014) believed that FFP would not significantly reduce competitive imbalance, but rather protect the competitive position of the wealthiest clubs. In effect, the most valuable resources, that is, the most skilled players, are still concentrated in the Big Five leagues (Frick, 2009; Tovar, 2020), often at the cost of overmanned rosters (Andreff, 2018).

Meanwhile, even if experiences from international tournaments significantly boost the morale of players, the sports science literature provides evidence that previous workload (such as the three-day-match routine that occurs during simultaneous international and domestic competition participation) negatively affects the sports performance of professional football players (Springham *et al.*, 2020). Under such circumstances, and considering that football clubs outside the top leagues operate with a shortage of effective workers in the current market conditions, the following can be hypothesized:

H1: The use of limited resources for international competitions makes football clubs less competitive in the domestic league during a given season.

The described changes have led to an increase in inequality not only at the international level but also domestically, where the biggest clubs have enhanced domination in the league competition (Norbäck *et al.*, 2021; Pawlowski *et al.*, 2010). According to Maclean *et al.* (2022), board managers of Scottish football clubs share this viewpoint, as they believe that the introduction of FFP creates a 'poverty trap' for smaller teams. Researchers (e.g. Birkhauser *et al.*, 2019; Gallagher & Quinn, 2020; Garcia-del-Barrio & Rossi, 2020; Plumbley *et al.*, 2019) have emphasized that FFP regulations limited the possibility of private investors entering the market and recapitalizing smaller clubs to make them more competitive in the national league. Consequently, such restriction drives the consolidation of the current hierarchy of forces within a given league. In the most recent paper on this issue, Serrano *et al.* (2022) applied a long-term perspective, and with a sample of 17 different leagues. They confirmed the heterogeneity of the impact of FFP on competitive balance at the national level, which was claimed in previous research, and observed a slight tendency to escalate the imbalance within the leagues. Plumley *et al.* (2019) postulated that club size should be included as an external variable in the FFP regulation to make smaller clubs competitive. However, this suggestion has not yet been applied.

Although Franck (2014) argued that FFP only regulated the payroll and that football club owners could build a competitive advantage through investment in other resources such as infrastructure and

youth academies, it must be noted that such investments only offer returns over a long period of time. In practice, on average, about 60% of club revenue on average is spent on player salaries (Deloitte Sports Business Group, 2022). The most successful teams receive increasing pay-outs from the UCL, increasing their financial and, subsequently, sporting advantage over the rest of the clubs. Therefore, it can be assumed that football clubs from outside the top level that manage to join the UEFA can improve their domestic competitiveness using the funds and experience obtained in exactly the same way as units from the Big Five leagues (Ruta *et al.*, 2022). Based on this and following the approach of Rohde and Breuer (2016), we have assumed a one-year lag[1] for the short-term sporting outcomes of football clubs' potential investments and hypothesized that:

H2: Promotion to international competition in one year positively affects a club's sports performance in the following season.

RESEARCH METHODOLOGY

Research Design and Case Selection

This study analyzes the case of Polish Ekstraklasa. The choice of this league was based on two irrefutable arguments. First, this league is a typical example of a football league outside of the top class: it was ranked 30th in the UEFA league ranking at the end of the 2020/21 season (Kassies, 2021). This outcome gives the best clubs in the league one slot in the ECL and three slots in the EL qualification. Second, Ekstraklasa is one of the most competitively balanced leagues in Europe (Lubaś, 2020), resulting in a high diversity of clubs representing the country in European competitions. During the last 10 years (seasons 2011/12–2020/21), 12 Polish clubs participated in the ECL and EL qualifications (Table 1). Technically, the volatility of the teams that appear in European cups provides the option to investigate the impact of that factor on domestic competitiveness.

Table 1. Football clubs representing Polish Ekstraklasa in UEFA competitions (seasons 2011/12–2020/21)

Club / Season	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	Times of participation
Legia Warszawa	▲	●	▲	▲	▲	▲	●	●	●	●	10
Lech Poznan	○	●	●	●	▲	○	●	●	○	▲	7
Slask Wrocław	●	●	●	●	●	○	○	○	○	●	6
Jagiellonia Bialystok	●	○	○	●	●	○	●	●	○	○	5
Piast Gliwice	○	○	●	○	○	●	○	○	●	●	4
Cracovia	○	○	○	○	○	●	○	○	●	○	2
Wisla Krakow	▲	○	○	○	○	○	○	○	○	○	1
Ruch Chorzow	○	●	○	○	○	○	○	○	○	○	1
Zaglebie Lubin	○	○	○	○	○	●	○	○	○	○	1
Arka Gdynia	○	○	○	○	○	○	●	○	○	○	1
Gornik Zabrze	○	○	○	○	○	○	○	●	○	○	1
Lechia Gdansk	○	○	○	○	○	○	○	○	●	○	1

Note: ▲ The club participates in a group stage of UEFA competitions ● The club participates in UEFA competitions but not in the group stage; ○ The club does not participate in UEFA competitions.
Source: own elaboration based on 90minut.pl.

To test the first research hypothesis regarding the effects of competing internationally on sports performance in the domestic league in the ongoing season, the following equation was estimated:

$$LEAGUE\_POINTS_{it} = f(UEFA\_COMPETITION_{it}, controls) + \in_{it} \quad (1)$$

[1] Scenarios for two- and three-year lags were also tested. They both provided consistent results, and the solutions are presented later in the paper. These results are available from the author on request.

here LEAGUE_POINTS stands for the league points achieved by the *i*-th team in season *t* according to the regular system, in which three points are assigned for winning the game and one point is assigned for a draw. UEFA_COMPETITION means participation in a European competition, which, in the case of European football clubs, means playing in the UEFA Champions League or UEFA Europa League, including qualifications to both tournaments.

Considering how long the unit is affected by European competition may matter for domestic competitiveness, thus, the second equation to be solved was estimated as follows:

$$LEAGUE\_POINTS_{it} = f(GROUP\_STAGE_{it}, controls) + \in_{it} \quad (2)$$

where GROUP_STAGE means participation in European competition when being promoted to the main round of UCL or EL (when winning the qualification phase).

To test the second research hypothesis, regarding the effects of competing internationally on sports performance in the domestic league in the subsequent season, equations analogous to those presented before were estimated. Thus, the following formulas were obtained:

$$LEAGUE\_POINTS_{it} = f(GROUP\_STAGE_{it}, controls) + \in_{it} \quad (3)$$

$$LEAGUE\_POINTS_{it} = f(GROUP\_STAGE_{it-1}, controls) + \in_{it} \quad (4)$$

where both UEFA_COMPETITION and GROUP_STAGE mean the same thing as described above, but they were both taken for the season preceding the period under examination.

The estimated models also include control variables that were considered to explain sports performance in professional football. Player wage expenditures (WAGES) were considered to be a dominant factor explaining sports performance in professional football (Barajas & Rodríguez, 2010; Caruso *et al.*, 2017). Following the approach of Gasparetto and Barajas (2018), this factor was included in the models as a logarithm of payroll. Second, Barros and Leach (2006) and Barros *et al.* (2015) asserted that the number of fans influences the sports performance of football clubs. Thus, the empirical models contain the ratio of the average home attendance of a given team in a given season to the average attendance in the league in that period (FAN_BASE). Third, as some authors have claimed, historical success (PAST_SUCCESS) could influence the current results of a football club (Gasparetto & Barajas, 2018; Macmillan & Smith, 2007; Pitts, 2016). The total number of points achieved by a given club in league history was determined to be the most accurate and accessible data in this matter. PAST_SUCCESS was formed as a ratio of points achieved by a club on the opening day of the season to the average of all clubs participating in the league in a given season. Finally, to include observations in various time periods (2011-12 to 2020-21), the SEASON dummy variable was also included.

To explore the robustness of the finding, the same type of sports performance predictors were applied for models with league positions as dependent variables. Consequently, the four ordered logistic regressions were calculated as follows:

$$LEAGUE\_POSITION_{it} = f(UEFA\_COMPETITION_{it}, controls) + \in_{it} \quad (5)$$

$$LEAGUE\_POSITION_{it} = f(GROUP\_STAGE_{it}, controls) + \in_{it} \quad (6)$$

$$LEAGUE\_POSITION_{it} = f(UEFA\_COMPETITION_{it-1}, controls) + \in_{it} \quad (7)$$

$$LEAGUE\_POSITION_{it} = f(GROUP\_STAGE_{it-1}, controls) + \in_{it} \quad (8)$$

where LEAGUE_POINTS stands for a categorical variable taking the values {0,1,2,3,…,16}, while UEFA_COMPETITION, UEFA_COMPETITION$_{t-1}$, GROUP_STAGE, GROUP_STAGE$_{t-1}$, and all the control variables remain unchanged.

Data Collection and Analysis

A summary of the variables used in the analyses and descriptive statistics is presented in Table 2. The Ekstraklasa league consists of 16 teams, and, following the availability of the data, the 10 seasons were analyzed. This makes each season responsible for 0.10 observations in the sample. The average number of points collected per team in one season was 40.90 (SD = 9.70), and the average league position achieved was 8.36 (SD = 4.56), resulting from the size of the league and three missing observations. On average, clubs spent 20.84 million PLN (ca. 5 million EUR) on wages (with SD = 15.40), which gives an average value of 2.81 (SD = 0.69) for the LN(WAGES) variable. The average match attendance during

the entire 10-year period equaled 8,394 (SD = 5,243), which was transformed into a FAN_BASE ratio giving the mean of 1.01 and standard deviation of 0.60, while the average historical points were 1,278 (SD = 910), which gave the average ratio of 1.00 (SD = 0.71) for PAST_SUCCESS. As only three top clubs from the previous season and the winner of the national cup play in UEFA competitions in any given year, one in four clubs each year fulfills the requirement to be considered a UEFA competition participant. However, promotion to the group stage is a challenge for Polish football clubs: in the given 10-year period, it has happened only eight times.

Table 2. Overview and descriptive statistics of variables

Variable / Measure	Description	Type	M	SD
Dependent variables				
LEAGUE_POINTS	League points achieved by the *i*-th team after the 30th round of the season *t*	Metric	40.90	9.92
LEAGUE_POSITION	League position achieved by the *i*-th team after the 30th round in season *t*	Ordinal	8.36	4.56
Explanatory variables				
UEFA_COMPETITION	The club participates in an international competition in UCL or EL (1 = yes)	Dummy	0.25	–
GROUP_STAGE	The club participates in an international competition in the UCL or EL group stage (1 = yes)	Dummy	0.05	–
UEFA_COMPETITION_t-1	The club participates in an international competition in UCL or EL in season *t-1* (1 = yes)	Dummy	0.25	–
GROUP_STAGE_t-1	The club participates in an international competition in UCL or EL group stage in season t-1 (1 = yes)	Dummy	0.05	–
Control variables				
LN(WAGES)	Logarithm of total amount spent on players' wages by the *i*-th team in season *t* (in million PLN)	Metric	2.81	0.69
FAN_BASE	Ratio of the average home attendance of the *i*-th team in season *t* to the average attendance in the given season	Metric	1.01	0.60
PAST_SUCCESS	Ratio of the total number of points achieved by the *i*-th team before the start of season *t* to the average total number of points achieved by league participants before the given season	Metric	1.00	0.71
SEASON	Season *t* when the results given were obtained (2015/16 – 2020/21; 1 = yes)	Dummy	0.16 0.15[a]	–

[a] Related to seasons 2015/16, 2016/17, and 2017/18.
Source: own study.

These data were retrieved from the following sources: (*i*) the players' wages were acquired from EY's (2012, 2014, 2015) and Deloitte's (2013, 2016, 2017, 2018, 2019, 2020, 2021) annual reports considering the financial situation of the Ekstraklasa football clubs; (*ii*) the league points and indications of the clubs participating in international competitions were easily found in the league tables on the Ekstraklasa website (Ekstraklasa.org); (*iii*) the average seasonal home attendance was acquired from the Transfermarkt (2022) database; and (*iv*) the historical point achievements were acquired from the Polska-Piłka website (2022). Although sourcing player wages from two different audit groups may seem alarming at first glance, it should be noted that both of them took the data from the same primary sources: clubs' financial reports.

The dataset includes 157 observations in total. These are all the results for each club that played in Ekstraklasa between the 2011/12 and 2020/21 seasons (without observations for Bruk-Bet Termalica, which spent three years in Ekstraklasa without providing access to its financial data).

RESULTS AND DISCUSSION

The results of the ordinary least squares (OLS) regression (Table 3) and the ordered logistic regression models (Table 4) confirmed the dominant role of wages and the relevance of the fan base in explaining

the sports performance of football clubs. However, neither past successes (historically achieved league points) nor participation in international competition was a statistically significant predictor. All estimated models offer results that are consistent in terms of the signification of variables and stable in terms of the fit indices ($F > 7.500$; $p < 0.001$; adjusted-$R^2 > 0.350$ for the OLS regression and the Lr chi-square [13] > 789; [Prob > chi-square] < 0.001; McFadden's pseudo R-square ≥ 0.090 for ordered logistic regression).

Consequently, both the tested hypotheses were rejected. Participating in the European UEFA competition, regardless of whether it occurs at the group stage level (models 3-5 and 7-8) or in the qualification phase (1-2, 5-7), does not affect domestic competitiveness. Regardless of whether we took into account the number of points (1-4) or the position the league achieved at the end of the season (5-8), neither positive effects in the next season nor negative consequences in the same season were found.

Table 3. Results of OLS regression analyses

Variable / Model	**(1)**		**(2)**		**(3)**		**(4)**	
Explanatory variables								
UEFA_COMPETITION	1.784	(1.647)	–	–	–	–	–	–
GROUP_STAGE	–	–	-1.207	(3.267)	–	–	–	–
UEFA_COMPETITIONt-1	–	–	–	–	2.744	(1.527)	–	–
GROUP_STAGEt-1	–	–	–	–	–	–	4.297	(3.217)
Control variables								
LN(WAGES)	7.079***	(1.356)	7.424***	(3.267)	6.938***	(1.343)	7.017***	(1.353)
FAN_BASE	4.835**	(1.461)	5.475***	(1.412)	4.933**	(1.388)	5.137***	(1.385)
PAST_SUCCESS	-1.059	(1.118)	-1.074	(1.129)	-1.138	(1.109)	-1.365	(1.129)
Season dummies (Ref: 2011/12)	*included*		*included*		*included*		*included*	
Constant	15.319***	(3.944)	14.246***	(3.939)	15.485***	(3.882)	15.687	(3.964)
Model assessment								
adj-R^2	**0.371**		**0.366**		**0.380**		**0.373**	
F	8.069		7.932		8.341		7.675	
p	<0.001		<0.001		<0.001		<0.001	
Observations	157		157		157		157	

The unstandardized coefficients and standard errors (in brackets) are displayed. *p < 0.05; **p < 0.01; ***p < 0.001.
Source: own study.

On this basis, it can be claimed that the inconvenience related to starting in the European cups is not a problem for players from the weaker Polish league. The inconvenience mentioned is related to the need to organize a different mode of preparation for the competition, which, for teams that play in the UEFA qualifiers, begins earlier and, in the case of promotion to the group stage, involves competitions every three days (while the league's competitors only play once a week). Although it does not seem to be a problem for the wealthy top clubs with more productive players (Dimitropoulos & Scafarto, 2021) and broad, well-balanced teams (Andreff, 2018), it may be surprising for the case discussed.

However, equally interesting is the fact that the experience and extra fees obtained in the UEFA competition did not lead to an improvement in the competitive position of the Polish football clubs, even on a domestic basis. This could be because the exposure of players in such competitions leads to more highly ranked leagues becoming more interested in them (Lago-Peñas *et al.*, 2019; Simmons & Deutscher, 2012). Therefore, it seems that the fees obtained from the UEFA and the transfer receipts in the disguised player market are difficult to supplement in a way that improves the sports level. The findings of this study align with the concept of 'freezing' the hierarchy of forces in the European football market, which was observed after the implementation of the FFP (Dimitropoulos & Scafarto, 2021; Sass, 2016; Vöpel, 2011). In the context of Poland, the wide variance and general low level of spending efficiency among most Ekstraklasa football clubs could also explain why reinvesting the funds obtained from UEFA does not have the expected outcome (Wyszyński, 2016).

Table 4. Results of ordered logistic regression analyses

Variable / Model	(5)		(6)		(7)		(8)	
Explanatory variables								
UEFA_COMPETITION	-0.225	(0.374)	–	–	–	–	–	–
GROUP_STAGE	–	–	0.342	0.752	–	–	–	–
UEFA_COMPETITIONt-1	–	–	–	–	-0.510	(0.0351)	–	–
GROUP_STAGEt-1	–	–	–	–	–	–	-0.466	(0.758)
Control variables								
LN(WAGES)	-1.570***	(0.330)	-1.628***	(0.330)	-1.512***	(0.327)	-1.564***	(0.329)
FAN_BASE	-1.295***	(0.346)	-1.392***	(0.336)	-1.302***	(0.332)	-1.341***	(0.331)
PAST_SUCCESS	0.345	(0.256)	0.352	(0.257)	0.352	(0.255)	0.385	(0.258)
Season dummies (Ref: 2011/12)	*included*		*included*		*included*		*included*	
Constant cut 1	-9.342***	(1.138)	-9.453***	(1.136)	-9,240***	(1,130)	-9,298***	(1,139)
Constant cut 2	-8.328***	(1.084)	-8.461***	(1.084)	-8,222***	(1,074)	-8,290***	(1,087)
Constant cut 3	-7.658***	(1.055)	-7.802***	(1.056)	-7,553***	(1,044)	-7,623***	(1,059)
Constant cut 4	-7.124***	(1.035)	-7.273***	(1.037)	-7,020***	(1,024)	-7,088***	(1,040)
Constant cut 5	-6.686***	(1.022)	-6.834***	(1.023)	-6,583***	(1,010)	-6,649***	(1,027)
Constant cut 6	-6.316***	(1.011)	-6.463***	(1.012)	-6,214***	(1,000)	-6,278***	(1,017)
Constant cut 7	-5.972***	(1.003)	-6.119***	(1.004)	-5,869***	(0,991)	-5,934***	(1,008)
Constant cut 8	-5.636***	(0.995)	-5.783***	(0.996)	-5,530***	(0,984)	-5,598***	(1,000)
Constant cut 9	-5.301***	(0.987)	-5.446***	(0.988)	-5,194***	(0,976)	-5,263***	(0,992)
Constant cut 10	-4.964***	(0.980)	-5.107***	(0.980)	-4,854***	(0,969)	-4,926***	(0,985)
Constant cut 11	-4.612***	(0.973)	-4.752***	(0.972)	-4,496***	(0,962)	-4,572***	(0,977)
Constant cut 12	-4.216***	(0.964)	-4.353***	(0.963)	-4,095***	(0,954)	-4,175***	(0,968)
Constant cut 13	-3.733***	(0.954)	-3.866***	(0.952)	-3,608***	(0,944)	-3,692***	(0,958)
Constant cut 14	-3.051**	(0.943)	-3.178**	(0.940)	-2,926**	(0,934)	-3,012**	(0,947)
Constant cut 15	-1.883*	(0.952)	-2.000*	(0.947)	-1,758*	(0,945)	-1,846*	(0,956)
Model assessment								
Pseudo R-square	**0.090**		**0.090**		**0.092**		**0.090**	
Log likelihood	791.179		791.333		789.374		791.108	
Lr chi-square (13)	78.464		78.310		80.269		78.535	
Prob > chi2	<0.001		<0.001		<0.001		<0.001	
Observations	157		157		157		157	

The unstandardized coefficients and standard errors (in brackets) are displayed. *p < 0.05; **p < 0.01; ***p < 0.001.
Source: own study.

Considering our control variables, player wages (LN[WAGES]) and market size (FAN_BASE) turned out to be good predictors of the domestic sports performance of Polish football clubs, while historical points achieved (PAST_SUCCESS) was not significant. The players' wages are, in fact, a measure of their sports level. As Hall *et al.* (2002) pointed out, the bigger the payroll in relation to the competition, the better the players a club can hire. This influence is basically unquestionable in the literature (e.g., Barajas & Rodríguez, 2010; Caruso *et al.*, 2017; Gasparetto & Barajas, 2018) and it was confirmed again in this study.

However, the influence of the number of fans (i.e., market size) and past successes on football clubs' sports performance has been a topic of debate in the literature. Some have found the population and number of fans to be predictors of sports performance in the English Premier League and Brazilian League authors (e.g., Barros & Leach, 2006; Barros *et al.*, 2015), while others have obtained contradictory findings (Gasparetto & Barajas, 2018). For example, Gasparetto and Barajas (2018), Macmillan and Smith (2007), and Pitts (2016) argued for the influence of historical success on current performance, while Barros *et al.* (2011) argued against the existence of such an effect. In our case, as with Gasparetto and Barajas (2018), only one of these variables was significant: the number of fans. A solution to this inconsistency may be to consider that fan engagement and loyalty are, to some extent, a

result of previous successes and traditions of the club (Bauer *et al.*, 2008). This relationship is also visible in our case through the correlation between these variables (r = 0.59).

CONCLUSIONS

All this leads to the conclusion that the resources of football clubs outside the top leagues, such as Poland, do not limit the possibility of competing in two fields at the same time. It turns out that the efforts of football clubs to compete in the foreign market and their position in the domestic market remain independent of each other despite the use of the same resources to compete in both markets. However, the experience and fees from the UEFA are not sufficient to gain a lasting advantage in the domestic market and cover the potential loss of the most effective players being transferred out as a result of their increased profile during the European cups. This is how the 'poverty trap', in which football clubs' governing bodies believe in, works in practice (Maclean *et al.*, 2022). However, the question remains as to whether this trap is inevitable or results from the ineffective management of professional football clubs in the Polish context.

These findings have important implications for the management of football clubs in Poland and possibly for representatives of clubs from other leagues outside the top leagues as well. Football clubs' governing bodies should be aware that participation in UEFA competitions will not have negative consequences for their clubs and that, based on aggregated data for the experience of Polish clubs, participation does not provide the funds needed to improve their competitive position. Managers of Polish football clubs act very impulsively, leading to a high rotation of head coach positions after they are promoted to the European cups with their teams (Iwankiewicz, 2021). Based on the results, it seems that this turnover may result from the excessive expectations of the owners after the success of being promoted to UEFA competitions. This is because the influence of participation in European cups on sports results remains neutral in both short- and medium-term periods. Club managers should be aware of this.

The implications presented in this work apply to Polish football clubs and should be treated with due caution in the case of clubs from other countries outside the top leagues. The most relevant limitations of this paper lie in the limited scope of the research to one country and the sample size, which was affected by limited access to data. Thus, a cross-national study of two simultaneous competitions is now required. Additionally, our second hypothesis tests the sports results of football clubs in the following season (and, in the working versions, also in subsequent single periods), and thus tests the short-term effects of participation in international competitions. In future research, it would be worth testing whether such participation for a sustained period could lead to a better competitive position over time, but not necessarily in the years that immediately follow.

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