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INVESTING THE IMPACT AND THE CHALLENGES OF DIGITAL TRANSFORMATION AND GREEN ENTREPRENEURSHIP IN GREEK FOOD INDUSTRY

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Abstract

Purpose. Companies operating in every sector investigated various applications of digital technology, which ultimately resulted in their digital transformation to ensure their continued viability. This study examines the factors that affect the willingness of agrifood businesses toward digital transformation and green entrepreneurship, two trends that tend

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to a sustainable business model.

Methods. To approach the research question, a questionnaire based on closed-ended questions scored on a Likert scale was developed and completed by 288 industry executives. The collected data were analyzed in the development of Principal Component Analysis.

Findings. Findings highlighted five crucial components the executives should consider for integrating green entrepreneurship practices. They combined them with the digital transformation strategies of SMEs in Greece's agri-food sector. These factors are related to the lack of digital human resource skills and limited funding, product innovation and consumer awareness in the digit era, innovative sustainable materials and life cycle assessment of SME products, executive training for SMEs on the Circular Economy, and executives' knowledge of ESG and green entrepreneurship.

Keywords: ESG, green entrepreneurship, green accounting, agrifood sector, Greece, regression analysis, sustainability

JEL classification: O1; M2; M10; M40

1. Introduction

Sustainable development is characterized by the achievement of a state of balance wherein the economic, social, and environmental aspects are all aligned to create lasting prosperity and universal welfare. (Úbeda, Javier Forcadell and Suárez, 2022; Abdullah, Saraswat and Talib, 2023; Achmad et al., 2023; Ozturk, Alqassimi and Ullah, 2024). The objectives are as follows: mitigation of greenhouse gas emissions, conservation of natural resources, advancement of social inclusivity, support for human rights, and development of sustainable institutions and infrastructure. (Sarango-Lalangui et al., 2023; D'Apolito et al., 2024) . This worldwide undertaking is in accordance with the Sustainable Development Goals of the United Nations, which comprise a set of objectives aimed at eliminating poverty, protecting the environment, and promoting welfare for all. The importance of digital transformation for small and medium-sized enterprises (SMEs) is being recognized as a growing focus within the global pursuit of sustainable development. Examining the complex relationship between digitization, small and medium-sized enterprises (SMEs), and their significant impact on environmentally sustainable business ventures, with a specific focus on the agrifood sector of Greece, is the aim of this research (Rosales Carreón and Worrell, 2018; Úbeda, Javier Forcadell and Suárez, 2022; Ozturk, Alqassimi and Ullah, 2024).

Sustainable development can be aided by small and medium-sized enterprises (SMEs) that implement environmentally responsible business strategies that minimize their impact on the environment, uphold social responsibility principles, and enhance local communities' welfare. Concurrently, digitalization is being recognized as a powerful catalyst in optimizing resource utilization, reducing inefficiency, and improving universal access to education and healthcare. In addition, it promotes the development of economies characterized by reduced carbon emissions. Notwithstanding this, it is critical to ensure that the benefits of digitalization are distributed equitably, while digital technology's environmental and social repercussions are comprehensively assessed and mitigated. Incorporating environmental consciousness and a digital perspective has emerged as critical elements in modern corporate strategies, as organizations increasingly opt for digitization (Kohtamäki et al., 2020; Johnston and Cortez, 2023). Prodigious digital technologies present unparalleled prospects for corporations to augment their development possibilities and broaden their portfolios. The eco-centric approach takes precedence by emphasizing the intentional incorporation of sustainability criteria into a business's operational, procedural, and innovative processes.

The economic ramifications of the digitalization process are extensive, encompassing financial progress, educational achievements, environmental sustainability, and economic growth. The advancement of digitization on a global scale presents prospects for sustainable and equitable prosperity. However, it is imperative to establish a harmonious and balanced equilibrium among the economic, social, and environmental aspects to attain sustainable results. The environmental impacts of digitization may be both positive and detrimental. One possible advantage is that it could potentially mitigate CO2 emissions through by reducing transaction and travel expenses. Industrial processes, intelligent communities, and transportation networks are all improved through digitization. Despite this, it could potentially result in increased energy consumption and carbon dioxide emissions (Avelar et al., 2024). The potential for variation in the impact on environmental sustainability has sparked debates regarding a relationship that follows an inverted U-shaped curve (Khan, Daddi and Iraldo, 2020) The emergence of mobile technology has profoundly influenced the digital transformation of numerous aspects of human existence. This transition has significantly impacted economic prosperity and human progress. It can enhance the availability and inclusivity of healthcare, education, and human development (Favoretto et al., 2022; Zhou and Liu, 2023).

The extent to which digitalization influences inclusive human development is contingent upon many circumstances and mechanisms. Furthermore, it impacts health systems through the redistribution of healthcare resources and the enhancement of accessibility. In addition to protecting human rights, privacy, and online security, the primary objective of policies should be to advance digital inclusion. (Adam and Alhassan, 2021). Digitalization, when viewed through an economic lens, possesses the potential to foster sustainable economic growth. It can stimulate economic growth, enhance productivity, and foster financial success. Additionally, globalization possesses the capacity to be strengthened, thereby promoting economic advancement. But without economic transformation, technology could impede economic advancement. (Kohtamäki et al., 2020; Johnston and Cortez, 2023; Leal-Rodríguez et al., 2023).

The primary objective of this research is to examine the determinants that impact the propensity of small and medium-sized enterprises (SMEs) in Greece's agrifood sector to embrace green entrepreneurship to advance digital transformation. The enduring necessity to comprehend the intricate dynamics inherent in this field of study is the impetus for undertaking this research. The information for this research was gathered through the distribution of questionnaires to 288 executives employed in the agri-food sector of Greece. In addition, we highlighted the factors and research trends associated with investigating agrifood companies' propensity to embrace digitalization and green entrepreneurship in Greece using Principal Component Analysis (PCA). In conclusion, the analysis was conducted using SPSS software version 26.0. The results of the present analysis identify five variables that may influence the adoption of green entrepreneurship-oriented digital transformation practices in Greece's agrifood industry. The factors encompassed in this list are as follows: (i) inadequate funding and a dearth of digital HR expertise; (ii) consumer awareness and product innovation in the digital age; (iii) sustainable materials and life cycle assessments that are innovative and suitable for small and medium-sized enterprise (SME) products; (iv) executive education for SMEs regarding the circular economy; and (v) the level of understanding of executives regarding environmental, social, and governance (ESG) and green entrepreneurship. The subsequent describes the organization of the present research paper: Section 2 describes the materials and methods, Section 3 presents the most critical portion of the literature review pertaining to the field under investigation, and Section 4 details the results. The paper concludes with a discussion of the research findings in Section 5.

2. Literature Review

The food business is a significant part of household spending. Hong Kong has the world's highest per capita food expenditure, surpassing the United States' spending of $5,002.2 in 2018 (Kruk et al., 2021). Based on Eurostat's 2020 data, households in the European Union dedicated over 956 billion euros in 2019, which accounted for almost 6.8% of the EU's Gross Domestic Product (GDP) (Castillo-Díaz et al., 2023). This expenditure was explicitly designated for the acquisition of non-alcoholic meals and drinks. This represents 13.0% of families' overall expenses and is the third most significant area of household expenditures. It is surpassed by housing, water, electricity, gas, and other fuels, which account for 23.5% of household spending, and transportation, which accounts for 13.1%. In Romania, families allocated a significant amount, namely 26.0%, of their overall consumption towards food and non-alcoholic drinks (Kruk et al., 2021; Maritano et al., 2024; Yu and Yao, 2024). This proportion was the highest when compared to all other countries. Similarly, Lithuanian households dedicated a substantial proportion, namely 20.2%, of their total consumption to these specific goods. Eurostat, 2020. The National Statistical Service of Greece (2021) reported that in 2019, there was a verified rise in the proportion of Greece's average household budget dedicated to food and non-alcoholic drinks, increasing from

20% to 23.1%. Information technology can effectively address the global challenges faced by agro-food companies. Intelligent packaging is essential in the food packaging industry. The technology constantly evolves and has considerable promise for enhancing food safety, quality, traceability, and customer convenience (Kruk et al., 2021; Yu and Yao, 2024). Modern packaging protects against chemical, biological, and physical changes. It also protects food from transit vibrations. It also allows food delivery and storage, reducing advertising and promotion costs. The global population has expanded from 1 billion in 1804 to 7,794,798,739, and consumer preferences and market dynamics are changing, causing new issues for the agro-food industry. According to Ceniti et al. (2021), Rizou et al. (2020), and Trmcic et al. (2021), COVID-19 safety protocols are a critical industrial issue (Rizou et al., 2020; Ceniti et al., 2021; Trmčić et al., 2021) The agro-food industry must quickly implement COVID-19 worker protections. According to the World Health Organization (WHO, 2020), this will also prevent the spread of the virus and promote food sanitation.

According to Sen et al. (2017), combining sustainable development with digitalization may improve the capacity of food sector companies to meet current and future needs more efficiently and reliably. These techniques aim to improve efficiency, productivity, and quality, while also improving resource allocation and waste management for businesses in the industry (Johnston and Cortez, 2023; Zhou and Liu, 2023; Ozturk, Alqassimi and Ullah, 2024). Specifically, the transition of enterprises in the agrifood industry towards green entrepreneurship may support their adoption of renewable energy sources, use of recyclable materials, improvement of production techniques, and adoption of responsible environmental management practices. Furthermore, green entrepreneurship may augment the prominence of small and medium enterprises (SMEs) in the market, attract new customers, and strengthen their competitive advantage. Nevertheless, digitization and automation enhance precision, ease, and effectiveness, while decreasing the expenses per unit. Furthermore, investing in and promoting digital solutions aims to ensure the utmost degree of food safety. Digital technologies provide a very effective alternative for enhancing the sustainability of food systems (Annosi et al., 2021; Lioutas, Charatsari and De Rosa, 2021).

2.1. The relationship between agrifood industries and environmental and social sustainability

Food systems and rural economies depend on rural agriculture and food enterprises. Decentralized networks have been effective during disasters like the COVID-19 epidemic. Multiple studies show that agribusinesses benefit local resources, culture, quality of life, and the economy. Rural communities are becoming complex ecosystems that include cultivation, processing, distribution, and consumption to enhance environmental, economic, social, and food circumstances. (Abou-foul, Ruiz-Alba and Soares, 2021; Nguyen et al., 2024)Connecting all food system participants increases community resilience, a key indicator of social sustainability. Building community resilience requires social capital and human interactions. Creating networks within local communities fosters the development of social capital. These factors are closely interconnected with the rejuvenation and economic prosperity of rural areas, the generation of employment prospects, small-scale farming, the promotion of local food production, the provision of affordable and top-notch products to consumers, and the enticement of non-family individuals to establish new farms. In addition, Abdollahzadeh and Sharifzadeh (2014) provide empirical evidence to support the idea that creating tourist companies in rural regions leads to a higher demand for agricultural goods produced locally.

Also, the agrifood industry has the most significant environmental influence on the economy. According to the 2030 Agenda set by the United Nations, one crucial objective of sustainable development is to protect and promote solid agricultural ecosystems. Fiseha and Oyelana (2015) performed research that shows how use agriculture methods may significantly improve the welfare of communities (Fiseha and Oyelana, 2015). This involves improving the overall quality of the living environment, promoting the welfare of individuals, and fostering a peaceful coexistence between farmers and residents. Agribusinesses are transitioning from the conventional linear food system model, which follows a sequential sequence of "production-processing-consumption-waste," to the circular model. The prosperity of agrifood firms relies heavily reliant on the institutional framework and governmental assistance. However, further study is necessary to understand this association completely.

2.2. The Agrifood Industry's Digital Transformation

Amid difficult social, economic, and operational circumstances, enterprises are motivated to capitalize on the substantial innovation prospects stemming from the agro-food industry's continuous and rapid technical progress in information and communication technology. Companies in this area have global challenges that may be solved via information technology and digitalization, improving competitiveness and efficiency. According to Annosi et al. (2020), digitalization can address several challenges in the agrifood business, such as the growing food demand and the optimal use of resources. (Annosi et al., 2020). Their investigation revealed that the existing challenges in the market significantly affect the sustained expansion of digital technology for enterprises. Moreover, as stated by Ranta et al. (2021), digitization positively impacts the integration of new techniques into corporate business models (Ranta, Aarikka-Stenroos and Väisänen, 2021). It offers significant benefits, including as improved allocation of resources and the creation of wealth. Stephens and Barbier (2021) argue that digitization brings new prospects for developing and investigating alternative food networks. It establishes a distributed network of regional activities centered on a digital platform (Viciunaite, 2023). Furthermore, it enables cutting-edge virtual hardware mediation between manufacturers and customers. This fosters more consumer engagement in the manufacturing of products across many businesses and sectors, resulting in a restructuring of worldwide food distribution that advances sustainability and mitigates environmental damage. Cronin and Halog (2021) provide empirical support for this occurrence within the framework of Australian alternative food networks.

Moreover, digital platforms facilitate user engagement in healthier and more sustainable food habits, enhancing alternative sources' feasibility. Shree et al. (2021) also acknowledge the impact of digital platforms, highlighting their transformative effect on the operations of enterprises in business-to-business (B2B) markets (Shree et al., 2021). Furthermore, Bernardi and Moggi (2021) have shown that digitization plays a vital role in the generation and transmission of data, fostering innovation, and supporting sustainability-oriented initiatives in both the business-to-business (B2B) and business-to-consumer (B2C) sectors (Moggi and Dameri, 2021). The digitization of the agrifood business is a primary focus on the political agenda of governmental authorities. The principal strategic objectives are allocating financial and material resources and paying attention to the agrifood sector, specifically in energy, sustainability, water resources management, intelligent farming, food safety, and precision agriculture. Emerging technologies present a prospect to enhance the industry's efficiency and competitiveness, while also addressing escalating environmental and economic concerns. Automation, robotics, artificial intelligence, forecasting systems, blockchain for agricultural commodities, and cybersecurity concerns within the agrifood chain are the technologies included in this list. According to Jorge-Vázquez et al. (2021), incorporating digital technologies into the food industry is crucial for enhancing competitiveness, economic efficiency, and growth, among other structural and organizational factors. Furthermore, incorporating digital tools improves the sustainability of agricultural and food systems in the long run. Moreover, the digitization process can enhance productivity, quality, and efficiency, thereby fortifying the standing of businesses. Furthermore, it guarantees food safety and facilitates optimizing waste and resource management.

3. Materials and Methods

This section serves to present the methodological approach utilized in this study. The study addresses significant theoretical and practical gaps by investigating how small and medium enterprises in the Greek food industry can adapt to digital transformation. Additionally, it aims to examine the impact of digitalization on green entrepreneurship. A survey was used as the principal means of gathering information in this inquiry. Due to the sensitivity of purposeful processes to beginning circumstances, we selected a sample of executives from Greek agrifood firms. Hence, it is crucial to emphasize the significance of digital transformation in promoting green entrepreneurship before taking concrete steps. Additionally, it is imperative to involve individuals from the sector committed to developing and implementing strategies that integrate the aspects of digitalization and sustainable entrepreneurship.

From May to November 2023, we collected data from CEOs in the agrifood sector using a national quantitative research methodology. A five-point Likert scale was predominantly employed in the survey, with responses extending from five (5) to one (1), representing strong disagreement and strong agreement, respectively. The survey aimed to achieve two objectives: (i) evaluate the degree to which small and medium-sized businesses in the Greek food sector can adjust to digital transformation; and (ii) examine the consequences of their digitalization on green entrepreneurship and the process by which they transition to green entrepreneurship. To gather data on the demographic characteristics, we employed closed-ended questionnaires. Thirty agrifood industry executives in Greece participated in a preliminary questionnaire evaluation administered to a representative sample. The criterion for evaluating the dependability was Cronbach's alpha. Using the Kolmogorov-Smirnov test, the normality of the data was evaluated. To resolve the absence of data, we implemented the pairwise deletion method. Descriptive statistics, principal component analysis, and the T-test were employed to analyze the data. Blumberg and Schindler define principal component analysis as a statistical method for examining the variability in observable variables through their representation in the notion of a reduced set of unobserved variables referred to as factors (Blumberg and Schindler, 2014). Principal component analysis may be applied to validate an interesting construct. There are two main objectives of principal component analysis. It reduces the amount of data and then identifies the fundamental a set of variables' fundamental dimensions or structure. The proportion of variation, absolute variance, and interpretability of a factor are the determinants in its selection, according to Leech et al. (2015) were more remarkable than one is typically retained in factors. It is also needs to be mentioned that we follow a focus group approach to employees of agrobusinesses, in order to collect representative data for our research question.

4. Results

Table 1 presents the frequencies of the sample. Of the respondents, 69.8% are male and 30.2% are female. Furthermore, a significant proportion (36.5%) are 45-55 years old, while 40.6% of the participants have completed a continuing education program. Furthermore, many businesses in the sector (68.4%), whose executives took part in this study, had less than 50 employees, indicating the small scale of the sector's companies. However, it is noteworthy that 56.9% of the firms in the sector reported a financial turnover ranging from 1,000,001 to 2,000,000 €.

Table 1. Frequencies statistics of the demographics

		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	201	69,8	69,8	69,8
	Female	87	30,2	30,2	100,0
	Total	288	100,0	100,0	
Age_group	18-24	29	10,1	10,1	10,1
	25-35	35	12,2	12,2	22,2
	36-45	50	17,4	17,4	39,6
	46-55	105	36,5	36,5	76,0
	more 55	69	24,0	24,0	100,0
	Total	288	100,0	100,0	
Educational_level	High education	27	9,4	9,4	9,4
	College	117	40,6	40,6	50,0
	Higher education	89	30,9	30,9	80,9
	Master/PhD degree	55	19,1	19,1	100,0
	Total	288	100,0	100,0	
SMEs_size	Less than 50	197	68,4	68,4	68,4
	50-100	68	23,6	23,6	92,0
	101-249	23	8,0	8,0	100,0
	Total	288	100,0	100,0	
Financial_Turnover	Less than 1,000,000 €	124	43,1	43,1	33,3
	1,000,001-2,000,000 €	164	56,9	56,9	100,0
	Total	288	100,0	100,0	

Furthermore, as indicated by the validity and reliability test results (Table 2), each item under consideration has been deemed valid, as the r-table value is less than the r-count value for each query. With a Cronbach's alpha value of 0.811, this questionnaire can be classified as highly reliable.

Table 2. Cronbach's alpha Reliability test

Cronbach's Alpha	Number of Questions
,811	38

Moreover, both Chi-Square tests (Table 3) were used to test the sample's representativeness. The test's findings indicate that the sample is representative, with a margin error of 2% and a confidence level of 95%.

Table 3. Chi-Square test

R	R Square	Adjusted R Square	Std. Error of the Estimate
,981[a]	,962	,962	,09174

According to Sklavos, Duquenne, and Theodossiou (2022), green entrepreneurship and digital transformation increase businesses' efficacy, satisfy consumer demand for environmentally sustainable products, decrease the environmental footprint, and bolster corporate social responsibility. Furthermore, the COVID-19 pandemic has emerged as a pivotal occurrence altering our way of life; companies are compelled to modify their routine procedures, and remote work has become the prevailing practice. Consequently, because of the COVID-19 pandemic, business activities and business models have been subject to digital transformation. The agri-food industry in Greece is notorious for being among the most dynamic and competitive economic sectors and for its promising development prospects. Nonetheless, it is critical to emphasize the trend factors that can further encourage executives and businesses in the food industry to implement green entrepreneurship and digital transformation practices. Consequently, the present analysis employs Principal Component Analysis (PCA) to decrease the dimensionality of a few underlying variables that may bolster enterprises' inclination to adopt environmentally sustainable practices by integrating emerging technologies. The analysis produced the principal component, standard deviations, and loadings of each variable or dimension on the principal component. The following formula was used to determine the scores for each component:

$$C_i = b_i 1(X_1) + b_i 2(X_2) + \cdots bip(X_p)$$

Where,

Ci= the subject's score = the subject's score on principal component i (i component extracted)

bip = the regression coefficient (or weight) for observed variable p, as used in creating principal component i.

X_1 - X_p = the subject's score on observed variable 1 to p.

The Condition Index (CI) was employed to assess multicollinearity in the model that adhered to the subsequent parameters:

Where,

EV=Eigen Values

Hi=the highest

Lo=the lowest

Furthermore, the data underwent SPSS analysis (version 26.0).

The PCA results are discussed individually regarding the entrepreneurial inclination of small and medium-sized enterprises (SMEs) in the analyzed sector toward green entrepreneurship and digital transformation, Tables 5 and 6 display the component matrices of the principal component analysis for the dimension of green entrepreneurship willingness and its enhancement through the integration of digital transformation. Before delving into the PCA results, it is essential to investigate the Kaiser-Meyer-Olkin measurement. The Kaiser-MeyerOlkin (KMO) measure of sampling adequacy in the present investigation yielded a value of 0.922 (Table 4), which Kaiser and Rice (1974) referred to as “marvelous.” This value signifies that the data are suitable for a variable reduction. Alternatively stated, it is possible to reduce the total number of variables.

Table 4. KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		,922
Bartlett’s Test of Sphericity	Approx. Chi-Square	21534,193
	df	528
	Sig.	0.000

Communalities represent the amount of variance in each variable that is accounted for. Preliminary communalities are estimations of the variance in each variable after all factors or components have been accounted for. For principal components analyses, this is always set to 1.0 (for correlation analyses) or the variable’s variance (for covariance analyses). Extraction communalities refer to approximations of the variance in each variable that can be accounted for by the factors (or components) in the factor solution. Variables below 0.5 indicate inadequate factor solution fit and should, be excluded from the analysis. Thus, according to the findings presented in Table 4, neither variable was omitted in our case, as they are all greater than 0.5.

Table 5. Communalities

	Initial	Extraction
QB1	1,000	0,902
QB2	1,000	0,837
QB3	1,000	0,870
QB4	1,000	0,960
QB5	1,000	0,950
QB6	1,000	0,949
QB7	1,000	0,922
QB8	1,000	0,935

QB9	1,000	0,826
QB10	1,000	0,860
QB11	1,000	0,915
QB12	1,000	0,923
QB13	1,000	0,790
QB14	1,000	0,894
QB15	1,000	0,908
QB16	1,000	0,938
QB17	1,000	0,947
QB18	1,000	0,851
QB19	1,000	0,867
QB20	1,000	0,931
QB21	1,000	0,910
QB22	1,000	0,861
QB23	1,000	0,905
QB24	1,000	0,947
QB25	1,000	0,956
QC4	1,000	0,873
QC5	1,000	0,933
QC6	1,000	0,938
QC7	1,000	0,859
QC8	1,000	0,958
QC1	1,000	0,962
QC2	1,000	0,955
QC3	1,000	0,957
Extraction Method: Principal Component Analysis.		

The eigenvalues, variance explanations, and cumulative variance explanations for our factor solution are presented in Table 5. The eigenvalues determine the values in the initial panel. There are an equivalent number of components or factors for the initial solution as there are variables. The quantity of variance in the observed variables explained by each component or factor is indicated in the "Total" column. The column labeled "% of Variance" provides the proportion of variance explained by a particular factor or component concerning the overall variance of all variables. The "Cumulative%" column provides the proportion of variance explained by all factors or components leading up to the present one. A few factors account for a significant portion of the variance in a well-designed factor analysis, while the remaining factors account for comparatively minor quantities of variance. Consequently, all those residual factors contributing a negligible quantity to the cumulative variance can be retained. In our scenario, we have retained the initial five components or factors whose Eigenvalues are all greater than one (1) and collectively explain 90.88% of the variance. The remaining 33 factors, contributing only 9.12% of the variance, have been eliminated.

Table 6. Total Variance Explained by Principal Component Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**18,462**	**55,945**	**55,945**	18,462	55,945	55,945	17,199	52,119	52,119
2	**5,693**	**17,250**	**73,195**	5,693	17,250	73,195	4,614	13,982	66,101
3	**2,633**	**7,980**	**81,175**	2,633	7,980	81,175	3,200	9,697	75,798
4	**1,967**	**5,960**	**87,135**	1,967	5,960	87,135	2,560	7,757	83,555
5	**1,236**	**3,745**	**90,880**	1,236	3,745	90,880	2,417	7,325	90,880
6	0,548	1,660	92,540						
7	0,482	1,460	94,000						
8	0,364	1,103	95,103						
9	0,290	0,880	95,983						
10	0,231	0,700	96,683						
11	0,177	0,537	97,219						
12	0,160	0,485	97,704						
13	0,113	0,343	98,047						
14	0,094	0,285	98,332						
15	0,076	0,231	98,563						
16	0,063	0,192	98,755						
17	0,056	0,169	98,924						
18	0,047	0,143	99,066						
19	0,040	0,122	99,188						
20	0,038	0,116	99,305						
21	0,037	0,112	99,417						
22	0,028	0,085	99,502						
23	0,024	0,071	99,574						
24	0,023	0,069	99,643						
25	0,020	0,061	99,704						

26	0,018	0,054	99,758
27	0,016	0,047	99,805
28	0,015	0,046	99,851
29	0,013	0,038	99,890
30	0,011	0,033	99,922
31	0,009	0,028	99,951
32	0,009	0,026	99,977
33	0,008	0,023	100,000

Extraction Method: Principal Component Analysis.

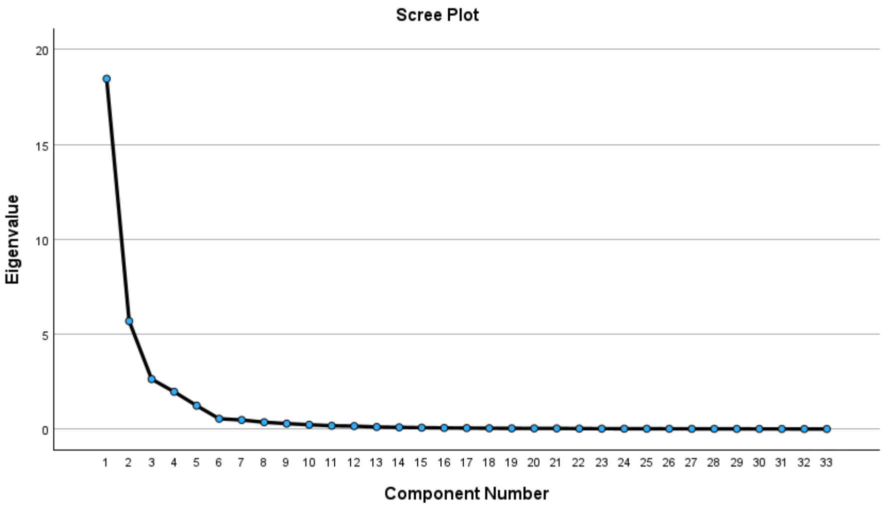

Figure 1. Scree plot

The rotated component matrix is presented in Table 7, which also provides the factor loadings for each variable on the factors or components after the rotation process. The rotated factor is correlated to varying degrees with each number. By utilizing these correlations, it is possible to develop an interpretation of the components or factors. This is accomplished by identifying a pattern shared by numerous variables with substantial loadings for a specific factor or component. Factor analysis rotation methods begin with the original axis and implement a mathematical rotation to simplify the relationships between factors and variables. By utilizing Factor Analysis, we successfully identified five (5) factors from a set of 33 store attributes (one factor, distance from the store, was eliminated as the community was relatively small). Put simply, we have reduced 33 attributes of apparel stores to five representative factors. According to the data presented in Table 6, twenty-three (23) variables exhibit a correlation with the initial factor, four (4) variables demonstrate a correlation with the second factor, two (2) variables correlate with the third factor, two (2) variables correlate with the fourth factor, and the remaining two (2) variables demonstrate correlations with factor five.

Table 7. Rotated Component Matrix

	Component				
	1	2	3	4	5
QB25	,957				
QC5	,947				
QB24	,946				
QC8	,945				
QB5	,941				
QB6	,940				
QB7	,923				
QB23	,916				
QC6	,914				
QC4	,907				
QB15	,907				
QB20	,902				
QB4	,896				
QB9	,889				
QC2	,870				
QC1	,869				
QB17	,776				
QB11	,758				
QB16	,717		,624		
QB12	,715		,624		
QC7	,712				
QB10	,650				
QB1	,603				
QC3		,946			
QB14		,937			
QB22		,877			

QB19	,858			
QB21		,844		
QB18		,748		
QB8			,954	
QB3			,713	
QB2				,877
QB13				,697

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

As shown in Table 8, the Component Transformation Matrix delineates the precise rotation implemented on our factor solution. The rotated factor matrix is derived from the original (unrotated) factor matrix using this matrix. When the off-diagonal elements approach zero, it indicates that the rotation was of a relatively minor magnitude. When the off-diagonal elements exceed ±0.5 in magnitude, a rotation of greater magnitude was implemented. It is evident from the table that most of the off-diagonal values are negligible or nearly negative, suggesting that the rotational effort needed in the present scenario was minimal.

Table 8. Component Transformation Matrix

Component	1	2	3	4	5
1	,960	,113	,194	,166	-,022
2	-,008	,835	-,375	-,029	,402
3	,249	-,151	-,649	-,619	-,332
4	-,074	,168	-,361	,652	-,641
5	,106	-,489	-,519	,404	,563

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

For our study, all the variables are correlated with five factors and are named and shown in Table 9.

Table 9. Names of extracted factors along with their respective variables

1st Factor	2nd Factor	3rd Factor	4th Factor	5th Factor
Lack of digital HR skills and limited funding	Product Innovation and Consumer Awareness in the Digit era	Innovative Sustainable Materials and Life cycle assessment of SMEs products	Executive training for SMEs on the Circular Economy	Executives' knowledge of ESG and green entrepreneurship

5. Discussion

The world has gradually shifted into the digital domain. The digital transformation, initiated before the widespread use of information and communications technology (ICT), has accelerated and continues progressing during the COVID-19 pandemic. Digital technologies and processes fundamentally transform infrastructure and provide exceptional opportunities for enterprises in many sectors, tiny firms. Nevertheless, these opportunities also bring about new challenges as digital transformation completely transforms corporate ecosystems, fundamentally altering their nature and the structure of companies and markets. (Tronvoll et al., 2020; Plekhanov, Franke and Netland, 2022). This raises concerns regarding employment and expertise, confidentiality, security, and social and economic issues (interaction). Utilizing digital technology poses a significant problem for organizations. Furthermore, it is suggested that while addressing financial concerns, the uncertain attributes of digital technologies may still hinder the adoption of these technologies by small and medium-sized firms (SMEs). The restricted ability to take advantage of and execute the significant changes presented by digital possibilities made possible by the breakthroughs of Industry 4.0, resulting in a lower return on investments (Arranz, Arroyabe and Fernandez de Arroyabe, 2024; Pett, Haddad and Nagpal, 2024). Small and medium-sized enterprises (SMEs) must undergo digital restructuring and transformation to sustain economic expansion and rapid globalization. Thus, innovation is fostered, and the commercial sustainability of SMEs is secured for the foreseeable future. Furthermore, digitalization provides various advantages, including reduced investment in ICT apparatus, enhanced interaction and integration into global markets, and decreased transaction costs and expenditures associated with procuring and delivering products and services (Xin *et al.*, 2023). The benefits aid in the sustainable expansion of small and medium-sized businesses (SMEs). Consequently, it is believed that digitalization could potentially result in cost savings, time and resource conservation, particularly for smaller companies with limited market and negotiating power and inadequate internal capabilities to manage complex business environments. Artificial Intelligence (AI) and the Internet of Things (IoT) may profoundly transform SME business models and operations, which could benefit diverse corporate procedures. Furthermore, there is now enhanced accessibility to digital resources such as training opportunities, financial services, and career prospects, which feature offerings from both state and federal governments(Ghauri, Mazzarol and Soutar, 2024; Qiao, Chang and Zeng, 2024). Organizations can extract inventive resources and enhance performance by generating data and analyzing internal operations using innovative methods.

However, digitization and sustainability have become a significant trend for small and medium-sized enterprises (SMEs) in recent years. This trend provides unique chances for SMEs to improve their operations, minimize their environmental footprint, and promote social well-being. The use of state-of-the-art technologies shows this powerful combination. Sustainability refers to carrying out business or activities in a manner that fulfills the current generation's requirements without jeopardizing future generations' capacity current generation's requirements without jeopardizing future generations' capacity to meet their requirements (Ghauri, Mazzarol and Soutar, 2024). The concept has three primary foundations: environmental, economic, and social sustainability. Environmental sustainability is centered on reducing environmental damage and safeguarding natural resources. Economic sustainability encompasses the objective of securing enduring financial stability and expansion. Social sustainability prioritizes equitable labor standards, inclusivity, and the community's welfare (Anastasiou et al., 2021). A firm's carbon footprint is a substantial indicator of its environmental effect. It serves as an indirect measure of the energy, product, and service consumption and quantifies the carbon footprint associated with a company's operations or goods (Ragazou and Sklavos, 2021; Ragazou, 2021; Sklavos et. al, 2024). Digitalization is the act of incorporating digital technology into many areas of corporate operations. The digitalization process enables small and medium-sized enterprises (SMEs) to optimize their operations, expand into new markets, and enhance their management of resources. It equips them with the necessary tools and skills to streamline operations, improve client experiences, and make choices based on data. For small and medium-sized enterprises (SMEs), digitization is a technology change and a necessary strategy that may promote economic development while reducing negative environmental and societal impacts. Finally, a limitation of our study is related to the less control of collected data and the quality of discussion that depends on the author's skills due to the use of a focus group.

6. Conclusions

The current study has highlighted five main components that can be characterized as those that impact the willingness of SMEs in the agrifood sector toward digital transformation and green entrepreneurship. Among the factors that have been indicated is the lack of digital skills in human resources, which can act as an inhibitor factor for SMEs to integrate digital transformation practices and can contribute to the transition to green entrepreneurship. Moreover, lacking digital skills cannot attract investments in digital transformation and green entrepreneurship. Another crucial factor is product innovation and consumer awareness in the digital era. Consumer behavior has experienced substantial changes in the digital age. The proliferation of technology and the internet has provided consumers with abundant information and options. This transition has fundamentally transformed how consumers engage with brands and arrive at buying choices. To prosper amidst this dynamic environment, enterprises must comprehend and adjust. Finally, among the most critical components were the Executives' knowledge of ESG and green entrepreneurship.

Social responsibility issues such as climate risk, environmental contamination, and financial deception are gaining prominence, prompting the academic and practical communities to progressively acknowledge ESG's significance (Li et al., 2023; Oh et al., 2024). Particularly since the incorporation of the MSCI index system, ESG has become a critical factor for Greek businesses, which they can leverage to bolster their competitive edge. ESG practice pertains to enterprises, given their status as the vanguards of social and economic development. An interdependent causal structure exists between cognition, behavior, and the environment. Cognitive theory posits that human behavior is impacted by observing and interpreting the environment throughout the learning process. Consequently, modifications in the external milieu resulting from ESG and its associated policies will trigger cognitive shifts among corporate executives, subsequently influencing micro-firm conduct. Corporate executives' investment decisions and perceptions substantially impact green innovation, a crucial mechanism for advancing green transformation. Green innovation is frequently not accorded the attention it merits due to its substantial financial commitments, considerable risk, and protracted investment return cycles. According to their perceptions and interpretations of environmental protection, executives' propensity to allocate organizational resources toward green innovation varies. Huang et al. (2019) discovered that the environmental consciousness of their executives positively influenced the technological innovation of their firms. Moreover, firm technological innovation efficiency was enhanced by the increased investment in research and development (R&D) by environmentally conscious executives, the level of green innovation achieved by organizations can be improved upon the ESG consciousness of executives.

Appendix

Code variable	Variable
QB1	I've heard of circular economy and green entrepreneurship
QB2	I can discuss and explain green entrepreneurial concepts
QB3	I can design and build new company solutions leveraging circular economy and green entrepreneurship.
QB4	I want to learn more about and use the circular economy at work.
QB5	I work for a green entrepreneurial company.
QB6	My employer does not practice green business.
QB7	I know circular economy and green entrepreneurship companies worldwide.
QB8	The company provides national circular economy and green entrepreneurship decision-making guidelines and other legal documents
QB9	I think the circular economy and green entrepreneurship will help my company become more sustainable locally and globally.
QB10	I believe the circular economy and green entrepreneurship in business benefits organizations economically and environmentally.
QB11	I can critically analyze and solve complicated green entrepreneurial and circular economy problems.
QB12	I discuss the business potential for our organization through green entrepreneurship and the circular economy with my colleagues.
QB13	I know the company's everyday actions' environmental, economic, and social impacts.
QB14	I contribute to circular and green entrepreneurship in my organization.
QB15	Solutions to reduce business environmental impact
QB16	Maximizing resource efficiency (recyclability, upgradeability, durability)
QB17	Waste recycling yields secondary materials
QB18	Replace traditional materials with sustainable ones
QB19	Eco-friendly product design
QB20	Optimization of packaging
QB21	Product and service life cycle assessment
QB22	Consumer awareness campaigns
QB23	Business environmental impact assessment methods
QB24	EU funds, regulations, environmental certificates
QB25	Digitization with IT support

QC1	Investments in digital transformation
QC2	A digital transformation education program
QC3	Digitization is crucial for firms to adopt green entrepreneurship and circular economy models
QC4	Digital transformation and green practices suffer from a lack of digital HR skills.
QC5	The high cost of digital transformation hinders the process and green business transition.
QC6	The problem of finding suitable partners hinders digital transformation and green business.
QC7	Few funding sources
QC8	Greek entrepreneurship needs internal control to embrace the two approaches.

References

1. Abdullah, A., Saraswat, S. and Talib, F. (2023) 'Barriers and strategies for sustainable manufacturing implementation in SMEs: A hybrid fuzzy AHP-TOPSIS framework', *Sustainable Manufacturing and Service Economics*, 2, p. 100012. Available at: https://doi.org/10.1016/J.SMSE.2023.100012.
2. Abou-foul, M., Ruiz-Alba, J.L. and Soares, A. (2021) 'The impact of digitalization and servitization on the financial performance of a firm: an empirical analysis', *Production Planning & Control*, 32(12), pp. 975–989. Available at: https://doi.org/10.1080/09537287.2020.1780508.
3. Achmad, G.N. *et al.* (2023) 'Government support, eco-regulation and eco-innovation adoption in SMEs: The mediating role of eco-environmental', *Journal of Open Innovation: Technology, Market, and Complexity*, 9(4). Available at: https://doi.org/10.1016/J.JOITMC.2023.100158.
4. Adam, I.O. and Alhassan, M.D. (2021) 'The effect of mobile phone penetration on the quality of life', *Telecommunications Policy*, 45(4). Available at: https://doi.org/10.1016/j.telpol.2021.102109.
5. Anastasiou, E. *et al.* (2021) 'Territorial and Human Geography Challenges: How Can Smart Villages Support Rural Development and Population Inclusion?', *Social Sciences 2021, Vol. 10, Page 193*, 10(6), p. 193. Available at: https://doi.org/10.3390/SOCSCI10060193.
6. Annosi, M.C. *et al.* (2020) 'Learning in an agile setting: A multilevel research study on the evolution of organizational routines', *Journal of Business Research*, 110, pp. 554–566. Available at: https://doi.org/10.1016/J.JBUSRES.2018.05.011.
7. Annosi, M.C. *et al.* (2021) 'Digitalization within food supply chains to prevent food waste. Drivers, barriers and collaboration practices', *Industrial Marketing Management*, 93, pp. 208–220. Available at: https://doi.org/10.1016/j.indmarman.2021.01.005.
8. Arranz, C.F.A., Arroyabe, Marta.F. and Fernandez de Arroyabe, J.C. (2024) 'Organisational transformation toward circular economy in SMEs. The effect of internal barriers', *Journal of Cleaner Production*, p. 142307. Available at: https://doi.org/10.1016/J.JCLEPRO.2024.142307.

9. Avelar, S. *et al.* (2024) 'Confluence of sustainable entrepreneurship, innovation, and digitalization in SMEs', *Journal of Business Research*, 170. Available at: https://doi.org/10.1016/J.JBUSRES.2023.114346.
10. Blumberg, C.D.R. and Schindler, P. (2014) 'Business research methods'.
11. Castillo-Díaz, F.J. *et al.* (2023) 'Assessment of the sustainability of the European agrifood sector in the context of the circular economy, *Sustainable Production and Consumption*, 40, pp. 398–411. Available at: https://doi.org/10.1016/j.spc.2023.07.010.
12. Ceniti, C. *et al.* (2021) 'Food Safety Concerns in "COVID-19 Era"', *Microbiology Research 2021, Vol. 12, Pages 53-68*, 12(1), pp. 53–68. Available at: https://doi.org/10.3390/MICROBIOLRES12010006.
13. D'Apolito, E. *et al.* (2024) 'Sustainability and bank credit access: New evidence from Italian SMEs', *Research in International Business and Finance*, 69. Available at: https://doi.org/10.1016/J.RIBAF.2024.102242.
14. Favoretto, C. *et al.* (2022) 'From servitization to digital servitization: How digitalization transforms companies' transition towards services', *Industrial Marketing Management*, 102, pp. 104–121. Available at: https://doi.org/10.1016/j.indmarman.2022.01.003.
15. Fiseha, G.G. and Oyelana, A.A. (2015) 'An Assessment of the Roles of Small and Medium Enterprises (SMEs) in the Local Economic Development (LED) in South Africa', *Journal of Economics*, 6(3), pp. 280–290. Available at: https://doi.org/10.1080/09765239.2015.119176 17.
16. Ghauri, S., Mazzarol, T. and Soutar, G.N. (2024) 'Values congruence and SMEs' active membership in business co-operatives', *Journal of Co-operative Organization and Management*, 12(1). Available at: https://doi.org/10.1016/J.JCOM.2023.100227.
17. Johnston, W.J. and Cortez, R.M. (2023) 'Business-to-business digitalization, artificial intelligence, and social action', *Journal of Business Research* [Preprint]. Available at: https://doi.org/10.1016/j.jbusres.2023.113952.
18. Khan, O., Daddi, T. and Iraldo, F. (2020) 'The role of dynamic capabilities in circular economy implementation and performance of companies', *Corporate Social Responsibility and Environmental Management*, 27(6), pp. 3018–3033. Available at: https://doi.org/10.1002/CSR.2020.
19. Kohtamäki, M. *et al.* (2020) 'The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization', *Technological Forecasting and Social Change*, 151, p. 119804. Available at: https://doi.org/10.1016/J.TECHFORE.2019.119804.
20. Kruk, S.R.L. *et al.* (2021) 'Digitalizing environmental governance for smallholder participation in food systems', *Earth System Governance*, 10. Available at: https://doi.org/10.1016/j.esg.2021.100125.
21. Leal-Rodríguez, A.L. *et al.* (2023) 'Digitalization beyond technology: Proposing an explanatory and predictive model for digital culture in organizations', *Journal of Innovation and Knowledge*, 8(3). Available at: https://doi.org/10.1016/j.jik.2023.100409.
22. Leech, N.L., Barrett, K.C. and Morgan, G.A. (2015) *IBM SPSS for intermediate statistics : use and interpretation*.
23. Li, H. *et al.* (2023) 'The ESG rating, spillover of ESG ratings, and stock return: Evidence from

Chinese listed firms', *Pacific Basin Finance Journal*, 80. Available at: https://doi.org/10.1016/j.pacfin.2023.102091.

24. Lioutas, E.D., Charatsari, C. and De Rosa, M. (2021) 'Digitalization of agriculture: A way to solve the food problem or a trolley dilemma?', *Technology in Society*, 67. Available at: https://doi.org/10.1016/j.techsoc.2021.101744.
25. Maritano, V. *et al.* (2024) 'Anti-counterfeiting and fraud mitigation solutions for high-value food products', *Journal of Food Protection*, p. 100251. Available at: https://doi.org/10.1016/j.jfp.2024.100251.
26. Moggi, S. and Dameri, R.P. (2021) 'Circular business model evolution: Stakeholder matters for a self-sufficient ecosystem', *Business Strategy and the Environment*, 30(6), pp. 2830–2842. Available at: https://doi.org/10.1002/BSE.2716.
27. Nguyen, N. *et al.* (2024) 'Digitalization strategy adoption: The roles of key stakeholders, big data organizational culture, and leader commitment', *International Journal of Hospitality Management*, 117, p. 103643. Available at: https://doi.org/10.1016/j.ijhm.2023.103643.
28. Oh, H.J. *et al.* (2024) 'A preliminary study for developing perceived ESG scale to measure public perception toward organizations' ESG performance', *Public Relations Review*, 50(1). Available at: https://doi.org/10.1016/j.pubrev.2023.102398.
29. Ozturk, I., Alqassimi, O. and Ullah, S. (2024) 'Digitalization and SMEs development in the context of sustainable development: A China perspective', *Heliyon*, 10(6). Available at: https://doi.org/10.1016/J.HELIYON.2024.E27936.
30. Pett, T., Haddad, G. and Nagpal, G. (2024) 'Does empowering leadership affect SMEs' sustainability performance through knowledge transfer?', *European Management Journal* [Preprint]. Available at: https://doi.org/10.1016/J.EMJ.2024.03.008.
31. Plekhanov, D., Franke, H. and Netland, T.H. (2022) 'Digital transformation: A review and research agenda', *European Management Journal* [Preprint]. Available at: https://doi.org/10.1016/j.emj.2022.09.007.
32. Qiao, P., Chang, M. and Zeng, Y. (2024) 'The influence of digitalization on SMEs' OFDI in emerging countries', *Journal of Business Research*, 177. Available at: https://doi.org/10.1016/J.JBUSRES.2024.114633.
33. Ragazou, K. (2021) 'Home based telecommuting in the context of COVID-19: The challenges of Greek teleworkers', *Journal of Business and Social Science Review 2 (1) 119-125*. Available at: https://doi.org/ 10.48150/jbssr.v2no1.2021.a9.
34. Sklavos, G., Theodossiou, G., Papanikolaou, Z., Karelakis, C., and Ragazou, K.,(2024) 'Environmental, Social, and Governance-Based Artificial Intelligence Governance: Digitalizing Firms' Leadership and Human Resources Management', *Sustainability (Switzerland)*, 16(16). Available at: https://doi.org/ 10.3390/su16167154.
35. Ragazou, K. and Sklavos, G. (2021) 'Circular economy as a footpath for regional development in European Union'. Available at: https://doi.org/10.33422/IVCSS.2020.05.152.
36. Ranta, V., Aarikka-Stenroos, L. and Väisänen, J.M. (2021) 'Digital technologies catalyzing business model innovation for circular economy—Multiple case study', *Resources, Conservation and Recycling*, 164. Available at: https://doi.org/10.1016/J.RESCONREC.2020.105155.
37. Rizou, M. *et al.* (2020) 'Safety of foods, food supply chain and environment within the COVID-19 pandemic', *Trends in food science & technology*, 102, pp. 293–299. Available at: https://doi.org/10.1016/J.TIFS.2020.06.008.

38. Rosales Carreón, J. and Worrell, E. (2018) 'Urban energy systems within the transition to sustainable development. A research agenda for urban metabolism', *Resources, Conservation and Recycling*, 132, pp. 258–266. Available at: https://doi.org/10.1016/j.resconrec.2017.08.004.
39. Sarango-Lalangui, P. *et al.* (2023) 'Impact of environmental sustainability on open innovation in SMEs: An empirical study considering the moderating effect of gender', *Heliyon*, 9(9). Available at: https://doi.org/10.1016/J.HELIYON.2023.E20096.
40. Shree, S. *et al.* (2021) 'Digital payments and consumer experience in India: a survey based empirical study', *Journal of Banking and Financial Technology 2021 5:1*, 5(1), pp. 1–20. Available at: https://doi.org/10.1007/S42786-020-00024-Z.
41. Trmčić, A. *et al.* (2021) 'Food safety and employee health implications of COVID-19: A review', *Journal of Food Protection*, 84(11), pp. 1973–1989. Available at: https://doi.org/10.4315/JFP-21-201.
42. Tronvoll, B. *et al.* (2020) 'Transformational shifts through digital servitization', *Industrial Marketing Management*, 89, pp. 293–305. Available at: https://doi.org/10.1016/J.INDMARMAN.2020.02.005.
43. Úbeda, F., Javier Forcadell, F. and Suárez, N. (2022) 'Do formal and informal institutions shape the influence of sustainable banking on financial development?', *Finance Research Letters*, 46. Available at: https://doi.org/10.1016/j.frl.2021.102391.
44. Viciunaite, V. (2023) 'Alternative food networks on digital platforms: Consumer preferences for platform versus local food attributes', *Journal of Rural Studies*, 100, p. 103017. Available at: https://doi.org/10.1016/J.JRURSTUD.2023.103017.
45. Xin, Y. *et al.* (2023) 'Do international resources configure SMEs' sustainable performance in the digital era? Evidence from Pakistan', *Resources Policy*, 80. Available at: https://doi.org/10.1016/J.RESOURPOL.2022.103169.
46. Yu, H. and Yao, L. (2024) 'The impact of digital trade regulation on the manufacturing position in the GVC', *Economic Modelling*, 135. Available at: https://doi.org/10.1016/j.econmod.2024.106712.
47. Zhou, H. and Liu, J. (2023) 'Digitalization of the economy and resource efficiency for meeting the ESG goals', *Resources Policy*, 86. Available at: https://doi.org/10.1016/j.resourpol.2023.104199.