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Artificial intelligence in e-commerce: The moderating roles of consumer habits and security issues on purchase intention

Angga Febrian, Joel Mero

ABSTRACT

Objective: This study aims to analyse the influence of artificial intelligence (AI) technology use on perceived ease of use, perceived usefulness, and purchase intentions in e-commerce, considering the moderating roles of consumer habits and security issues.

Research Design & Methods: We employed quantitative methods by collecting questionnaire data from 312 respondents who utilise AI technology in the e-commerce retail sector. We used the structural equation modelling (SEM) covariance-based approach to test the research model and hypotheses in two stages: the measurement model and the structural model.

Findings: The research results indicate that AI capabilities can impact the perceived ease of use and usefulness. Of these two variables, only perceived usefulness increased consumer purchase intention. Customer habits moderate by strengthening the influence of perceived usefulness on purchase intention, while security issues have no moderating effect.

Implications & Recommendations: The study's results indicate that customer habits can strengthen the relationship between perceived usefulness and purchase intention. Security issues do not significantly moderate the relationship between perceived ease of use and purchase intention. These results suggest that companies can build positive consumption habits through loyalty programs and personalised user experiences, thereby increasing perceived usefulness and encouraging continued purchase intentions. While security factors still need managing to maintain consumer trust.

Contribution & Value Added: This study complements existing research by explicitly addressing AI-shaping factors such as accuracy, insight, and interaction with consumer behaviour in e-commerce. Furthermore, it broadens our understanding of customer habits, which can strengthen AI's influence on purchase intentions. The study's originality lies in integrating technology and behaviour into a comprehensive model that explains AI's role in shaping consumer decision-making in e-commerce.

Article type:	research article
Keywords:	artificial intelligence; customer habits; e-commerce; security issues; technology acceptance model
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INTRODUCTION

Rapid technological advances are transforming the business landscape, which can pose a threat or open up new opportunities. One of these changes is the shift in online shopping patterns brought about by artificial intelligence (AI) technology (Aiolfi, 2023). McKinsey (2022) reports that companies utilising AI have generated an additional 20% revenue. This increase results from AI's ability to interpret external data and use it as lessons to achieve specific goals and tasks through flexible adaptation

(Kaplan & Haenlein, 2019). Companies that utilise it properly will gain a competitive advantage (Wamba-Taguimdje *et al*., 2020). Customers' ability to adopt technology also constitutes a concern for companies, as they must determine whether customers are comfortable using the technology, which impacts the selection of technology based on consumer preferences (Na *et al*., 2023). This issue is particularly relevant in the use of AI to increase purchases in e-commerce (Febrian, 2025; Febrian *et al*., 2025). We aimed to examine the effectiveness of AI utilisation in e-commerce.

Previous studies have confirmed that the use of technology in the form of AI can increase perceived usefulness (PU) and perceived ease of use (PEOU) (Kim & Park, 2024). This technology is an external factor that can either create positive or negative customer perceptions. Furthermore, AI can adjust to customer needs based on data recorded from previous consumer activities. Consumers will also feel helped because they do not need to do it manually, for example, when searching for product keywords on a website. Therefore, e-commerce utilises this convenience to deliver excellent customer service. The use of new technologies, such as AI, also runs the risk of being rejected by customers (Bawack *et al*., 2022). One of the determining factors causing rejection is customer habits and security issues (Afroz Lari *et al*., 2022).

However, previous studies have overlooked both these factors in examining the impact of AI use in e-commerce, focusing solely on the direct influence of its use without considering supporting factors that can either strengthen or weaken the relationship with consumer behaviour. Previous studies have also confirmed that customer habits act as a moderator by strengthening the relationship between customer experience and satisfaction with using technology and purchase intentions (Nazir *et al*., 2023). However, no study has measured the impact of customer habits and security issues on the relationship between PEOU and PU in terms of purchase intentions (PI), which constitutes the novelty of our research. Therefore, we aimed to develop a conceptual model that explains how AI influences PEOU and PU, and how these two factors drive consumer PI. Furthermore, we evaluated the role of customer habits and security issues as moderating variables to improve the understanding of the relationship between technology acceptance and consumer behaviour in e-commerce. The remainder of this paper is structured as follows. First, we present the development of hypotheses using theory. The next step includes a presentation of the methods and data analysis, followed by a discussion of the theoretical and practical implications and the conclusion of the study

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

In e-commerce, AI refers to the use of tools, techniques, systems, or algorithms to support activities related to the purchase and sale of products or services over the internet (Bawack *et al*., 2022). Artificial intelligence can predict individual behavior and preferences, as well as the performance of companies and organizations, based on collected data (Pallathadka *et al*., 2023). The purpose of utilising AI in e-commerce is to enhance the customer experience, increase operational efficiency, and develop innovative methods to reach and serve customers while maintaining low costs (Pillarisetty & Mishra, 2022). We investigated the effect of AI by considering its impact on PEOU and PU. We utilised three dimensions to assess the effects of a practical online consumer experience: accuracy, insight, and interaction (Yin & Qiu, 2021). Notably, AI can help accurately identify the commodities customers seek, thereby providing a good experience for consumers. For example, when consumers enter keywords or product images into the search field, AI can identify and locate the products they are looking for, thereby maintaining the accuracy of product inventory (Ram Kishen *et al*., 2021). This activity aims to facilitate more accurate and faster consumer decisions (Khrais, 2020). Moreover, AI also provides predictions based on user insights with personalised results. For example, companies develop systems that utilise past consumer data, such as search or purchase history, to gain essential insights into consumer behaviour (Bock *et al*., 2020). To facilitate its services, AI can help serve consumers. Some of the features companies use to provide human-like services include replying to consumer messages by understanding the language used in the conversation, thereby offering fast and precise responses (Choudhury *et al*., 2020). Previous research has shown that AI can impact PU and PEOU (Kim & Park, 2024; Wang *et al*., 2023). Moreover, PU is related to how practical the technology is to interact with (Davis, 1989). Meanwhile, PEOU is defined as the user's ability to use new or new information technology without difficulty (Davis *et al*.,

1989). This means that when using a particular technology, users will be able to use it comfortably without having to make special efforts that complicate their use. The technology acceptance model (TAM) theory explains that these two factors can influence attitudes towards the use of technology and the intention to use it, ultimately leading to the choice of technology (Na *et al*., 2023). Therefore, it is essential to comprehend how AI can enhance the value of these two factors. Thus, we hypostatise:

H1: AI has a significant effect on PU.

H2: AI has a significant effect on PEOU.

We may see consumer behaviour by how much internal and external factors influence PI (Ajzen & Fishbein, 1975). It is essential to understand this intention because there is a positive relationship between PI and actual purchase behaviour (Shaouf *et al*., 2016). In online shopping, PU refers to the extent to which consumers are willing to buy a product through an online store (Pavlou, 2003). Regarding the factors that form this intention, several previous studies have explained that customer perceptions of using technology can increase PI. For example, PEOU and PU are dominant predictors of attitude formation and behavioural intentions in the early stages of using new technology (Li & Liu, 2014). Ultimately, customer considerations for using a particular technology can influence online purchasing decisions (Beyari & Garamoun, 2022). Thus, we hypostatise:

H3: PEOU has a significant effect on PI.

H4: PU has a significant effect on PI.

Each customer has their habitual behaviour. Habit is a tendency towards a repeatedly conducted action (Applebaum, 1951). In online shopping behaviour, these habits arise due to stimuli provided by the environment and satisfying experiences from certain products in the past (Hsu *et al*., 2015). Moriuchi (2019) found that consumers who often use technology for product purchasing activities will find it easier to adopt technology on various platforms. It is also essential to understand the characteristics of consumers in terms of technology usage habits. Previous research shows that consumer experience satisfaction will have a more substantial influence on PI if it is formed from consumer habits (Nazir *et al*., 2023). However, the moderating role of habits in the relationship between customer perceptions of technology use and purchase intentions has not been examined in the context of AI utilisation. This study introduces the moderating role of habits in increasing PI to address this gap. This is in line with Gefen (2003), who asserts that habitual behaviour not only influences the relationship between PU and PI but can also strengthen the relationship between PEOU and PU. Thus, this study deepens our understanding of the moderating role of customer habits in the adoption of AI technology in e-commerce, providing more comprehensive insights into the influence of habits on PI. Thus, we hypostatise:

H5: Customer habits moderate the relationship between PU and PI.

Furthermore, AI offers numerous benefits that can facilitate the online purchasing process for customers, but it also poses potential security risks related to cyber threats (Afroz Lari *et al*., 2022). The ease of accessing e-commerce raises security issues that can hinder its development if not appropriately managed (Zhang *et al*., 2012). These security issues are one of the primary challenges for companies in designing, implementing, and managing current information systems (Kalloniatis *et al*., 2014). Companies can view this issue from the user's perspective (Chawla & Kumar, 2021). They want to make sure that the website or technology they use is safe to use (Tawalbeh *et al*., 2020). Consumers will make purchasing decisions after considering various factors, including security, which is one of the most significant risks associated with online purchases (Kim, 2020). Companies must ensure that they maintain the security of personal information, security systems, and payment methods (Page & Lepkowska-White, 2002). As found by Mangin and Bourgault (2014), security issues can strengthen a person's desire to use technology. In this context, this study positions security issues as a moderator in strengthening the relationship between PEOU and PI. Mutahar *et al*. (2022) found that perceived risk and security issues significantly strengthen the influence of PEOU on user attitudes and behavioural intentions in online banking services. By integrating these perspectives, this study provides a more comprehensive understanding of the moderating effect of security issues on the adoption of AI technology in e-commerce. Thus, we hypostatise:

H6: Security issues moderate the relationship between PEOU and PI.

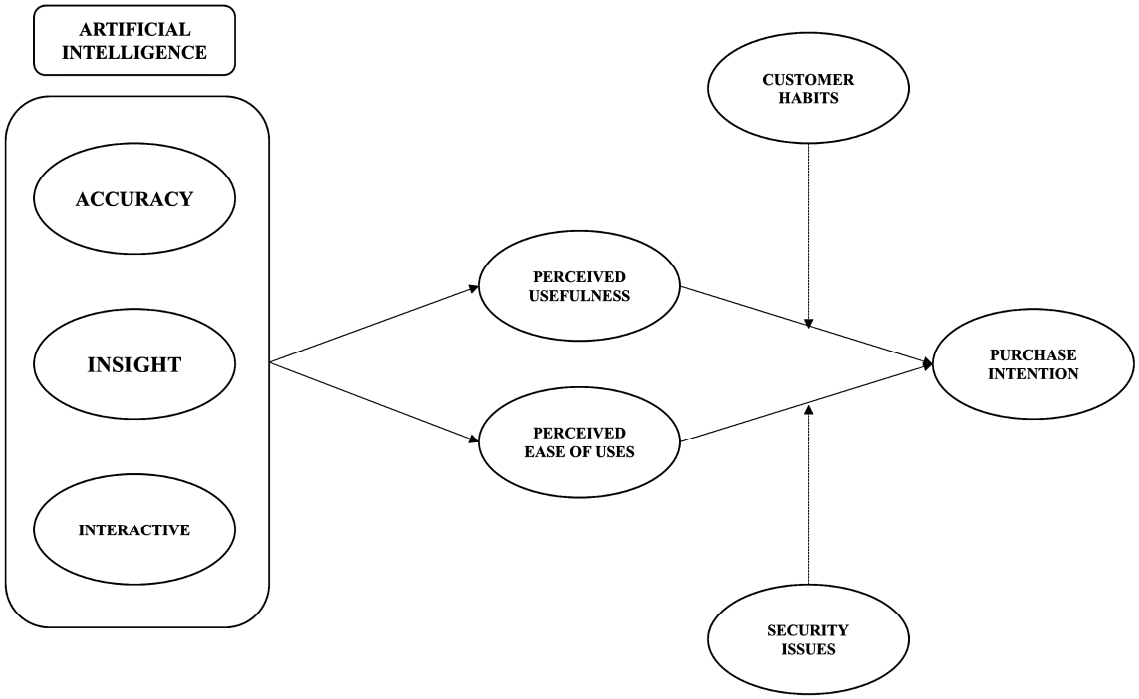

Figure 1. Research model
Source: own elaboration.

RESEARCH METHODOLOGY

Questionnaire Development, Sampling Technique, and Data Collection

We conducted a literature review to explore the research problem, leading to the development of a theoretical model. In this study, we employed a quantitative method using the structural equation modelling (SEM) approach, specifically the AMOS 24 tool, to test the conceptual framework and proposed hypotheses. Notably, SEM was the right tool to use in this research model because it is a comprehensive statistical technique used to evaluate and validate complex conceptual models (Shahzad *et al*., 2023). We collected survey data from 350 respondents who had experience using AI service features on e-commerce platforms. However, we used only 312 data points in the analysis due to considerations regarding data normality. We tested for normality by removing extreme values (outliers) ±3.0, based on the proposed criteria (Hair *et al*., 2017; Hair *et al*., 2017), using the SPSS Normality test. We selected respondents using a purposive sampling method, a sampling technique that selects participants based on specific criteria aligned with the research objectives. Inclusion criteria in this study included respondents being active users of e-commerce platforms and having interacted with or used AI-based features (such as automatic product recommendations, chatbots, or intelligent search systems). We focused on the context of the e-commerce market in Indonesia. We based object selection on the relevance of the phenomenon of increasing e-commerce use in Indonesia. To maintain data confidentiality, respondents provided voluntary consent to participate without collecting personal identities. We also analysed all data anonymously in accordance with ethical research principles.

Measurement and Scaling Technique

We divided the questionnaire into four main parts. Firstly, we determined the respondents' demographic information and suitability in relation to the required criteria. Demographic information included gender, age, education level, and e-commerce brand. Secondly, we asked respondents to fill in several questions related to the use of AI, adopted from Yin and Qiu (2021), PU (Wang *et al*., 2023),

PEOU (Wang *et al*., 2023), security issues (Aytekin *et al*., 2021), consumer habits (Nazir *et al*., 2023), and PI (Yin & Qiu, 2021). We developed the questions using a 5-point Likert scale: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1).

RESULTS AND DISCUSSION

Respondents' Demographic Profile

The demographic profile of respondents showed that women dominated the sample, with a total of 172. The number of men was 140. The age category was dominated by young respondents aged between 17 and 26, with 210 respondents; 27-42, with 83 respondents; and 43-58, with 19 respondents. The widely purchased types of products through e-commerce were fashion and electronic products. The most visited e-commerce brand was Shopee.

Common Method Bias

Before testing the validity and reliability of all constructs, we checked whether the collected data were bias-free. We followed the recommendations of Kock *et al*. (2021) and Mahmud *et al*. (2017) by focusing on the measurement method using Herman's single-factor statistical approach. This is the most popular test to assess common method bias. We analysed all constructs using exploratory factor analysis (EFA). Notably, common method bias can be assumed if a single factor emerges from the unrotated factor solution. Moreover, AMOS assisted in data testing. In this study, the variance explained by a single factor using confirmatory factor analysis (CFA) was <50% according to the recommended criteria (Harman, 1976), indicating the absence of common method bias in the data set used.

Confirmatory Factor Analysis

We conducted validity and reliability measurements by conducting confirmatory factor analysis (CFA) on all constructs. Notably, the AI construct used second-order CFA, and the other constructs used first-order CFA. (Chau, 1997; Hair Jr *et al*., 2010) We assessed model fit using goodness of fit indices such as the CMIN/df ratio (≤3.0), goodness of fit (≥0.9), the root mean square error of approximation (RMSEA) (≤ 0.08), the comparative fit index (CFI) (≥0.9), Tucker-Lewis index (TLI) (≥0.9), Normed Fit Index (NFI) (≥0.9). A value of 0.80-0.90 is still acceptable in some circumstances (Bentler & Yuan, 1999; Byrne, 2001).

Convergent and Discriminant Validity

Convergent validity is crucial for assessing the measurement model. We measured validity by examining the average variance extracted (AVE) value, which should be greater than 0.50. In exploratory research, a composite reliability value between 0.60 and 0.70 is acceptable, while in more advanced stages, the value should be higher than 0.70 (Sarstedt *et al*., 2014). Nunnally and Bernstein (1978) also explain that CR 0.6 is still acceptable. In our study, all constructs had the required values shown in Table 1.

Structural Model

We conducted SEM at the beginning of the study to evaluate the formulated hypothesis and test the goodness-of-fit. We modified the model to ensure the structural model fit index by justifying the error correlation in a factor that was still considered reasonable (Anderson & Gerbing, 1988). We tested the hypothesis after obtaining a measurement fit model with a standard goodness-of-fit index value. As shown in Table 2, the results of the structural model test confirmed that the implementation of AI technology had a significant effect on PU ($\beta = 0.332$, $p < 0.001$) and PEOU ($\beta = 0.301$, $p < 0.001$). This indicates that the higher the level of AI implementation in providing accurate recommendations and responsive interactions, the greater the user's perception of the ease and benefits of using digital platforms. In other words, AI plays a key role in strengthening consumers' positive perceptions of the efficiency and effectiveness of technology-based systems.

Table 1. Factor loading, validity, and reliability for the construct

Constructs	Dimensions	Question items	Factor loading	AVE	CR
AI	Accuracy	When I shop online, AI technology helps me find the things I want accurately, based solely on the words I enter	0.749		0.60
		Only by entering my picture can I look for the desired item	0.685	0.50	
		Only with a helping voice can I look for the things I want	0.679		
	Insight (IS)	E-commerce websites can recommend the product that I want based on my habits. I am looking for a similar product.	0.58	0.50	0.60
		Attractive website appearance in accordance with the preference I	0.587		
	Interactivity (IT)	The website offers several possible items I like	0.694	0.50	0.67
		Questions I can answer with the help of AI virtual services	0.752		
		AI services can answer questions for me in a way appropriate to the time	0.775		
		The answer from AI is closely related to the question that I have submitted	0.585		
PEOU		AI-powered websites are easy to use	0.79	0.66	0.74
		I do not need to emit Lots of power to understand AI	0.686		
		Shopping becomes easy with the help of products offered by AI	0.786		
		I am easy to use a website that utilises technology	0.664		
		Become skilled in using application shopping or an AI-powered e-commerce website, which is easy for me	0.7		
PU		I found the best offers through AI technology on e-commerce websites	0.691	0.58	0.63
		The use of AI in online shopping is increasing the accuracy of purchases	0.764		
		The use of AI for online shopping is beneficial for me	0.745		
		The use of AI for online shopping saves time	0.832		
PI		I am willing to browse products recommended by “e-commerce brands” powered by AI when shopping	0.722	0.66	0.63
		I am willing to buy products recommended by “e-commerce brands ”	0.795		
		I tend to buy products recommended by “e-commerce brands.”	0.904		
		I tend to buy products that are not planned when shopping at "e-commerce brands.”	0.814		
Security issue		I am worried that the use of AI can endanger the user	0.804	0.66	0.62
		I am worried that the use of AI can harm customers.	0.799		
		I am worried that the products recommended by AI are not appropriate for use	0.715		
		According to me, the products offered by AI will lead to something that consumers do not desire	0.552		
Customer habits		I often use e-commerce websites to order products	0.757	0.60	0.65
		Booking products online has already become a usual activity for me	0.936		
		Every time I think about booking a product online, e-commerce brand sites come to mind	0.947		
χ2 /CMIN df = 1.341, Chi-Square = 434.569, GFI= 0.90, RMSEA= 0.36, TLI= 0.96, NFI= 0.90					

Source: own study.

Furthermore, PU had a positive and significant effect on PI ($\beta = 0.412$, $p < 0.001$). These findings confirm that consumers tend to have higher PI when they perceive tangible benefits from using AI

technology. Conversely, PEOU had a negative and statistically insignificant effect on PI (β = -0.177, p> 0.001). This means that even though the system is considered easy to use, this ease of use is not strong enough to drive purchasing decisions, and consumers are more likely to consider the benefits or added value offered by AI technology. The model testing has met the goodness-of-fit indicators, including CMIN df = 2.093, Chi-Square = 194.632, GFI = 0.931, RMSEA = 0.059, TLI = 0.949, and NFI = 0.928, which indicate values within the fit criteria limits and demonstrate that the model fits the observed data.

Table 2. Structural model

Hypotesis	Path	Estimate	S.E	C.R	P	Result
H1	AI to PU	0.332	0.033	10.008	0.000	Supported
H2	AI to PEOU	0.301	0.027	10.976	0.000	Supported
H3	PU to INTEN	0.412	0.123	3.341	0.000	Supported
H4	PEOU to INTEN	-0.177	0.09	-1.978	0.048	Not Supported

Source: own study.

Moderation Effect

We conducted moderation testing on the security issue and customer habit variables to see their effect on the relationship between other variables in the model. The results showed that customer habits successfully moderated and strengthened the relationship between PU and PI, indicating that customer habits play an essential role in driving PI. Conversely, security issues did not significantly moderate the relationship between PEOU and PI, indicating that they did not have a strong enough moderating effect on the relationship. Figure 2 shows a diagram of the moderation relationship based on a table from Jeremy Dawson (Dawson, 2023), which clarifies the interaction between the moderating variables in this study. We examined the path coefficient value of the interaction variable in relation to the dependent variable. The customer habit interaction value was significant (p <0.05, 0.004). These results suggest a moderating effect, strengthening the relationship between the independent and dependent variables. Meanwhile, testing the moderating role of security issues yielded an insignificant value (p > 0.05, -0.068). These results indicated no moderation effect on the relationship.

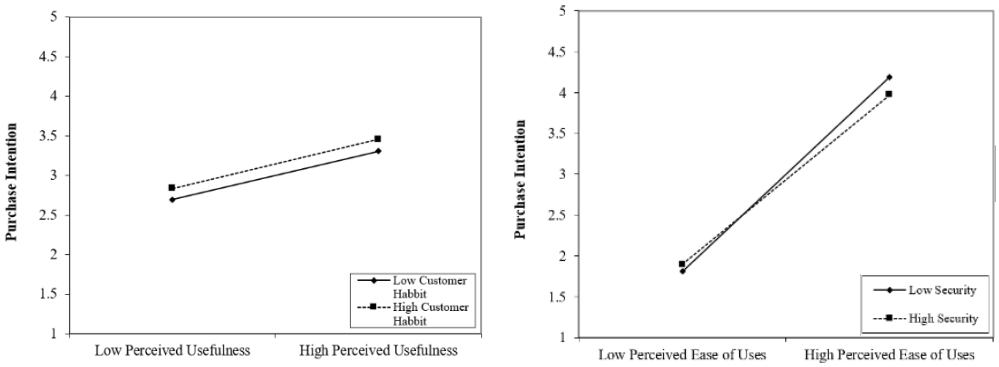

Figure 2. Diagram moderation effect
Source: own elaboration.

Discussion

The findings of this study contribute generally to the proposed theoretical model in the field of digital marketing and the application of AI technology in the retail business sector, particularly in the e-commerce industry. These findings provide a deeper understanding of the factors underlying the concept of AI formed by accuracy, insight, and interaction. They can improve consumer perceptions, specifically PEOU and PU. These findings are consistent with previous studies in the literature related to the role that AI can have in building customer perceptions of the benefits of this technology in the decision-making process (Jain *et al*., 2023). This study complements our understanding of AI's ability to analyse

when consumers are engaging in activities on the website, enabling AI devices to provide suggestions and solutions tailored to customer needs and preferences.

We also found that PU significantly affected PI. These results support previous studies (Nguyen *et al*., 2023). This suggests that consumers are more motivated to buy when they perceive the real benefits of the technology, such as personalised product recommendations or increased efficiency in product searches. Notably, PU helps consumers feel that using AI technology supports their needs and desires in the shopping experience, thereby strengthening their intention to make a purchase. Another finding is that PEOU had no significant effect on PI. These results differ from previous studies, which consistently reported a considerable impact, particularly in the application of the technology acceptance model (Islam *et al*., 2023). Consumers already consider ease of use as a basic standard in using e-commerce platforms, so it is no longer a strong differentiating factor. Consumers tend to focus more on direct benefits or PU, such as personalised recommendations and time efficiency, which directly impact purchasing decisions. Moreover, consumers are increasingly skilled at using technology, so they prioritise features that can improve the shopping experience and results rather than just easy navigation. In other words, PU offers more direct and tangible value in the shopping experience, making ease of use a secondary factor in influencing PI.

We also examined the direct and positive impact of AI on PEOU and PU, which in turn affects PI. However, we also investigated the moderating role of security issues and customer habits. We found that customer habits can be moderated by strengthening the relationship between PU and PI. Consumer habits formed from external factors will create new purchasing behaviours that last a long time and influence purchasing decisions (Sheth, 2020). In the context of social commerce, repeated interactions lead to increased familiarity between users. This familiarity will serve to obtain information on the experiences of other users and will become a consideration when making a purchase (Wang *et al*., 2021).

Previous studies indicate that security concerns do not play a moderating role in the relationship between perceived ease of use (PEOU) and purchase intention (PI). The lack of a moderating effect of security-related issues is supported by research on consumers' perceptions of risk in technology use. Specifically, privacy-related risks may vary depending on users' need for human interaction when engaging with technology (Song *et al*., 2022). Security issues in AI-based service applications were also found to negatively impact attitudes (Pan *et al*., 2019). This teaches us that consumers often overlook security issues when shopping on e-commerce sites. The research results also confirmed that perceived ease of use (PEOU) and perceived usefulness (PU) positively influence consumer acceptance of AI. However, the absence of a moderation effect of security issues suggests that security issues can be a strength, as individuals become increasingly concerned about data threats associated with AI technology. Coupled with the absence of a direct effect of security issues, this suggests that in the context of AI utilisation in e-commerce, cognitive function before accepting or rejecting AI is closely related to perceived utility value, namely, how useful or easy it is to use AI. One will not know the level of concern others have about accepting or rejecting personal data used in AI-based applications or platforms (Park & Jones-Jang, 2023). However, the positive assessment impact of PEOU and PU can be reversed into a strength because individuals are less concerned about data threats associated with AI technology. Consumers' lack of security concern is also due to their understanding that companies can use customer data to provide a better experience and assist in decision-making (Rohden & Zeferino, 2023).

Ultimately, the findings of this study support the technology acceptance model (TAM) (Mogaji e*t al*., 2024), which shows that technology will be readily accepted and used if it has benefits (PU) and is easy to use (PEOU). However, it is necessary to evaluate the application of this theory, which posits that not all technologies employed in business processes can enhance consumer purchasing intentions. It is essential to consider other factors that can impact the effectiveness of this technology in promoting positive consumer behaviour. Notably, AI enables automation and personalisation, thereby increasing operational efficiency and a more relevant user experience, ultimately increasing purchasing interest. The application of AI in e-commerce enhances operational efficiency and provides a more appropriate and engaging experience for users, ultimately driving purchasing interest and decisions. As measured by the theory of planned behaviour (TPB), purchase intention supports the use of AI in e-

commerce by explaining how psychological factors influence consumer intentions regarding technology. In TPB, attitudes, subjective norms, and perceived behavioural control influence consumer behaviour. Consumers who experience the convenience, efficiency, and benefits of personalisation by AI, such as automatic product recommendations, tend to have a positive attitude toward its use. Social norms, such as favourable reviews or trends that highlight AI as a helpful feature, also contribute to increased consumer acceptance. In addition, when consumers feel they have sufficient control (*e.g.*, ease of navigation and a good user experience), they are more motivated to shop on AI-powered e-commerce platforms, thereby increasing their interest and loyalty.

Practical Implications

Companies widely use AI-based technology in today's industry to gain efficiency and effectiveness in providing consumer services. Therefore, it is essential to examine the impact of AI on increasing PI in e-commerce studies. The results of this study explain several vital implications for e-commerce industry marketing managers. Firstly, AI can provide high-accuracy insights and interactivity in creating consumer PEOU and PU. The e-commerce industry can integrate AI to learn user patterns and preferences, enabling it to provide more relevant product recommendations. This technology enables consumers to search for and select products that meet their needs, thereby increasing their PI. E-commerce can also utilise AI to improve the interactions quality through chatbot features or personalised recommendations, thereby strengthening customer loyalty. The use of AI in e-commerce also requires consideration of ethical issues, particularly regarding consumer data privacy and security. Data collection and analysis must be conducted transparently and responsibly to maintain user trust in digital platforms.

Secondly, customer habits have been shown to strengthen the relationship between PU and PI, so e-commerce businesses need to consider how to build and maintain positive consumption habits. For example, business actors can encourage habits through loyalty programs, recommendation notifications, or incentives that make consumers more accustomed to using their platforms. Companies can create user communities, such as in social commerce, that foster familiarity among users, encouraging trust and a tendency to make decisions based on the experiences of other consumers. The ability to combine e-commerce and social commerce has the potential to drive further consumption growth that benefits goods providers (Febrian, 2023).

Third, the absence of a moderating role from the security issue factor suggests that, in the context of e-commerce, some consumers prioritise the benefits of AI over privacy risks. However, it is still essential for companies to maintain data transparency to minimise potential concerns. E-commerce businesses can strengthen consumer trust by implementing responsible data management and maintaining transparent communication about the security measures they have in place. Maintaining long-term loyalty is crucial, particularly as consumer awareness of data security continues to increase. Fourth, when AI technology can increase PEOU and PU, companies can use an approach that emphasises the benefits of technology over privacy risks to attract customers. However, this strategy needs to be balanced with an understanding of data protection and the benefits of AI for customers. Marketing that highlights the practical benefits of AI, such as increased efficiency and enhanced user experience, can alleviate concerns that some customers may have and increase acceptance of AI in e-commerce. Therefore, the e-commerce industry can optimise the use of AI technology to enhance positive consumer perceptions and drive PI, while striking a balance between security and habits that may influence consumer behaviour in the long term.

CONCLUSIONS

Artificial intelligence technology significantly increases PEOU and PU in e-commerce consumers. However, PEOU alone cannot increase consumer PI. This finding also highlights that customer habits can strengthen the relationship between PU and PI. However, security issues negatively affect the relationship between PEOU and PI. This suggests that, in the context of e-commerce, consumer concerns regarding security may be less significant than the perceived benefits offered by AI. From an academic perspective, this article represents a significant empirical step in enriching the digital mar-

keting model, particularly in e-commerce, by deepening the understanding of key factors in the concept of AI, namely accuracy, insight, and interactivity. This finding aligns with previous literature, which shows that AI has a positive impact on fostering positive perceptions of technology. Moreover, this study offers insight into how AI analyses consumer activity on websites to provide personalised suggestions tailored to individual needs and preferences. From a practitioner's perspective, our study provides several recommendations to the e-commerce industry for maximising the use of AI in enhancing user experience through features such as personalised product recommendations and responsive interactions. Businesses can consider consumer habit factors in their marketing strategies by encouraging continued use of the platform and building a user community to increase trust. Meanwhile, although security issues do not have a strong moderating role, companies are still advised to manage data transparency to maintain long-term customer loyalty.

Research Limitations

Although this study provides insight into the influence of AI use on increasing PI, scholars may use its several limitations as directions for further research. Firstly, the data collected was limited to Indonesia, which restricts the applicability of the research model to other cultures. Additional research can consider other countries or compare them. Secondly, although this study identified factors that shape PI by looking at internal perceptions from customers (PEOU and PU), there may still be other internal factors that this study did not explore, as explained by many previous studies on the variable perceived enjoyment, which can also increase purchase intentions. These results suggest that other consumer perception factors may still offer valuable insights into the influence of AI technology, provided that the moderating roles of security issues and customer habits are considered. Finally, this study employed a quantitative approach, which may have limitations in exploring and understanding respondents' subjective perspectives or experiences in depth.

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This research is a collaboration between Angga Febrian and Joel Mero. Angga Febrian contributed 95% of the research, including the formulation of the research idea, data collection, and analysis of the results. Joel Mero contributed 5% participated in the development of the theoretical framework.

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Use of Artificial Intelligence

The manuscript is free of AI/GAI usage.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Navigating the Global Innovation Landscape: The interplay of knowledge management, corporate diplomacy, and business performance in multinational corporations

Anh Tuan Tran, Bui Thanh Khoa

ABSTRACT

Objective: The study aimed to explore how knowledge management practices influence innovative capacity and, subsequently, business performance, while also analysing the moderating influence of corporate diplomacy on this relationship. We investigated the complex interplay between knowledge management, innovative capacity, and business performance within the global business environment, examining the moderating role of corporate diplomacy. The research stemmed from the increasing pressure on organisations to innovate and adapt amidst globalisation, recognising knowledge management's and corporate diplomacy's crucial roles in achieving sustainable competitive advantage.

Research Design & Methods: We utilised a quantitative research design employing partial least Squares structural equation modelling (PLS-SEM). We collected data from 208 multinational corporations (MNCs) operating in diverse Asian markets.

Findings: The findings revealed that knowledge acquisition, utilisation, and dissemination positively influenced innovative capacity, which, in turn, positively affected business performance. Furthermore, corporate diplomacy demonstrated a positive direct effect on business performance. Crucially, we observed a negative moderating effect of corporate diplomacy on the relationship between innovative capacity and business performance.

Implications & Recommendations: Research Implications: This study contributes to the theoretical understanding of how firms can leverage both technological and sociopolitical capabilities to achieve superior performance. It highlights the importance of integrating innovation and diplomacy strategies for MNEs seeking to compete effectively in the global arena. Practical Implications: The findings provide valuable insights for managers seeking to enhance their firms' performance through a combination of knowledge management, innovation and diplomacy. The study suggests that investments in both areas and efforts to align and integrate these capabilities can yield significant returns. It also underscores the importance of adapting diplomatic strategies to leverage specific innovations and target key stakeholders.

Contribution & Value Added: This study offers a novel perspective on the interplay between knowledge management, innovative capacity, business performance, and the moderating role of corporate diplomacy. It moves beyond examining these capabilities in isolation to explore their synergistic effects on business performance. By highlighting the importance of integrating these two strategic levers, the study provides valuable insights for both academics and practitioners.

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INTRODUCTION

The global business environment has undergone rapid and profound changes in recent decades, driven by globalisation, technological advancements, and shifting geopolitical dynamics. These transformations have pushed companies to adopt innovative strategies to secure competitive advantages and sustain growth. Knowledge management has emerged as a strategic asset in this context, enabling organisations to create, distribute, and apply knowledge to enhance their innovative capacity and business performance (Akhtar *et al.*, 2024). The capacity to effectively manage knowledge is fundamental to promoting innovation, as it equips organisations with the essential tools required to develop new products, processes, and business models. These elements are vital for addressing the intricate demands of global markets (Bui, 2024).

Simultaneously, scholars consider innovative capacity to be a key determinant of business performance. Firms that possess strong innovative abilities are more capable of adjusting to market shifts, satisfying customer demands, and sustaining their competitiveness (Truong & Nguyen, 2024). However, achieving this requires not only internal innovation processes but also the ability to navigate external challenges, such as geopolitical risks and regulatory complexities. This is where corporate diplomacy plays a pivotal role. Corporate diplomacy, defined as the strategic management of relationships with external stakeholders, enables firms to mitigate risks, shape regulatory environments, and foster trust among diverse actors (Hartwell & Ursprung, 2024). By aligning corporate interests with societal and geopolitical demands, corporate diplomacy is increasingly recognised as a critical enabler of sustainable growth in the global business environment (Yiu & Saner, 2017). Moreover, the implementation of the United Nations' Sustainable Development Goals (SDGs) has amplified the need for businesses to demonstrate their commitment to social and environmental sustainability. Corporate diplomacy is instrumental in helping firms navigate these complexities by forging partnerships, fostering transparency, and engaging in constructive dialogues with governments, civil society organisations, and other stakeholders (Salvi & Ruël, 2022). In this context, businesses that integrate corporate diplomacy into their strategies are better equipped to address stakeholder expectations, enhance their reputation, and achieve long-term performance goals.

Despite the essence of knowledge management, innovative capacity, and corporate diplomacy in shaping business performance, existing literature has largely examined these dimensions in isolation. Academics have directed limited focus towards the synergies among these elements and how corporate diplomacy moderates the relationship between innovative capacity and business performance. As global businesses navigate an increasingly interconnected and volatile environment, a comprehensive understanding of these interdependencies is imperative.

While both corporate diplomacy and innovative capacity individually contribute to enhanced business performance, their interaction may involve complex trade-offs rather than simple additive effects. As firms intensify their corporate diplomatic activities to secure social license, manage regulatory relationships, and navigate political complexities, they potentially face diminishing or even negative returns on these investments with respect to innovation outcomes. This trade-off perspective suggests that excessive diplomatic engagement may divert critical resources, financial, human, and attentional, away from core innovation activities (Henisz, 2016). Furthermore, the institutional orientation often associated with corporate diplomacy might foster organisational conservatism and risk aversion that conflict with the experimental mindset necessary for breakthrough innovations (Bolewski, 2022). As stakeholder relationships deepen, firms may also face mounting pressure to align their innovation efforts with external expectations rather than market opportunities, potentially compromising the commercial viability of their innovations (Rajagopal, 2024).

These theoretical tensions suggest that while moderate levels of corporate diplomacy may enhance the innovation-performance relationship by securing necessary operational legitimacy and market access, excessive diplomatic activities might diminish innovation's performance impact through resource diversion, strategic compromise, and organisational inertia.

We sought to address this gap by exploring the relationship between knowledge management, innovative capacity, and business performance, with a special focus on the moderating role of corporate diplomacy. First, while extensive research exists on the individual impacts of knowledge management and innovative capacity on business performance, their integrated effects remain underexplored. Prior studies have confirmed knowledge management's role in promoting innovation by facilitating the generation and application of new ideas (Agyapong *et al.*, 2024) and linked innovative capacity to improved financial and environmental performance (Akhtar *et al.*, 2024). However, scholars rarely address the interplay between these dimensions, particularly in the context of global businesses operating in dynamic and complex environments. Understanding how knowledge management and innovative capacity jointly influence business performance is critical for developing holistic strategies that enhance organisational resilience and competitiveness. Secondly, while scholars have studied the direct effects of corporate diplomacy on business performance, its potential moderating role in the relationship between innovative capacity and business performance remains largely unexplored (Jiang *et al.*, 2024). It is important to understand whether and how corporate diplomacy influences innovation effectiveness in driving business performance. The central research gap identifies an inadequate theoretical conceptualisation and empirical testing of the mediating or moderating function of corporate diplomacy within the specific relationship between an organisation's innovative capacity and its business performance. Existing literature strongly establishes the importance of both constructs individually, as well as their related components (Jiang *et al.*, 2024a). On the one hand, concepts closely aligned with innovative capacity, such as green creativity and green innovation, are proven predictors of enhanced environmental and financial performance. Furthermore, studies demonstrate that internal organisational mechanisms, notably green dynamic capability, can strengthen the relationship leading from green creativity through green innovation to performance outcomes (Agyapong *et al.*, 2024). Scholars consider corporate diplomacy a critical strategic approach, often identified as a dynamic capability, for utilising diplomatic skills to manage influence, obtain a 'social license to operate,' and navigate complex sociopolitical environments (Egea *et al.*, 2020). The theoretical intersection is evident, as key functions of corporate diplomacy, such as engaging external stakeholders, are viewed as dynamic capabilities essential for enterprise performance in regimes of rapid technological change. However, research focusing on corporate diplomacy's direct effect on performance has predominantly focused on the synergistic or substitutive interactions *between* the dimensions of corporate diplomacy itself (Jiang *et al.*, 2024a). Crucially, acknowledged limitations within current corporate diplomacy scholarship explicitly call for future studies to examine underlying mechanisms, such as legitimacy and knowledge exchange, mediators of corporate diplomacy's influence on performance (Bolewski, 2022; Salvi & Ruël, 2022). This highlights the need for further exploration into how corporate diplomacy interacts with internal resource strengths. Therefore, a significant gap remains in exploring the precise mechanisms by which the strategic deployment of diplomatic influence, via instruments like networking, competitive intelligence, corporate reputation, and lobbying, either mediates the path from internal innovative capacity to competitive BP outcomes, or moderates the strength of that innovation-to-performance link, thereby leveraging the firm's non-market strategy to amplify its internal innovative capabilities.

This understanding can help organisations optimise their investments in both innovation and corporate diplomacy. Addressing these gaps is not only academically significant but also practically relevant. In an era where businesses are expected to contribute to global sustainability initiatives, such as the SDGs, understanding the role of corporate diplomacy in enhancing knowledge management and innovation can provide actionable insights for managers. Moreover, given the increasing prevalence of complex global challenges, such as climate change, supply chain disruptions, and geopolitical conflicts, exploring these interdependencies is essential for fostering sustainable business practices and long-term performance. We aimed to bridge these research gaps by examining the relationship between knowledge management, innovative capacity, and business performance in the global business environment, with a specific focus on the moderating role of corporate diplomacy. Firstly, we investigated how knowledge management and innovative capacity jointly influence business performance, thereby providing a holistic understanding of their interplay. Secondly, we examined how corporate

diplomacy moderates this relationship, highlighting its potential to amplify the positive effects of innovative capacity. By addressing these objectives, the study seeks to contribute to the theoretical and practical understanding of how businesses can leverage knowledge management, innovation, and corporate diplomacy to achieve sustainable growth and competitive advantage.

The research article is organised as follows: Section 2 reviews relevant literature and theoretical foundations. Section 3 details the research methodology. Section 4 presents the findings and analysis. Section 5 discusses the results, and Section 6 concludes with implications, limitations, and future research suggestions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Corporate Diplomacy in Multinational Corporations (MNCs)

Corporate diplomacy has emerged as a critical capability for multinational corporations (MNCs) operating in an increasingly complex global landscape. Defined as the strategic use of diplomatic skills by firms to build relationships with key stakeholders and advance corporate interests, corporate diplomacy enables MNCs to navigate challenges posed by geopolitical uncertainties, cultural differences, and institutional voids (Bucheli *et al.*, 2023). It facilitates the cultivation of legitimacy and the acquisition of valuable resources in host countries, which is particularly vital for addressing the liability of outsidership that MNCs often face (Muldoon, 2005).

Social capital theory provides a robust framework for understanding corporate diplomacy, as it emphasises the importance of networks and relationships in accessing resources and reducing transaction costs (Lin, 2002). We may conceptualise corporate diplomacy as a multidimensional construct targeting three key stakeholder groups: host-country exchange partners, host-country regulators, and expatriate compatriots (Jiang *et al.*, 2024). Host-partner-oriented diplomacy focuses on building relationships with local business partners to enhance business legitimacy and market access (Ingenhoff & Marschlich, 2019). Host-regulator-oriented diplomacy involves cultivating ties with government officials to secure regulatory support and navigate political uncertainties. Meanwhile, compatriot-oriented diplomacy leverages connections with expatriates to tap into trust-based networks that facilitate resource exchange (Egea *et al.*, 2020).

Empirical studies have underscored the positive impact of corporate diplomacy on business performance. For instance, Jiang *et al.* (2024) found that corporate diplomacy enhances subsidiary performance by mitigating operational uncertainties, improving resource acquisition, and fostering local market integration. Furthermore, the complementary and substitutive effects of different forms of corporate diplomacy suggest that MNCs must adopt a portfolio approach to maximise their effectiveness. For example, host-partner-oriented diplomacy can substitute compatriot-oriented diplomacy by providing similar resources, while host-regulator-oriented diplomacy complements compatriot-oriented diplomacy by offering unique regulatory insights (Yiu & Saner, 2017). These findings highlight the strategic importance of corporate diplomacy in global operations, particularly in the context of emerging markets where institutional and cultural challenges are pronounced.

Resource-based View With Knowledge Management and Innovative Capacity

The resource-based view (RBV) posits that firms achieve competitive advantage by leveraging resources that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Knowledge management (KM) and innovative capacity are two such strategic resources that enable firms to respond effectively to environmental changes and maintain competitive positioning. Notably, KM encompasses the processes of knowledge acquisition, dissemination, and utilisation, which collectively enhance an organisation's ability to generate and apply insights (Ngoc-Tan & Gregar, 2018). On the other hand, innovative capacity refers to a firm's ability to develop new products, services, processes, or business models that drive performance outcomes (Khraishi *et al.*, 2022).

Knowledge acquisition involves the identification and assimilation of external and internal knowledge, which serves as a foundation for innovation (Idrees *et al.*, 2023). For instance, firms that

actively acquire market intelligence and technological insights are better positioned to identify opportunities and threats, thereby enhancing their innovative potential (He *et al.*, 2013). Knowledge dissemination, which entails the sharing of information across organisational units, fosters collaboration and creative problem-solving (Khoa & Huynh, 2024; Mikulecký & Mikulecka, 1999). Finally, knowledge utilisation emphasises the practical application of insights to develop solutions that address business challenges, making it a crucial driver of innovation (Wach *et al.*, 2018). Together, these dimensions of KM strengthen a firm's absorptive capacity and innovative capacity, enabling it to achieve superior performance in dynamic markets (Bui, 2024).

As a derivative of KM, innovative capacity plays a pivotal role in translating knowledge into tangible business outcomes. The development of eco-friendly products, the adoption of advanced manufacturing processes, and the creation of new business models exemplify how innovative capacity contributes to sustainability and competitive advantage (Ávila, 2021; Liu *et al.*, 2019). Moreover, innovative capacity is intricately linked to corporate diplomacy, as firms with stronger innovative capabilities are often better equipped to engage stakeholders and build legitimacy. For example, innovative firms can leverage their technological advancements to establish credibility with host-country regulators, thereby enhancing the effectiveness of corporate diplomacy (Hartwell & Ursprung, 2024). This study proposed the research model as Figure 1.

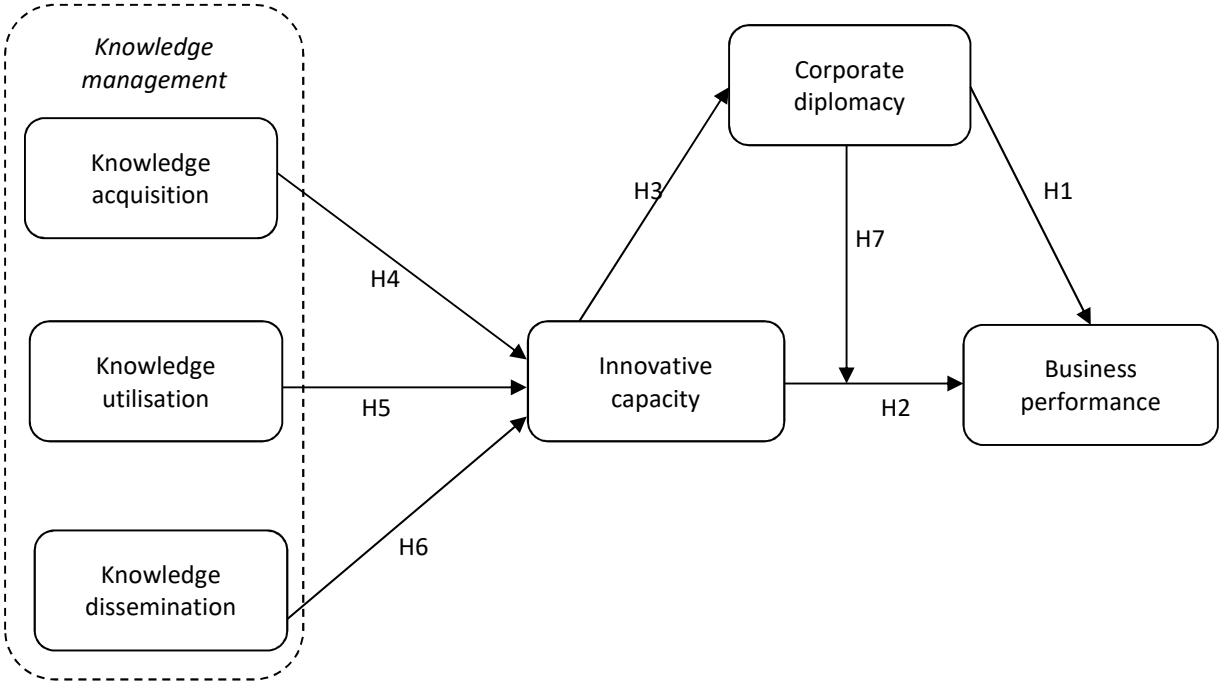

Figure 1. Research model
Source: own elaboration.

Research Hypotheses Development

Research has empirically linked corporate diplomacy to enhanced business performance through its capacity to address the liability of outsidership and secure legitimacy in host markets. By building relationships with critical stakeholders such as host-country regulators and local business partners, corporate diplomacy enables MNCs to access essential resources and navigate institutional complexities (Egea *et al.*, 2020). For instance, host-regulator-oriented diplomacy provides firms with regulatory insights and political legitimacy, which are crucial for reducing operational uncertainties and fostering market acceptance (Li *et al.*, 2017). Similarly, host-partner-oriented diplomacy facilitates resource acquisition and market integration by fostering trust and cooperation with local exchange partners (Najaf & Najaf, 2021). These mechanisms collectively enhance subsidiary performance, as evidenced by Jiang *et al.* (2024), who found that corporate diplomacy significantly improves sales growth, profitability, and return on investment in foreign subsidiaries. Therefore, we proposed H1:

H1: Corporate diplomacy positively impacts business performance.

Innovative capacity constitutes a critical determinant of business performance, as it enables firms to develop new products, services, and processes that meet evolving market demands. Drawing on the RBV, innovative capacity constitutes a unique and inimitable resource that drives competitive advantage and value creation (Barney, 1991). Empirical studies have demonstrated the positive impact of innovation on financial and operational outcomes. For example, Truong and Nguyen (2024) found that firms with high innovative capacity achieve superior environmental and financial performance by introducing eco-friendly products and processes. Similarly, Akhtar *et al.* (2024) highlighted the role of green innovation in enhancing market differentiation and customer satisfaction. These findings underscore the strategic importance of innovative capacity in achieving business success. Hence, we hypothesised:

H2: Innovative capacity positively impacts business performance.

Innovative capacity enhances a firm's ability to engage stakeholders and build legitimacy, thereby strengthening its corporate diplomacy efforts. Firms with strong innovative capabilities are better positioned to demonstrate their value to host-country regulators, local partners, and expatriate compatriots. For instance, innovative firms can leverage their technological advancements to establish credibility and gain regulatory support (Henisz, 2016). Moreover, the development of unique and sustainable solutions enhances a firm's reputation and facilitates trust-based relationships with stakeholders (Yiu & Saner, 2017). These dynamics suggest that innovative capacity serves as a foundation for effective corporate diplomacy. Therefore, we proposed H3:

H3: Innovative capacity positively impacts corporate diplomacy.

Knowledge acquisition constitutes a foundational element of knowledge management that enables firms to identify and obtain critical information that drives innovation. Firms that invest in acquiring external knowledge, such as market insights or technological advancements, are better equipped to generate novel ideas and solutions (Khraishi *et al.*, 2022; Weisha, 2021). For instance, partnerships with external stakeholders can provide access to new knowledge domains, fostering creativity and innovation. The application of acquired and disseminated knowledge is crucial for translating innovative ideas into tangible outcomes. Knowledge utilisation enables firms to align their resources with strategic goals, fostering the development of new products, processes, or business models (Wach *et al.*, 2018). Duong *et al.* (2022) highlight that effective knowledge utilisation enhances organisational agility, enabling firms to respond proactively to market opportunities. Knowledge dissemination facilitates the internal sharing of acquired knowledge, promoting collaboration and cross-functional integration. This process ensures that all organisational units are aligned and equipped to contribute to innovation initiatives (Bui, 2024). By fostering a culture of knowledge sharing, firms can enhance their innovative capacity and drive organisational performance. Hence, we hypothesised:

H4: Knowledge acquisition positively impacts innovative capacity.

H5: Knowledge utilisation positively impacts innovative capacity.

H6: Knowledge dissemination positively impacts innovative capacity.

Corporate diplomacy amplifies the impact of innovative capacity on business performance by shaping favourable external conditions, such as regulatory support and market access (Jiang *et al.*, 2024; Tran, 2024). Firms that engage in corporate diplomacy are better positioned to leverage their innovative capacity for competitive advantage and long-term performance. Corporate diplomacy can enhance the positive impact of innovative capacity on business performance by building trust and credibility with stakeholders. By showing dedication to ethical and sustainable business practices, firms can enhance their reputation and attract customers, investors, and partners, which ultimately contributes to improved business performance (Yiu & Saner, 2017). The effectiveness of innovative capacity in driving business performance may be contingent upon the moderating role of corporate diplomacy. By building relationships with key stakeholders, corporate diplomacy enhances a firm's ability to capitalise on its innovative capabilities (Salvi & Ruël, 2022). Specifically,

compatriot-oriented diplomacy is hypothesised to be the most effective mechanism due to the inherent benefits of shared culture, trust, and accelerated communication, which efficiently transfers readily usable tacit knowledge. Furthermore, we hypothesise specific interaction effects that define the nuances of the moderating mechanism. First, compatriot-oriented diplomacy and host-partner-oriented diplomacy are expected to exhibit a negative joint effect (substitution) on performance, as both aim to acquire similar market resources and business legitimacy, resulting in diminishing marginal returns or redundancy when both efforts are high (Jiang *et al.*, 2024a; 2024b). Secondly, compatriot-oriented diplomacy and host-regulator-oriented diplomacy are expected to show a positive joint effect (complementarity) on performance, as the politically derived resources (regulatory knowledge, political legitimacy) acquired through the regulator channel are distinct and non-substitutable by compatriot networks. Instead, compatriots can serve as effective intermediaries to officials, maximising the combined impact. This multi-faceted mechanism, rooted in cultivating social capital, demonstrates how corporate diplomacy moderates the efficacy of innovative capacity by optimising access to external support and managing strategic tensions among stakeholder demands (Ingenhoff & Marschlich, 2019). These dynamics suggest that corporate diplomacy amplifies the impact of innovative capacity on business performance. Therefore, we hypothesised:

H7: Corporate diplomacy moderates the relationship between innovative capacity and business performance.

RESEARCH METHODOLOGY

Measurement Scale

We captured knowledge management (KM across three dimensions: knowledge acquisition (KAC; 5 items; *e.g.*, 'Our firm often gathers intelligence about competitors' activities'), reflecting the ability to gather knowledge internally and externally (Ngoc-Tan & Gregar, 2018); knowledge utilisation (KUT; 5 items; *e.g.*, 'We effectively incorporate acquired knowledge into our decision-making processes'), focusing on applying knowledge for problem-solving and improved performance (Duong *et al.*, 2022); and knowledge dissemination (KDI; 4 items; *e.g.*, 'We ensure that knowledge is shared systematically across departments'), measuring knowledge sharing within the organisation (Khoa & Huynh, 2023). Innovative capacity (ICA; 5 items; *e.g.*, 'Our firm develops new and unique products tailored to global markets') assessed the firm's ability to create new offerings (Fidel *et al.*, 2018). Corporate diplomacy (CDI; 5 items; *e.g.*, 'We actively engage with host-country regulators to build positive relationships') measured stakeholder relationship management (Jiang *et al.*, 2024). Finally, we evaluated business performance (BP; 3 items; e.g., 'Our firm's sales growth has exceeded that of major competitors') relative to competitors, considering sales growth, profit margins, and return on investment (Khoa, 2023). We assessed the reliability and validity of these scales through confirmatory factor analysis (CFA) and internal consistency tests. We rated each construct on a 5-point Likert scale, ranging from 1 ('Strongly Disagree') to 5 ('Strongly Agree'), ensuring a robust evaluation of the relationships between knowledge management, innovative capacity, business performance, and the moderating role of corporate diplomacy.

Sample and Data Collection

We employed a quantitative research design targeting senior and middle managers from multinational corporations (MNCs) operating across multiple countries. We constructed the sampling frame using databases from international business associations and chambers of commerce, focusing on MNCs with significant international operations.

We used a stratified random sampling technique to ensure representation across different industries and geographical regions. We administered the survey online using the Qualtrics platform between October 2023 and January 2024. Following the approach of Yiu and Saner (2017), this study targeted respondents with at least three years of experience in their current organisation and direct involvement in international operations. To minimise common method bias, we implemented several procedural remedies:

1. We used different response formats for different sections.
2. We randomised the question order.
3. We guaranteed respondent anonymity.
4. We created a psychological separation between predictor and criterion variables.

We distributed the survey to 413 potential respondents. We strategically selected multinational corporations (MNCs) from the manufacturing, services, and technology sectors as these industries face a strong need for corporate diplomacy to translate their innovative capacity into superior business performance. The manufacturing sector faces acute demands for sustainability and green innovation due to its substantial resource consumption and environmental impact, making corporate diplomacy essential for securing operational and political legitimacy from local partners and regulators (Szegedi *et al.*, 2025). Innovation inherently drives the technology (High-Tech) sector, yet its performance is highly susceptible to external non-market turbulence, such as political risks and techno-nationalism. High-tech MNEs rely on corporate diplomacy as a dynamic capability to manage these complex geopolitical forces and coordinate global strategies, ensuring innovation efforts successfully circumvent institutional barriers. Finally, the services sector must overcome the inherent liability of outsidership by deeply embedding itself in local economies. Service MNEs utilise corporate diplomacy, often through robust corporate social responsibility and host-partner-oriented diplomacy, to cultivate trust, acquire an 'institutional role,' and gain a competitive edge in diverse regulatory environments. Therefore, these three sectors offer distinct contexts from physical resource management to geopolitical risk and market embeddedness to comprehensively study the moderating influence of corporate diplomacy on innovation outcomes.

After two follow-up reminders, we received 234 responses (56.7% response rate). Following data cleaning and removal of incomplete responses, we retained 208 valid responses for analysis, exceeding the minimum sample size requirement for structural equation modelling (Hair Jr *et al.*, 2016). To assess non-response bias, we compared early and late respondents using t-tests on key variables, showing no significant differences. Additionally, we conducted Harman's single-factor test to check for common method variance, with the unrotated factor solution accounting for less than 50% of the variance, suggesting common method bias was not a significant concern. The sample demonstrated good representation across management levels, industries, and geographical regions. The majority of respondents (78.4%) have more than five years of experience in their current organisation, suggesting they possess sufficient knowledge about their organisation's practices and capabilities. Table 1 presents the demographic profile of the respondents.

Table 1. Respondent Profile

Characteristic	Category	Frequency	Percentage
Position level	Senior management	73	35.1%
	Middle management	135	64.9%
Industry sector	Manufacturing	82	39.4%
	Services	76	36.5%
	Technology	50	24.1%
Experience	3-5 years	45	21.6%
	6-10 years	98	47.1%
	>10 years	65	31.3%
Home country	Asia-Pacific	89	42.8%
	Europe	62	29.8%
	Americas	57	27.4%

Source: own study.

RESULTS AND DISCUSSION

Measurement Scale

We evaluated the measurement model using convergent validity, discriminant validity, and internal consistency reliability to ensure the reliability and validity of the constructs used in this study. We employed the partial least squares structural equation modelling (PLS-SEM) and analysed using SmartPLS software. Convergent validity was assessed through three metrics: Cronbach's Alpha (α), composite reliability (CR), and average variance extracted (AVE). Cronbach's Alpha measures internal consistency, with values above 0.7 indicating acceptable reliability. Composite reliability (CR) evaluates the reliability of the construct as a whole, with a threshold of 0.7. AVE measures the proportion of variance captured by the construct relative to the variance due to measurement error, with values above 0.5 considered adequate (Hair *et al.*, 2010). Furthermore, we assessed the outer loadings of the individual items, with values above 0.7 generally considered acceptable (Hair *et al.*, 2019). Table 2 summarises the results for each construct. All constructs demonstrated satisfactory levels of convergent validity. Cronbach's Alpha (CA) values ranged between 0.793 and 0.916, indicating high internal consistency for all constructs. Similarly, the CR values ranged between 0.880 and 0.934, exceeding the threshold of 0.7, and AVE values ranged between 0.594 and 0.881, confirming that more than 50% of the variance in indicators was explained by the respective latent variables. Outer loadings for all items were above 0.7, further supporting the reliability of the measurement model.

Table 2. Convergent validity results

Construct	CA	CR	AVE	Outer Loading
Knowledge acquisition (KAC)	0.835	0.884	0.604	0.716-0.821
Knowledge utilisation (KUT)	0.830	0.880	0.594	0.715-0.804
Knowledge dissemination (KDI)	0.793	0.866	0.617	0.771-0.806
Innovative capacity (ICA)	0.906	0.930	0.726	0.840-0.866
Corporate diplomacy (CDI)	0.916	0.934	0.881	0.927-0.956
Business performance (BP)	0.901	0.918	0.835	0.907-0.925

Source: own study.

We evaluated discriminant validity through the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio. The Fornell-Larcker criterion requires that the square root of AVE for each construct surpasses its correlation with other constructs. Furthermore, HTMT values below 0.85 indicate acceptable discriminant validity (Henseler *et al.*, 2014). Table 3 summarise the results. The Fornell-Larcker criterion confirmed discriminant validity, as the square root of AVE for each construct exceeded its correlations with other constructs. Moreover, HTMT values were below 0.85 for all construct pairs, further supporting discriminant validity. These results indicate that each construct was distinct and measured a unique dimension of the research model.

Table 3. Discriminant validity results

Variable	Fornell-Larcker criterion results						HTMT criterion results					
	BP	CDI	ICA	KAC	KDI	KUT	BP	CDI	ICA	KAC	KDI	KUT
BP	**0.914**											
CDI	0.437	**0.938**					0.464					
ICA	0.704	0.455	**0.852**				0.774	0.485				
KAC	0.463	0.200	0.627	**0.777**			0.531	0.221	0.717			
KDI	0.451	0.053	0.591	0.631	**0.785**		0.532	0.093	0.695	0.774		
KUT	0.551	0.331	0.686	0.634	0.574	**0.771**	0.626	0.371	0.783	0.759	0.701	

Source: own study.

Structural Model

We assessed the structural model through evaluation of R^2, f^2, Q^2, variance inflation factors (VIF), and path coefficients to assess the relationships among the constructs. We used Smart-PLS software for the PLS-SEM analysis.

The R^2 values indicate the proportion of variance explained by the independent variables, while Q^2 values assess the predictive relevance of the model. Table 4 presents the R^2 and Q^2 results. The R^2 values indicated that knowledge management dimensions (KAC, KUT, KDI) explained 55.4% of the variance in innovative capacity, while innovative capacity and corporate diplomacy explained 55.6% of the variance in business performance, and innovative capacity explained 20.7% of the variance in corporate diplomacy. Moreover, Q^2 values exceeded zero for all constructs, confirming the model's predictive relevance (Hair *et al.*, 2017).

Table 4. R^2 and Q^2 Values

Construct	R^2	Q^2
Innovative Capacity (ICA)	0.554	0.397
Business Performance (BP)	0.556	0.446
Corporate Diplomacy (CDI)	0.207	0.180

Source: own study.

We assessed the variance inflation factor (VIF) values to ensure no multicollinearity among the predictor variables. Noteworthy, VIF values below 5 indicate acceptable levels of collinearity (Hair *et al.*, 2011). Table 5 presents the VIF results and f2 value. All VIF values were below 5, indicating no significant collinearity issues among the predictor variables in the structural model. The PLS-SEM analysis in Table 5 revealed that knowledge utilisation had the most substantial impact on innovative capacity, exhibiting a medium effect size ($f^2 = 0.220$), while knowledge acquisition and dissemination demonstrated more negligible effects ($f^2 = 0.059$ and 0.050, respectively). As expected, innovative capacity itself strongly influenced business performance, with a large effect size ($f^2 = 0.489$). Interestingly, innovative capacity also had a medium-sized effect on corporate diplomacy ($f^2 = 0.261$), suggesting a link between innovation and diplomatic engagement. While corporate diplomacy's direct impact on business performance was relatively small ($f^2 = 0.073$), its primary role was a negative moderator of the innovation-performance relationship, a previously discussed finding. These results underscore the importance of knowledge utilisation for driving innovation and, ultimately, business performance, while also highlighting the complex interplay between innovation, corporate diplomacy, and firm success.

Table 5. Collinearity (VIF) and f^2 results

Relationship	VIF	f^2	Effect Size
KAC → ICA	2.033	0.059	Small
KUT → ICA	1.827	0.220	Medium
KDI → ICA	1.814	0.050	Small
ICA → BP	1.419	0.489	Large
ICA → CDI	1.000	0.261	Medium
CDI → BP	1.348	0.073	Small

Source: own study.

We conducted the path analysis to evaluate the hypothesised relationships between knowledge management dimensions (KAC, KUT, KDI), innovative capacity (ICA), business performance (BP), and the moderating effects of corporate diplomacy (CDI). The analysis used partial least squares structural equation modelling (PLS-SEM) in Smart-PLS software to generate path coefficients, t-values, and p-values and assess the significance of the relationships and the strength of the moderating effects.

The results in Table 6 show that all the direct relationships between knowledge management dimensions (KAC, KUT, KDI) and ICA were positive and statistically significant. The strongest predictor of

ICA was KUT with a path coefficient of β = 0.423, t = 6.241, p < 0.001, followed by KAC with β = 0.232, t = 3.382, p < 0.01, and KDI with β = 0.202, t = 2.915, p < 0.01. These findings highlight the importance of effectively acquiring, utilising, and sharing knowledge to enhance the firm's ICA. Furthermore, the relationship between ICA and BP was also significant (β = 0.555, t = 13.805, p < 0.001), indicating that innovation-driven organisations achieve superior business outcomes. This result aligns with prior research emphasising the critical role of innovation in driving organisational success (Chen & Chang, 2013). Moreover, ICA positively impacts CDI (β = 0.455, t = 8.965, p < 0.001), and CDI has a positive effect on the BP (β = 0.209, t = 3.9, p < 0.001).

Table 6. Path coefficients and hypothesis testing

Hypotheses	Path Coefficient (β)	t-value	p-value	Result
KAC -> ICA	0.232	3.382	0.001	Yes
KUT -> ICA	0.423	6.241	0.000	Yes
KDI -> ICA	0.202	2.915	0.004	Yes
ICA -> BP	0.555	13.805	0.000	Yes
CDI -> BP	0.209	3.900	0.000	Yes
ICA -> CDI	0.455	8.965	0.000	Yes
mod_ICA_BP -> BP	-0.255	4.993	0.000	Yes

Source: own study.

We found that corporate diplomacy moderated the relationships between ICA and business performance significantly. The negative and significant path coefficient for the interaction term in Table 6 (mod_ICA_BP -> BP, β = -0.255) indicates that CDI negatively moderated the relationship between ICA and BP. This confirms the hypothesis of a negative moderating effect. This negative moderation implies that the positive effect of ICA on BP is weaker when CDI is high, as shown in Figure 2. While innovation is generally beneficial for performance, the benefits diminish when a firm engages in extensive corporate diplomacy.

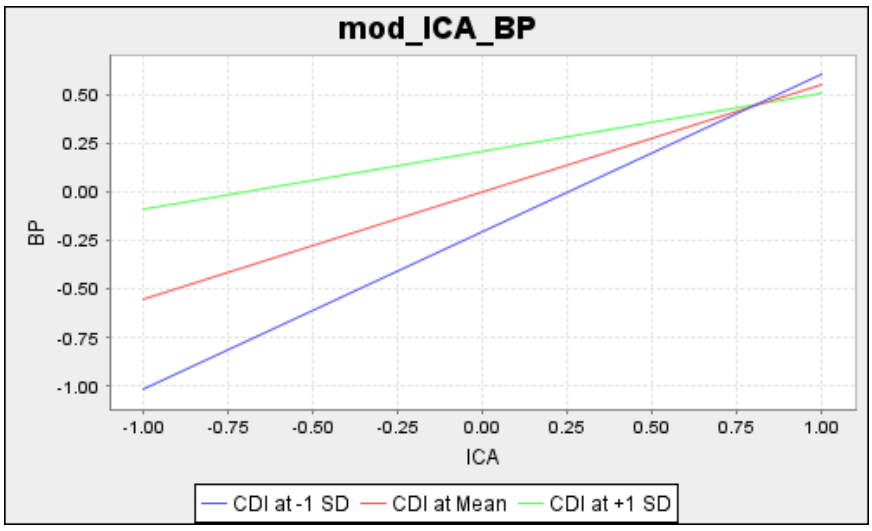

Figure 2. The moderating effect of corporate diplomacy on the relationships between innovative capacity and business performance

Source: own elaboration.

Discussions

We investigated the relationships between knowledge management, innovative capacity, and business performance in the global business environment, with corporate diplomacy serving as a moderating factor, as in Figure 3. The results validated the existing literature and extended prior research by underscoring corporate diplomacy's pivotal role in enhancing knowledge management practices' effectiveness and translating innovative capacity into superior business outcomes.

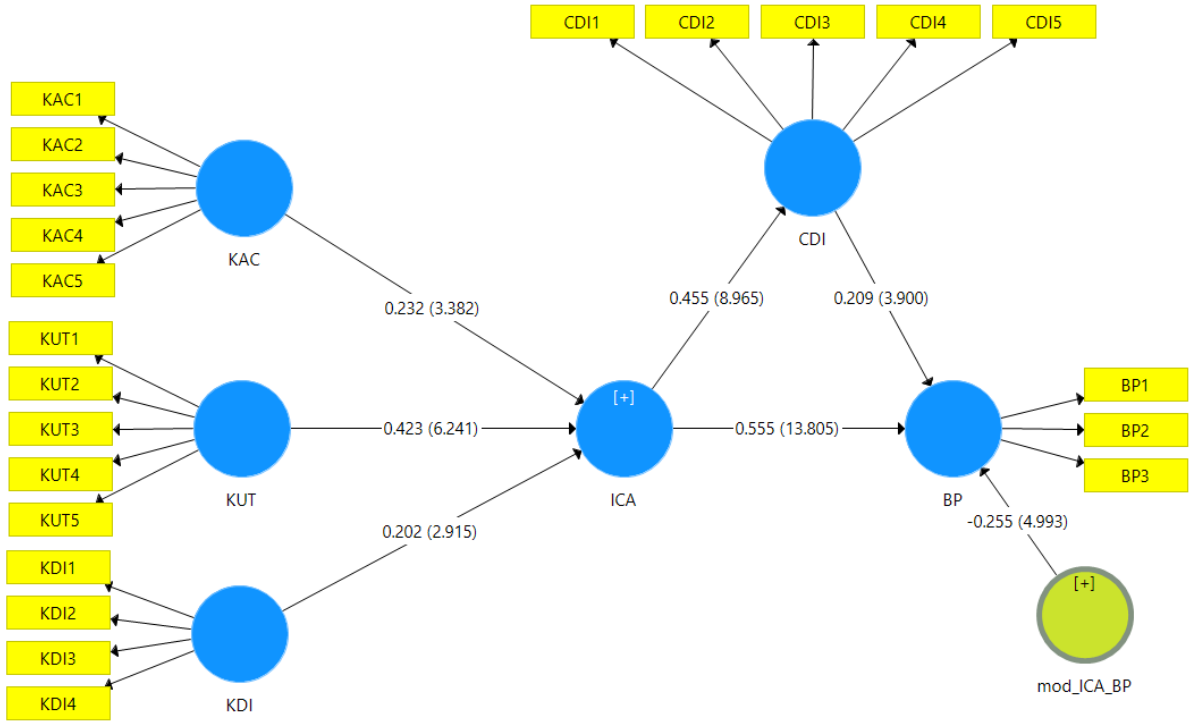

Figure 3. PLS-SEM results model
Source: own elaboration in SmartPLS.

Our findings are consistent with prior research that emphasises the significance of knowledge management as a critical driver of innovative capacity. We found that knowledge acquisition, utilisation, and dissemination all enhance innovative capacity significantly, mirroring the conclusions of Santoro *et al.* (2018), who highlighted the role of knowledge management processes in enhancing creativity and innovation. Specifically, our results align with their assertion that effective knowledge acquisition from external sources like partnerships and market research enhances a firm's ability to innovate. Similarly, Joseph (2023) demonstrated that the application of knowledge is instrumental in driving innovation, a finding corroborated by our study, which identified knowledge utilisation as the strongest knowledge management predictor of innovative capacity. Moreover, our findings reveal that knowledge dissemination is critical for fostering collaboration and promoting the diffusion of innovative practices within organisations. This supports the work of Bui (2024), who argued that internal knowledge-sharing mechanisms, such as training programs and cross-departmental collaborations, are essential for creating an innovative culture. By validating these relationships in the context of multinational corporations (MNCs), our study provides further evidence that knowledge management dimensions are indispensable for building innovative capacity and achieving competitive advantage.

The positive and significant relationship between innovative capacity and business performance observed in this study is consistent with prior research by Zeb *et al.* (2021), who posited that firms with strong innovative capacity are better equipped to introduce novel products, improve operational efficiency, and adapt to shifting market demands. Our findings also align with insights from Zhang *et al.* (2023), who emphasised the importance of innovation in contributing to the United Nations' Sustainable Development Goals (SDGs). In addition to improving profitability and market share, innovative capacity enables firms to engage in ethical and sustainable practices, thereby enhancing their reputational capital. Notably, this study reveals relatively high explanatory power ($R^2 = 0.548$) for the innovative capacity-business performance relationship, further supporting the proposition that innovation is a key determinant of business success in dynamic global markets. This finding adds to the growing body of literature that underscores the strategic importance of innovation as a source of sustainable competitive advantage in the resource-based view framework (Bhat *et al.*, 2024; Zhao *et al.*, 2024).

Innovative capacity and corporate diplomacy are intertwined drivers of business performance, particularly for multinational enterprises. A firm's ability to develop novel products, services, and processes (innovative capacity) creates potential value, but realising this potential often requires navigating complex international environments and building relationships with diverse stakeholders. This is where corporate diplomacy becomes crucial. By engaging in strategic stakeholder management and building sociopolitical capital, firms can gain access to new markets, secure critical resources, mitigate risks, and enhance their reputation (Egea *et al.*, 2020). Furthermore, innovative offerings can serve as valuable tools for corporate diplomacy, strengthening relationships with governments and communities, particularly in sectors with high social impact (Doh *et al.*, 2022). This synergistic interplay between innovation and diplomacy creates a virtuous cycle, where innovation generates value, diplomacy facilitates its capture, and enhanced performance fuels further investment in both capabilities.

The negative moderating effect of corporate diplomacy on the relationships between innovative capacity and business performance, constitutes a distinctive contribution of this study. The moderating effect of corporate diplomacy on the innovative capacity-business performance relationship further validates the work of Hartwell and Ursprung (2024), who argued that corporate diplomacy enhances credibility and stakeholder trust, which are crucial for translating innovation into business success. By engaging with governments, NGOs, and civil society organisations, firms can align their innovative efforts with broader societal goals, thereby creating value for both the business and its stakeholders. However, high levels of corporate diplomacy may divert resources (financial, human, and time) away from innovation activities, thus reducing the impact of innovation on performance (Jiang *et al.*, 2024). Moreover, a strong focus on diplomacy might encourage risk aversion, potentially hindering the implementation of radical innovations that could disrupt existing relationships. Firms might prioritise maintaining harmony over pursuing potentially disruptive innovations (Rajagopal, 2024). Extensive diplomatic efforts could shift the firm's focus away from market-oriented innovation towards building and maintaining relationships with stakeholders. This might lead to innovations that prioritise social or political objectives over market competitiveness. To maintain positive relationships, firms might compromise on the features or quality of their innovations, potentially limiting their market impact. While corporate diplomacy can enhance a firm's ability to operate effectively in global markets, theoretical perspectives suggest that excessive diplomatic engagement may actually attenuate the relationship between innovative capacity and business performance. Firstly, resource allocation theory (Barney, 1991) suggests that organisations possess finite resources that must be distributed across competing strategic activities. As corporate diplomacy intensifies, it consumes significant financial, human, and attention resources that might otherwise support innovation implementation. This resource diversion can constrain a firm's ability to translate innovative capacity into tangible performance outcomes, particularly when diplomatic activities expand beyond optimal levels (Ocasio, 1997).

Secondly, institutional theory provides a framework for understanding how excessive corporate diplomacy might constrain innovation's performance impact. As firms deepen their diplomatic engagements, they become increasingly embedded in institutional networks that demand conformity to established norms and practices (DiMaggio & Powell, 1983). This institutional isomorphism can generate strategic rigidities that impede the implementation of truly novel or disruptive innovations. While moderate institutional embeddedness provides the legitimacy necessary for innovation acceptance, excessive conformity pressure may lead firms to pursue incremental rather than transformative innovations, thereby reducing innovative capacity's performance impact (Henisz, 2016).

Recent corporate practices reflect the regulatory mechanisms identified in this study. The Huawei case exemplifies the successful employment of corporate diplomacy to safeguard innovation capacity and sustain performance amid geopolitical instability. Since the implementation of US sanctions in 2019, Huawei has augmented its collaborations with governments in the Middle East, Africa, and Latin America through scholarly investments, joint research and development centres, and global communication initiatives (Ambashi, 2020). These actions have empowered the organisation to bolster its institutional legitimacy and mitigate policy risks, thereby enabling it to maintain its innovation performance despite external constraints (Tang & Li, 2011; Kuo, 2024).

In contrast, the Apple case clearly illustrates the strategic trade-offs between innovation and diplomacy. Apple's deep dependence on the Chinese supply chain and regulatory environment has compelled it to engage in diplomacy to maintain favourable relations with the Chinese government, while shifting production to India and Vietnam to mitigate geopolitical risks (Chennai & Cupertino, 2022). Furthermore, Apple has recently intensified its exploration of investment avenues to establish most of its manufacturing and innovation hubs within the United States, aiming to avoid being caught between U.S.-China tensions (Vengattil, 2025).

These two cases reinforce the study's empirical findings that corporate diplomacy is a conditional capability which boosts innovation performance when balanced, but can undermine outcomes when it crosses a threshold or deviates from political direction.

While prior studies have explored the individual relationships between knowledge management, innovative capacity, and business performance, few have examined these constructs in an integrated framework or considered the moderating role of corporate diplomacy. For instance, Bhardwaj and Srivastava (2021); and Islam *et al.* (2022) emphasised the importance of knowledge management and innovation but did not account for the external environmental factors that influence these relationships. By incorporating corporate diplomacy as a moderating variable, this study bridges this gap and provides a more comprehensive understanding of how firms can leverage knowledge management and innovative capacity to achieve superior performance. Furthermore, this study contributes to the growing body of research on business diplomacy by empirically validating its impact on organisational outcomes. While Salvi and Ruël (2022) underscored the importance of corporate diplomacy in navigating complex global environments, our findings extend their work by demonstrating its moderating effects on knowledge management and innovation processes. This highlights the need for MNCs to integrate corporate diplomacy into their strategic frameworks to enhance their competitiveness and sustainability.

CONCLUSIONS

Theoretical Contributions

This study provides valuable insights into the complex interrelationships between knowledge management, innovative capacity, corporate diplomacy, and business performance in multinational corporations operating in Asian markets. Our analysis revealed that knowledge management practices, specifically knowledge acquisition, utilisation, and dissemination, significantly enhance firms' innovative capacity. Knowledge utilisation emerged as the strongest predictor (β = 0.423), followed by knowledge acquisition (β = 0.232) and dissemination (β = 0.202), collectively explaining 55.4% of the variance in innovative capacity.

The findings further demonstrate that innovative capacity strongly drives business performance (β = 0.555), confirming innovation's critical role in achieving competitive advantage. Corporate diplomacy also exhibits a positive direct effect on business performance (β = 0.209), suggesting that stakeholder relationship management contributes independently to organisational success. However, our most notable finding is the negative moderating effect of corporate diplomacy on the innovation-performance relationship (β = -0.255). This unexpected result indicates that while both innovation and diplomacy individually enhance performance, excessive diplomatic activities may diminish the performance benefits derived from innovation.

This study extends the RBV framework by incorporating corporate diplomacy as an external factor that complements and enhances the effectiveness of internal resources, such as knowledge management and innovative capacity. Traditional RBV perspectives emphasise the role of internal resources and capabilities in achieving competitive advantage. However, this research demonstrates that external factors, such as corporate diplomacy, can interact with and strengthen internal resources, providing a more comprehensive view of resource optimisation. By situating corporate diplomacy within the RBV framework, the study bridges the gap between internal resource management and external environmental factors, offering a more holistic perspective on how firms can achieve sustainable competitive advantage. This extension is particularly relevant in dynamic and

uncertain global environments, where external stakeholder relationships and geopolitical factors play a critical role in shaping organisational outcomes.

Another key contribution of this study lies in its empirical validation of corporate diplomacy as a critical variable in global business environments. While much of the existing literature on corporate diplomacy has been normative, focusing on its conceptual importance, this study provides robust evidence of its practical impact on organisational performance. By integrating corporate diplomacy into the relationships between innovative capacity and business performance, the study underscores the necessity for firms, particularly MNCs, to adopt a dual focus on internal resources and external stakeholder engagement. This empirical contribution extends the understanding of corporate diplomacy beyond its traditional domains, such as public affairs and corporate social responsibility, situating it as a strategic enabler of innovation and performance.

The study provides a significant contribution to the knowledge management and innovation literature by empirically demonstrating the interconnectedness of knowledge management dimensions and their collective influence on innovation outcomes. While previous research has often focused on individual knowledge management practices or isolated elements of innovation, this study provides a comprehensive framework that aligns these constructs. By identifying the distinct yet complementary roles of knowledge acquisition, utilisation, and dissemination in boosting innovative capacity, the research highlights the importance of a balanced approach to knowledge management practices. Furthermore, the findings provide new insights into the mechanisms through which knowledge management practices translate into enhanced business performance, offering actionable guidance for both scholars and practitioners.

Finally, this study emphasises the strategic importance of integrating internal resources (knowledge management and innovative capacity) with external factors (corporate diplomacy) to achieve superior performance in global business environments. This dual focus addresses a critical gap in the literature, where studies have traditionally either concentrated on internal capabilities or external environmental factors. By demonstrating the interactive effects of knowledge management, innovative capacity, and corporate diplomacy, the study provides a robust framework for understanding how firms can navigate the complexities of global markets. This contribution is particularly relevant for MNCs, which operate in environments characterised by high levels of uncertainty, competition, and geopolitical challenges.

Managerial Implications

The findings of this study provide actionable insights for managers, policymakers, and practitioners operating in global business environments. By highlighting the interplay between knowledge management, innovative capacity, business performance, and corporate diplomacy, this research offers practical strategies to enhance organisational competitiveness and sustainability.

Managers in multinational corporations must prioritise the systematic implementation and optimisation of knowledge management practices to enhance their innovative capacity. Specifically, firms should develop mechanisms to acquire external knowledge through strategic alliances, partnerships, and market research. This includes monitoring technological trends, understanding customer needs, and identifying opportunities in competitive markets. Moreover, firms can encourage the application of acquired knowledge by integrating insights into product development, business processes, and problem-solving. Managers should create an environment where knowledge is actively utilised to generate value. The managers foster cross-departmental collaboration and knowledge-sharing by implementing platforms such as intranets, training programs, and knowledge repositories. These systems ensure that knowledge flows seamlessly across the organisation, driving collective innovation efforts.

The study underscores the critical role of corporate diplomacy in moderating the relationships between innovative capacity and business performance. Managers must integrate corporate diplomacy into their strategic frameworks by building trust-based relationships with governments, non-governmental organisations, civil society, and local communities. These relationships can help firms navigate regulatory challenges, mitigate geopolitical risks, and access valuable resources. They need to train senior executives and managers in corporate diplomacy skills such as negotiation, cultural intelligence,

and stakeholder management. These capabilities enable firms to operate more effectively in diverse and dynamic environments. Furthermore, they can use corporate diplomacy to advocate for policies and initiatives that support innovation, such as government incentives for research and development, infrastructure development, and intellectual property protection.

Secondly, while investing in corporate diplomacy activities yields direct performance benefits through enhanced stakeholder relationships and reduced institutional friction, managers must carefully calibrate their diplomatic investments. Our findings suggest firms should pursue a balanced approach, engaging in sufficient diplomacy to secure operational legitimacy and market access, but not to the extent that it diverts critical resources from innovation or creates organisational inertia that undermines the implementation of innovative initiatives. Specifically, managers should consider corporate diplomacy as complementary to, rather than a substitute for, innovation strategies. Diplomatic efforts should be strategically aligned with innovation objectives, targeting stakeholders who can facilitate market acceptance of innovations rather than pursuing broad relationship-building that may not translate to performance gains. This balanced approach ensures firms capture both the direct benefits of diplomacy and the full performance impact of their innovative activities.

The study emphasises the pivotal role of innovative capacity in driving business performance. Managers should take strategic actions to maximise the impact of innovation on organisational success, including allocating sufficient resources to research and development activities to foster the development of novel products, services, and processes. This includes adopting emerging technologies such as artificial intelligence and data analytics to enhance innovation outcomes. Creating an organisational culture that encourages creativity, experimentation, and risk-taking. This involves empowering employees to contribute new ideas, rewarding innovation, and ensuring leadership commitment to innovative initiatives. They must use corporate diplomacy to secure external support for innovation, such as government grants, cross-sector collaborations, or access to international markets. Corporate diplomacy can also help firms mitigate external risks that may hinder innovation efforts, such as regulatory barriers or geopolitical instability.

Limitations and Future Research

This research has several limitations that should be acknowledged. Firstly, the cross-sectional design limits our ability to establish causal relationships between constructs. The relationships identified may evolve differently over time, particularly as firms develop deeper stakeholder relationships. Secondly, relying on single-source data from individual respondents within each firm introduces potential common method bias, despite our statistical controls. Thirdly, we operationalised corporate diplomacy as a unidimensional construct, potentially overlooking the nuanced effects of its different dimensions (host-partner, host-regulator, and compatriot-oriented diplomacy). A significant limitation of this study is that we measured business performance exclusively through three self-reported Likert-scale items assessing perceived performance relative to competitors, rather than through objective financial metrics. This approach introduces potential biases, as respondents may overestimate their organisation's performance due to social desirability or limited visibility into competitors' actual results. The subjective nature of these measures makes it difficult to validate the magnitude of performance effects or distinguish between different performance dimensions (financial, market, operational). Furthermore, the absence of objective performance data limited our ability to determine whether the observed moderating effect of corporate diplomacy translates into measurable financial outcomes that would interest shareholders and other stakeholders. Finally, we did not test for measurement invariance across industries or regional contexts, which may limit the generalisability of our findings across diverse business environments.

Several promising avenues for future research emerge from this study. Researchers should apply the Johnson-Neyman technique to identify the specific threshold at which corporate diplomacy begins to negatively moderate the innovation-performance relationship, providing more precise guidance for managerial decision-making. Future studies should also disaggregate corporate diplomacy into its constituent dimensions to determine which aspects most significantly influence the innovation-performance relationship. To address the limitations in performance measurement, future studies should

incorporate objective financial indicators from annual reports or financial databases (*e.g*., ROI, sales growth, market share) alongside subjective measures. This multi-method approach would enhance measurement validity and provide more robust evidence regarding the economic impact of knowledge management, innovation, and corporate diplomacy. Furthermore, multi-group analyses comparing the model across different industries, firm sizes, and regional contexts would enhance understanding of when and where the moderating effect is most pronounced.

Researchers should also consider employing multi-source data collection by gathering performance assessments from multiple stakeholders within each organisation and external industry analysts to mitigate common method bias. Moreover, longitudinal research designs tracking both perceptual and objective performance measures over time would not only establish causality more convincingly but also reveal whether the negative moderating effect of corporate diplomacy on the innovation-performance relationship affects short-term versus long-term performance differently. Furthermore, developing more nuanced performance measures that distinguish between financial, operational, market, and sustainability dimensions would provide deeper insights into which specific aspects of business performance are most affected by the interplay between innovation and corporate diplomacy. Finally, qualitative case studies exploring the mechanisms underlying the negative moderation effect would provide richer insights into the practical tensions between innovation implementation and diplomatic activities. By addressing these research directions, scholars can advance theoretical understanding of how firms can optimise the integration of innovative capacity and corporate diplomacy to achieve sustainable competitive advantage in complex global markets.

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Do digital small and medium-sized enterprises drive green economic growth in the European Union?

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ABSTRACT

Objective: The article aims to investigate whether digitalisation among small and medium-sized enterprises (SMEs) contributes to green economic growth (GEG) across European Union countries, focusing on environmental performance outcomes.

Research Design & Methods: Using panel data from 25 European Union countries for the period 2010-2023, we applied fixed-effects, moderation, and panel threshold regression models. Digitalisation was proxied by the share of enterprises with e-commerce turnover above 1%, while GEG was measured via adjusted net savings. The analysis controlled for energy intensity and globalisation, and tests interactions with trade openness and R&D investment.

Findings: The results revealed a robust, positive, and statistically significant relationship between SME digitalisation and GEG. Higher trade openness (interaction coefficient = 0.148) and R&D intensity (interaction coefficient = 0.058) amplified the impact.

Implications & Recommendations: Policymakers should treat SME digitalisation as both an innovation and an environmental strategy. Support should focus on scaling digital capabilities in traditional sectors, improving access to R&D resources, and fostering enabling conditions like trade integration and green startup support. Investments in digital infrastructure, skills training, ESG metrics, and regional innovation hubs are essential for realising the synergistic benefits of the green-digital transition.

Contribution & Value Added: This study shows that SME digitalisation is an important driver of environmental performance, but its impact depends on wider institutional and structural conditions. By combining fixed-effects, moderation, and threshold models, the study offers original evidence of a nonlinear digitalization-sustainability relationship, demonstrating that environmental gains intensify once SMEs reach higher levels of digital maturity. The study further identifies trade openness and R&D intensity as mechanisms that amplify these effects, contributing theoretically by clarifying how structural contexts shape the translation of digital capabilities into green economic outcomes.

Article type: research article

Keywords: Digital SMEs; green growth; trade openness; R&D investment; e-commerce; environmental performance; EU policy

JEL codes: L26; M13; M2; Q01; Q56

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INTRODUCTION

Green economic growth (GEG) and digital transformation are increasingly promoted as twin imperatives within the European Union's long-term development agenda (European Commission, 2025). Grounded in frameworks such as the European Green Deal and the Digital Decade 2030, the EU envisions a future in which technological innovation catalyses low-carbon economic activity, enhances resource efficiency, and fosters social inclusion. This dual transition is frequently framed as synergistic and self-reinforcing,

supported by the belief that digitalisation will accelerate green innovation and sustainability outcomes (Clegg & Casnici, 2023; Han & Zhang, 2022; Gobniece & Titko, 2024; Szczepańska-Woszczyna & Muras, 2023; Thirakulwanich *et al.,* 2025). However, despite strong policy narratives linking digital transformation to sustainability, the empirical evidence remains inconsistent, particularly regarding whether SME-level digitalisation translates into measurable improvements in environmental performance. Existing research tends to focus either on macro-level digital economy indicators or on firm-level innovation outcomes, leaving the specific environmental implications of digital SMEs insufficiently examined. Moreover, SMEs, which constitute more than 99% of all EU businesses, are positioned as key drivers of both green and digital transitions (Abbas *et al.*, 2024; European Commission, 2025; Titko *et al.*, 2023a; Szczepańska-Woszczyna *et al.,* 2022). However, the assumption that digitalisation seamlessly drives GEG through SME innovation may overlook significant structural and contextual challenges. Recent studies highlight SMEs' limited absorptive capacity to integrate advanced digital and green technologies due to resource constraints, knowledge gaps, and institutional fragmentation (Putri *et al*., 2025; Nie *et al.*, 2025; Gross-Golacka *et al.*, 2024). Furthermore, the role of cultural (Dacko-Pikiewicz, 2019b), educational (Korzeniowska & Sułkowski, 2020; Szczepańska-Woszczyna & Gatnar, 2022), and policy ecosystems in enabling these transitions is often underestimated. Titko *et al.* (2023b) and Verina *et al.* (2021) emphasised the importance of cultivating staff digital competencies and sustainability literacy to enhance transformation outcomes. However, institutional inertia and fragmented support systems continue to hinder the scaling of best practices across regions and sectors (Yang *et al.*, 2024; Obadire *et al.*, 2025). Despite the growing literature on digitalisation and sustainability, existing studies do not provide a clear empirical assessment of whether SME-level digitalisation improves environmental performance in a comparable, cross-country context. Prior work either examines digitalisation at the macroeconomic level or focuses on innovation outcomes rather than measurable green economic growth. Moreover, the conditional nature of this relationship, particularly the roles of trade openness, R&D intensity, and possible nonlinear effects, remains largely unexplored.

This gap prevents a full theoretical understanding of how and under which structural conditions digitalisation contributes to green outcomes. These unresolved issues justify the need for additional investigation. Although policy narratives assume that digitalisation naturally accelerates green transformation, empirical evidence remains inconsistent. It remains unclear whether SMEs, given their resource constraints, technological heterogeneity, and uneven access to innovation ecosystems, generate environmental gains from digitalisation, and whether such gains depend on broader institutional conditions. Clarifying these relationships is essential for advancing theory and guiding effective policy interventions.

Thus, while the convergence of digital and green transitions offers transformative potential, realising this vision will require more than technological adoption. It demands systemic change supported by coordinated innovation ecosystems, inclusive financing mechanisms, critical education, and robust SME support structures, particularly in areas such as circularity, energy efficiency, and carbon-neutral logistics (Pacheco *et al.*, 2024; Klingenberg & Kochanowski, 2015). Proponents argue that SMEs are particularly well suited to drive sustainability-oriented change because of their organisational agility, local embeddedness, and capacity for business model innovation (Dacko-Pikiewicz, 2019a; Quintás *et al.,* 2018; Arsawan *et al.*, 2024). Scholars consider digital technologies, especially those supporting e-commerce, IoT-enabled monitoring, blockchain for traceability, and AI for optimisation, to be critical enablers in green transition (Shao *et al.*, 2024; Ullah *et al.*, 2021; Kwilinski, 2023b). Moreover, policy narratives increasingly position digital SMEs, particularly those operating through e-commerce channels, as the cornerstone of Europe's digitally driven GEG strategy. These firms are expected to connect sustainable producers with conscious consumers, reduce emissions through smart logistics, and lead to innovation in green services (Mustafa *et al.,* 2022; Kwilinski, 2023a).

Considering studies (Lee & Kim, 2025; Maesaroh *et al.*, 2024; Hasbullah *et al.*, 2024), this vision involves several implicit tensions and oversimplification risks. Firstly, digitalisation is not inherently green. The growing deployment of digital infrastructures, including data centres, cloud computing, and AI, requires significant energy and material inputs and, in some cases, contributes to the environmental burden rather than alleviating it. Without alignment between digital tools and sustainability objectives, SMEs risk engaging in 'digital for digital's sake' rather than genuine ecological transformation (Li, 2024; lux *et*

al., 2023). Secondly, despite the promise of digital inclusion, uneven access to digital technologies and skills continues to marginalise many SMEs, especially in rural areas, low-income regions, or transition economies, thus exacerbating the digital divide and potentially reinforcing economic disparities (Bassi & Guidolin, 2021; Najmaei & Sadeghinejad, 2023; Pojani *et al.*, 2025). While the EU's Digital Decade emphasises the integration of SMEs into e-commerce ecosystems, the concentration of digital markets among a few dominant platforms raises concerns about market access, algorithmic discrimination, and value capture (Cherednichenko *et al.*, 2023; Zatonatska *et al.*, 2025; Zhuang, 2024). Furthermore, SMEs operating within these systems may struggle to retain autonomy, data ownership, and fair market share, which thus limits their ability to reinvest in green innovation. The presumed convergence between digital and green agendas also overlooks institutional fragmentation across EU member states, where regulatory inconsistencies, financing gaps, and bureaucratic burdens frequently impede SME participation in sustainability schemes. Moreover, empirical evidence on the environmental effectiveness of digitalisation in SMEs remains mixed. While some studies (Alfadul & AlKubaisy, 2024; Wit *et al.*, 2021; Yi, 2014; Zsolnai, 2002) affirm positive relationships between digital capability and environmental performance, others (Haq & Huo, 2023) caution that digitalisation alone does not guarantee meaningful decarbonisation or circularity unless deliberate sustainability strategies, appropriate metrics, and policy incentives accompany it (Wani *et al.*, 2024). For instance, greenwashing risks persist in the absence of standardised reporting and robust environmental accountability frameworks.

Accordingly, we addressed the following analytical problem: under what institutional and structural conditions does SME digitalisation generate measurable environmental benefits in EU economies? The objective was to quantify the impact of SME digitalisation on green economic growth, to test the moderating roles of trade openness and R&D intensity, and to evaluate whether these effects exhibit nonlinear threshold behaviour.

Given the strategic importance of SMEs in the EU's green and digital transition agendas and the growing reliance on digitalisation as a driver of sustainability, the study aimed to empirically identify whether and under which structural conditions SME digitalisation contributes to GEG in EU countries. Specifically, we examined the direct effect of SME digitalisation on environmental performance, the moderating roles of trade openness and R&D intensity, and the presence of nonlinear threshold effects. This study contributes to theoretical development by addressing a key limitation in the existing literature: the implicit assumption that digitalisation uniformly and linearly enhances environmental performance. Prior studies have provided important insights into how digital capabilities stimulate innovation and productivity. However, they have not established whether these mechanisms translate into green economic outcomes at the level of SMEs, nor under what institutional configurations such translation becomes feasible. The present study advances this line of inquiry by conceptualising SME digitalisation as a process whose environmental effectiveness depends on complementary structural conditions. Specifically, we examined the roles of trade openness and R&D intensity as enabling environments that shape the diffusion, scaling, and environmental orientation of digitally supported practices. This approach aligns with recent theoretical perspectives emphasising that digital technologies generate sustainability benefits only when embedded within supportive innovation and market ecosystems. Methodologically, the integration of fixed-effects, moderation, and threshold regression techniques enables the identification of context-dependent and nonlinear relationships that remain undetected in conventional linear empirical designs. Consequently, the study delineates the boundary conditions under which digitalisation contributes to green economic growth, thereby refining existing theoretical interpretations of the digitalisation-sustainability nexus in entrepreneurship and innovation research.

The article has the following structure: literature review analyses relevant literature on GEG, SME digitalisation, and their interlinkages, leading to the formulation of the research hypothesis. The research methodology section describes the methodological approach, including data sources, variable construction, and econometric techniques. The results and discussion section explores the empirical results and interprets the findings within existing theories and policy frameworks. Finally, conclusions summarise the main results, drawing policy implications, and outlining limitations and future research directions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Green economic growth (GEG) represents a synergistic development pathway that simultaneously pursues environmental sustainability, economic resilience, and social inclusion. Central to this transformation are structural and institutional determinants, notably the strategic role of small and medium-sized enterprises (SMEs), the acceleration of digital transformation, the emergence of innovative start-ups, and the facilitation of trade openness. Furthermore, SMEs are critical enablers of green economic (GE) transformation because of their adaptive capacity, innovation potential, and sectoral diversity. Feng *et al.* (2025a) highlight that SMEs across Mediterranean economies significantly contribute to GEG by adopting lean-green practices and implementing sustainable business strategies. When equipped with green human resource management (Aldaas *et al.,* 2022) and eco-efficient production models (Ahsan, 2024), these enterprises achieve both environmental improvements and operational efficiency.

The integration of circular economy principles into SMEs' operations further accelerates sustainable transformation. Ho *et al.* (2024) confirmed that circularity-infused green practices bolster productivity and business resilience. Moreover, Le and Ferasso (2022) provide empirical evidence from the food manufacturing sector, highlighting that green investments directly enhance SMEs' sustainable performance.

Previous studies (Dzwigol *et al.*, 2024; Ozturk *et al*., 2024) have shown that digitalisation acts as a catalyst for GEG by streamlining operations, reducing environmental footprints, enhancing resource efficiency, and unlocking new market opportunities through innovative technologies. It enables real-time monitoring of emissions, energy use, and supply chain processes, thereby empowering enterprises to make more informed and sustainable decisions. Islam *et al.* (2023) underscore the dual transition of Indonesian SMEs toward both digital and GE, emphasising the complementarity of digitalisation and sustainability. Their findings suggest that digital transformation is not merely a technological upgrade but also a strategic shift that reshapes business models towards environmental responsibility. Waqar *et al.* (2025) revealed that the fintech revolution facilitates circular economy practices and green innovation among SMEs by improving financial access, enabling more efficient resource allocation, and incentivising sustainable investments. Digital financial tools, such as blockchain, mobile payments, and digital credit scoring, contribute to building more transparent and inclusive green business ecosystems (Kwilinski, 2025).

The integration of digital solutions into manufacturing helps reduce waste and optimise production cycles, further enhancing SMEs' contribution to GE objectives. Huang *et al.* (2025) confirmed that through industrial intelligence and e-commerce, the digital economy significantly drives green transitions, especially when aligned with industrial policy and innovation support mechanisms. These transformations contribute not only to operational efficiency but also to the broader goals of carbon neutrality and sustainable consumption. In particular, e-commerce constitutes a powerful enabler of green business models that bridge local production with global markets while minimising the need for physical infrastructure and intermediaries. Caiyi *et al*. (2022) demonstrated that although the rapid expansion of e-commerce can exacerbate environmental pressures via increased packaging waste and transportation emissions, strategic governance, logistics innovation, and digital eco-certification can mitigate these effects and foster greener consumer behaviour. Zatonatska *et al.* (2024) and Kiselicki *et al.* (2022) further proved that e-commerce platforms create significant revenue opportunities for SMEs in developing and transition economies, especially when combined with digital marketing strategies and eco-oriented product positioning. In these contexts, digital platforms not only lower entry barriers to international markets but also support the adoption of traceable and transparent supply chains, which are crucial for meeting environmental, social, and governance (ESG) standards (Titko *et al.*, 2021; Williams, 2022).

Innovations in green logistics, such as route optimisation, real-time inventory management, and carbon tracking tools, contribute to decarbonising e-commerce operations. Zhou *et al.* (2023) and Liu (2023) emphasise that integrating e-commerce with green supply chain strategies enhances SMEs' ability to meet sustainability goals while remaining competitive.

Owing to their agility and disruptive innovation capabilities, start-ups are key agents of ecological modernisation. Sehnem *et al.* (2022) reported that start-ups that embed circularity in their

business models tend to outperform traditional enterprises in terms of sustainability indicators. The entrepreneurial ecosystem plays a vital role here: support structures, such as green subsidies and incubation environments, bolster the resilience and scalability of sustainable start-ups (Dragomir *et al.,* 2023; Shang, 2025). Sector-specific evidence, such as in tourism (Arteaga Estrella *et al.,* 2018), green logistics (Masudin *et al*., 2025), and ecotourism (Chen, 2019), demonstrates that start-ups are pioneering green practices across diverse contexts. Sokil *et al.* (2022) emphasise that start-ups in post-transition economies such as Ukraine exhibit significant potential for GEG, particularly when policy frameworks support long-term sustainability.

Trade openness supports GEG by enhancing the diffusion of environmentally friendly technologies, fostering competition, and broadening access to sustainable inputs. Bıçakcıoğlu *et al.* (2020) and Bıçakcıoğlu-Peynirci and Tanyeri (2022) empirically confirmed that green business strategies positively influence export performance, especially when firms align with global environmental standards. Increased integration into international markets incentivises green certifications, ecoinnovation, and sustainable value chain participation (Chen, 2019; Liu, 2023). However, institutional mechanisms that mitigate environmental leakage and reinforce compliance with green regulations must complement openness to trade (Nie *et al.,* 2025). Thus, the convergence of trade liberalisation and environmental protection policies becomes imperative for inclusive GEG.

Investment in R&D supports the transition to low-carbon and circular economies by generating knowledge that enhances resource efficiency, reduces environmental impact, and fosters green competitiveness. Fernando *et al.* (2019) highlight that environmental innovation, rooted in R&D, directly improves sustainable business performance, whereas Golden *et al.* (2021) underscore the role of green chemistry in creating market opportunities aligned with ecological goals. Public initiatives such as the North Carolina Green Business Fund (Hall & Link, 2015) and cleantech clusters (Davies, 2013) illustrate how targeted R&D investments can amplify regional GEG through spillovers and technological diffusion. In emerging economies, R&D also empowers SMEs to overcome infrastructure and policy gaps. Alkandi (2025) shows that green R&D enhances business outcomes when it is embedded in corporate social responsibility strategies. Maulidi (2025) and Singh *et al.* (2016) confirm that R&D-driven green product innovation increases cost efficiency and market performance, particularly among SMEs. Furthermore, R&D supports circular economy transitions in high-impact industries such as construction, textiles, and manufacturing (Gyimah *et al.,* 2025; Habtemaryam *et al.,* 2025) while improving firms' resilience and adaptability to sustainability challenges (Chalyi *et al.,* 2020). Chatzistamoulou and Tyllianakis (2022) noted that well-informed SMEs, often those investing in research, are more likely to follow GEG pathways.

Although prior research recognises the link between digitalisation and sustainability, there is a lack of focused, integrative analysis on how SME-level digital transformation specifically contributes to GE outcomes. Most existing studies treat digitalisation and GEG as parallel priorities but do not thoroughly examine their interaction within the SME sector. Addressing this gap is essential for evidence-based policy design, particularly within the EU and emerging markets, where SMEs dominate the economic landscape. Prior studies suggest several mechanisms through which SME digitalisation affects environmental performance. Digital tools improve energy efficiency through real-time monitoring, support waste reduction via data-driven optimisation, and enhance transparency in supply chains (Shao *et al*., 2024; Kwilinski, 2023b). Moreover, SMEs that adopt digital solutions often streamline logistics, reduce resource intensity, and accelerate green innovation. Nevertheless, the evidence remains mixed, and the environmental benefits may depend on the firms' absorptive capacity and access to complementary resources. These insights support the expectation that SME digitalisation is positively associated with environmental performance. Thus, we developed the following research hypothesis 1:

H1: The digitalisation of SMES enhances GEG.

Internationalisation-related theories further suggest that trade openness amplifies the environmental returns to digitalisation. Open economies benefit from greater exposure to advanced technologies, sustainability standards, and competitive pressures that incentivise digital innovation with green outcomes (Philbin *et al*., 2022; Ozturk *et al*., 2024). Empirical studies show that firms in highly integrated markets adopt cleaner production, improve energy efficiency, and apply environmental man-

agement tools more rapidly than those in closed economies. Therefore, SMEs operating in more open trade environments are likely to achieve stronger environmental gains from digitalisation:

H2: Trade openness positively moderates the relationship between SMES digitalisation and GEG.

Innovation capability theory suggests that R&D enhances firms' ability to translate digital capabilities into environmental improvements. Countries with higher R&D intensity possess stronger knowledge infrastructures, greater absorptive capacity, and more developed technological ecosystems, which enable SMEs to leverage digital tools for eco-efficiency and green innovation (Yang & Liu, 2024; Cobbinah *et al.*, 2025). Thus, the environmental impact of SME digitalisation should be stronger in economies with robust R&D investment:

H3: R&D investment positively moderates the relationship between SME's digitalisation and GEG.

Figure 1 shows the study's theoretical framework.

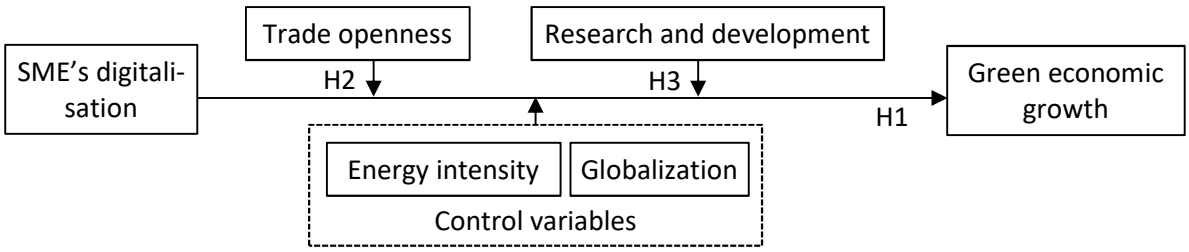

Figure 1. The theoretical framework of the study
Source: own elaboration.

RESEARCH METHODOLOGY

To test the hypotheses, in the empirical analysis, we relied on three complementary econometric models: a benchmark fixed-effects specification, a moderation model with interaction terms, and a panel threshold model. The baseline fixed-effects panel regression examined the average effect of digital SMEs on GEG across European countries over time. The model controlled for unobserved heterogeneity at the country and year levels:

$$GEG_{\mathrm{it}} = \alpha + \beta_1 DigitalSMEs_{it} + \beta_2 Controls_{it} + \mu_i + \lambda_i + \epsilon_{it} \quad (1)$$

in which:

GEG - GEG indicator for country i in year t;
$\mathrm{DigitalSMEs}$ - measure of digital small and medium-sized enterprises in country i in year t;
$Controls$ - vector of control variables;
μ_i - country fixed effects, capturing time-invariant heterogeneity across countries;
λ_i - time fixed effects, capturing year-specific shocks and trends;
ϵ_{it} - error term.

We measured the explained variable (GEG) by adjusted net savings, including particulate emission damage (as a percentage of the GNI), obtained from the World Bank's World Development Indicators. This indicator reflects the integration of environmental externalities into national accounts, in line with the EU Green Deal and the broader sustainability agenda. Wani *et al.* (2024) employed adjusted savings to analyse the impact of green technology, energy, foreign direct investment (FDI), and globalisation in G7 economies (Wani *et al.,* 2024). Khan *et al.* (2023) investigated the interaction effects of green innovation, energy efficiency, and FDI on GEG in OECD countries via related sustainability indicators. Sohag *et al.* (2019) examined the relationships among GEG, cleaner energy, and militarisation in Turkey and operationalised GEG through adjusted or environmentally corrected economic measures.

In line with the literature review, we recognised SME digitalisation as a multidimensional organisational capability, which integrates several interrelated dimensions: technological infrastructure and connectivity, enabling access to digital platforms and cloud-based services; process automation and integration of internal operations; data-driven decision-making and analytics-supported managerial

routines; and digitally enabled business models that reshape firms' value creation logic in markets (Ozturk *et al.,* 2024; Waqar *et al.,* 2025; Yang & Liu, 2024). These components jointly determine SMEs' ability to transition from basic digital adoption to advanced digital maturity, which is associated with stronger sustainability-oriented innovations, resource efficiency gains, and environmentally beneficial outcomes (Islam *et al.,* 2023; Cobbinah *et al.,* 2025).

However, empirical operationalisation of this comprehensive construct remains challenging due to heterogeneity of data coverage, differing survey methodologies, and temporal inconsistencies in measurement across countries (Philbin *et al.,* 2022; Chatzistamoulou & Tyllianakis, 2022; Haq & Huo, 2023). Cross-country comparable indicators that reflect advanced forms of digital transformation (cloud computing, ERP integration, industrial automation, AI-driven operations) are only partially available for SMEs, and typically for shorter time windows or limited sets of sectors. This constraint restricts their use in long-horizon econometric designs, especially when the focus extends to environmental outcomes that require robust panel identification. To ensure methodological consistency across 25 EU countries over 2010-2023, we therefore adopted an entry-level, behaviour-revealing proxy of digital adoption: the share of SMEs with e-commerce sales accounting for at least 1% of turnover (Eurostat, 2024). This indicator captures the commercialisation dimension of digitalisation, a fundamental step in SMEs' digital transition according to the EU's Digital Intensity framework and Digital Decade Policy Programme 2030, which prioritise the diffusion of basic digital competencies among SMEs as a minimum progress benchmark (European Commission, 2021; 2025). Importantly, engagement in e-commerce is not merely a technical adjustment but entails a broader organisational transformation. It reflects firms' ability to adopt digitally supported marketing practices, maintain online customer interfaces, integrate order management and distribution systems, synchronise logistics, and handle digital payment and data-processing arrangements (Kiselicki *et al.,* 2022; Mustafa *et al.,* 2022; Shao *et al.,* 2024). Such infrastructural and operational capabilities constitute critical preconditions for deeper digital upgrading, facilitating the diffusion of circular-oriented innovations, the optimisation of energy and material use, emission-reducing logistics strategies, and sustainable customer engagement, mechanisms empirically linked to improved environmental performance of SMEs (Huang *et al.,* 2025; Zhou *et al.,* 2023; Nie *et al.,* 2025). Accordingly, we should regard this indicator as a lower-bound operationalisation of SME digitalisation, signalling threshold digital readiness that enables firms to participate in digital markets, interface with global supply chains, and internalise efficiency-enhancing routines.

In this study, we selected energy intensity (EI) and the overall globalisation index (GLO) as control variables. Higher energy intensity (measured as total primary energy supply per unit of GDP (toe per 1 000 USD at PPP) implies lower efficiency in the use of energy resources, which directly contributes to higher greenhouse gas emissions and environmental degradation (IEA, 2023). Empirical research consistently documents a negative association between energy intensity and indicators of environmental performance and sustainable economic growth (Baloch *et al.*, 2020; Shokoohi *et al*., 2022; Dzwigol *et al*., 2024). In the context of this study, we expected digital SMEs to improve their environmental outcomes partly through gains in resource use efficiency. However, baseline differences in energy intensity across countries reflect structural characteristics of production and consumption that independently affect environmental outcomes. Countries with energy-intensive industrial sectors tend to exhibit worse environmental performance regardless of the level of digitalisation (IEA, 2023). The overall globalisation index, developed by Dreher (2006) and updated by Gygli *et al.* (2019), aggregates the economic, social, and political dimensions of globalisation to measure the extent of international integration. Globalisation influences environmental performance through several documented mechanisms. On the one hand, it facilitates the transfer of cleaner technologies, best practices, and sustainability standards across borders, improving environmental outcomes. On the other hand, increased trade and production associated with globalisation can exacerbate resource consumption and pollution in the absence of adequate regulations (Shahbaz *et al.,* 2015). Globalisation creates incentives to adopt digital technologies to access international markets, comply with global standards, and compete effectively (Skare & Soriano, 2021; Elfaki & Ahmed, 2024).

To investigate whether the association between environmental performance and digitalisation among SMEs depends on broader structural and institutional conditions, the analysis incorporates interaction terms between digitalisation and two moderating variables: trade openness (trade as a percentage of GDP) and research and development (R&D) expenditure (as a percentage of GDP).

$$GEG_{\text{it}} = \alpha + \beta_1 DigitalSMEs_{it} + \beta_2 Controls_{it} + \beta_3 Controls_{it} + \beta_3 (DigitalSMEs_{it} \times Moderator_{it}) + \mu_i + \lambda_i + \epsilon_{it} \quad (2)$$

in which:

$Moderator_{it}$ - moderating variable;

$(DigitalSMEs_{it} \times Moderator_{it}$ - an interaction term indicating whether the impact of digital SMEs on GEG depends on the moderator;

International trade facilitates the diffusion of advanced technologies and environmental standards, thereby increasing the capacity of digital SMEs to contribute to sustainable development (Philbin *et al.,* 2022; Ozturk *et al.,* 2024). Higher trade intensity has been associated with stronger linkages between technological innovation and environmental outcomes because of exposure to global competition and access to cleaner technologies (Wang *et al.,* 2021). Similarly, R&D expenditure captures national investment in innovation and knowledge creation, which conditions SMEs' ability to leverage digital tools for environmental improvement. Prior studies identify R&D intensity as a critical enabling factor for translating digitalisation into green outcomes by fostering the development and adoption of sustainable technologies (Yang & Liu, 2024; Cobbinah *et al.,* 2025). Countries with higher R&D spending tend to exhibit stronger synergies between digitalisation and environmental performance because of greater absorptive capacity and technological capabilities.

To examine potential nonlinear effects, we estimated a panel threshold model (Hansen, 1999). This model tests whether the effect of digital SMEs on GEG changes when the moderating variable exceeds an estimated threshold:

$$GEG_{\text{it}} = \begin{cases} \alpha_1 + \beta_1 DigitalSMEs_{it} + \epsilon_{it}, if\ q_{it} \leq \gamma \\ \alpha_1 + \beta_2 DigitalSMEs_{it} + \epsilon_{it}, if\ q_{it} > \gamma \end{cases} \quad (3)$$

in which:

q_{it} - threshold variable;

γ - estimated threshold value separating the two regimes.

We based the empirical analysis on a panel dataset comprising European Union member states over the 2010-2023 period. We excluded Malta and Cyprus from the sample because of data limitations. Table 1 summarises descriptive statistics for the variables used in models (1)-(3).

Table 1. Descriptive statistics of variables

Stats	GEG	$DigitalSMEs$	$Startup$	TO	RD	EI	GLO
Mean	9.472764	16.93234	123.9626	126.4206	1.719255	3.565331	82.50955
SD	5.543195	7.639241	246.2969	63.44917	0.8783699	1.142731	3.953934
Min	-11.35125	3.07	0	50.92252	0.38208	0.97	71.00684
Max	21.79603	37.66	1724.768	412.1772	3.70532	7.1	90.6544
VIF		1.44	1.44	1.20	2.77	1.25	3.00

Source: own study.

Table 1 presents the VIF statistics, which indicate no substantial multicollinearity among the regressors, with all values remaining below 3.0. This suggests that correlations among the explanatory variables are not sufficiently high to distort coefficient estimates or their inference.

RESULTS AND DISCUSSION

Table 2 reveals the results of the baseline fixed-effects panel regressions examining the effect of digital SMEs on GEG in European Union countries. Across all three model specifications, the coefficient of $DigitalSMEs$ remained positive and statistically significant at the 5% level, suggesting that greater digitalisation among SMEs was associated with improved GEG.

The R-squared values remained high across all the models (approximately 0.87). Both country and year fixed effects were included in all the models to control for unobserved heterogeneity.

Table 2. Baseline regression outputs

Variables	Model 1	Model 2	Model 3
$DigitalSMEs$	0.0857** (0.0394)	0.0942** (0.0426)	0.0938** (0.0427)
EI		-0.6966*** (0.1843)	-0.6916*** (0.1877)
GLO			0.1572 (1.0802)
Constant	2.8044*** (0.1071)	2.7702*** (0.1167)	2.7709*** (0.1169)
Observations	350	350	350
R-squared	0.8676	0.8684	0.8684
Individual FE	YES	YES	YES
Year FE	YES	YES	YES

Note: standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Source: own study.

To verify the robustness of the baseline findings, we estimated alternative model specifications and reported them in Table 3. Model (4) includes the lagged dependent variable to address potential dynamic effects and persistence in environmental performance over time. The coefficient of $DigitalSMEs$ remained positive and statistically significant at the 5% level (0.0995), confirming the positive association between digitalisation in SMEs and GEG. This stability indicates that the observed association was not sensitive to the relaxation of the strict exogeneity assumption, mitigating concerns that short-run endogeneity may bias the estimates.

Table 3. Alternative model specifications for robustness

Variables	Model 4	Model 5	Model 6	Model 7
$DigitalSMEs_{t-1}$	0.0995** (0.0429)			
$Startup$		0.0322*** (0.0101)	0.0220** (0.0106)	0.0221** (0.0106)
EI			-0.5053*** (0.1880)	-0.4951*** (0.1902)
GLO				0.4096 (1.0623)
Constant	2.7670*** (0.1158)	2.9290*** (0.0347)	2.9578*** (0.0369)	2.9563*** (0.0372)
Observations	325	350	350	350
R-squared	0.8635	0.8662	0.8618	0.8658
Individual FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Note: standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: own study.

The persistence of this relationship in a dynamic specification suggests that the environmental benefits of digitalisation are not short-lived but accumulate over time. This aligns with evidence showing that digital adoption generates learning effects, organisational restructuring, and gradual efficiency gains that materialise only after repeated use (Thirakulwanich *et al.,* 2025). The stability of the coefficient across models also indicates that the effect was not driven by a single-year anomaly but reflected a structural association between SME digitalisation and green economic dynamics. Models (5)-(7) tested the robustness of the results by replacing the dependent variable with an alternative measure:

venture capital investments in start-ups and early-stage firms ($Startup$). By focusing on venture capital investments in startups and early-stage enterprises, the measure reflected the allocation of financial resources toward new, potentially environmentally friendly technologies and business models that support the transition to a greener economy (Mrkajic *et al*., 2019; Rizzitello *et al*., 2025). $Startup$ remained positive and statistically significant at the 1% or 5% level, with coefficients ranging from 0.0322 to 0.022. This suggests that higher levels of start-up activity are associated with improved environmental performance, which is consistent with the baseline findings.

Table 4 presents the results of the moderating effect regressions, which aimed at examining whether trade openness and R&D investment influence the strength of the relationship between SME digitalisation and GEG.

Table 4. Moderating effect regression results

Variables	Model 8	Model 9	Model 10	Model 11
$DigitalSMEs$	0.0849** (0.0417)	0.06027* (0.0415)	0.0757* (0.0426)	0.0781* (0.0429)
TO	0.5629*** (0.1367)			
$TO \times Digital$		0.1482*** (0.0450)		
RD			0.1950*** (0.0649)	
$RD \times Digital$				0.0575** (0.0237)
EI	-0.6985*** (0.1826)	-0.7179*** (0.1847)	-0.6712*** (0.1852)	-0.6944*** (0.1861)
GLO	-0.0675 (1.0526)	-0.1979 (1.0675)	0.4316 (1.0693)	0.3180 (1.0731)
Constant	0.1226 (0.6531)	2.7469*** (0.1152)	2.7400*** (0.1158)	2.7404*** (0.1166)
Observations	350	350	350	350
R-squared	0.8758	0.8733	0.8725	0.8711
Individual FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Note: standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Source: own study.

The value of DigitalSMEs was consistently positive and statistically significant across all four models, with coefficients ranging from 0.0603 to 0.0849. This confirmed the hypothesis (H1) that higher levels of digitalisation among SMEs are associated with improved GEG in EU countries. In Model 9, the interaction effect between trade openness and digitalisation was positive and highly significant (0.1482). This finding suggests that in countries with greater trade openness, the positive impact of digital SMEs on GEG is amplified (H2). We may interpret the result as evidence that access to international markets enables digital SMEs to adopt and scale green technologies more effectively, enhancing their environmental contribution. Model 11 includes an interaction between R&D expenditure and digitalisation, which also has a significant positive effect (0.0575). This finding indicates that in countries with higher levels of investment in R&D, digital SMEs are better positioned to translate their technological capabilities into green outcomes (H3). Thus, innovation-friendly environments enhance the effectiveness of digital transformation in supporting environmental goals. Across all the models, environmental intensity had a negative and statistically significant effect. This means that higher pollution levels reduce the potential for GEG. Moreover, the globalisation index was not statistically significant in any of the models, suggesting that, unlike targeted trade openness, general global integration does not strongly influence the green performance of digital SMEs.

Table 5 extends this analysis by introducing threshold regression models to explore potential nonlinearities in the digitalisation-GEG relationship. The results demonstrate that the positive impact of digital SMEs becomes significantly stronger once a certain threshold level of digital adoption is reached.

Table 5. Results of threshold regression analysis

Variables	Model 12	Model 13
$DigitalSMEs$ ($q_{it} \leq \eta$)	0.1769*** (0.0650)	0.2076*** (0.0636)
$DigitalSMEs$ ($q_{it} > \eta$)	0.1409*** (0.0394)	0.1615*** (0.0382)
TO	0.3548*** (0.1095)	
RD		0.1724** (0.0668)
EI	-0.4128** (0.1810)	-0.4723*** (0.1806)
GLO	0.0761 (1.0077)	0.6415 (1.0157)
Constant	0.9629** (0.4822)	2.5169*** (0.0995)
Observations	350	350
R-squared	0.1489	0.1380

Note: standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
Source: own study.

In Models (12) and (13), the coefficient for $DigitalSMEs$ increased to 0.1769 and 0.2076, respectively, suggesting that the relationship is not strictly linear and that countries with more digitally mature SME sectors exhibit disproportionately greater environmental benefits. The threshold results indicate that the environmental benefits of SME digitalisation accelerate only once economies surpass a minimum level of structural readiness. Below this threshold, digital uptake may be insufficient to overcome technological and organisational constraints, resulting in weaker or insignificant green outcomes. Scholars have identified similar nonlinear patterns in studies of digital maturity and eco-innovation, which show that environmental returns emerge only after firms accumulate sufficient technological capabilities and supportive institutional conditions (Yang & Liu, 2024). Therefore, the identified threshold corresponds to a point at which digital capabilities begin to interact synergistically with national innovation systems, enabling SMEs to leverage digital tools for substantive environmental gains. Moreover, the interaction terms in Table 7 also remained positive and significant. Both trade openness and R&D investment continue to enhance the environmental impact of digital SMEs, which supports H2 and H3. The stronger effects observed in open economies are consistent with theories of technological diffusion, which argue that exposure to international markets accelerates the adoption of digital and green innovations (Philbin *et al.,* 2022). Furthermore, SMEs engaged in or operating within open trade environments benefit from access to foreign technologies, external knowledge flows, and competitive pressures that reward environmentally efficient practices. By contrast, the moderating role of R&D intensity reflects the importance of national absorptive capacity: economies with higher R&D investment provide more supportive innovation ecosystems, enabling SMEs to translate digital tools into meaningful environmental improvements (Cobbinah *et al.,* 2025). These distinct mechanisms explain why the strength of the digitalisation effect varies across contexts.

The RD and SME digitalisation interaction term in Model 13 was 0.1724, whereas the TO and $DigitalSMEs$ terms were 0.1615. These results reinforce the conclusion that supportive policy environments, characterised by open markets and strong innovation systems, are critical for realising the full green potential of digital SMEs. The threshold effects highlight the importance of building comprehensive policy frameworks that not only support digital transformation but also foster innovation ecosystems and global integration to achieve sustainable economic development.

The results show that SME digitalisation contributes positively to green economic growth, but the magnitude and significance of this effect depend strongly on broader institutional and structural conditions. The moderation and threshold findings highlight the nonlinearity of the digitalisation-environment nexus and demonstrate that digital technologies generate meaningful environmental benefits only when combined with enabling factors such as openness and innovation capacity. These results reinforce existing theoretical expectations while extending empirical knowledge on the contextual nature of digital-led green transitions.

CONCLUSIONS

The study empirically examined the impact of digitalisation among SMEs, including high-tech startups, on GEG across 25 EU countries over the 2010-2023 period. The findings consistently show that digitalised SMEs have a statistically significant and positive effect on GE performance, measured by adjusted net savings (mean = 6.41%) as a proxy for GEG. Beyond the average positive effect, the study demonstrates that the environmental gains from SME digitalisation are strongly conditioned by broader structural factors. Both trade openness and R&D intensity significantly amplify the green impact of digital adoption, while the threshold analysis confirms that these benefits materialise only once economies surpass a minimum level of institutional and technological readiness.

In the baseline regression models, the coefficient for SME digitalisation, measured by the percentage of enterprises with e-commerce turnover of at least 1%, ranged from 0.0603 to 0.0849, which were statistically significant at the 10% or 5% level. In the robustness models, the coefficient remained stable at 0.0995, confirming the reliability of the results. Interaction models further revealed that this positive effect was significantly strengthened by trade openness (interaction term = 0.1482) and R&D investment (interaction term = 0.0575), indicating that SMEs embedded in open and innovation-intensive economies are better positioned to generate green outcomes. Threshold regression analysis confirms the presence of nonlinear effects. Specifically, once digitalisation among SMEs exceeds a certain threshold, its positive impact on GEG intensifies, rising to 0.2076 in high-digitalisation regimes. This suggests that the green benefits of SME digitalisation are not merely linear but accelerate beyond the tipping point of digital maturity.

These results corroborate the theoretical arguments of Islam *et al.* (2023) and the empirical findings of Wani *et al.* (2024) and Khan *et al.* (2023), who show that technology adoption and innovation facilitate the decoupling of economic growth from environmental degradation by enabling cleaner production processes, improved resource efficiency, and the diffusion of green innovations. Therefore, policymakers should treat SME digitalisation not only as a competitiveness agenda but also as a core environmental strategy. Investment in digital infrastructure, subsidies for e-commerce adoption, and digital skills training should be targeted, especially for SMEs operating in traditional and high-emission sectors (Islam *et al.,* 2023; Huang *et al.,* 2025; Waqar *et al.,* 2025). Public–private partnerships and regional digital hubs can play a role in accelerating this transformation.

This study extends prior work by demonstrating that the positive impact of SME digitalisation on environmental performance is contingent on institutional and structural conditions, particularly the levels of trade openness and R&D investment. The significant interaction effects identified here align with those of Chen (2019) and Maulidi (2025), who document that open trade regimes and strong innovation ecosystems enhance firms' capacity to adopt and deploy sustainable technologies effectively. Specifically, the finding that trade openness amplifies the environmental benefits of digital SMEs suggests that international market access facilitates knowledge spillovers and incentivises firms to meet higher environmental standards, which is consistent with the 'pollution halo' hypothesis (Duan & Jiang, 2021). Therefore, trade policies should integrate sustainability benchmarks, such as those requiring green certifications, digital traceability, and compliance with environmental standards, as part of trade facilitation for SMEs (Bıçakcıoğlu *et al.,* 2020; Chen, 2019; Zhou *et al.,* 2023). Bilateral and multilateral trade agreements should support digital platforms that promote green product visibility in international markets. Similarly, the positive moderating effect of R&D intensity supports the view that absorptive capacity and innovation infrastructure are critical for translating digital investments

into measurable green outcomes (Sehnem *et al*., 2022; Shang, 2025; Dragomir *et al*., 2023). Governments should expand innovation grants, tax reliefs, and cofinancing schemes for SMEs to develop eco-innovations, especially in terms of clean tech, energy efficiency, a circular economy, and green logistics (Fernando *et al*., 2019; Maulidi, 2025; Golden *et al*., 2021). National and EU-level R&D frameworks should also emphasise support for low-carbon digital technologies.

The threshold effects observed in the study suggest that SMEs below a certain digital maturity level may not yet benefit from the green gains of digital transformation. Targeted interventions, particularly in lagging regions, rural economies, and transition countries, are essential to avoid regional digital-environmental inequality (Putri *et al.,* 2025; Gross-Golacka *et al.,* 2024; Obadire *et al.,* 2025). This includes increasing access to high-speed internet, local business digitalisation support centres, and training programs.

While digital tools can reduce emissions and enhance efficiency, there is also a risk of digital greenwashing without proper metrics. Authorities should incentivise SMEs to adopt transparent ESG indicators, use lifecycle assessment tools, and report digitally enabled environmental improvements (Lux *et al.,* 2023; Alfadul & AlKubaisy, 2024). Digital platforms such as blockchain can also serve to track green claims across supply chains (Zhou *et al.,* 2023; Liu, 2023).

Realising the synergy between digitalisation and GEG requires not only isolated programs but also coordinated institutional frameworks. This includes collaboration across digital, environmental, trade, and innovation ministries. Building institutional capacity at the regional and local levels to support SME transitions is critical (Nie *et al.,* 2025; Yang *et al.,* 2024; Klingenberg & Kochanowski, 2015).

Building on these findings, the study offers several targeted policy recommendations that directly reflect the moderation and threshold patterns identified in the empirical analysis:

- The empirical results clearly demonstrate that the environmental impact of SME digitalisation depends on broader structural factors. Thus, policymakers should avoid uniform, one-size-fits-all approaches and instead design interventions that reflect the distinct trajectories of countries with low versus high institutional and technological readiness. Recognising these asymmetries is essential for ensuring that digitalisation policies translate into measurable sustainability gains.
- In countries operating below the threshold levels of trade openness or R&D intensity, digital tools alone are insufficient to generate environmental improvements. Policy efforts should prioritise expanding innovation capacity, strengthening national research infrastructure, and reducing barriers to global market integration. These measures create the necessary absorptive capacity for SMEs to effectively deploy digital technologies in ways that enhance resource efficiency and environmental performance.
- For countries that already exceed the threshold conditions, the policy focus should shift toward deepening the technological sophistication of SMEs. This includes supporting investments in advanced digital infrastructures, data-intensive technologies, artificial intelligence, and digitally enabled green innovations. Such interventions can accelerate the non-linear gains identified in the empirical analysis and reinforce the role of digitalisation as a catalyst for green economic transformation.
- Given the identified moderating role of structural variables, policymakers should cultivate complementary ecosystem elements, such as digital skills development, broadband expansion, innovation networks, and knowledge-transfer platforms, that magnify the environmental benefits of SME digital adoption. These ecosystem components help ensure that digitalisation is embedded in a supportive institutional context rather than functioning as an isolated technological upgrade.
- In their design, digitalisation incentives should promote environmentally beneficial practices rather than solely commercial digital adoption. Policy instruments could include targeted subsidies for digital green technologies, regulation that encourages resource-efficient digital solutions, and performance-based incentives that reward SMEs for integrating digital tools into sustainability-oriented business models.

While this study offers valuable insights into the relationship between SME digitalisation and GEG in the EU, readers should acknowledge several limitations. The operationalisation of digitalisation relies on a narrow indicator capturing only the share of SMEs engaged in online sales, which does not fully reflect the multidimensional nature of digital transformation. The use of aggregate

SME-level data prevents the analysis of heterogeneity across micro-firms, medium-sized enterprises, and technology-intensive startups. The absence of startup-specific indicators limits the study's ability to explore whether young, innovation-driven firms contribute differently to green economic outcomes. Acknowledging these limitations provides a clearer basis for interpreting the results and defining priorities for further research. It uses proxy indicators (*e.g.*, e-commerce turnover and adjusted net savings) that may not fully capture the complexity of digitalisation and GEG. The analysis does not account for sectoral differences, relies on a relatively short time period, and is limited to EU countries, which may reduce its global applicability. Future research should use firm-level data, include a longer timeframe, and explore sector-specific and regional differences. The broader ESG impacts of SME digitalisation should also be considered.

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Young employees' digital entrepreneurship intention: An application of the unified theory of acceptance and use of technology

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ABSTRACT

Objective: This study investigated young working people's intention to start up a digital business under the influence of their habit of using online platforms such as social media and e-commerce, from a new theoretical perspective and in the context of an emerging economy of Vietnam.

Research Design & Methods: Utilising the unified theory of acceptance and use of technology (UTAUT2) on a research sample of 301 working people aged 18 to 35 in Vietnam, we investigated a moderated mediation model by structural equation modelling (SEM) analysis.

Findings: The habit of using online platforms (for either social media or e-commerce) positively affects users' performance and effort expectancy, but negatively impacts risk perception of the platforms for digital entrepreneurship. In turn, performance expectancy and effort expectancy have a positive effect on attitude toward platform startup, and the attitude has a positive relationship with the establishment of digital entrepreneurial intention. However, the risk perception does not affect attitude toward using platforms for startups, which we may attribute to fear-of-missing-out syndrome (FOMO).

Implications & Recommendations: Young workers should examine risk concepts to avoid following trends, rather than ignoring potential risks to achieve sustainable entrepreneurship. Managers should be aware that the working environment cultivates employees' intention to do their own job during working time. Meanwhile, startup facilitators should think about platforms as a productive source of new businesses.

Contribution & Value Added: This study significantly extends the UTAUT2 application into a new domain, a new purpose rather than just the adoption of a technology for its designed objectives; that is, entrepreneurship among working people. This suggests significant potential for literature development if researchers find new applications for long-lasting theories.

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INTRODUCTION

Businesses are the engine of economies. In this metaphor, entrepreneurship, which creates new companies, plays the role of the fuel tank. Nowadays, entrepreneurship has become a global phenomenon with the participation of labourers at different levels, age groups, professions, and sectors. More people in more nations believe that it is easier to start a business now. However, there are also more people being afraid of failure, which deters them from starting a business. People who have exited from a business are more likely to start a new business than those who have never done so (Global Entrepreneurship Research Association (GERA), 2025). In other words, a pilot startup constitutes a

necessary condition for people to keep going with businesses. A traditional pilot is costly because it requires significant investment in rent, inventory, and other operations. Such high costs prevent people from starting up. However, digital development has opened opportunities for startup rehearsal because of its cost advantages.

Although 73% of surveyed economies have low awareness of AI in business, most entrepreneurs value digital marketing and communication technologies (Global Entrepreneurship Research Association (GERA), 2025), which are critical components of digital business. Digital business is business conducted in an internet environment. Started in the 1990s, when the internet became commercialised, digital business has developed into a diversity of models such as content, commerce, context, connection, B2C and B2B, etc. (Bernd, 2020). One may conduct digital business through corporate websites, social media platforms (*e.g.*, Facebook, TikTok, Instagram, Zalo), e-commerce platforms (*e.g.*, Amazon, Shoppee, Tiki, Lazada, Sendo) and mobile apps (of corporations). In Viet Nam, e-commerce has played an important role in the economic structure, experienced a fast growth rate of 27% in 2024, reaching 32 billion USD, and this upward trend continues for the last decade (VECOM, 2025).

In 2025, 79.0 million Vietnamese (78.8% of the population) used the internet. They own 76.2 million social media accounts, an increase of 3.5 million accounts compared to 2024. Notably, 95.4% of internet users in Vietnam use at least one social media platform in January of the year; and 51.2% social media users are women, the rest of 48.8% are men (We Are Social & Meltwater, 2025). With an average of 6.5 hours per day active on the internet, the Vietnamese are heavily exposed to digital business either as active buyers or passive information receivers.

Young working people at the age of 18 to 35 have more opportunities and time for work, study and entertainment on the internet, and thus using platforms becomes their habit. Observations and interactions with traders on such platforms may cultivate users' feelings of ease in doing digital business. Such an acquaintance may facilitate digital entrepreneurship intention as people seek opportunities to make use of these platforms while still working at their current positions. It is not unusual for employees in Vietnam to do their own business online during their office hours. It becomes more attractive because it is cheap to start and also cheap if they fail. People at the age of 18 to 35 have the potential for productivity, professional knowledge, innovative working morale and a strong desire to enhance personal values to pursue entrepreneurial achievements. They are the most potential target for studies on entrepreneurial intention, especially in digital business.

Considering the above, we asked the following research question: 'How does the habit of using online platforms affect the digital entrepreneurial intention of young employees in Vietnam?' The study aimed to investigate the relationship between young workers' digital habits and their career intention of startup through the lens of UTAUT2. By answering the question, our study contributes to extending an old theory, UTAUT2, into a new domain of entrepreneurship, enriches the recent, rare literature on employee entrepreneurial intention around the world and suggests implications for employees, managers, and startup facilitators.

The article is structured as follows. After this introduction, we present the literature review and hypotheses development following with the research model. Then, we discuss the methodology, findings, and discussion. Next, after presenting contributions, implications, limitations, and future research directions, we elaborate on the conclusions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Entrepreneurship Intention

Entrepreneurship is the establishment of new organisations or enterprises at diverse scales based on business ideas to exploit gaps among old demands or to meet new consumer demands, thereby achieving financial goals or satisfying personal work desires. During this course, entrepreneurs accept different kinds of risks (MacMillan, 1993; Hisrich & Drnovsek, 2002). According to Bird (1988), the entrepreneurial intention of an individual is a mental state towards the foundation of a new business operation or an enterprise from previous ideas and plans. Entrepreneurial intention is the start and an indicator of a series of behaviours to establish a business (Fishbein & Ajzen, 1977).

Entrepreneurial intention constitutes a large topic in business literature. Research investigates intentions mostly on students at either undergraduate or postgraduate levels (Kang *et al*., 2023; Lien *et al*., 2022; Vankov *et al*., 2024) due to data availability (Lien & Hoang, 2022). Studies on working people's entrepreneurship intention are of great interests but there is still a dearth of them. We may categorise some research on this topic into two groups: corporate entrepreneurship (or intrapreneurship in the work context) and personal startup intention.

Regarding corporate entrepreneurship, Urban and Moloi (2022) found that dimensions of organisational justice have positive yet non-significant relationships with employee entrepreneurship intention within their work in the form of initiatives. However, gender plays an important role in the relationship between procedural justice and intention.

Considering personal entrepreneurship that motivates employees to spin out, personality, experience and national culture play a role. According to Jahanshahi *et al*. (2025), in Latin American countries, individuals' intention to start up is enhanced by their selfish personalities of Machiavellianism, psychopathy, and narcissism. Feeling ostracised or marginalised in the workplace, people are more interested in starting their own business to escape these feelings. Vrontis *et al*. (2022) noted that risk awareness and professional experience negatively affect Lebanese international entrepreneurial intentions after their first employment. In later working-life, an interplay of necessity, fulfilment and experienced later life, and age promotes ageing workers of 50 or over to start social business (Djebali *et al*., 2023).

Moreover, features of the workplace are critical factors. Small firms produce more entrepreneurs than larger ones, especially for people at lower management levels, because they are educated comprehensively on building up and running a business as a whole (Gast *et al.*, 2017). In terms of human resource management, job satisfaction negatively affects employees' entrepreneurial intentions (Li *et al*., 2022). Furthermore, in the Singapore IT sector, Lee *et al*. (2011) found work environments with an unfavourable innovation climate and/or incentives for excellence influence entrepreneurial intentions, through low job satisfaction. Lee *et al.*'s (2011) and Li *et al*.'*s* (2022) discoveries contradict Lien and Hoang's (2022) finding of high job satisfaction still pushing people out of work to start up because they pursue new challenges in life to satisfy their fulfilment needs.

Digital Entrepreneurship

Digital entrepreneurship is the establishment of business operations or enterprises in the internet environment. Most of the accessible studies of digital entrepreneurship intention are about students' intention. Lam *et al.* (2025) investigated and found that digital competence positively moderates the relationship between outcome expectations and entrepreneurial intention, but negatively moderates the link between self-efficacy and intention. Based on the basic frameworks of entrepreneurial intention theory, the theory of planned behaviour, expectancy theory, and a sample of 482 students, Ghatak *et al*. (2023) validated that experiences in social organisation and digital organisation lead to intention of digital social entrepreneurship via the mediating roles of empathy, moral obligation, self-efficacy, perceived social support, perceived feasibility and perceived desirability.

Theoretical Frameworks

The majority of the studies look into the intention through the main lenses of the theory of planned behaviour (Wach & Wojciechowski, 2016), entrepreneurial event model (Lien & Hoang, 2022) and social cognitive theory (Lam *et al*., 2025). Based on the unified theory of acceptance and the use of technology (UTAUT) (Venkatesh *et al*., 2003), the UTAUT2, proposed by Venkatesh *et al.* (2012), better explains consumer adoption and use of technology in non-organisational contexts, and include new constructs of hedonic motivation, price value, and habit, in addition to former factors of performance expectancy, effort expectancy, social influence and facilitating conditions. Habit is the behaviour of an individual doing an action repeatedly, such that performing it becomes unconscious. In this research, it is the habit of using social media and e-commerce platforms.

Venkatesh *et al.* (2012) continue to introduce UTAUT2 to heighten the model's capacity in explaining the impacts on technology users' behaviours and intention. UTAUT and UTAUT2 serve to study people's intention and usage of specific information technologies (Martinez & McAndrews, 2023;

Wang *et al*., 2023). Moreover, some researchers extend its use to predict entrepreneurs' actions leading to business success in the field of entrepreneurship (Gonzalez-Tamayo *et al*., 2024); to the best knowledge of the authors, this is the first study analysing working people's entrepreneurship intention from the UTAUT2 perspective. Different from personal consumption intention and decision that could be made in a short time, entrepreneurship is a more complex process that normally takes months and years to develop. During which, entrepreneurs transform themselves step by steps from setting their minds ready to acquiring adequate inputs for a new business. By adapting the original UTAUT2 model to this new context, this study focuses on the habit dimension and makes the implied role of attitude visible, as in the hypotheses below.

Hypotheses Development

While social media serves to exchange information, images, daily lives, and communication, e-commerce is seen as online platforms that facilitate information search, price comparison, enquiry response and purchase decision-making. In studies of digital business, social media and e-commerce are perceived as platforms for advertising and sales thanks to their increasing popularity all over the world (Javid *et al*., 2019). Furthermore, brick-and-mortar enterprises can also use social media and e-commerce to expand their business, reach more customers, and create more long-term business partnerships (Rabie *et al*., 2016).

Today's social media applications provide smart features that help increase the number of potential customers (Alalwan, 2018). Large database, affiliate tools and product suggestions, *etc*., make it easier for some people to know about a new product. Social media platforms also bring products/services to customers beyond the distance of space and time, via live streaming, where sellers can have real-time interactions with viewers, thereby improving sales efficiency (Gunadi *et al.*, 2023). Frequent social media users interact with such developments every day, and they may feel that social media is efficient at running a profitable business. This led us to hypothesis H1.

H1: The habit of using social media positively impacts the performance expectancy of the platforms for digital entrepreneurship.

Through surfing and reading online content, social media users can easily see the results of entrepreneurship on online platforms. At any time, users can trace business statistics of platforms (Alalwan, 2018). In Vietnam, with statistics showing that the rate of online sales is increasing sharply each year, social media users may think it is easy to sell items they perceive as potential (Ministry of Trade and Industry, 2023) without heavy investment. People can start an online business at any time by becoming an intermediate of other businesses. Their job is to communicate with their audience on the friend or follower lists. When an order is made, they will inform the partner to complete delivery and payment. Hypothesis H2 suggests:

H2: The habit of using social media positively impacts the effort expectancy of the platform for digital entrepreneurship.

Exposure to commerce on social media due to frequent use also makes users more risk-aware. The risks are customer information piracy, counterfeit products, or fake orders to boost sales, etc. (Kang & Kim, 2013). Nowadays, when customers are not satisfied with brands, many choose to speak out first on social media as a way to make the brand negotiate. Once such a post appears and is advertised, thousands of users know, and a scandal is looming. One scandal can kill a business without a chance to explain. However, when all people cannot stop using social media and easily forget news after a short time, such risks would soon be over when newer things come up. In other words, risks become normalised and people accept them as the norm in the virtual world. The above argument leads to hypothesis H3:

H3: The habit of using social media negatively impacts the risk perception of the platform for digital entrepreneurship.

When shopping for an item on e-commerce platforms, in addition to purchasing that product, users can also experience the product layout in the stores (Alalwan, 2018). The internal content of the goods, continuous exposure and experience make users feel the platforms are a very efficient tool for their

products/services to reach customers (Kang & Kim, 2013). With an account on an e-commerce platform, a person can become a businessperson immediately. Therefore, the objective of starting a business, or performance expectancy, is achieved, as stated in hypothesis H4:

H4: E-commerce shopping habits positively impact the performance expectancy of the platform for digital entrepreneurship.

Currently, it is common that holidays, festivals, or special days in months such as June 6, August 8, *etc*. will be characterised by large discounts and huge sales, combined with statistics on goods exchanged and sold on these occasions, partly hinting at the user's perception (Alibudbud, 2022). The rate of users switching to starting a business with an item on the platform is increasing, so users can find it easier to understand how to transact and trade on the e-commerce platforms with their e-commerce shopping habits. Therefore, we proposed hypothesis H5:

H5: E-commerce shopping habits positively impact the effort expectancy of the platform for digital entrepreneurship.

Purchasing on e-commerce platforms comes with many benefits, but there are still potential risks such as poor quality, lost or incomplete goods (Salam *et al*., 2003). In particular, payment forms linked to e-wallets bring many incentives to users. However, online scam phenomenon is becoming a societal, even a criminal issue in many countries and causing worries among people when they conduct online payment (Norris & Brookes, 2021). However, most of the products sold on e-commerce platforms are of small value, with prices below 1 million Vietnam Dong (equivalent to 50 USD). Therefore, people may not think of such risks as big problems. Hence, we proposed hypothesis H6:

H6: E-commerce shopping habits negatively impact the risk perception of the platform for digital entrepreneurship.

Platforms' performance expectancy in online entrepreneurship is defined as the level of usefulness associated with technology platforms that help them improve their productivity and save time (Venkatesh *et al*., 2012). In this study, online platforms act as tools that bring lower costs or higher benefits, thus bringing usefulness and forming positive attitudes for users. Hence, we put forward hypothesis H7:

H7: Performance expectancy of the platforms in digital business entrepreneurship positively impacts users' attitudes towards digital entrepreneurship.

Effort expectancy of the platform in online business entrepreneurship is a personal evaluation of the ease of online business entrepreneurship without any effort. According to Hansen (2006), the primary motivation for choosing to perform a technology-related behaviour is to minimise the physical and mental effort required to complete that task. Once such expectancy is achieved, users express positive affection for the tool as stated in hypothesis H8:

H8: Effort expectancy of the platform in digital business entrepreneurship positively impacts users' attitudes towards digital entrepreneurship.

Perceived platform risk in online business entrepreneurship is the level at which an individual believes that activities on the platforms could have negative consequences on their data security, productivity, and finances. Eneizan *et al*. (2019) show that perceived risk has a significant impact on the intention to use mobile marketing. Furthermore, Abualrob and Kang (2016) assert that risk perception has a direct and strong impact on non-use of online platforms. Therefore, the authors proposed hypothesis H9:

H9: Perceived risk of the platforms in digital business entrepreneurship has a negative impact on users' attitudes towards digital entrepreneurship.

UTAUT2 combines former theories, including the theory of planned behaviour (TPB), which predicts the relationship between attitude and behaviour intentions. Studies based on the TPB model indicate that attitudes towards entrepreneurship have a strong impact on entrepreneurial intention, as shown by Walker *et al*. (2013). The context varies, so digital business also constitutes potential for such a relation, as stated in hypothesis H10:

H10: Attitude towards digital business entrepreneurship positively influences the digital entrepreneurial intention of young workers.

Stress in daily life is the interaction between people and the environment, in which people apprehend an environmental event as threatening, harmful and requiring personal changes or adaptation (Lazarus, 1993). Stress level is defined by a combination of psychological, physical, and environmental factors that make an individual feel stressed with his work, such as workload irrelevant to his/her personal competence and under-expected rewards such as salary, bonus or environment and professional development. In Shapero and Sokol's (1982) EEM model, we may view a certain level of stress over the current job as an 'entrepreneurial event.' The level of stress over the current job will perpetuate other behaviours related to the individual losing commitment to the organisation, to the job, leaving the organisation and choosing alternative careers (Schlaegel *et al.*, 2021). In particular, when the level of work stress is high, it will strongly increase the relationship between positive attitudes towards online entrepreneurship and online entrepreneurial intention and vice versa; the low level of work stress will reduce the relationship between these two variables (Bailey *et al.*, 2015). For that reason, the level of work stress is expected to moderate and enhance the transformation of a positive attitude of digital entrepreneurship into an online entrepreneurial intention of young people, as stated in hypothesis H11:

H11: Current job stress positively moderates the relationship between attitude toward digital entrepreneurship and digital entrepreneurial intention of young workers.

Figure 1 summarises all hypotheses.

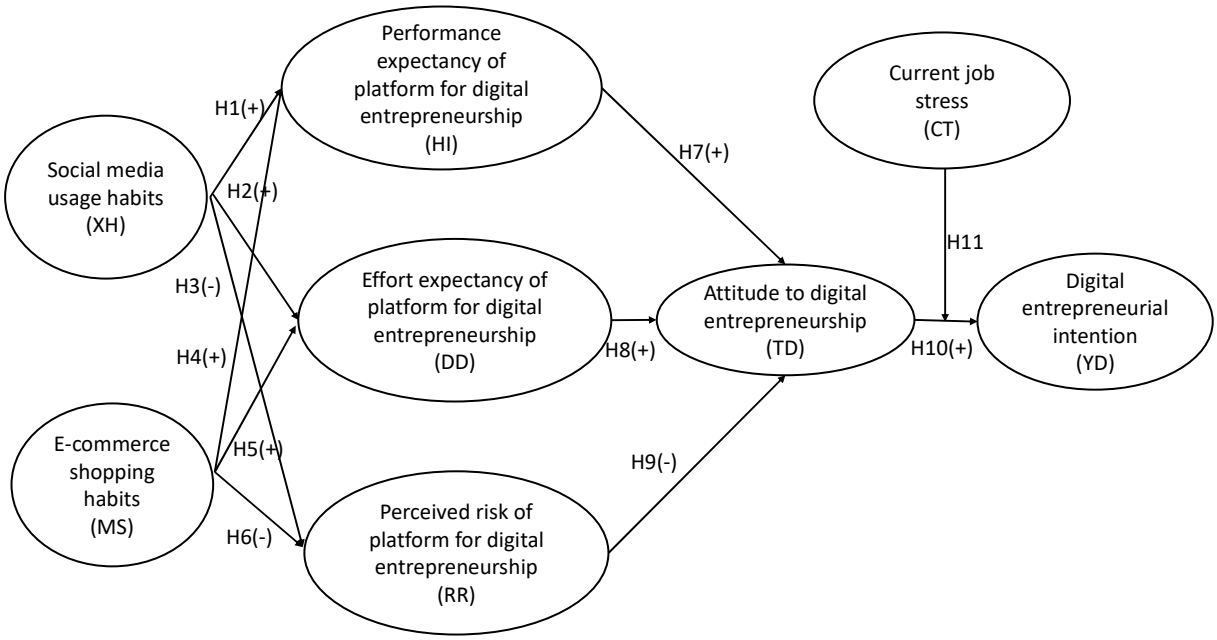

Figure 1. The proposed research model
Source: own elaboration.

RESEARCH METHODOLOGY

To measure constructs in the model, we used scales developed in previous studies. Scales for social media use habit (XH), e-commerce shopping habit (MS), and performance expectancy of the platform for digital business entrepreneurship (HI) and effort expectancy of platforms for digital business entrepreneurship (DD) were adapted from Venkatesh et al. (2012). Furthermore, we referenced the risk perception of platforms for digital business entrepreneurship (RR) to Featherman and Pavlou (2003). We measured attitudes towards digital business entrepreneurship (TD) using five observed variables in Ajzen (2002) that show TD as 'beneficial,' 'satisfied,' 'deserved,' 'good,' and 'enjoyable.' The depend-

ent variable of the digital entrepreneurial intention (YD) scale includes three observed variables referenced from the scale of Yang *et al*. (2015), with adaptation for platform business. Finally, we took the current job stress (CT) from Lee *et al.* (2011). All were 5-point Likert scales (1 – completely disagree, 5 – completely agree), and a mix of normal and reversed statements.

According to Hair *et al*. (2019), the sample size needs to be at least 5 times, better at 10 times, the total number of observable variables (27 in this study), so the sample size is at a minimum of 270, and we targeted a sample of 300 for quality estimation. We also collected demographic data, including gender, hometown, educational background, job expertise, participation entrepreneurship course, and family background in business (Ghatak *et al*., 2023; Kang *et al*., 2023; Wach & Wojciechowski, 2016). We collected data using a convenience sampling technique, and we screened participants to ensure that they were not entrepreneurs at the time. We distributed the survey questionnaire in Ho Chi Minh City and neighbouring provinces either directly or online, from October 2023 to January 2024. We analysed the data using the SEM technique on Smart PLS 3.0 software with scores of reversed questions converted before processing.

RESULTS AND DISCUSSION

We received 360 survey responses, with 301 valid questionnaires (83.6%). Among the respondents, men accounted for 50.8%, nearly corresponding to Vietnam's population structure in 2024, with 50.2% of women and 49.8% of men (VMEDIA, 2024). In addition, those who originated from southern provinces accounted for three-fourths of the respondents. People of Northern and Central origin accounted for over 20%. Regarding educational background, a majority of respondents were trained in natural sciences and engineering/technology, accounting for 56.5%. Two other groups of educational background, 'social sciences, humanities, education' and 'business, economics, and finance' accounted for 23.9% and 18.3% respectively. The two most popular working sectors of the participants were 'business, economics, and finance' and 'engineering and manufacturing,' with 34.2% and 31.2% respectively. This was consistent with the prediction of occupational distribution by the Ministry of Labor, Invalids and Social Affairs at the end of 2024 (Tổng Cục Thống kê, 2025).

Table 1. Descriptive statistics

Description	Value	Observations	Percentage
Gender	Male	153	50.8%
	Female	148	49.2%
Hometown	North	11	3.7%
	Central	58	19.3%
	South	232	77.1%
Education background	Natural sciences, engineering, and technology	170	56.5%
	Social sciences, humanities, and education	72	23.9%
	Business, economics and finance	55	18.3%
	Arts	0	0%
	Health	4	1.3%
Working Sector	State agency – Public services	14	4.7%
	Education and training	31	10.3%
	Information technology	7	2.3%
	Business – Economics – Finance	103	34.2%
	Engineering – Manufacturing	94	31.2%
	Law	20	6.6%
	Environment – Agriculture	32	10.6%
Entrepreneurship course participation	Yes	122	40.5%
	No	179	59.5%
Family background in business	Yes	95	31.6%
	No	206	68.4%

Source: own study.

The number of people participating in entrepreneurship courses was about 40% (see Table 1), showing the popularity of entrepreneurship education in Vietnam.

Reliability analysis results show that all scales had a Cronbach's Alpha coefficient greater than 0.7 (see Table 2); demonstrating internal consistency. Besides, the correlation coefficients between observed variables and the total scale were greater than 0.5. Therefore, the scale set with 27 observed variables meets the requirements for further analysis.

To check for common method bias, we conducted Harman's single-factor test. Consequently, the first factor accounted for 26.969% of the variance, which is lower than the threshold of 50%. In other words, common method bias was not an issue of this research.

Testing the Measurement Model

Outer loadings of all observables on their corresponding latent constructs in the model were greater than 0.7; the composite reliability (CR) value of the factors ranged from 0.892 to 0.977 (all above 0.7). Besides, the standardised factor loading values of the observed variables were all greater than 0.5. Simultaneously, the average extracted variance value (AVE) of the factors ranged from 0.733 to 0.934 (> 0.5) (Table 2). All indicators demonstrate that the eight factors of the research model satisfied the requirements of convergent validity.

Table 2. Composite reliability value and average extracted variance of the factors

Variable	Cronbach's Alpha	Rho_A	Composite Reliability	Average variance extracted (AVE)
CT	0.965	0.966	0.977	0.934
DD	0.889	0.893	0.923	0.751
HI	0.874	0.877	0.923	0.799
MS	0.893	0.914	0.933	0.823
RR	0.953	0.956	0.969	0.913
TD	0.914	0.916	0.936	0.745
XH	0.818	0.822	0.892	0.733
YD	0.935	0.935	0.958	0.885

Source: own study in SmartPLS.

We confirmed discrimination among the latent constructs through the HTMT index when testing Bootstrap (Henseler *et al*., 2015), when we found that the cross-correlation coefficients were smaller than the intra-scale correlation coefficients. Results indicate that all factors achieved discrimination when the HTMT value was less than 0.85 (Table 3).

Table 3. HTMT test results for discriminant validity

Variable	CT	CT*TD	DD	HI	MS	RR	TD	XH	YD
CT									
CT*TD	0.218								
DD	0.153	0.026							
HI	0.146	0.124	0.329						
MS	0.047	0.093	0.181	0.159					
RR	0.078	0.073	0.232	0.132	0.077				
TD	0.254	0.116	0.287	0.522	0.136	0.128			
XH	0.084	0.079	0.533	0.317	0.117	0.355	0.310		
YD	0.388	0.008	0.267	0.170	0.099	0.059	0.537	0.255	

Source: own study in SmartPLS.

Testing the Structural Model

The VIF coefficients were all smaller than 3, so multicollinearity did not occur in the model. Figure 2 presents the final structure model test results.

Our study supported eight among eleven hypotheses, except for H6, H9, and H11 (Table 4). E-commerce shopping habits (MS) did not affect risk perception (RR). Moreover, in general, risk perception

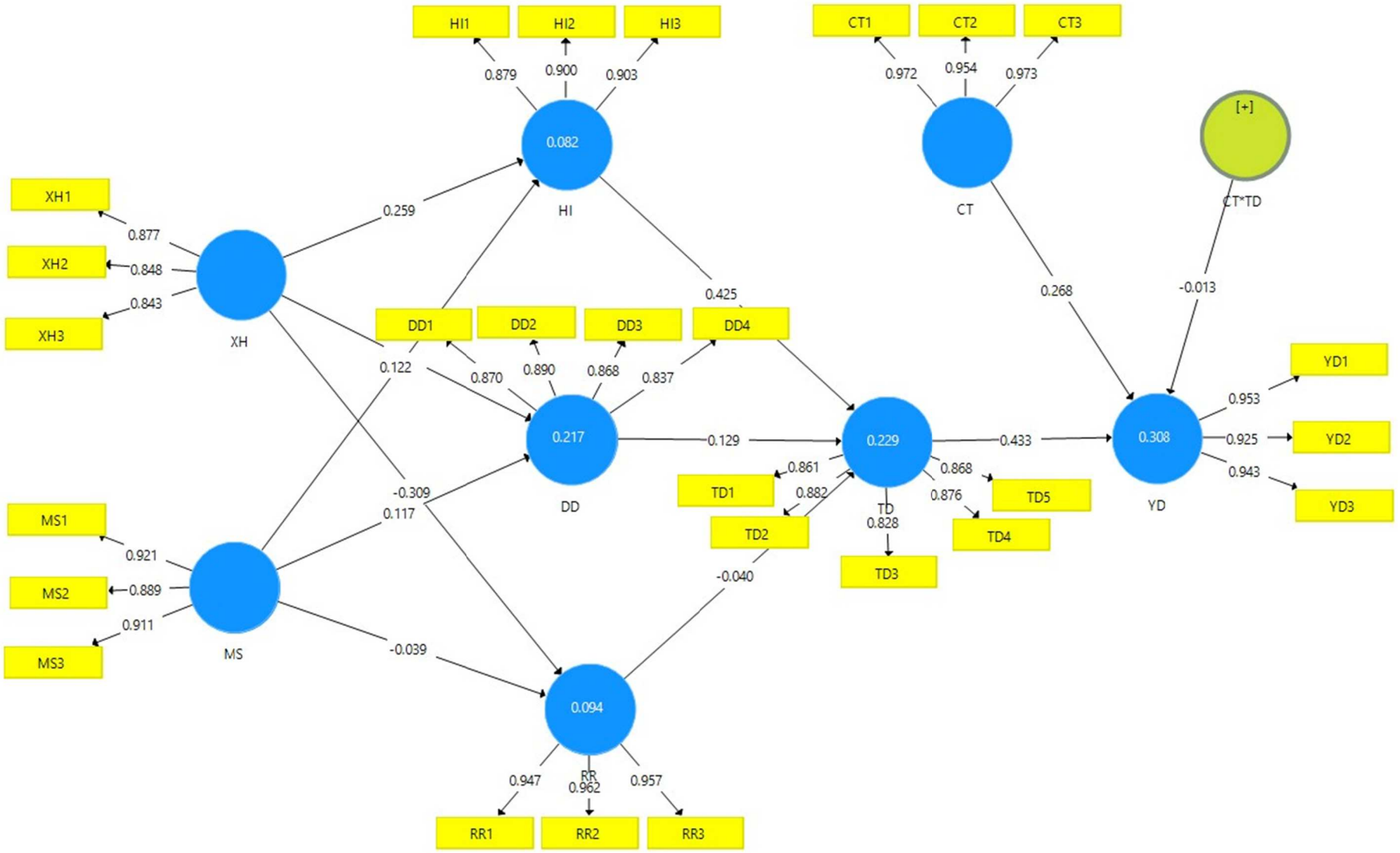

Figure 2. Structure model test results
Source: own elaboration in SmartPLS.

of platforms had no impact on attitude to digital entrepreneurship (TD). Overall, p-values of indirect relations smaller than 0.05 (Table 5) confirmed the mediating roles of performance expectancy (HI) and effort expectancy (DD) and attitude towards digital entrepreneurship (TD) in the relationship between social media usage (XH), e-commerce shopping habits (MS) and digital entrepreneurial intention (YD) of young workers in Vietnam.

Table 4. PLS-SEM results

Hypothesis testing (reliability of 95%)				
Relationships	**Hypotheses**	**Estimation**	**P-values**	**Conclusions**
XH → HI	H1	0.259	0.001	Accepted
XH → DD	H2	0.445	0.000	Accepted
XH → RR	H3	-0.309	0.000	Accepted
MS → HI	H4	0.122	0.023	Accepted
MS → DD	H5	0.117	0.011	Accepted
MS → RR	H6	-0.039	0.500	Rejected
HI → TD	H7	0.425	0.000	Accepted
DD → TD	H8	0.129	0.030	Accepted
RR → TD	H9	-0.040	0.422	Rejected
CT*TD → YD	H11	-0.013	0.807	Rejected
TD → YD	H10	0.433	0.000	Accepted

Source: own study in SmartPLS.

Table 5. Indirect relationships of intermediate variables

Relationship	Original Sample Mean	Sample Mean	Standard Deviation	T Statistics	P Values
HI → TD → YD	0.184	0.185	0.032	5.673	0.000
XH → HI → TD	0.110	0.110	0.039	2.856	0.004
XH → HI → TD → YD	0.048	0.048	0.018	2.661	0.008
MS → HI → TD	0.052	0.052	0.024	2.137	0.033
MS → HI → TD → YD	0.022	0.023	0.011	2.063	0.039
XH → DD → TD	0.057	0.058	0.028	2.042	0.041
DD → TD → YD	0.056	0.057	0.028	2.011	0.045

Source: own study in SmartPLS.

Social media use (XH) had a medium impact on effort expectancy (DD) (f^2 of 0.251), but a low impact on performance expectancy (HI) (f^2 of 0.073). Meanwhile, e-commerce shopping habits had a low impact on both (f^2 respectively of 0.018, 0.016). The impact of performance expectancy (HI) on attitude (TD) was medium with an f^2 value of 0.215, while the effort expectancy (DD) had a lower impact on attitude (TD) with f^2 value approaching the low threshold of 0.02 (0.019). The impact of the attitude (TD) on entrepreneurial intention YD was also at a medium level with an f^2 of 0.251 (Table 6).

Table 6. Effect size f2 Statistics of independent variables on dependent variables

Variable	CT	CT*TD	DD	HI	MS	RR	TD	XH	YD
CT									0.093
CT*TD									0.000
DD							0.019		
HI							0.215		
MS			0.018	0.016		0.002			
RR							0.002		
TD									0.251
XH			0.251	0.073		0.105			
YD									

Source: own study in SmartPLS.

The above low to medium impact was further supported by the statistics of R^2. Social media use habit (XH) and e-commerce shopping habit (MS) explained the variance of the performance expectancy (HI) at 8.2%, and the effort expectancy (DD) at 21.7%. Even though significant, social media use accounted for only 9.4% variance of perceived risk (RR). Two significant variables, HI and DD, explained 22.9% of the variance of the attitude to digital entrepreneurship (TD). Totally, the model explained 30.8% of the variance of the digital entrepreneurship intention (YD). We used Levene (F-test) and either the independent-samples T-test or ANOVA to test the significance of the control variables. Sig values were greater than 0.05 for all tests. Therefore, the control variables such as gender, origins, educational background, working sectors, and family background in business or entrepreneurship course participation had no impact on digital entrepreneurial intention.

The hypothesis testing results show that the habit of using social media and e-commerce shopping habits have a direct and positive relationship with users' performance expectancy and effort expectancy of platforms for digital business entrepreneurship. Simultaneously, performance expectancy and effort expectancy positively influence attitude towards digital business entrepreneurship at an explanatory level of 22.9%. These results are consistent with Venkatesh *et al*. (2012). This result also agrees with Gefen's (2003) study, in which he stated that when an individual has a habit of using a similar system before, he/she will find the new system more useful and easier, characterised by a bias created by habits. In this research context, when workers consider social media usage and e-commerce shopping as habits, they will easily perceive the benefits of such platforms for purposes other than information searching and shopping.

Social media usage habit has a direct and inverse relationship with risk perception of platforms for digital entrepreneurship (H3 accepted). In other words, individuals with a habit of using online platforms will reduce their risk perception of starting a business on such platforms. Using online platforms regularly will lead to habit formation (Turel *et al.*, 2011). This habit can motivate behaviours, reducing users' awareness of reasoned events through the guidance of the subconscious, because it operates according to repetitive habits, that is, habitual 'semi-automation' (Honkanen, 2005). In other words, habits promote automaticity of performance, reduce attention and awareness of potential risks (Ajzen, 2002). This result agrees with the findings of Farivar *et al*. (2017) that habits impact the relationship between risk perception and behavioural intention, the stronger the habit, the stronger the decline in risk perception.

However, risk perception did not have a negative impact on attitudes towards digital entrepreneurship (H9 rejected). This result contradicts previous studies (Nabi & Liñán, 2013; Singhal *et al*., 2019), *i.e.*, when an individual has a perceived risk of a direction at work, it will create a negative attitude or reduce a positive attitude towards that direction. Nabi and Liñán (2013) confirmed that perception of risks as threats negatively impacts attitude toward entrepreneurship. According to Featherman and Pavlou (2003), e-commerce accompanies financial, time and privacy risks that participants are easily aware of. Moreover, Martins *et al*. (2014) found that perceived risk has a negative relationship with user adoption of electronic platforms. Our finding is critical because it shows that the young workforce participating in this survey is 'willing to ignore' potential risks in platform digital business entrepreneurship.

This paradox is similar to Lien's (2022) finding that even board directors have low risk propensity, but they still have a high positive attitude toward financial derivatives which are highly risky. The directors' explanation is their thoughts of high potential for making money with the instruments. This agrees with the theory of risk-benefit trade-off suggested by Starr (1969) that says people accept risks voluntarily because of their perception of benefits (real or imagined). This acceptance is enhanced if people see more advertising and people participating. With social media and e-commerce shopping habits, users are exposed to a heavy flow of information about success stories every day, and that fact may cause them to see more benefits than risks in digital entrepreneurship on platforms.

We may also explain this phenomenon by the manifestations of FOMO syndrome (Fear of Missing Out) or negative emotions when people feel that they may miss the startup opportunity on platforms while other people grasp it successfully. This syndrome can spread swiftly in individuals and organisations and lead to behavioural changes (Elhai *et al*., 2016). Research by Gartner *et al*. (2022) considers the addition of FOMO factor to the TAM model when business decision makers have to use or reject a new technology system at work. In this case, we understand FOMO as the decision makers' fear that

they may lose relationships with managers because of not applying technological systems according to trends, leading to 'obsolescence' in technology at the company, which motivates them to apply new production technology systems. Thus, using FOMO to explain an UTAUT2 research is understandable. To sum up, young workers' perception of risk in online business entrepreneurship exists but does not affect their attitude towards digital business entrepreneurship.

The level of current job stress does not have a moderating effect on the relationship between attitudes toward digital entrepreneurship and digital entrepreneurial intention (H11 rejected). However, the level of stress in the current job has a direct and positive impact on young workers' entrepreneurial intention, with an estimated coefficient β = 0.268. This result is similar to the study of Lee *et al*. (2011) that when an individual feels stress at work, they will tend to look for new orientations to satisfy their needs. To satisfy those needs, people, especially those with high capacity and skills, will have an inclination towards innovation and form an entrepreneurial intention. According to Robbins and Judge (2013), an individual is stressed when there is a difference between what is expected and what is actually received, including their perception of the environment, the organisation, and themselves. Therefore, the level of stress at work is shown as an independent variable, positively impacting online entrepreneurial intention.

Finally, a positive attitude towards online entrepreneurship has a direct and positive impact on the online entrepreneurial intention of young workers. Moreover, this effect is strong with the estimated coefficient β = 0.433. It is consistent with UTAUT2 and other research (Armitage & Conner, 2001) in that attitudes toward the object lead to the intention to perform the behaviour corresponding to that attitude or to abandon implementation.

CONCLUSIONS

Young workers, even when they accept and ignore risks associated with digital business on platforms, should seriously learn about the risks to build sustainable startups. Potential learning sources are courses, seminars, and workshops. Moreover, young workers should accept calculated risks and avoid unnecessary ones during the process.

Meanwhile, business managers should be aware that while working with them, employees still think about doing their own business. This may affect their productivity due to inefficient time consumption. Moreover, the environment at the workplace (stress, time for personal purposes) facilitates these developments. Accepting the fact will enable managers to proactively deal with the situation and get the workforce pool available for any replacements needed.

For startups facilitators such as governments, incubators and mentors, etc., it is imperative to recognise that online platforms have high potential for startup projects. They should promote this type of startup more strongly by supporting amateur business people well-prepared for the struggling process ahead, in terms of knowledge and skills for running highly risky businesses on digital platforms.

The study significantly contributes to extending UTAUT2 application into a new domain, other than just using a new technology for its original purpose. It clarifies the impact of online platform usage habits on the cognitive aspects of platform users. In turn, such cognition positively impacts attitudes, and then digital entrepreneurship intention. Users not only adopt the platforms for communication and shopping, they can also develop their startup intention on the platforms because they recognise that the platforms can help them do business effectively and easily, the feelings they get from shopping and social media using habits. Researchers can follow this approach to expand research on recent widely used theories into new directions.

This research also contributes to the recent limited literature on working people's entrepreneurship. They can start up without quitting their recent jobs, as in the past, because they can utilise digital platforms to develop businesses of various sizes. This is a new type of 'dual careers' that goes against any companies' productivity goals.

The research has inevitable limitations. Firstly, the sample in Vietnam limited outcomes generalisation. Secondly, this research was susceptible to common method bias of single-source, self-report and cross-sectional data, even when some preventative measures were taken in the questionnaire

design and data collection steps. Thirdly, the study stopped at the behavioural intention step in the UTAUT2 model, while actual behaviour is of greater interest to stakeholders.

Future studies should expand to other nations and territories to make the research scope more representative. To overcome the common method bias and reach the final destination of entrepreneurship actions, researchers should conduct longitudinal studies with multiple data sources, both objective and self-report. Besides, it is advisable to conduct further research on the impacts of FOMO factor on the risk perception of platform users for online business entrepreneurship and other contexts.

To sum up, UTAUT2 and entrepreneurship constitute a new combination for research, and the outcomes look fruitful. Beyond the original function, people can utilise a technology for an unintended purpose, and developing a new business based on the technology is one option. This suggests great potential for literature development if researchers find new applications for long-lasting theories in various areas of study.

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Use of Artificial Intelligence

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Financial well-being through digital financial literacy, financial behaviour, and financial confidence

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ABSTRACT

Objective: The study aims to explore how digital financial literacy, financial confidence, and financial behaviour can enable private university students to manage their financial well-being.

Research Design & Methods: In this study, we used a cross-sectional research design and a deductive approach. Besides, using the snowball sampling technique, the researchers collected data from 319 private university students in Bangladesh. We analysed the collected data using SPSS and Smart PLS software.

Findings: We found that digital financial literacy has no significant effect on the financial well-being of the private university students in Bangladesh. However, financial confidence and financial behaviour have a significant positive impact on financial well-being. Regarding the mediating effect, financial confidence fully mediates the relationship between digital financial literacy and financial well-being. Finally, financial confidence partially mediates the relationship between financial behaviour and financial well-being.

Implications & Recommendations: Institutions of higher learning can develop initiatives to equip the youth with basic financial skills and the ability to use digital platforms. The government can develop initiatives that will provide opportunities for the youth to access financial information through the development of financial programs within learning institutions.

Contribution & Value Added: The research makes a unique contribution to theory by revealing financial confidence as a crucial mediator through the lens of the technology acceptance model (TAM) and the theory of planned behaviour (TPB).

Article type:	research article
Keywords:	digital financial literacy; financial behaviour; financial confidence; financial well-being; TPB, and TAM
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INTRODUCTION

By adopting digital tools through the technology acceptance model (TAM) lenses (Davis, 1989), individuals can access more efficient financial services, further enhancing their financial well-being. In this digital era, humans live a life entirely based on technology. Financial knowledge is no longer just basic; it must be elevated to match the level of financial technology. Therefore, today's young generation must understand digital financial literacy (Respati *et al.*, 2023) to ensure financial well-being. In the twenty-first century, digital financial literacy is one of the most crucial skill sets (Golden & Cordie, 2022). Financial problems do not solely arise from low income; they can also result from a lack of knowledge in this sector (Clarence & Pertiwi, 2023; Hayati & Syofyan, 2021). Digital financial literacy (DFL) refers to the skills and competencies required to access, interpret, and utilise digital financial tools and platforms (*e.g.*, financial apps, online banking, mobile financial services) to make informed financial decisions (Choung *et al.*, 2023; Golden & Cordie, 2022). As per the assumptions of TAM, ease

of use and usefulness of these digital tools have directly influence the adoption and practical usage. Previous empirical studies showed that individuals with higher DFL have sound financial wellbeing as they tend to develop stronger financial knowledge, financial behaviour, and financial confidence (Barus *et al.*, 2024; Hayati & Syofyan, 2021; Respati *et al.*, 2023). Besides, as per the assumptions of the theory of planned behaviour (TPB), financial behaviour of an individual is usually influenced by their attitudes toward financial management, by perceived social norms about financial practices, and finally, by a sense of control over financial outcomes (Ajzen, 1991). This theoretical perspective suggests that financial knowledge affects behaviour and financial confidence, which are built through knowledge and the capacity to act on that knowledge, playing a critical role (Hayati & Syofyan, 2021). Consequently, the more adept individuals are at understanding and utilising digital financial tools, the greater their confidence and the more effective their financial behaviour will likely be. Financial confidence also comes with financial well-being, the feeling of being confident with your money and setting goals/vision based on that (Hayati & Syofyan, 2021). Financial well-being also indicates being prepared for both expected and unexpected situations.

Nowadays, young individuals find it very challenging to manage their finances, which can be attributed to the lifestyle or even the lack of knowledge in the sector of digital financial literacy (Hayati & Syofyan, 2021; Mbatane & Kekana, 2024; Rahim *et al.*, 2022). Moreover, at this stage of life, students, especially those attending private universities, need to manage their daily expenses, university tuition, and more. It becomes increasingly important for them to manage their finances (Mbatane & Kekana, 2024; Rahim *et al.*, 2022). Focusing on private university students is essential because this group represents Generation Z, who are soon to enter the workforce and must manage high tuition fees compared to their public university counterparts in Bangladesh. Their understanding of digital financial literacy, financial knowledge, financial behaviour, financial confidence, and financial well-being is critical for effective personal financial management in the digital era (Respati *et al.*, 2023).

Though scholarly attention to DFL and financial outcomes is gradually increasing, there are still some gaps, including theoretical, contextual, methodological, and content gaps. To identify those gaps, we have developed a Table (see Appendix 1). Firstly, in terms of the theoretical gap, most prior studies examined DFL and financial well-being, focusing on single behavioural theoretical perspectives, such as the theory of planned behaviour (TPB) (Mishra *et al*., 2024; Rahayu *et al*., 2022). However, the integration of the technology acceptance model (TAM) with TPB reshapes better financial behaviour and financial wellbeing, yet this theoretical integration remains relatively unexplored. Thus, in our study, we integrated those two theories to develop our research frameworks and hypotheses development. Secondly, despite the increasing importance of these financial dimensions, global studies on digital financial literacy among private university students remain scarce, and in Bangladesh, research on this subject is nearly non-existent. Finally, most prior studies have focused on common constructs or variables such as financial literacy, digital financial literacy, financial well-being, financial decision-making, and financial inclusion (Lu *et al*., 2026; Amarsanaa *et al*., 2025; Mullappallykayamkulath, 2022), yet less attention has been paid to financial confidence. Thus, we considered financial confidence as one of the intervening (mediating) variables in our study. Considering all gaps, we proposed an integrated conceptual model by combining TPB and TAM to explore how digital financial literacy, financial confidence, and financial behaviour can enable private university students to manage their financial well-being.

In the following section, we have discussed the literature review, theoretical underpinning and hypotheses development. After that, we deliberated the detailed methodology part. In the next section, we analysed the results and discussed our findings. Finally, we discussed theoretical, managerial, and practical implications.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Integrating the theory of planned behaviour (TPB) and the technology acceptance model (TAM) provides a robust theoretical framework for understanding the dynamics among digital financial literacy, financial confidence, financial behaviour, and financial well-being (Kennedy, 2013; Rajdeep Kumar Raut & Kumar, 2023). TAM suggests that users are more likely to accept a technology when they find it easy to use and

useful (Wijayanto *et al.*, 2024). In digital finance, this means that someone with higher digital financial literacy (DFL) tends to view online financial platforms as user-friendly, making them more willing to use these tools (Wijayanto *et al.*, 2024). In turn, using these tools more effectively can build their financial confidence (FC) as they become skilled at managing money through technology (Shesadri Kiran Tharimala *et al.*, 2024). Meanwhile, TPB complements TAM by focusing on attitudes and perceived control in predicting behaviour. Moreover, TPB's components explain how DFL and FC shape attitudes toward money management and the perceived ease or difficulty of financial tasks (Shih *et al.*, 2022). For example, a person with strong DFL often sees digital finance services as straightforward, which enhances their perceived behavioural control and improves their actual financial behaviour (Safira Amalia Hapsari, 2021; Sharif & Naghavi, 2020). Over the past decade, digital finance has transformed how people manage money, making DFL a critical skill and FC a key predictor of sound financial decisions. DFL and FC shape financial behaviour (FB) and ultimately influence financial well-being (FWB). Considering the above constructs, we proposed the following framework:

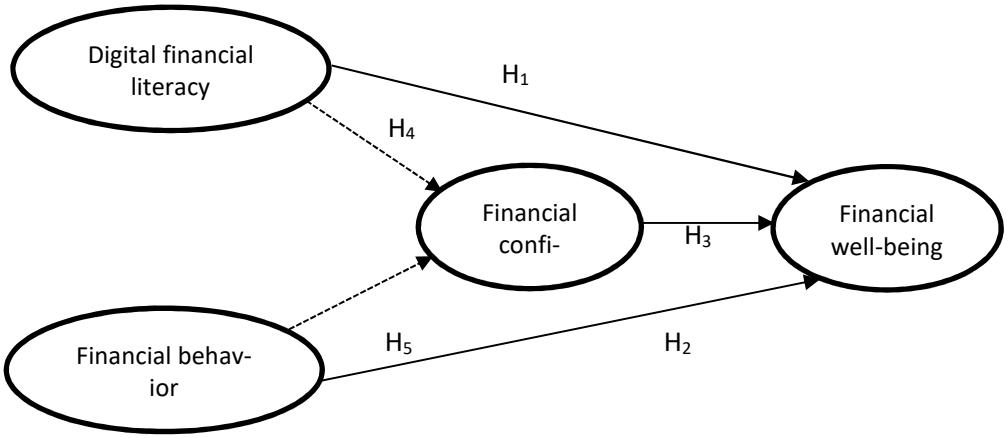

Figure 1. Proposed research framework
Source: own elaboration.

Based on our proposed research framework, we described the empirical literature review and developed our hypotheses in the following section.

Digital Financial Literacy, Financial Behaviour, and Financial Well-being

Digital finance literacy is the ability to acquire, understand, and use digital financial tools, including mobile banking services, online investing tools, and e-wallets. Empirical evidence repeatedly illustrates a link where higher levels of digital financial literacy exist with better financial decision-making and financial well-being (Lu *et al.,* 2026; Andriansyah & Khaira Amalia Fachrudin, 2025; Choung *et al.*, 2023; Kumar *et al.*, 2023). Studies have shown that financial literacy with technology helps improve the management of routine financial transactions and also helps shape sustainable financial plans and stability. Reducing transaction costs and information asymmetry enabled by technology-enabled financial literacy is the key to achieving financial well-being (Pak *et al.,* 2026; Lone *et al.*, 2025). However, financial behaviour consists of the actions, decisions, and habits related to the management of finances. It entails savings habits, budgeting habits, investment, and consumption patterns. Healthy financial behaviour results from a combination of good attitudes towards financial management, positive social views, and a good understanding of the consequences attached to financial choices, as postulated by TPB. Empirical evidence supports that disciplined financial behaviour is linked to improved financial well-being (Kanth *et al.,* 2026; Rai *et al.,* 2025; She *et al.*, 2024; Sabri *et al.*, 2023; Riyazahmed, 2021; Hashmi *et al.*, 2021). For example, individuals who demonstrate prudent financial practices often experience lower levels of financial stress and higher satisfaction with their financial status (Hayati & Syofyan, 2021). Considering the findings of earlier studies and theoretical assumptions, we proposed the following hypotheses:

H1: Digital financial literacy positively impacts financial well-being.

H2: Financial behaviour positively impacts financial well-being.

Financial Confidence and Financial Well-being

Financial confidence is how someone believes they can make sound financial choices. It is founded upon self-efficacy, part of TPB. If people know they can, they will likely make practical and sound financial choices. Financial confidence enables a person to take risks, make wise investments in quality opportunities, and forge other long-term financial habits that put that person' financial well-being (Sajid *et al.*, 2024; Nam, 2022). Besides, Respati *et al.* (2023) and Barus *et al.* (2024) revealed that financial confidence can be linked to lower financial stress and improved money problem handling, which enhance the financial well-being. Considering the findings of earlier studies and theoretical assumptions, we proposed the following hypothesis:

H3: Financial confidence positively impacts financial well-being.

Financial Confidence as a Mediator

Earlier studies found that financial confidence is the vital bridge linking digital financial literacy to measurable improvements in everyday financial well-being (Rai *et al.*, 2025; Tahir *et al.*, 2021). Skills remain underused without the belief that one can apply that knowledge under uncertainty, even with technical know-how (such as navigating apps, interpreting digital statements, or using online budgeting tools) (Bandura, 1997; Lusardi & Mitchell, 2014). Sometimes, having confidence encourages doing small experiments (like trying a budgeting feature, comparing loan offers, setting automatic transfers, and persisting after early setbacks). Previously published empirical work indicates that digital literacy's positive effect on well-being largely operates through its ability to raise financial confidence, which in turn prompts consistent, prudent financial choices (Rai *et al.*, 2025; Respati *et al.*, 2023; Mullappallykayamkulath, 2022; Lone & Bhat, 2022; Tahir *et al.*, 2021). For practitioners, the implication is clear: pair technical instruction with opportunities that build mastery and low-risk success. This may include simulations, guided trials, feedback, and peer support. Everything combined indicates only one way: digital competence becomes a habitual good practice, translating into sustained improvements in financial outcomes and overall financial well-being, which ultimately promotes resilience in financial decision-making (Lone & Bhat, 2022; Rai *et al.*, 2025; Tahir *et al.*, 2021). Considering the findings of earlier studies, we proposed the following hypothesis:

H4: Financial confidence mediates the relationship between digital financial literacy and financial well-being.

H5: Financial confidence mediates the relationship between financial behaviour and financial well-being.

RESEARCH METHODOLOGY

Research Design, Sampling Issues, and Data Collection Procedures

We collected the data for this research from the students of private universities in Bangladesh using a cross-sectional research design and snowball sampling technique. We developed a questionnaire with Google Forms and distributed it among respondents to obtain their perspectives. The questionnaire link has been sent to the faculty members of private universities, and they have been asked to distribute the Google form among their respective students. Here, faculty members served as research enumerators in this situation. Furthermore, the student respondents were also requested to forward the questionnaire to their friends. We sent the link through social media, such as email, WhatsApp, Messenger, LinkedIn, etc. until we obtained the required sample size. After distributing the questionnaire and obtaining responses from 65, we conducted the pilot test, which showed good data consistency. Table 2 shows the values of reliability. After a certain period of time, we received data from 330 re-

spondents. While data mining, we found 11 inconsistent data values that may have had an essential effect on the analysis and results. Finally, we found that the actual sample size of this study was 319.

Demographic Detail of the Respondents

Regarding gender, 58% of students were male and 42% female. Considering departments, 48% of the students were from the department of business, followed by Computer Science and Engineering (CSE)(21%), and the rest were from other departments. Bachelor students constituted the most respondents (88%). In terms of earnings, most of the students (60%) depended on their family support. However, 22% of the students' earning sources were part-time or full-time jobs. The rest of the students managed their education expenses through scholarships (internal or external) and different kinds of loans.

Constructs With Sources of Scale and Data Analysis Tools

In this study, we took FWB as the dependent variable, while DFL and FB were independent variables, and the mediating variable was FC. Researchers adapted measurements from published literature based on the Bangladeshi viewpoint, making necessary alterations and adjustments. Except demographic variables, all other variables (Table 1) had a five-point Likert scale from 'strongly disagree' to 'strongly agree' with values from 1 to 5, respectively. Researchers used two software (SPSS and smart PLS-SEM) to complete the data analysis procedure.

Table 1. Measurement of scale

Variables	Number of items	Sample item	Sources
DFL	14	I have a good understanding regarding digital payment applications	(Lyons, & Kass-Hanna, 2021; Respati *et al.*, 2023)
FB	14	I have a good financial plan for next 1 year	(Zulaihati *et al.*, 2020; Lyons, & Kass-Hanna, 2021)
FC	3	I have enough confidence on my future finance	(Respati *et al.*, 2023)
FWB	3	My current financial condition is good	(Respati *et al.*, 2023)

Source: own study.

Common Method Variance (CMV)

Using Harman's single-factor method, we checked the CMV. The first factor (single factor) accounted for only 33.251% of the variance, which was less than 50%. This finding indicates that there was no CMV issue.

Ethical Subject Matters

Through a consent form, we stated that all the data obtained would solely be used in this research effort and would remain confidential.

Data Analysis and Results

First stage: Preliminary Analysis

The data were normally distributed as the skewness and kurtosis values were within ±3. We also employed Mahalanobis and Cook's distances employed to study the outliers. However, we deleted 11 responses from the datasheet due to the missing values and outliers.

Second Stage: Measurement Model Evaluation

We followed a two-stage estimation approach (measurement and structural model). In the measurement model, we examined the research variable's factor loadings, reliability, convergent, and discriminant validity (Table 2). In this study, the factor loading of all items was above 0.60 (Chin, 1998). Besides, the reliability (Cronbach's alpha) and construct reliability (an internal consistency criterion) were also acceptable as all values were more than 0.70 (Hair *et al.*, 2016). Besides, all of

the values of average variance extracted (AVE) were more than 0.50, demonstrating the variables' convergent validity (Fornell & Larcker, 1981).

Table 2. Construct validity and reliability

Items	Factor loadings	VIF	Alpha	CR	AVE
Digital financial literacy					
DFL_3	0.734	2.059	0.903	0.926	0.588
DFL_4	0.734	2.409			
DFL_6	0.804	2.657			
DFL_7	0.733	1.880			
DFL_8	0.729	1.695			
DFL_9	0.819	2.576			
DFL_10	0.808	2.279			
DFL_13	0.768	1.680			
Financial behaviour					
FB_8	0.798	2.255	0.877	0.886	0.617
FB_9	0.789	2.554			
FB_10	0.761	2.275			
FB_12	0.811	2.157			
FB_13	0.75	1.622			
FB_14	0.802	2.156			
Financial confidence					
FC_1	0.871	1.960	0.810	0.823	0.725
FC_2	0.895	2.415			
FC_3	0.785	1.573			
Financial wellbeing					
FWB_1	0.834	1.604	0.776	0.792	0.688
FWB_2	0.812	1.728			
FWB_3	0.842	1.519			

Note: Alpha= Cronbach's Alpha, CR= Composite reliability, AVE= Average variance extracted.
Source: own study.

Table 3. Fornell-Larcker criterion and HTMT2 criterion

Variables	Fornell-Larcker criterion				Variables	HTMT criterion		
	DFL	F B	FC	FWB		DFL	FB	FC
DFL	0.767				**FB**	0.231		
FB	0.214	0.786			**FC**	0.245	0.536	
FC	0.213	0.463	0.851		**FWB**	0.128	0.578	0.648
FWB	0.125	0.511	0.531	0.829				

Source: own study.

Using the Fornell-Larcker criterion, we also checked the discriminant validity. In this study, the square root of AVE for each construct (Table 3) was greater than its correlation with other constructs in the conceptual framework (Fornell & Larcker, 1981). However, Henseler *et al.* (2015) stated that the Fornell-Larcker approach sometimes fails to indicate discriminant validity consistently. Thus, it is suggested that the Heterotrait-Monotrait Ratio of correlations (HTMT) can be used as an alternative method. From Table 3, the HTMT value of all constructs was below 0.85 (Roemer *et al.*, 2021), which means it fulfilled the discriminant validity criteria.

Structural Model Evaluation

Table 4 and Figure 2 findings demonstrate that FB and FC directly impact students' FWB. The findings revealed that FB and FC positively impact students' FWB (β_{FB} =0.342, P = 0.00, and β_{FC} =0.379, P =

0.000). Thus, H2 and H3 are supported. However, DFL negatively impacts students' FWB (β_{DFL} =-0.028, P = 0.517). However, the findings are insignificant. Thus, H1 is rejected.

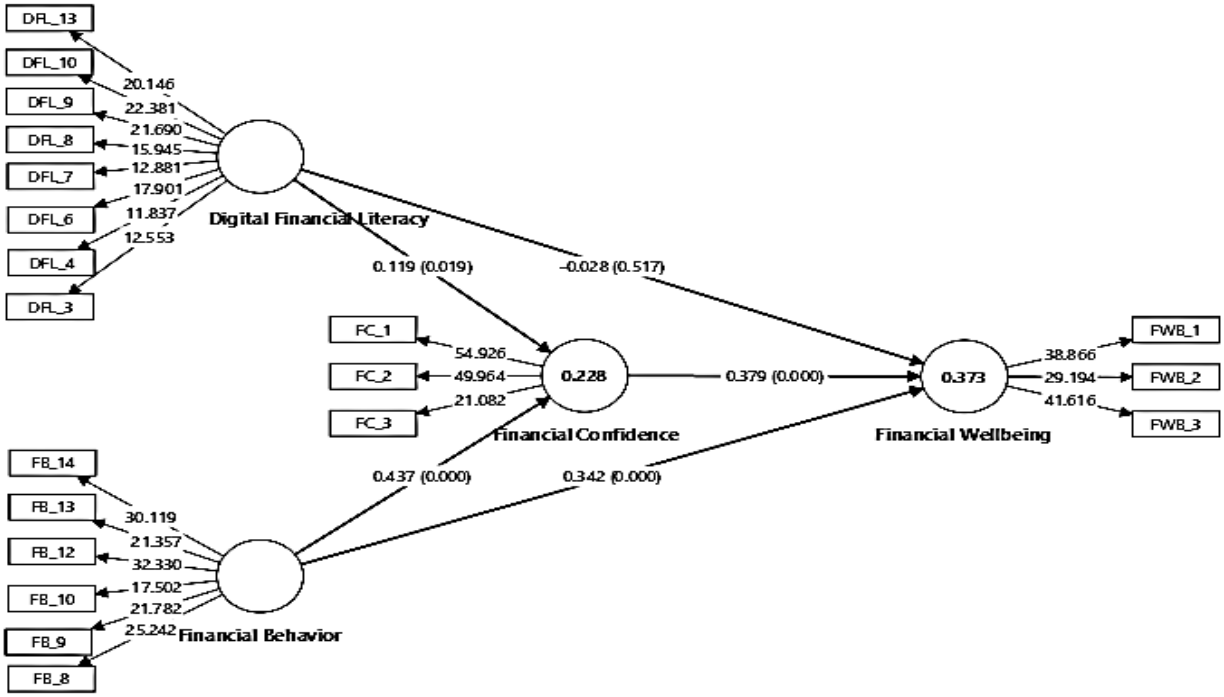

Figure 2. Structural model
Source: own elaboration.

Table 4. Direct and indirect effect

Hypothesis	Structural Path	Coefficient	T statistics	P values	2.5%	97.5%	Decision
	DFL> FWB	-0.028	0.648	0.517	-0.122	0.049	**H1** (Not supported)
	FB > FWB	0.342	4.687	0.000	0.196	0.482	**H2** (Supported)
	FC> FWB	0.379	5.586	0.000	0.246	0.510	**H3** (Supported)
Mediating Effect	DFL> FC> FWB	0.045	2.248	0.025	0.007	0.083	**H4** (Supported)
	FB> FC> FWB	0.166	3.986	0.000	0.094	0.256	**H5** (Supported)

Source: own study.

Regarding mediation analysis (Table 4), FC fully mediates (full mediation) the relationship between DFL and FWB. Besides, FC partially mediates (partial mediation) the relationship between FB and FWB. Thus, H4 and H5 were supported.

Table 5. Predictive relevance of the model

Construct	R Square	Q^2 Predict
FC	0.228	0.205
FWB	0.373	0.246

Source: own study.

Table 5 shows R^2 values for FC (22.8%) and FWB (37.3%), which means the FC construct exhibited weak explanatory power, while the FWB construct exhibited moderate explanatory power (Hair & Alamer, 2022). Finally, we showed the predictive relevance of the predicted variables using Q^2 (Hair *et al.*, 2022). Table 5 shows that the predictive relevance of our constructs was significant (>1.0) (Chin, 1998).

RESULTS AND DISCUSSION

The findings of this study provide important insights into the complex relationships among university students, such as digital financial literacy (DFL), financial behaviour (FB), financial confidence (FC), and financial well-being (FWB). Whereas some of the hypotheses produced expected findings, others provided counter-intuitive findings that provided insights into the complex relationships among the processes connecting financial knowledge, mental readiness, and actual well-being. Starting with H1, which hypothesized the positive direct effects of DFL on the well-being of university students, but the hypothesis was not supported. This undermines perceived usefulness in DFL, an important element in TAM, according to which individuals only use technologies and benefit from them when they perceive them as relevant and helpful toward their objectives (Davis, 1989). Therefore, H1's rejection could be due not to an absence of exposure to the digital environment but to an incompatibility between students' knowledge about finance and their present objectives or needs. This result defies previous research suggesting that greater financial literacy, even in the digital form, leads to improved economic performance (Barus *et al.*, 2024; Lyons & Kass-Hanna, 2021). However, the lack of direct effects among university students is not completely surprising. During this stage of their lives, students do not yet have the luxury of considering the overall well-being of money matters including long-term saving, planning for investments, or retirement plans. Their money concerns are centred around immediate needs such as handling monthly allowances, rudimentary digital payments, or informal saving habits (Rahim *et al.*, 2022). Therefore, even though they have acquired certain levels of DFL, this may not immediately translate into improved well-being since they are still using money tools in an instrumental manner. Moreover, students' knowledge can remain superficial, focusing on employing apps or wallets without an accurate grasp of consumer rights, risk in finance, or discipline when it comes to budgets (Koskelainen & Scornavacca, 2023; Mbatane & Kekana, 2024).

In contrast, H2, which hypothesised that financial behaviour (FB) is positively linked to financial well-being, was supported. According to the TPB, behaviour is shaped by intention, attitude, and perceived control; students who form good money habits are more likely to experience material and psychological rewards manifested in their sense of well-being. This comports with the large body of evidence indicating that regular and disciplined financial actions like budgeting, avoiding reckless purchases, and saving regularly are strongly linked with positive monetary outcomes and decreased anxiety (Kanth *et al*., 2026; Rai *et al*., 2025; She *et al*., 2024; Barus *et al*., 2024; Xiao & Neill, 2016). Besides, H3, which framed FC as positively correlated with the well-being of students, was also supported. This supports the function of self-efficacy as well as perceived behavioural control in TPB, which further indicates that confident students with good decision-making skills are likely to adopt good money habits and are also likely to feel less stressed about money (Koskelainen & Scornavacca, 2023; Rahim *et al.*, 2022). Confidence enables students to operate through multifaceted online platforms, gauge risks, and make wise choices, particularly when faced with an abundance of money choices and information in the modern age.

H4, FC is a full mediator between digital financial literacy and the financial well-being of Bangladeshi undergraduates, which we may also explain from the perspectives of the TPB and TAM. According to the TPB, knowledge does not only affect, as assumed, individuals' actual behaviours, but also their perceived behavioural control, which closely corresponds with the measure of financial confidence (Ajzen, 1991). In this regard, as much as digital financial literacy might be acquired by learners, knowledge by itself never translates into financial well-being unless it strengthens their self-confidence in handling and implementing financial choices. Here, the linkage of financial confidence as a psychological factor to DFL and practical usages of finance helps to reduce the stress that translates into overall financial well-being. As such, as these university students clearly show, it is not actually literacy that performs the decisive function of converting digital knowledge into material financial benefits; instead, the key actually lies with their confidence level. However, H5, which suggested that FC partially mediates the FB and FWB relationship, was confirmed. This finding brings theoretical richness to the research. Although DFL may not guarantee well-being in itself, it can indirectly contribute by building

financial confidence, which can, in turn, have a positive effect on well-being. Those who know how to use digital money platforms can develop feelings of control and mastery, enhancing their financial self-efficacy. Thus, this research highlights that financial literacy and financial behaviour are crucial but not enough singlehandedly to ensure financial wellbeing among university students; instead, financial confidence is also one of the key levers.

CONCLUSIONS

We examined how digital financial literacy, financial confidence, and financial behaviour help students achieve financial well-being. The findings reveal that financial confidence and financial behaviour have a significant positive effect on students' financial well-being, while digital financial literacy does not affect students' financial well-being without financial confidence. Regarding the mediating effect, financial confidence fully mediates the relationship between digital financial literacy and financial well-being, while financial confidence partially mediates the relationship between financial behaviour and financial well-being.

Theoretical Implication

This research focused on students' digital financial literacy, financial confidence, financial behaviour, and wellbeing through the TPB and TAM to enrich the existing body of knowledge. A theoretical link is framed among student financial and planned behaviour, supposing that students who participate in responsible behaviours and experience a sense of capability are more likely to achieve better financial wellbeing. In our study, we also found that financial behaviour and financial confidence significantly impact student financial well-being. The assumptions of TPB theory suggest that stronger behaviour and confidence mean greater well-being over a longer term. However, our findings also show that digital financial literacy directly does not affect student financial wellbeing, which does not meet the traditional findings or expectations. It means digital financial literacy alone does not ensure financial well-being unless it improves the students' financial confidence and responsible financial behaviour. TAM also leads us to expect stronger digital capability, financial confidence, and positive financial behaviour to ensure sustainable financial wellbeing.

Managerial and Practical Implications

This research can motivate educators to integrate digital financial modules into existing courses to enhance students' capabilities. Universities and colleges can introduce programs that teach students basic budgeting and how to use digital platforms or financial services effectively. Policymakers can devise youth-focused inclusion policies that increase digital financial accessibility. Governments of emerging markets can accelerate digital adoption by funding campus-based financial programs. Financial institutions like banks can develop engaging platforms that foster confidence and healthy money habits. Fintech providers can add learning modules and tutorials within software for sustained engagement. In short, the study highlights that all the stakeholders should work together to build an immersive experience for the students so that they are ready to tackle every type of financial circumstance they face in the future.

Limitations and Areas for Future Research

The main limitation of our research is its cross-sectional aspect, which restricts us from concluding causal relations or series over time. All of our research variables were individual-level variables, while some organisational or national-level variables, such as organisational support, would be considered intervening variables for future research. In addition, we suggest including some control variables (Education level and source of income) for future research.

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Appendix A: Prior studies (context, theory and variable)

In-text Citation	Context	Content (variable)	Theory
Lu *et al.* (2026)	Malaysia	Financial literacy, digital financial literacy (IV), financial wellbeing (DV), digital financial inclusion (MV)	Family resource management theory
Amarsanaa *et al.* (2025)	Japan	Digital financial literacy (IV), demographic variables (IV), anxiety (DV)	Theory of planned behavior, technology acceptance model, and human capital theory, social cognitive theory
Bhat *et al.* (2024)	India	Digital financial literacy, knowledge, experience, skills (IV) financial wellbeing, satisfaction, capability, anxiety (DV) Impulsivity and self-control (MV)	N/A
Mishra *et al.* (2024)	India	Digital financial literacy (IV), financial decision making, intention toward investment (DV)	Theory of planned behavior
Low *et al.* (2023)	Malaysia	N/A	N/A
Mullappallykayamkulath (2022)	India	Digital financial literacy (IV) saving/spending behaviors (DV)	N/A
Rahayu *et al.* (2022)	Indonesia	Demographic factors (IV), digital financial literacy (DV), and digital financial literacy (IV), behaviors (DV)	Theory planned behavior
Tony and Desai (2020)	India	Digital financial literacy (IV) financial inclusion (DV)	Theory of cognitive dissonance
Prasad *et al.* (2018)	India	Awareness and demographic characteristics (IV) and Use of digital platforms for financial transactions (DV)	N/A

Note: N/A=Not applicable, IV=Independent variable, DV=Dependent variable, MV=Mediating variable.
Source: own elaboration.

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The contribution share of authors is equal and amounted to 25% for each of them.

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Use of Artificial Intelligence

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Employee resilience in the post-merger integration phase: Unveiling the role of employee cognitive uncertainty

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ABSTRACT

Objective: The article aims to empirically examine how employee resilience (ER) during post-merger integration (PMI) develops through two complementary behavioural mechanisms: the reduction of cognitive uncertainty (CU) driven by visionary leadership (VL) and communication effectiveness (CE), and organisational identification (OI) as a source of adaptive capacity.

Research Design & Methods: We applied structural equation modelling (covariance-based SEM and PLS Path Modelling methods) using data from a unique survey of 305 office workers across 295 mergers and acquisitions (M&A) in 2014-2023, evaluating their experiences during the PMI phase.

Findings: Results confirmed the proposed dual-mechanism structure. Namely, CU negatively affects ER and serves as a central mediating mechanism linking organisational practices to adaptive behaviour and CE influences ER exclusively through the reduction of CU (full mediation). Meanwhile VL exerts both a direct positive effect and an indirect effect via reduced CU (partial mediation). In parallel, OI independently and positively predicts ER. The effects of control variables (gender, age, residence, and firm size) were not significant.

Implications & Recommendations: The findings indicate that ER during PMI is not merely an individual trait but a behavioural capability shaped by organisational practices. Managers can strengthen ER by systematically reducing employees' CU through CE and VL, while simultaneously fostering identification with the newly formed organisation.

Contribution & Value Added: This study contributes to M&A integration research by introducing a dual-mechanism framework that integrates cognitive (uncertainty reduction) and identity-based (organisational identification) pathways to explain how resilience develops during PMI. It reconceptualises CU as a manageable cognitive state that directly conditions adaptive capacity. By uncovering the mechanisms underlying resilient behaviour, the study deepens theoretical understanding of employee adaptation in conditions of profound organisational change.

Article type: research article

Keywords: mergers and acquisitions; post-integration phase; employee resilience; behavioural adaptation, cognitive uncertainty; organisational identification

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INTRODUCTION

Mergers and acquisitions (M&A) are complex organisational changes (Bansal & King, 2022) that require a multidimensional approach. Therefore, the economic literature carefully analyses M&A, typically from organisational, financial, and legal perspectives, providing a deep insight into each stage of these processes (Gemson, 2024; García & Herrero, 2022; Sułkowski *et al.,* 2019). However, a significant number of M&A still fail to meet their economic expectations (Dao & Bauer, 2021; Kaur & Sharma, 2024; Paumen *et al.*, 2022).

Analysis of the existing literature reveals a need to extend previous studies and examine the role of human integration in creating M&A's success (Birkinshaw *et al.*, 2000; van Oorschot *et al.*, 2023). Notably, M&A success as such is defined as the ability to establish a stable new organisation that generates positive economic outcomes. One can measure this success in various ways, either financially or culturally (Carleton & Lineberry, 2004). The literature emphasises the critical role of employees, particularly during the post-merger integration (PMI) phase, which is essential for establishing a new organisational entity (Thakur & Yadav, 2025). This ongoing issue has led to the emergence of studies focused on human integration and the behavioural aspects of M&A, including employees' adaptive behaviours.

One such adaptive behavioural capability is employee resilience (ER), which refers to employees' ability to adapt to changes and cope with changing circumstances under conditions of uncertainty (Kuntz *et al.*, 2016; Näswall *et al.*, 2019). This aspect is especially relevant given its direct positive contribution to organisational resilience (Wang & Wang, 2023), which is critical in the context of M&A. Moreover, ER constitutes a pivotal determinant, especially during the PMI, as it underpins individuals' capacity to accommodate organisational transformation and navigate heightened uncertainty (Cooper *et al.*, 2013; Khan *et al.*, 2020).

Uncertainty constitutes another significant psychological state induced by organisational changes (Haynie *et al.*, 2016). As very complex and profound changes, M&A generate considerable uncertainty among employees (Bansal & King, 2022). During PMI, new rules are still being developed, leading to a significant increase in CU. People often lack confidence in their decisions and fear making mistakes (Enke & Graeber, 2023). The amount and consistency of rules affect their daily uncertainty (Bernards *et al.*, 2021). Beyond ambiguity arising from missing or inconsistent information, the central challenge during PMI is uncertainty about the future consequences of present decisions, as employees must allocate effort, adapt to new expectations, and engage with the emerging organisation without knowing how these choices will affect future outcomes. Accordingly, in this study, we focused on uncertainty rather than ambiguity. Following Enke and Graeber (2023), we define cognitive uncertainty (CU) as 'people's subjective uncertainty over their *ex ante* utility-maximising decision.' This definition reflects the forward-looking nature of decision-making during PMI, in which uncertainty stems from not knowing how current actions will translate into future rewards, evaluations, or organisational fit.

Beyond CU, PMI also challenges employees' sense of belonging and attachment to the newly formed organisation. During PMI, employees must not only understand new goals, roles, and tasks, but also redefine their organisational identification (OI). This suggests that ER may emerge from two complementary behavioural mechanisms: a cognitive mechanism, in which visionary leadership (VL) and effective communication (CE) reduce uncertainty, and an identity-based mechanism, in which OI provides meaning and a sense of belonging that sustain adaptive behaviour.

Despite the growing recognition of ER as a critical factor in successful post-merger integration (PMI), existing research provides limited insight into how it is formed and how it can be managed and strengthened in the context of heightened uncertainty that characterises M&A processes. Prior studies have established that leadership and communication are important antecedents of employee attitudes and behaviours during organisational change. However, the cognitive mechanisms through which these organisational practices translate into resilient employee behaviour during PMI remain insufficiently understood. Although scholars widely acknowledge uncertainty as a defining feature of PMI, research has predominantly examined uncertainty as a general contextual condition rather than as a specific cognitive state that shapes decision-making and adaptive capacity (Allen *et al.*, 2007; Diduc, 2022; Steigenberger, 2017). Leaving unanswered how uncertainty experienced at the levels of goals, roles, and tasks influences ER, and it can be actively managed by organisations during PMI. Simultaneously, although researchers have examined OI in M&A contexts, its role as an independent identity-based pathway to resilience has not been clearly integrated with uncertainty-based explanations. Consequently, there remains a need for a coherent framework that would explain ER during PMI through complementary cognitive and identity-based mechanisms.

In this study, we addressed this gap by developing a dual-mechanism framework of ER during PMI. Specifically, we conceptualised CU as a central mediating mechanism through which VL and CE shape ER, while positioning OI as an independent identity-based pathway that supports adaptive capacity. By

doing so, we advance understanding of ER not merely as an individual disposition or outcome, but as a behavioural capability emerging from complementary cognitive and identity-based processes under conditions of organisational transformation.

Accordingly, we focused on the human dimension of M&A integration and the mechanisms underlying employees' adaptive behaviours. Drawing on behavioural insights, we examined the factors influencing ER and explored the significance of CU during PMI. Consequently, we aimed to empirically examine how ER during PMI develops through two complementary behavioural mechanisms: the reduction of CU driven by VL and CE, and OI as a source of adaptive capacity. Previous studies analysing the importance of employees' behaviour during M&A focused on a limited number of cases, often providing in-depth insight into a single integration (Diduc, 2022; Edwards *et al.*, 2024; Lipponen *et al.*, 2017; Mühlemann *et al.*, 2022; Sung *et al.*, 2017). To strengthen the empirical basis for understanding employee behaviour during PMI, we analysed a unique sample of 305 respondents, each representing one of 295 different M&A between 2014 and 2023. We propose that an employee's position may affect their CU. To ensure a consistent perspective, we focused on a specific group, *i.e.*, office workers.

The remainder of this article is organised as follows. The following section provides a literature review and hypotheses development. The next section describes the methods, including the data collection procedure and the sample characteristics. The subsequent section presents and discusses the results of the empirical analyses. The final section concludes the study and outlines its limitations.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Employee Resilience

Employee resilience (ER) constitutes a crucial determinant of organisational success in managing M&A, particularly during the PMI phase (Cooke *et al.*, 2021; Khan *et al.*, 2020). Thus, in our study, we applied the concept of ER, defined as a behavioural 'capacity of employees to utilise resources to continually adapt and flourish at work, even when faced with challenging circumstances' (Kuntz *et al.*, 2016; Näswall *et al.*, 2019). This definition explicitly captures employees' ability to adapt to challenges connected with uncertainty (Kuntz *et al.*, 2016), making it suitable to the examined M&A context.

The literature provides substantial evidence of the connection between ER and organisational resilience (Liang & Cao, 2021; Wang & Wang, 2023), which further justifies the application of this concept in studies of a newly established entity. Furthermore, it is worth noting that the idea of ER relates to psychological resilience, which was also found to affect employee commitment to change in the M&A context (Cho *et al.*, 2017). However, personal resilience (stress-coping ability) and ER (resilient workplace behaviours), although related, are distinct concepts (Tonkin *et al.*, 2018).

The importance of ER in M&A, particularly during the PMI phase, lies in its ability to enable employees of the new entity to adapt and cope with existing uncertainty (Cooper *et al.*, 2013; Khan *et al.,* 2020). Several studies addressed ER in response to uncertainty. Li and Tong (2021) emphasised the importance of implementing programs that build ER to enhance their capacity to manage uncertainty. Breevaart and Woerkom (2024) suggest that as employees face increasing uncertainty in navigating their careers, enhancing ER is crucial in building employee work engagement. Liang and Cao (2021) argue that resilient employees enable organisations not only to survive but also to flourish, as they enhance the capacity to learn from adversity and uncertainty. Wang and Wang (2023) explored ways to strengthen the resilience of project managers and employees in coping with the uncertainty and complexity inherent in construction projects. McEwen (2022) noted that due to the prevalence of high pressure, constant change, and uncertainty in contemporary workplaces, resilience becomes increasingly significant. Plimmer *et al.* (2023) found that the following three factors, *i.e.*, role ambiguity, job insecurity, and unclear organisational goals are negatively correlated with ER. These factors are linked to the three dimensions of CU: goal uncertainty, role uncertainty, and task uncertainty (Bernards, 2023).

Cognitive Uncertainty

Cognitive uncertainty (CU) arises when agents face a complex problem with relatively poor access to information (Al-Najjar *et al.*, 2003). Enke and Graeber (2023) claim that CU, induced by the complexity

of the issues, is the origin of decision anomalies as it changes people's behaviours and responses. As they analysed CU from the perspective of decision-making theory, they defined CU as 'people's subjective uncertainty over their ex-ante utility-maximising decision.' They claimed its importance in predicting 'systematic biases in economic decisions.' CU resulting from limited access to information refers to uncertain or incomplete information about situations, rules, and procedures (Bernards *et al.*, 2021; Raaphorst, 2018). It also arises from conflicting or contradictory information (Bernards *et al.*, 2021). As such, CU that stems from both the complexity of a problem and limited access to relevant information may lead to ineffective decisions and problems during M&A.

Notably, some studies used the term 'ambiguity' to refer to a similar concept. However, uncertainty is a broader concept than ambiguity and is more oriented toward the future. Dequech (2000) distinguishes between ambiguity, which refers to missing information that could, in principle, be known, and uncertainty, when some information simply does not exist at the time a decision is made, as the future has yet to be determined. Consequently, ambiguity may be considered as a potential source of uncertainty (Bernards *et al.*, 2021; O'Driscoll & Beehr, 1994).

Uncertainty is a context-dependent concept, hence it lacks a precise definition, leading to various ideas of uncertainty in the literature, for instance, strategic and implementation uncertainty (Allen *et al.*, 2007; Bordia *et al.*, 2004), effort-to-performance uncertainty, performance-to-outcome uncertainty, and uncertainty regarding supervisors' acceptance (O'Driscoll & Beehr, 1994), and finally, CU (Bernards, 2023, 2024; Bernards *et al.*, 2021). In his works, Bernards combined three types of CU experienced by employees, *i.e.*, goal uncertainty, role uncertainty, and task uncertainty.

In our research, we concentrated on CU as conceptualised by Bernards. We focused on the PMI phase, when employees consider adjusting their daily responsibilities to meet the requirements of the newly established entity. During the post-acquisition phase, employees experience multiple and overlapping uncertainties, such as uncertainty about job security, roles and responsibilities, strategic priorities, and future organisational practices. Integration team members must make decisions under both their own uncertainty and the uncertainty experienced by others, which together significantly complicate their decision-making processes (Diduc, 2022).

Linking Cognitive Uncertainty and Employee Resilience

Notably, ER relies on employees' ability to cognitively interpret their work environment and translate this understanding into adaptive behaviour. Meanwhile, CU undermines this capacity by impairing sensemaking and decision-making, thereby limiting employees' ability to evaluate alternative courses of action and deploy available resources effectively. When organisational goals, roles, or task expectations are unclear or conflicting, employees increasingly devote their cognitive resources to managing uncertainty rather than engaging in adaptive action. This diversion constrains the behavioural flexibility that characterises ER, particularly during PMI, when rapid adjustment to new structures, expectations, and workflows is required. Accordingly, heightened CU is expected to weaken employees' resilient behaviour during PMI. Regarding this mechanism and consistent with prior studies demonstrating the negative impact of constructs conceptually related to CU, such as role ambiguity, job insecurity, unclear organisational goals, etc., on ER (Bernards, 2023; Cooke *et al.*, 2021; Khan *et al.*, 2020; Kuntz *et al.*, 2016; Liang & Cao, 2021; Plimmer *et al.*, 2023; Wang & Wang, 2023), we propose the following hypothesis:

H1: There is a negative relationship between cognitive uncertainty and employee resilience.

Visionary Leadership

Effective leadership during M&A helps integrate team members and reduces uncertainties, thereby contributing to the success of the integration (Diduc, 2022). Empirical evidence suggests that leadership also plays a significant role in the development of ER. Breevaart and Woerkom (2024) argue that as employees experience growing uncertainty, leaders who actively support subordinates in identifying, utilising, and developing their strengths have a significant impact on the development of ER. Nguyen *et al.* (2016) found that empowering leadership, fostering subordinates' autonomy and confidence and promoting participative decision-making, has a significantly positive effect on ER. Caniëls and Curseu (2024) proved

that leaders' resilient behaviours shape the resilience of other employees. Dimas *et al.* (2018) provided evidence on a positive relationship between transformational leadership and team resilience.

Because we conducted our study in the context of M&A and PMI, we decided to focus on visionary leadership (VL) for several reasons. First, it is fundamentally oriented toward shaping the future. It focuses on the vision of the future that a leader communicates, guiding employees toward contributing to the shared goal (Bernards, 2023; Stam *et al.*, 2014). Second, scholars widely regard VL as one of the most popular forms of leadership (Mascareño *et al.*, 2020) and consider it an essential element of effective leadership (Buss & Kearney, 2024). Studies that reduce transformational leadership to its visionary component underscore the importance of VL in the context of organisational changes (Jensen *et al.*, 2019). Through cultivating a sense of meaning, visionary leaders are likely to strengthen employees' capacity to adapt and persevere in challenging contexts. Consistent with prior empirical findings on leadership and ER (Breevaart & Woerkom, 2024; Caniëls & Curseu, 2024), we hypothesised:

H2: There is a positive relationship between visionary leadership and employee resilience.

One reason effective leadership is crucial to the PMI is that it provides direction and reduces employees' uncertainty (Steigenberger, 2017). Thus, VL constituted a particularly critical factor in our study because it is recognised as essential for reducing employees' CU by providing clear directions and giving employees a sense of purpose in their work (Bernards, 2023). Beyond offering directions and guidelines to employees, VL also employs another mechanism: it reduces CU through team cohesion (Bernards, 2023). Furthermore, VL operates at a collective level (Stam *et al.*, 2014), aligning team efforts and enhancing groups' ability to navigate uncertainty and the complex changes that occur during the PMI. It aligns goals, which contributes to team creativity and innovation (Mascareño *et al.*, 2020).

Studies by Breevaart and Woerkom (2024) and Li and Tong (2021) suggest that leadership may influence ER, especially when employees cope with uncertainty. Liu *et al.* (2023) go even further, claiming that leader mindfulness affects ER, with perceiver environmental uncertainty as a moderating factor.

Building on the above findings, we focused on VL as a critical leadership style to cope with uncertainty and change, which may strengthen ER during PMI. From this study's perspective, the interplay between VL and CU is particularly significant. As previously discussed, employees' CU subsequently influences their resilience. Therefore, one could expect that employees' CU would mediate the effectiveness of VL in fostering ER. While existing studies separately explored the effects of leadership on uncertainty and the relationship between uncertainty and ER, an integrated framework in the PMI context remains underdeveloped. Thus, drawing on prior research (Bernards, 2023; Breevaart & Woerkom, 2024; Li & Tong, 2021), we hypothesised:

H3: Cognitive uncertainty mediates the relationship between visionary leadership and employee resilience.

Communication Effectiveness

Effective communication of change to employees can be conceptualised along four dimensions: usefulness, sufficiency, timeliness, and accuracy in interactions (Bansal & King, 2022). It was found to be critical to integration success in both the pre-acquisition and post-acquisition phases (Al Hosani *et al.*, 2020; Gomes *et al.*, 2013; Senior *et al.*, 2017), with open communication identified as a significant determinant of integration outcomes (Angwin *et al.*, 2016). Soontornchaiya and Charoensukmongkol (2024) found that management communication affects shared goals and organisational commitment during PMI.

Communication effectiveness (CE) plays a crucial role in shaping ER, particularly during organisational change, such as M&A. Effective communication of organisational change is essential for fostering employees' positive attitudes towards this change (Amiot *et al.,* 2006; Bansal & King, 2022). Communication plays a crucial role in the success of acquisitions by increasing employee coping abilities and productivity (Appelbaum *et al.*, 2017). This way, it may foster ER defined as the capability to adapt to change and cope with changing circumstances. Consistent with prior findings (Amiot *et al.,* 2006; Appelbaum *et al.*, 2017; Bansal & King, 2022), we hypothesised:

H4: There is a positive relationship between communication effectiveness and employee resilience.

Notably, M&A announcements can lead to several adverse outcomes, including communication issues and increased uncertainty (Senior *et al.*, 2017). However, effective communication helps address uncertainties related to change (Allen *et al.*, 2007). Al Hosani *et al.* (2020) demonstrated that it is a crucial factor in alleviating feelings of alienation among employees during the PMI. It is also essential for building trust (Al Hosani *et al.*, 2020; Allen *et al.*, 2007). Efficient communication is necessary to address employees' uncertainty and ambiguity about future M&A outcomes (Amiot *et al.*, 2006). Birkinshaw *et al.* (2000) claimed that clear and consistent communication reduced uncertainty and facilitated both task and human integration. By reducing ambiguity, effective communication provides employees with the information they need to make sense of organisational change, thereby lowering CU and encouraging a stronger sense of control. Regular vertical and horizontal communication enhance employees' commitment to organisational change (Appelbaum *et al.*, 2017). Therefore, we may see reducing CU as a key pathway through which communication supports ER, making it a central factor in successfully navigating the PMI. Although prior research examined the relationships between CE and uncertainty and between uncertainty and ER, these studies evolved independently, and the integrated framework in the context of PMI remains underdeveloped. Consequently, building on prior studies (Al Hosani *et al.*, 2020; Allen *et al.*, 2007; Amiot *et al.*, 2006; Birkinshaw *et al.*, 2000), we proposed the following hypothesis:

H5: Cognitive uncertainty mediates the relationship between communication effectiveness and employee resilience.

Organisational Identification

Within the identity pathway proposed in this study, organisational identification (OI) represents a stabilising resource that supports employees' adaptive capacity during PMI. It is a 'specific form of social identification where the individual defines him or herself in terms of their membership in a particular organisation' (Mael & Ashforth, 1992). It encompasses both cognitive and affective identification (Xenikou, 2014).

There is a wide array of studies on pre-integration and post-integration OI. For instance, Sung *et al.* (2017) conducted pre- and post-merger analyses. They found that changes in employees' perception of a company's overall status and individual position affect their OI. Lipponen *et al.* (2017) and Mühlemann *et al.* (2022) found a positive relationship between pre- and post-integration OI. Edwards *et al.* (2024) argue that pre-merger work-related identification is a buffer during organisational change. Scholars consider OI to be a significant determinant of M&A success, especially in the PMI (Kroon *et al.*, 2009). Thakur and Yadav (2025) analysed PMI, considering this phase crucial for shaping organisational changes. Klok *et al.* (2022) revealed that OI becomes a critical emotional process in the post-M&A phase, as employees renegotiate their sense of belonging and attachment to the newly formed entity (Klok *et al.*, 2022).

Trenerry *et al.* (2021) highlighted workplace resilience and team identification as important factors during organisational change. They observed that OI can support collective adaptation and help employees align with new goals and group norms. Peng and Liang (2023) found a positive effect of OI on ER during the COVID-19 pandemic. Arshad *et al.* (2023) observed an indirect effect of OI on ER, with sequential mediation by the desire to have a significant impact through work (motivation to make a meaningful difference or contribution through their job) and voice behaviour (proactive communication and focus on improvement).

Overall, the literature suggests that OI enhances employees' adaptive responses and coping mechanisms, thereby strengthening their resilience. Therefore, in line with previous findings (Trenerry *et al.*, 2021; Peng & Liang, 2023; Arshad *et al.*, 2023), we proposed that:

H6: There is a positive relationship between organisational identification and employee resilience.

RESEARCH METHODOLOGY

Our study was based on a questionnaire consisting of two sections. The first one assessed respondents' demographic characteristics (gender, age, place of residence, and the size of the firm they worked for during the M&A). The second part consisted of 33 statements, representing five scales, as proposed by other authors. We modified the statements in two ways. First, as we measured variables retrospectively, we converted each statement into the past tense. Second, we asked respondents to indicate their feelings 'directly after the merger/acquisition took place,' and in three statements, it was necessary to clarify that they pertained to the situation within the new company. Respondents indicated the answers for each statement on the 5-point Likert-based scale (from 'strongly disagree' to 'strongly agree').

We measured ER as a latent variable on a 9-statement behavioural 'Employee Resilience Scale' by Näswall *et al.* (Näswall *et al.,* 2015; Näswall *et al.*, 2019). We selected this scale because it focuses on interactions with the work environment and includes references to work-related challenges. As used in our study, a sample statement from this scale was: 'I effectively collaborated with others to handle challenges at work.'

We measured CU using the 10-statement scale by Bernards (2023), covering all three dimensions of CU (goal, role, and task). Regarding role uncertainty, the questions in the Bernards scale were inspired by a survey of employee willingness to participate in organisational change by Miller *et al.* (1994). As used in our study, a sample statement from this scale was 'In my role as a team member, I knew exactly what was expected of me.'

To obtain the CE variable, we devloped the 4-statement scale based on the concept by Bansal and King (2022). It covered four dimensions of CE, *i.e.,* content, accuracy, usefulness, and timeliness. As used in our study, a sample statement from this scale was 'The content of the communication was sufficient.'

For the VL variable, we adapted the 5-statement scale proposed by Bernards (2023), based on a scale developed by Jensen *et al.* (2019). In some studies, including Jensen *et al.* (2019), the authors refer to transformational leadership, limiting it only to its visionary component. As used in our study, a sample statement from this scale was: 'My manager communicated a clear vision of the team's future.'

To measure the OI variable, we used a 5-statement scale by Mael and Ashforth (1992). Other studies also applied it in order to analyse behaviour during PMI, *e.g*., Kroon *et al.* (2009) and Kroon and Noorderhaven (2018). As used in our study, a sample statement from this scale was 'The new company's successes were my successes.'

We translated the questionnaire into Polish. To maintain the scales' validity, the translation process involved two independent forward translations and two independent back translations, expert review, pre-testing, and adjustment.

We defined our target population as office workers employed in an acquired or merged company in Poland in the last 10 years before the data collection. Regarding previous studies, we assumed that respondents could accurately recall their emotions during important events that happened within the last 10 years. Organisational change presents significant challenges for employees, eliciting a wide range of emotions and behaviours. Previous studies demonstrate that emotions enhance memory retention, with emotion-processing regions, particularly the amygdala and orbitofrontal cortex, facilitating the encoding and retrieval of details associated with negative events (Kensinger, 2007). Emotional memories play a crucial role in structuring autobiographical narratives (Cantó-Milà *et al.*, 2023). However, prior studies also indicate that individuals often experience difficulties in recalling numerical information in autobiographical surveys (Bradburn *et al.*, 1987). This finding is consistent with the telescoping effect, a cognitive bias where respondents tend to remember recent events as older than they actually are (backward effect) or distant events as newer (forward effect) (Bokati & Kreinovich, 2019). Consequently, we decided to omit numerical questions, especially the specific date of the M&A in which respondents had participated.

The data was collected by a professional company using the computer-assisted web interviewing method (respondents were chosen from a panel). After the data quality control, we excluded 15 observations from the initial sample. These were cases where respondents reported involve-

ment in an M&A of an entity other than a private company (public school, public hospital, government administration unit, etc.).

The final sample consisted of 305 respondents. The sample constituted a diverse representation of the study population. Participants represented 295 different integration processes (a merger or an acquisition). In eight cases, there were two representatives from the same company that either merged or acquired another company, and in one case, there were three representatives. The geographic distribution of respondents by NUTS 2 regions (provinces) was approximately proportional to the size of the general population. Women comprised approximately two-thirds of the sample. Half of the respondents were 36 years old or younger, with the middle 50% of respondents falling between 31 and 45 years old. Table 1 presents the full frequency distributions of respondents' characteristics.

Table 1. Frequency distributions and descriptive statistics for the respondents' characteristics

Variable/*Category*			**Count**		**Percent**
Gender					
Female			197		65%
Male			108		35%
Place of residence					
Rural area			39		13%
A town with less than 50k inhabitants			43		14%
Town with 50-100k inhabitants			38		12%
City with 100-200k inhabitants			40		13%
City with 200-500k inhabitants			49		16%
A city with more than 500k inhabitants			96		31%
Company size					
Small or medium-sized enterprise (1-249 employees)			119		39%
Large enterprise (250 employees or more)			186		61%
	Min.	Mean	Median	Std.	Max.
Age	18	38.6	36	10.8	75

Source: own study.

We analysed the data using structural equation modelling (SEM) methodology. It was the most commonly used method in previous studies (Johnson, 2016; Rafferty & Griffin, 2006). First, we tested the measurement model for the factors explained in the literature review, including reliability and validity testing. Then, we estimated the full latent variable model. As a robustness check, we estimated the model using two approaches: covariance-based SEM and partial least squares path modelling (PLS).

RESULTS AND DISCUSSION

As mentioned in the previous section, the statements used in the questionnaire were modified versions of scales used by other authors. We performed the reliability analysis and discriminant validity to check whether the employed scales produced consistent results and whether the constructs were distinct from one another. The analyses considered the ordinal nature of the observed items (*i.e.*, the answers 'strongly disagree,' 'disagree,' *etc.*, were treated as ordinal variables, not as numerical ones). We calculated two measures of reliability, *i.e.*, ordinal alpha (Zumbo *et al.*, 2007), which is a standard Cronbach's alpha formula applied to the polychoric correlation matrix, and composite reliability as proposed by Green and Yang (2009) for ordinal data. Table 2 presents the results of the reliability analysis. The higher the values of these measures, the more reliable a scale for the construct. All constructs had values of both measures close to 0.9. These results demonstrated very good reliability of the measurement model.

For discriminant validity, we used two criteria: the Fornell-Larcker criterion (Fornell & Larcker, 1981) and the Heterotrait-monotrait ratio (Henseler *et al.*, 2015; Voorhees *et al.*, 2016). The former states that the average variance extracted by a construct should be larger than its squared correlations with other constructs. The latter states that the heterotrait-monotrait ratio of correlations should be

no larger than 0.85. The results of these tests, presented in Table 3, indicated good discriminant validity of constructs under study.

Table 2. Reliability analysis for the constructs under study

Construct	Ordinal alpha[1)]	Composite reliability[2)]
ER – Employee Resilience	0.88	0.86
CU – Cognitive Uncertainty	0.96	0.96
VL – Visionary Leadership	0.94	0.92
CE – Communication Effectiveness	0.93	0.92
OI – Organisational Identification	0.86	0.84

Notes: [1)] Based on the polychoric correlations. [2)] Using the approach from Green and Yang (2009) for ordinal data.
Source: own study.

Table 3. Discriminant validity of the constructs under study

Fornell-Larcker criterion[1)]						Heterotrait-monotrait ratio					
Construct	**ER**	**CU**	**VL**	**CE**	**OI**	**Construct**	**ER**	**CU**	**VL**	**CE**	**OI**
ER	0.462					ER	1.000				
CU	0.295	0.729				CU	0.533	1.000			
VL	0.361	0.287	0.752			VL	0.596	0.515	1.000		
CE	0.320	0.334	0.550	0.782		CE	0.562	0.575	0.736	1.000	
OI	0.345	0.095	0.375	0.292	0.569	OI	0.559	0.295	0.622	0.543	1.000

Notes: 1) Average variance extracted (calculated from polychoric correlations) in the diagonal and squared correlations in the lower triangle.
Source: own study.

Having a reliable and valid measurement model, we calculated the full latent variable model. Since all items were ordinal variables, we estimated model parameters using the diagonally weighted least squares method. We computed standard errors and test statistics using full-weight measures (Finney & DiStefano, 2013). We determined the metric of each latent variable by the variance standardisation method (*i.e.*, by fixing their variances to 1). We present the results as a completely standardised solution. The means of each factor were set to zero. The control variables were all introduced into the model as dummy variables. The dichotomisation was apparent for gender and company size. Age was divided into groups according to median and place of residence: city below 200k vs. city over 200k inhabitants. We performed the analysis using the R package lavaan 0.6.17 (Rosseel, 2012). Figure 1 presents the structural part of the estimated model. Appendix A presents the full results of the SEM model.

The scaled (robust to nonnormality) fit measures for this model were as follows: comparative fit index (CFI) = 0.982, Tucker-Lewis index (TLI) = 0.984, root mean square error of approximation (RMSEA) = 0.042 (90% confidence interval for RMSEA was estimated as [0.037, 0.048]), standardised root mean square residual (SRMSR) = 0.055. All of these measures demonstrate that the model fit the data very well.

The regression coefficients presented in Figure 1, on the path lines from the exogenous factors to the mediator and the endogenous factor, represent the sign and strength of each factor's influence. They can take values from -1 to 1, with values close to 0 indicating no relationship at all and values closer to -1 or 1 showing an ever-stronger connection. The estimated relationship between OI and ER was statistically significant and positive, indicating that the more employees identified with the new organisation, the more resilient they became. The effects of VL and CE on CU were statistically significant and negative. Further along the causal path, the effect of CU on ER was also statistically significant and negative. This means that the indirect influence of VL and CE on ER was positive, the products of the coefficients on the respective indirect paths were positive and statistically significant. Meanwhile, the direct relationship proved to be insignificant for CE on ER and only slightly significant for VL on ER. This means that CU served as mediator for the relationship between CE and ER, as well as (partially) VL and ER. All control variables proved to be insignificant additions to the model, hence we did not show their estimated parameters on the diagram. The residual variance of ER was 0.480, indicating that all exogenous factors in the model collectively explained 52.0% of the variance in ER.

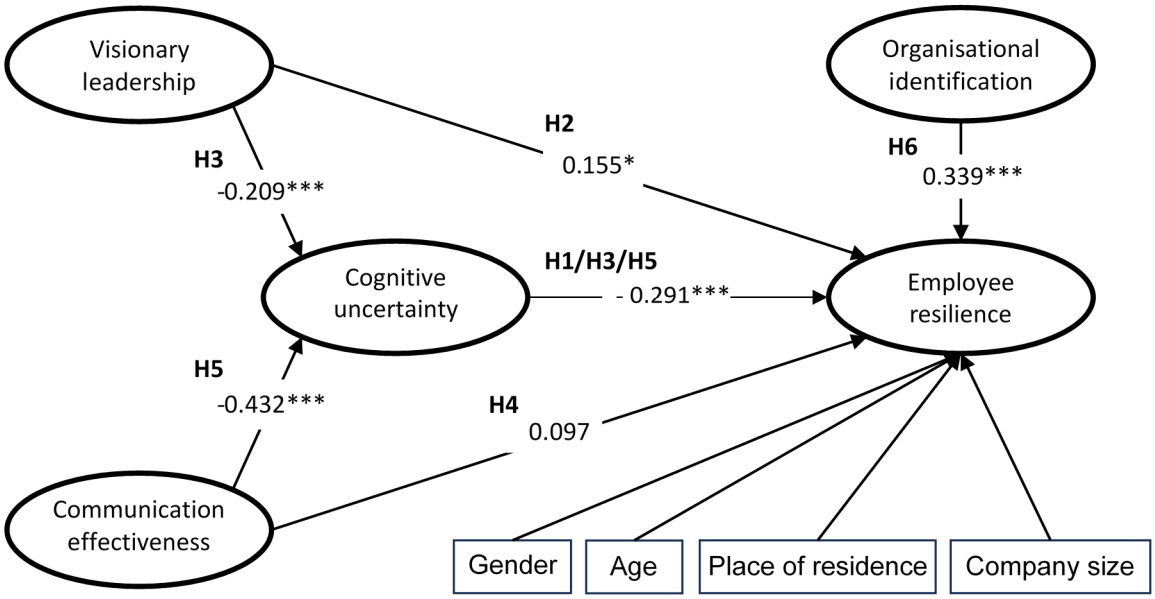

Figure 1. Estimated parameters of the SEM model (significance codes: * 0.05, ** 0.01, * 0.005)**
Source: own elaboration.

We performed the above analysis using a common factor-based approach (*i.e*., covariance-based SEM) to estimate model parameters. The reason for that was twofold. First, our measurement model was reflective (observed indicators are functions of constructs, not the other way round). Second, our variables were ordinal in nature, which one should consider in the estimation procedure. Covariance-based SEM allowed for a polychoric correlation matrix in the estimation process. Nevertheless, we cannot exclusively categorise the phenomenon under study as either common factor or composite-based, and whether to use covariance-based SEM or partial least squares path modelling (Sarstedt *et al.*, 2016). This question becomes irrelevant when the results from the two methods align. This is the case of this study. As a robustness check, we estimated the model with PLS using SmartPLS software (Ringle *et al.*, 2024), treating the data as quasi-continuous. The coefficients for structural relationships were very similar: OI on ER (0.306), VL on ER (0.152), VL on CU (-0.238), CE on CU (-0.367), CE on ER (0.076), and CU on ER (-0.288); with the same respective coefficients being statistically significant based on bootstrap p-values and the control variables being equally insignificant. Likewise, the reliability measures and discriminant validity tests produced similar outcomes.

We treated the observations as independent since the vast majority of respondents represented different integration processes. Only ten mergers were represented by two or three employees. We did not analyse the consistency of the responses from different informants as the number of cases was too small for any meaningful analysis.

Our findings largely corroborate the existing literature and align with most of our hypotheses. Analysing the outcomes of this study, we found a negative relationship between CU and ER during PMI, which supports H1. This suggests that higher levels of CU, including uncertainty about goals, roles, and tasks, undermine employees' behavioural capabilities to adapt to changes, thereby reducing their resilience during PMI. This finding is consistent with previous studies, such as Plimmer *et al.* (2023), who found that role ambiguity, job insecurity, and unclear organisational goals are negatively correlated with ER.

Regarding the impact of VL on ER during the PMI, we found a significant positive direct effect and a complementary (partial) mediation of CU. The direct impact of VL on ER supports H2, indicating that VL directly fosters ER by providing direction, inspiration, and confidence, which strengthen employees' capacity to cope with the challenges of PMI. This result aligns with previous findings on leadership contributing to the development of ER (Breevaart & Woerkom, 2024; Nguyen *et al.*, 2016). The mediating effect of CU on the relationship between VL and ER supports H3. These results are consistent with studies suggesting that leadership influences ER, especially when employees face uncertainty (Breevaart &

Woerkom, 2024; Li & Tong, 2021). Specifically, when leaders articulate a clear and compelling vision, employees experience less uncertainty about their goals, roles, and tasks during organisational changes, enabling them to adapt more effectively and maintain higher levels of resilience during PMI. These findings also align with prior studies indicating that VL reduces employee CU (Bernards, 2023).

Initially, the effect of CE on ER was found to be significant. However, after including CU as a mediator in the model, the direct effect became insignificant, leading to the rejection of H4. Instead, we found a full mediation effect (indirect effect), indicating that CU mediated the relationship between CE and ER. This finding supports H5. By clarifying goals, roles, and tasks, effective communication minimises ambiguity, enabling employees to adjust more effectively and remain resilient throughout the PMI process. The negative association between CE and CU confirms previous studies, identifying CE as an essential factor in addressing change-related uncertainties (Allen *et al.*, 2007). Previous studies showed that CE builds trust and alleviates feelings of alienation among employees during the PMI phase (Al Hosani *et al.*, 2020; Allen *et al.*, 2007). As a factor strengthening employee coping abilities and productivity, CE plays a crucial role in the success of acquisitions (Appelbaum *et al.*, 2017).

The positive effect of OI on ER supports H6, confirming OI as a key factor in the post-M&A phase, shaping employees' emotional adjustment to the new organisation and influencing integration success. Our results align with those of Klok *et al.* (2022), who found that OI becomes a critical emotional factor as employees renegotiate their sense of belonging and attachment to the newly formed entity. Similarly, Trenerry *et al.* (2021) noted that fostering team and OI supports collective adaptation and alignment with new goals and norms. However, Trenerry *et al.* (2021) treated OI and resilience as separate constructs and found no direct causal link between them. Our findings underscore the importance of CU as a channel through which CE and VL impact ER. PMI is widely recognised as one of the most complex and failure-prone stages of the M&A process, shaped by a range of challenges (Steigenberger, 2017; Gomes *et al.*, 2013; Angwin *et al.*, 2016). Prior research has shown that overcoming these barriers requires not only effective strategic alignment but also targeted interventions at the employee level that foster clarity, engagement, and adaptation (Diduc, 2022). These studies emphasise that integration is not only a structural or procedural task but a deeply behavioural process in which employees' perceptions, emotions, and adaptive capacities are decisive for organisational outcomes. Our findings contribute to this discourse by showing how CU mediates the relationship between leadership, CE, and ER, which are factors identified as central to overcoming post-acquisition obstacles (Diduc, 2022). Moreover, the role of OI observed in our study aligns with prior research that emphasises the importance of fostering a sense of belonging and shared purpose to support successful integration (Klok *et al.*, 2022). Our results provide empirical support for the proposed dual-mechanism framework, confirming CU as the central mediating mechanism through which VL and CE influence ER during PMI. They also confirm the stabilising role of OI as an independent identity-based pathway that supports ER. In this way, our results align with but also extend previous research by identifying cognitive mechanisms that underpin employees' behavioural adaptation, thereby offering a deeper understanding of how individual-level processes contribute to resolving the persistent challenges of the PMI phase.

CONCLUSIONS

In this study, we empirically examine how ER during PMI develops through two complementary behavioural mechanisms: the reduction of CU driven by VL and CE, and OI as a source of adaptive capacity.

From a theoretical perspective, this study makes two primary contributions. First, it identifies CU as the central mediating mechanism through which VL and CE influence ER during PMI. Although prior research has established leadership and communication as important antecedents of employee attitudes and behaviours in M&A contexts, it has largely treated their effects on resilience as direct or outcome-based. What has been missing is a clear explanation of the cognitive process through which these organisational practices translate into resilient behaviour. By explicitly demonstrating that CU mediates the effects of VL and CE on ER, this study shifts the focus from antecedents alone to the underlying mechanism of resilience formation under conditions of heightened organisational uncertainty. Thus, rather

than merely confirming earlier findings, this study extends the literature by explaining the mechanism of resilience formation under conditions of profound organisational change.

In doing so, the study advances M&A integration research by reconceptualising uncertainty from a static individual trait to a manageable cognitive state that directly affects employees' capacity to adapt. It also contributes to the resilience literature by conceptualising ER not as a fixed individual trait, but as a behavioural capability that can be actively shaped through organisational practices that reduce uncertainty.

Second, the study identifies OI as an independent identity-based pathway to employee resilience. It complements the uncertainty-reduction mechanism and offers an original dual-mechanism framework that integrates cognitive and identity-based drivers of employee behavioural adaptation during PMI. This framework offers a more comprehensive theoretical explanation of how resilience emerges during organisational integration.

From a practical perspective, the findings have strong implications for business practice. They suggest that organisations involved in mergers and acquisitions can actively strengthen ER by systematically reducing CU during the PMI phase. First, managers should prioritise effective and structured communication, ensuring that information about goals, roles, and tasks is timely, sufficient, accurate, and useful. Such communication reduces employees' uncertainty and enables them to focus their cognitive resources on adaptation rather than sensemaking.

Second, the results highlight the importance of VL during PMI. Leaders who articulate a clear and compelling vision of the future provide employees with direction and meaning, reducing uncertainty and supporting resilient behaviour. Leadership development programmes that strengthen visionary capabilities may therefore play a crucial role in improving integration outcomes.

Third, the positive effect of OI on ER indicates that fostering a sense of belonging to the new organisation is essential. Practices such as inclusive culture-building initiatives, symbolic integration activities, and fair treatment of employees from legacy organisations can reinforce identification with the new entity and, in turn, enhance resilience. Taken together, these findings underscore that successful PMI requires not only structural and strategic alignment but also deliberate cognitive and behavioural interventions at the employee level.

Finally, the study contributes methodologically by drawing on data from employees involved in 295 distinct mergers and acquisitions, thereby reducing the risk of shared organisational context bias that characterises much of the existing literature. This design strengthens the external validity of the findings and supports the generalisability of the proposed cognitive-behavioural framework across diverse M&A contexts.

This study has several limitations that should be acknowledged. First, to obtain a diverse sample covering 295 M&A transactions, we conducted a retrospective study based on PMI experiences that occurred up to 10 years prior to data collection. Although prior research suggests that emotionally salient events can be reliably recalled (Kensinger, 2007; Cantó-Milà *et al.*, 2023), we cannot exclude some degree of recall bias. Second, the study focused exclusively on office workers, which ensured a consistent perspective but limited the finding's generalisability to other occupational groups, such as operational or blue-collar employees. Third, the sample was drawn from Polish organisations, which may constrain the results' cross-cultural applicability.

Our findings open new avenues for future studies, particularly regarding the interplay between the analysed factors in the context of the PMI phase. Further research should also investigate additional mediators and moderators, such as M&A type, integration approach, the share of employee layoffs following the M&A, psychological safety, trust, or other leadership styles, to deepen the understanding of behavioural adaptation processes. Comparative cross-cultural analyses could be employed to examine how national and organisational cultures shape the relationships between cognitive uncertainty and employee resilience. Moreover, extending the investigation beyond office workers to include operational employees could reveal occupation-specific patterns of ER formation.

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Appendix A:

Full results of the SEM model

Item loadings

	Estimate	p-value		Estimate	p-value
Cognitive uncertainty			Employee resilience		
CU1	0.886	0.000	*ER1*	0.756	0.000
CU2	0.854	0.000	*ER2*	0.669	0.000
CU3	0.868	0.000	*ER3*	0.707	0.000
CU4	0.902	0.000	*ER4*	0.695	0.000
CU5	0.845	0.000	*ER5*	0.741	0.000
CU6	0.922	0.000	*ER6*	0.743	0.000
CU7	0.759	0.000	*ER7*	0.598	0.000
CU8	0.816	0.000	*ER8*	0.611	0.000
CU9	0.860	0.000	*ER9*	0.634	0.000
CU10	0.837	0.000	Organisational identification		
Communication effectiveness			*OI1*	0.655	0.000
CE1	0.844	0.000	*OI2*	0.708	0.000
CE2	0.907	0.000	*OI3*	0.679	0.000
CE3	0.850	0.000	*OI4*	0.839	0.000
CE4	0.938	0.000	*OI5*	0.868	0.000
Visionary leadership					
VL1	0.902	0.000			
VL2	0.738	0.000			
VL3	0.867	0.000			
VL4	0.905	0.000			
VL5	0.920	0.000			

Regression coefficients

Regressor for ER	Estimate	p-value	Regressor for CU	Estimate	p-value
Organisational Identification	0.339	0.000	Communication Effectiveness	-0.432	0.000
Communication Effectiveness	0.097	0.216	Visionary leadership	-0.209	0.002
Cognitive uncertainty	-0.291	0.000			
Visionary leadership	0.155	0.049			
Gender = *female*	0.049	0.435			
Age <= *36*	0.100	0.111			
Place = *city over 200k in-habitants*	-0.053	0.407			
Company size = *Small or medium*	-0.043	0.509			

Source: own elaboration.

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The contribution share of authors is as follows: Anna Blajer-Gołębiewska (35%) – conceptualisation, methodology, investigation, writing, supervision, project administration, funding acquisition; Arkadiusz Kozłowski (30%) – formal analysis, data curation, writing, visualisation; Magdalena Markiewicz (20%) – conceptualisation, methodology, investigation, writing, supervision, funding acquisition; Florian Jais (15%) – conceptualisation, methodology, investigation, writing.

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Use of Artificial Intelligence

This text is free of AI/GAI usage.

Conflict of Interest

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Stakeholder perspectives for business through future scenarios: The case of sustainable recovery in Peru

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ABSTRACT

Objective: This article aims to provide an overview of the stakeholders' perspectives towards the climate change-oriented recovery of businesses in Peru, contributing to moving forward the literature related to the Stakeholder Theory and Sustainable Development.

Research Design & Methods: We used a qualitative approach and conducted four focus group sessions to collect data. Moreover, we used a future studies methodology to obtain structured feedback from the stakeholders regarding four plausible future scenarios for businesses in Peru.

Findings: The government appears as the key actor regulating the business environment, facilitating, among others, essential policies and resources such as decentralisation, education, biodiversity, technology, alliances, and energy transition that stakeholders could build upon as well.

Implications & Recommendations: Our theoretical contribution emphasises the uncertainty around the stakeholders' purposes, according to the different perspectives that we found toward a common concern. Moreover, this contribution supports stakeholder salience under crisis periods, drawing attention to redefining stakeholder priorities. Moreover, we built upon sustainable development literature, analysing how Peruvian companies can adapt and achieve resilience toward future scenarios.

Contribution & Value Added: Future Studies methodology allowed us to assess how stakeholders are salient in crises towards business recovery. Peru constitutes a relevant case due to its institutional context, climate vulnerability, and socio-economic crises.

Article type: research article

Keywords: Stakeholder salience; Stakeholder theory; Sustainability; Climate change; Future studies

JEL codes: M000, M100, M140

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INTRODUCTION

Climate change has multiple negative effects on people's livelihoods, particularly on business development. Businesses in emerging markets would be especially susceptible to the impacts of climate change, as their weak institutional environments (Young & Ahlstrom, 2014) shape an unstable context for organisations, such as in Latin America (Vassolo *et al.*, 2012).

Latin America has been continuing to recover its GDP after COVID-19, but it is clearly underperforming compared to other regions (World Bank, 2024). Peru, Chile, and Brazil introduced the largest financial packages to overcome the economic crisis (United Nations, 2021).

According to Ministerio del Ambiente (MINAM) (2018), Peru has seven of the nine characteristics of countries that make them particularly vulnerable to climate change recognised by the UNFCCC (United Nations Framework Convention on Climate Change): (i) low-lying coastal areas, (ii) arid zones, (iii) areas exposed to floods, droughts and desertification, (iv) fragile mountain ecosystems, (v) disas-

ter-prone areas, (vi) areas with high urban air pollution, and (vii) an income-dependent economy generated by fossil fuels. Furthermore, Peru faces important socio-economic challenges such as public-private corruption and institutional constraints (Briolo & Cordova, 2022) and insufficient public policies for new businesses (Huamán *et al*., 2022).

Hence, considering the struggles in the Peruvian economy and its climate change-related challenges, this article aims to respond to the following research question: How can stakeholders in Peru promote sustainable rebuilding of businesses, adapting to and mitigating an upcoming (and ongoing) climate crisis?

We have collected primary data from four focus group sessions with 32 specific actors from academia, government, civil society, and business, obtaining local multi-stakeholder perspectives. The novelty and contribution of our findings to the stakeholder literature focus on emphasising the context as the shaper of stakeholders' responsibilities, identifying how local biases can get ahead of stakeholders' original purposes, and supporting stakeholders' new priorities' salience towards future perceived crises. We used a Future Studies methodology that allowed us to frame our results into four scenarios of recovery.

LITERATURE REVIEW

This study builds upon the stakeholder and sustainability perspectives to discuss how they can play a pivotal role in helping businesses with regard to climate change challenges. This multi-stakeholder approach allows for understanding the relationships between actors towards future business operations, while the sustainability approach permits the analysis of upcoming environmental concerns derived from business activities (Monje-Cueto *et al*., 2024; Winnicka-Wejs *et al.*, 2026).

Stakeholder Perspective

According to Freeman (1994), there are different normative cores that could shape how we understand and develop stakeholder theory. These would supplement the practical and descriptive nature of the stakeholder theory. Then, the stakeholder approach does not rely on a single overriding management objective. Instead, it considers the continuous balancing and integration of multiple relationships and objectives (Freeman & McVea, 2001).

Jones and Wicks (1999) proposed a merger between practical and ethical dimensions of the theory, resulting in a convergent stakeholder theory, which suggests that firms should be able to manage a proper balance between ethical concerns and financial outcomes for stakeholders' benefit. Moreover, Freeman (1984) highlights that stakeholder relations are fundamental to corporate strategy, and companies must address ethical concerns while ensuring financial sustainability to create mutual value.

Despite the widespread acceptance of the stakeholder theory, it has exhibited some structural flaws that would undermine the achievement of strategic goals as well as firms' corporate governance and accountability (Sternberg, 1997). Some of these problems are (i) the difficulty of identifying all the stakeholders, (ii) the confusion of the purpose while trying to satisfy needs and expectations from many, (iii) the lack of consensus for the meaning of success, (iv) the constraints while trying to measure the stake that every stakeholder has, (v) managing competition as competitors would be stakeholders as well, (vi) legal demands from stakeholders whose rights were previously recognised, (vii) establishing the criteria for the distribution of benefits among the stakeholders, (viii) distribution of power to be represented and protected as stakeholder, and (ix) managing expectations from stakeholders abroad, beyond national borders (Ambler & Wilson, 1995).

Furthermore, Gonzalez-Perez *et al*. (2021) demonstrated that the prominence of some stakeholders of an organisation over others is contingent on crisis periods. This aligns with Bundy *et al*. (2021), who argue that during crises, firms adjust their stakeholder management strategies based on rational, emotional, and moral concerns, which alter the priority given to different stakeholders over time. This highlights how urgency becomes more pronounced in crisis scenarios, leading organisations to reconfigure their engagement approaches. Moreover, Chernyi and Uotila (2024) have demonstrated that stakeholder salience depends more on the internal organisational perspectives of the managerial leaders rather than on their own attributes as stakeholders.

Sustainable Development Perspective

Sustainable development challenges represent the demands and needs from stakeholders towards a responsible and conscious performance from companies, which would have to accomplish three dimensions: economic, social, and environmental. However, the prominence of these demands is not uniform across all stakeholders. According to Mitchell *et al*. (1997), stakeholders' power, legitimacy, and urgency determine their salience, meaning that firms prioritise sustainable initiatives depending on how strongly these attributes are present in each stakeholder group. Therefore, businesses must navigate multiple and conflicting pressures when addressing sustainability concerns, balancing economic performance with environmental and social obligations. Elkington (1994) stated that modern companies must create initiatives that allow business, customers, and the environment to benefit from them.

According to Donaldson and Preston (1995), the stakeholder approach is not only a descriptive framework that reflects how companies interact with their environment but also an instrumental strategy linked to corporate success. Furthermore, it also represents a normative obligation, where companies have an ethical duty to integrate sustainable practices that respect the interests of all stakeholders. This suggests that corporate sustainability is not merely a competitive advantage but a fundamental responsibility of businesses. According to Dyllick and Hockerts (2002), there are six dimensions that managers would need to satisfy business sustainability: eco-efficiency, socio-efficiency, eco-effectiveness, socio-effectiveness, sufficiency, and ecological equity.

Scientific evidence has shown that firms' sustainable practices in emerging markets are able to improve environmental performance (Zhou *et al*., 2023) and banks' financial performance (Shahwan & Habib, 2023). Moreover, firms' sustainability practices and resilience initiatives enhance and support business recovery from the effects of COVID-19 disruptions, enabling the survival as well as the continuity of the economic activity in emerging economies (Ahmed *et al*., 2024). Hence, sustainability-oriented business strategies could have a positive impact on firms' performance as well as become a measure to counter the negative effects of crises.

Therefore, according to the literature review on the stakeholder theory and sustainable development, we proposed:

Proposition* 1*: Despite the institutional weakness of the Peruvian business environment, local stakeholders could identify constraints as well as propose clear paths and actions towards business recovery and climate change action.

Proposition* 2*: Stakeholders could identify and propose one or more salient stakeholders for the future of business in Peru, considering the current constraints for recovery and climate change action.

RESEARCH METHODOLOGY

Futures methodology (Wilkinson, 2017) allowed us to propose and analyse four possible future scenarios for Peruvian businesses under a climate change crisis. Thus, both dimensions of our RQ1 shaped these scenarios, business recovery (low-high) and climate change action (low-high). These four scenarios were (1) better socio-economic recovery and better mitigation of climate change, (2) better socio-economic recovery and worse mitigation of climate change, (3) worse socio-economic recovery and worse mitigation of climate change, and (4) worse socio-economic recovery and better mitigation of climate change (Figure 1).

Sampling

Multi-stakeholder participation is highly relevant to obtain different perspectives from academia, businesses, civil society, and government on how to recover businesses, considering the adaptation and mitigation strategies towards the climate change crisis. Although we selected the sample by research convenience, we used a strict sampling criteria to capture a proper diversity for each stakeholder group, considering the following demographic characteristics: 1) gender, 2) location,

3) position or role in the organisation, 4) years of experience, 5) stakeholder group, and 6) area of expertise or main responsibility (Table 1).

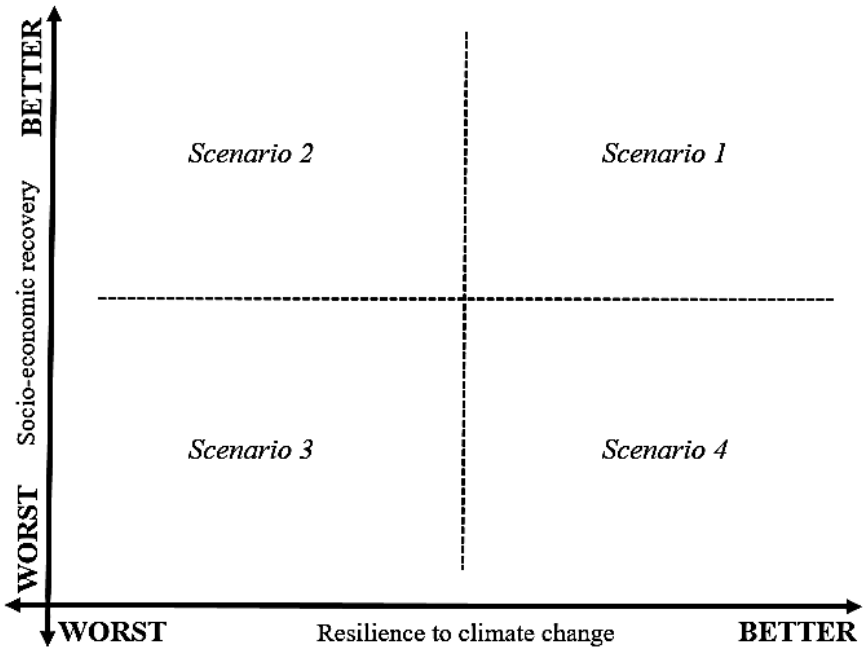

Figure 1. Four scenarios of futures methodology
Source: own elaboration.

The sampling included 32 participants distributed across four focus group sessions. Furthermore, 56% of the participants were women and 44% were men, 78% had more than ten years of experience, while 22% had less, and 44% belonged to the business sector, 16% to the public sector, 28% to civil society, and 25% to academia (Table 1).

Data Collection

We conducted four online focus group sessions during December 2020, which had a workshop structure since the participants were able to speak and register their contributions to each of the four scenarios. A focus group is a qualitative mechanism for collecting data from an intentionally sample of individuals to explore and analyse their perspectives about a specific phenomenon or gain a deep understanding of social issues (Nyumba *et al*., 2018). Hence, following Nyumba *et al*. (2018), our intentional sample did not aim at the national representativeness but followed our sampling criteria to ensure diversity of stakeholders' insights about the social phenomenon of business recovery ahead of climate change challenges. Each focus group session had an average of eight participants, two hours length, and two technological platforms: a pre-designed MIRO board that facilitated participants' interaction, and the Zoom platform for providing instructions on activities in MIRO and promoting live discussion. We recorded sessions on Zoom to analyse them and systematise data.

Data Analysis

The four focus group sessions delivered two sets of data. The first one came from the participants' work on the MIRO platform, through written contributions (dataset 1). The second one was based on the participants' opinions during the spoken discussion (dataset 2).

The data analysis began using a preliminary list of ten codes that reflect the specific contributions within the following main topics: 1) actor, 2) opportunities, 3) actions, 4) structure, 5) risk, 6) drivers, 7) managerial considerations, 8) limitations, 9) means, and 10) goals. Then, we analysed dataset 1 in MS Excel and dataset 2 using the Atlas.ti software, assigning the contributions to the codes included in the preliminary list in both cases. To keep the anonymity of the participants as well as to identify their contributions, we coded them in Table 2.

Table 1. Sample composition

Workshop	Gender	Location	Position or role in the organisation	Experience (years)	Society's group	Area of expertise / main responsibility
1	M	Lima	CEO and Director	+10	Business	Boards of directors member
1	F	Lima: Miraflores	Corporate Citizenship Manager	+10	Business	C-Suite: Sustainability and Social Responsibility
1	M	Lima	Politic / ex minister	+10	Government	Central government
1	M	Lima: La Molina	Operational Excellence Manager	+10	Business	C-Suite: Green supply chains
1	F	Lima	Educational Psychologist	+10	Social	Technical officer
1	F	Cusco	(PhD) Full professor and researcher	+10	Academia and government	Administrative Sciences
1	F	Lima: San Miguel	(PhD) Associate professor and researcher	+10	Social and academia	Humanities
1	M	Lima: Surco	(PhD) Head of the Interdisciplinary Center of Sustainability	+10	Social and academia	Technical officer: Sustainability and Social Responsibility
2	F	Lima: San Isidro	General Director	+10	Social	Boards of directors member
2	M	Arequipa	Owner	+10	Business	Business owner
2	M	Lima: San Borja	(PhD and Dr.) Medicine Dean / Public health	+10	Business and government	Specialised health doctor and government technical officer
2	F	Lima: Surco	(PhD) Vice chancellor and full professor	+10	Social and academia	C-Suite
2	F	Lima: San Miguel	Social Projects Manager	-10	Social and government	Technical officer: Education
2	F	Lima	Social and Business Administrator	-10	Business	Technical officer: Gastronomy
2	F	Lima	(PhD) Professor and researcher	+10	Academia	Social Sciences
3	M	Lima	(PhD) Professor / Business Director	+10	Business, academia, and social	Director / Sustainability and Social Responsibility
3	M	Lima: Magdalena	Supply Chain Global Manager	+10	Business	C-Suite: Supply chains
3	M	Piura	(PhD) Associate professor and researcher	+10	Academia and government	Finance
3	M	Lima: Surco	Sales Manager	+10	Business	C-Suite: Information technology
3	F	Lima: San Borja	Auditing Manager	+10	Business	C-Suite: Bank and finance
3	F	Lima	Senior Analyst of Finance Planning	-10	Business	Technical officer: Bank and finance
3	F	Lima	Marketing Coordinator	-10	Business	Technical officer: Poultry farming
3	F	Lima: San Isidro	Founder and President of the Board	+10	Social and business	Business owner / Director
4	M	Lima	Visual Arts Coordinator	+10	Government	Technical officer: Art and culture
4	M	Arequipa	SPA Founder / businessman	+10	Social and business	Gastronomy / Business owner (film and television)
4	M	Lima: San Borja	(PhD) Associate professor and researcher / Approlog Director	+10	Social and academia	Supply chains / C-Suite: Logistic Association
4	F	Lima: San Borja	Businesswoman. Senior Corporate Lawyer	+10	Business	Technical officer: Legal
4	F	Lima	Brand Manager	-10	Business	C-Suite: Beverages and foods industry
4	F	Lima: Jesús María	Project Manager	-10	Social	Tehnical officer: Democracy, human rights, and sustainability
4	M	Lima	Organisation and Processes Consultant	-10	Government	Technical officer: Health services
4	F	Lima: Surco	CEO and Director	+10	Business	Director: Construction
4	F	Lima: Miraflores	Entrepreneur – Founder of La Bizcocha	+10	Business	Business owner: Gastronomy

Source: own study.

Table 2. Coded participants of the focus group sessions

Focus group	Code	Society's group
1	PE1	Business
1	PE2	Business
1	PG1	Government
1	PE3	Business
1	PS1	Civil society
1	PA1	Academia and government
1	PS2	Civil society and academia
1	PS3	Civil society and academia
2	PS4	Civil society
2	PE3	Business
2	PE4	Business and government
2	PS5	Civil society and academia
2	PS6	Civil society and government
2	PE5	Business
2	PA2	Academia
3	PE6	Business, Academia, and Civil society
3	PE7	Business
3	PA3	Academia and government
3	PE8	Business
3	PE9	Business
3	PE10	Business
3	PA4	Business
3	PS7	Civil society and business
4	PG2	Government
4	PS8	Civil society and business
4	PA5	Civil society and academia
4	PE11	Business
4	PE12	Business
4	PS9	Civil society
4	PG3	Government
4	PE13	Business
4	PE14	Business

Source: own study.

RESULTS AND DISCUSSION

According to Figure 1, the first scenario considered the best possible option. The second and fourth scenarios suggested a moderate and balanced situation, while the third scenario represented the negative one. First, we exhibit the results from dataset 1, analysing each scenario, and then the results from dataset 2 as an overall conclusion for Peru.

Scenario 1: Better Socio-economic Recovery and Better Mitigation of Climate Change

How do Stakeholders View the Future of Business Amid the Climate Crisis?

Stakeholders expect strong regulations to ensure fair food supply chains, supported by public-private partnerships that protect vulnerable groups and biodiversity. They also call for a mindful food culture that favours local, seasonal crops, allowing transgenics to fight hunger in remote areas, and boosting exports of organic and native products that meet global sustainability standards.

> PE2, 2020: Protection of the ocean and public policies focused on the management of water resources. Additionally, policies regarding food security, protection, and prices for agricultural

> products for domestic consumption and for export as well. Another important aspect is the protection of indigenous peoples and their territories that are the heritage of humanity.

Moreover, stakeholders are looking for full support from the government to industries for them to change towards clean energy operations, providing appropriate regulations and incentives. Stakeholders also expect to have a generalised positive attitude towards non-carbon emission alternatives for transportation.

Stakeholders also anticipate appropriate use of technology to increase productivity, but in an environmentally-friendly and responsible manner. Moreover, having an internationally and environmentally high-standard concerned mining industry seems to be a primary target for the country. Stakeholders also expect to have health and education systems that drive the country's development.

> PS6, 2020: A good scenario would be to have a virtualised educational system that facilitates access to technology for everyone. On the other hand, having a health system with capabilities, not only in infrastructure but also in human capabilities.

Finally, the government is expected to promote national environmental and biodiversity consciousness through economic incentives, fostering a market-oriented approach in which circular economy models support economic recovery and the adoption of sustainable organisational models, such as B companies.

According to Stakeholders, What Events Will Shape Future Outcomes?

Stakeholders envision a path to economic recovery and climate action driven first by short-term measures such as expanding renewable energy, strengthening state presence and e-government, enforcing sustainability rules, protecting forests, promoting circular economy practices, and improving education and digital access. Over the medium and long term, deeper reforms, like decentralisation, inclusive economic growth, strategic public policies, the enforcement of National Determined Contributions (NDCs), stronger health systems, biodiversity protections, limits on genetically modified (GM) crops, major investments in science and technology, international cooperation, and incentives to shift from extractive industries to low-carbon digital services would help secure lasting environmental and economic gains.

> PS3, 2020: The good thing is that to date, different social and business actors are setting out to develop an agenda in favour of these food environments, through surveillance systems and the development of different tools.

Which Specific Actions Will Trigger Businesses' Recovery?

Business recovery needs to consider the limitations of corruption and lack of technological upgrade, as well as take advantage of the following opportunities: joint strategies for biodiversity recovery, technological transformation acceleration, adopting sustainable lifestyles, align with the national climate strategy, and unlink economic growth from environmental degradation. After this, Table 3 shows the path for Scenario 1 according to the necessary actions, means for achievement, and final goals.

Table 3. Actions, means, and goals for Scenario 1

Actions	Means	Goals
Identify good practices Reduce pressure over eco-systemic resources Accelerate transformation	Public policy implementation Public policy Education for sustainable development Incentives Regulation	Alliances between different actors Setting common goals Food security Protect biodiversity Enforce citizenship rights

Source: own study.

However, the actions, means, and goals exhibited in Table 3 would develop considering relevant structural issues such as society's culture and would help to overcome natural constraints such as geographical location. Moreover, they need to include managerial considerations such as strategic

planning and improving relationships with communities, as well as managing a risky environment related to technology transition. Finally, the main current and future responsible actor would be the government in both cases.

> PE2, 2020: The guardians of global nature, who are these indigenous communities of the Amazon, must be protected, protecting the reserves daily.

> PE12, 2020: Private companies must begin to play a much more prominent role in issues of diversity protection. Large industries have a responsibility towards climate change. Some positive actions have been taken in recent years, large companies are aware of the products they manufacture, the processes followed by the inputs, and which stakeholders are being affected.

Scenario 2: Better Socio-economic Recovery and Worse Mitigation of Climate Change

How do Stakeholders View the Future of Business Amid the Climate Crisis?

For this scenario, stakeholders foresee government incentives such as debt-free loans for GM products and a softer application of climate policies to boost business performance and economic growth. This growth would concentrate on urban expansion and large construction projects that ignore international environmental standards, while informal and often harmful activities (especially in mining) would continue unchecked, with little attention to climate change.

> PE1, 2020: For scenario 2 to occur, the technicians in the ministries, who are the ones who ultimately design policies, would not be convinced of the positive and catalytic impact of incorporating these aspects of sustainability in business activity. So, if those who make public policies are not convinced and believe that this is basically a "fashionable" issue, we would be on our way to scenario 2, if not an even worse one.

Furthermore, stalled decentralisation would concentrate public investment in the capital and coastal regions, marginalising Andean and Indigenous communities, while the economy remains dependent on fossil fuels and expanding extractive industries amid weak labour protections. Concurrently, ineffective governance would prevent the education system from overcoming structural limitations.

According to Stakeholders, What Events Will Shape Future Outcomes?

Stakeholders expect the government to pull out of the Paris Agreement, keep relying on fossil fuels, and hand over large areas of the Amazon for exploitation. Over the long run, they see climate rules becoming weaker while policies focus only on GDP growth, even if it means more jobs in polluting industries. Pro-extractive laws, better technology for mining and farming, legalised cocaine production and export, and a slow erosion of society's pro-environmental values would further deepen the damage.

> PS8, 2020: We must reform the State; not make it disappear as some might want, so that only private initiative can advance. If we have policies in favour of the environment, these must be instilled in classrooms and in families. We must form a society not to compete and succeed, but a society in which we understand that we all depend on each other, to understand that individual activity, however small it may be, will have repercussions on the whole society.

Which Specific Actions Will Trigger Businesses' Recovery?

Business recovery needs to consider the limitations of a perception of climate action as unprofitable, deprioritisation of climate action, centralisation, lack of technological upgrade, and lack of the State presence, as well as take advantage of the following opportunities: joint strategies for biodiversity recovery, access to digital connectivity, align with the national climate strategy, financial inclusion, recognition of being part of nature, and unlink economic growth from environmental degradation. Table 4 shows the path for Scenario 2 according to the necessary actions, means, and goals.

Nevertheless, the actions, means, and goals exhibited by Table 4 would develop under basic structural issues such as society's corruption. Moreover, they need to include managerial considerations

such as business awareness and strategic planning and consider a risky environment related to transition processes for government climate policies, market, and reputation. Finally, the main current and future responsible actors would be the government in both cases, followed by businesses.

Table 4. Actions, means, and goals for Scenario 2

Actions	Means	Goals
Identify good practices Accelerate transformation Reduce pressure over eco-systemic resources	Public policy enforcement Incentives Education for sustainable development Public policy implementation Public policy Regulation	Alliances between different actors Climate change mitigation Enforce citizenship rights Protect biodiversity Responsible governments

Source: own study.

> PE3, 2020: The scenario for economic growth is positive, it has an upward trend, despite COVID and the political crisis. However, I highly doubt that we have the capacity to articulate economic growth within the framework of environmental policies. There is a need to propose policies and initiatives that regulate transportation, waste, among others, but due to different positions, interests, or others, they could end up not generating or not producing the expected effects.
>
> PE3, 2020: If the government does not fulfil its regulatory role and does not have a clear strategy, there will be little progress in terms of environmental impact.

Scenario 3: Worse Socio-economic Recovery and Worse Mitigation of Climate Change

How Do Stakeholders View the Future of Business Amid the Climate Crisis?

The country faces a future where government mismanagement and political turmoil leave big problems unresolved. Public debt rises while plans to fight climate change are pushed aside. Mining and other extractive industries keep expanding without environmental safeguards, and hopes for new industrial or tech breakthroughs will fade. Tourism stalls, borders weaken regional cooperation, and socially responsible businesses disappear. Big agribusiness controls GM crops with no regard for biodiversity, while a deepening water crisis disrupts food supplies, sanitation, and basic services. Pollution and malnutrition grow as people overexploit natural resources.

Simultaneously, corruption and social unrest eat away at public trust. Transport, health, education, and energy systems struggle without long-term planning. Any economic rebound mainly benefits powerful sectors, widening the gap between the rich and the poor.

According to Stakeholders, What Events Will Shape Future Outcomes?

Stakeholders would be expecting a huge political turmoil, continuity of corruption and legislative weakness, absence of the State, a new government that only cares about economic growth, an increase of extractive high-pollution industries, as well as inefficient, opportunistic policies, a new wave of COVID-19, civil society absence, exchange rate volatility, and no education towards sustainability.

On the other hand, in the long term, they would expect a major individual behaviour in society following personal interests rather than collective ones, more extinction of different species, a paternalistic State intervention, fewer jobs, as well as fewer natural resources, and public funds investment without prioritising health and education.

> PS3, 2020: It is then necessary to become literate in sustainability, so that really everything that is written or thought, finally becomes tangible in practice.
>
> PA3, 2020: We are all looking for something in common, which is social well-being. To achieve this, there must be a balance between the economy and society. If education levels do not increase, there will not be greater social awareness. Social awareness is in all individuals, but

also in those who run companies. Education generates more tax awareness, more ecological awareness, awareness of not polluting, and of recycling.

Which Specific Actions Will Trigger Businesses' Recovery?

Business recovery needs to consider the limitations of corruption, lack of political leadership, perception of climate action as unprofitable, and lack of state presence, as well as take advantage of the following opportunities: adopting sustainable lifestyles, aligning with the national climate strategy, digital transformation acceleration, and joint strategies for diversity recovery. Thus, Table 5 shows the path for Scenario 3 according to the necessary actions, means, and goals.

Table 5. Actions, means, and goals for Scenario 3

Actions	Means	Goals
Identify good practices	Public policy Education for sustainable development Public policy implementation Incentives	Protect biodiversity Food security

Source: own study.

However, the actions, means, and goals exhibited in Table 5 would develop in the presence of basic structural issues such as society's corruption. Moreover, they need to include managerial considerations such as COVID-19-based recovery and strategic planning and consider a risky environment related to transition processes for government climate policies. Finally, the main current and future responsible actors would be the government in both cases.

> PS8, 2020: Not only do we need to take care of the safety of food products, but it is also very important to take care of how we produce them. Thus, we must see ourselves as a bioeconomy, and innovation and technology are very important for this. For all of this, infrastructure is also necessary.

Scenario 4: Worse Socio-economic Recovery and Better Mitigation of Climate Change

How Do Stakeholders View the Future of Business Amid the Climate Crisis?

People, rather than the government, would drive the fight against climate change by organising local initiatives and pushing for greener practices, while the State falls short on reviving the economy. Technology would play a big role in building cleaner industries and restoring biodiversity, but climate programs would often be poorly planned, wasting money and slowing real progress. For example, tourism would struggle to recover, which hurts the economy but gives nature a chance to heal. And while stricter environmental rules help cut carbon emissions, they also make it harder for businesses to grow.

> PE2, 2020: The COVID situation and other global crises have put large countries and world powers on alert, which have increased their control and influence measures, which is detrimental in different aspects for emerging countries. There will be a lot of tension regarding the protection of the sea, and Peru will play a fundamental role in this, as one of the main producers worldwide.

According to Stakeholders, What Events Will Shape Future Outcomes?

In the short term, stakeholders would expect a scenario with careless decisions towards the future and for quality education, low levels of Foreign Direct Investment (FDI), focus on investment and resilience only for the agriculture sector, lower global demand for metals, and a poor strategy for cities to grow.

Regarding the long term, they would be expecting a strong defence policy towards land but excluding economic interests, large and progressive investments in nature, better sustainability practices from citizens, international agencies' intervention, job losses in the hospitality sector, disappearance of highly polluting industries, and a state's inability to deliver overall reach policies.

PE2, 2020: Faced with the political uncertainty in the country, the markets will be very volatile and sensitive. The formation of political parties in the country will be affected by its decisions on issues of national interest.

Which Specific Actions Will Trigger Businesses Recovery?

Business recovery needs to consider the limitations of a lack of political leadership, lack of state presence, perception of climate action as unprofitable, and deprioritisation of climate action, as well as take advantage of the following opportunities: adopting sustainable lifestyles, align with the national climate strategy, and joint strategies for diversity recovery. Hence, Table 6 shows the path for Scenario 4 according to the necessary actions, means and goals.

Table 6. Actions, means, and goals for Scenario 4

Actions	Means	Goals
Identify good practices	Education for sustainable development Incentives Public policy implementation	Climate change mitigation Enforce citizenship rights Alliances between different actors Protect biodiversity

Source: own study.

Nevertheless, the actions, means, and goals exhibited by Table 6 would develop under basic structural issues such as society's corruption and poverty. Finally, the main current and future responsible actors would be the government in both cases, followed by business.

Overall Results for Peru

Results for Peru show a path to develop public policies to deal with the major concerns for business. This path has an important opportunity that needs addressing, i.e., education. Hence, developing an improved national educational system would lead to specific actions such as collaborative initiatives, which would be motivated by a strong environmental reason, shaped by the country's culture, and threatened by the potential risk of society's inertia. Moreover, acting collectively would be oriented towards an education for sustainable development, which in turn would be moderated by limitations such as the divergence between economic and environmental goals, and managerial considerations such as the current poor public management. Finally, continuing those collective actions through an education for sustainability would make it possible to achieve important goals, like having sustainable cities and communities. Likewise, Figure 2 exhibits opportunities, actions, means, and goals, influenced by drivers, structure considerations, risks, limitations, and managerial considerations.

Figure 2 shows how opportunities, drivers, and structural conditions merge into collective actions, which would be moderated by surrounding risks. Then, these collective actions turn into different strategic means towards business recovery, which in turn would be moderated by environmental limitations and managerial considerations. Finally, these means would aim to address specific targets such as the circular economy, strategic alliances, and reinforcing supply chains, among others. In addition, it is interesting to see at the bottom of Figure 2 how the role of the government is perceived as highly relevant at the beginning of the process and less relevant (but still present) at the end. The size of the keywords in Figure 2 responds to the number of their mentions during the focus group sessions.

Moreover, while respondents mentioned the mining sector, agriculture and tourism remained scarcely referenced, and fishing was not mentioned at all. These results are odd as well as insightful since fishing in Peru is one of the most popular industries and a major job provider. Furthermore, the study was expected to emphasise traditional limitations of society, such as informality, social unrest, illegal practices, and rural poverty. Nevertheless, respondents rarely mentioned them, probably due to the same centralisation issue that the study found highly relevant.

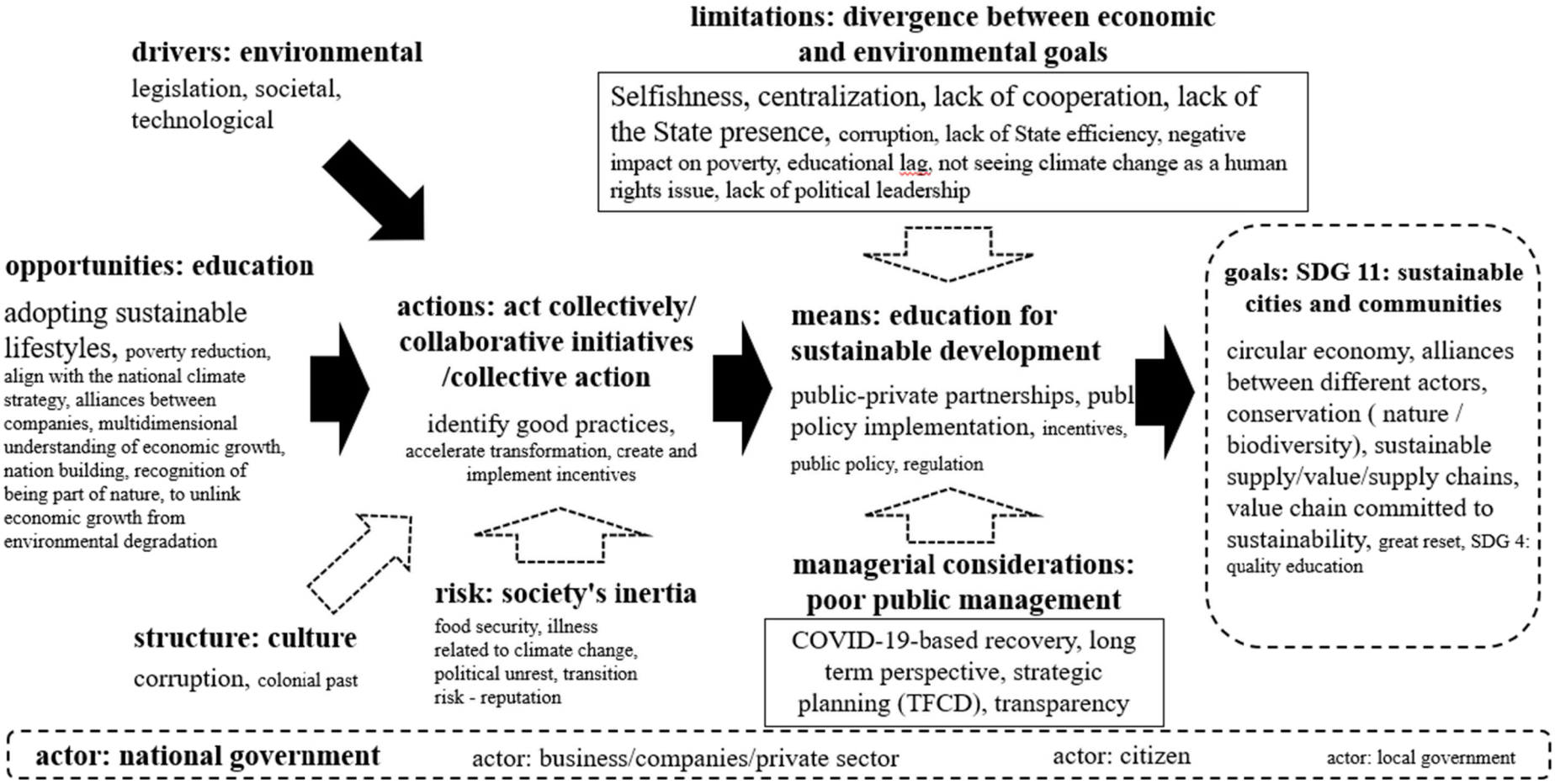

Figure 2. The Peruvian path towards sustainable recovery of business

Source: own elaboration.

Theoretical Implications

Following Freeman (1994) and Donaldson and Preston (1995), our findings promote the development of a normative core for stakeholder theory, one related to firms' responsibility toward the climate change crisis and sustainable development. Moreover, results of this study support Jones and Wicks (1999) regarding the convergent stakeholder theory, by drawing perspectives and recommendations for both rebuilding businesses as well as climate change mitigation and adaptation. Moreover, our results build upon Freeman and McVea (2001), providing new insights from emerging markets about how social constraints, strategic drivers and opportunities, and limitations or barriers for development can moderate and influence multiple relationships as well as multiple goals. In line with Saleem *et al*. (2020), these findings extend stakeholder theory in emerging economies, highlighting how social, institutional, and economic contingencies shape stakeholder interactions and firm responsibilities. In addition, most of the feedback provided to build our results could potentially fall into one of the flaws of stakeholder theory, referred to as the confusion and uncertainty about the stakeholders' purpose (Ambler & Wilson, 1995), since we have collected data from different stakeholders from Peruvian society, with different expectations and needs.

Furthermore, we support Gonzalez-Perez *et al*. (2021), who stated that stakeholder salience is contingent on crisis periods, which, according to their strategic goals and their ability to manage the crisis, reframe their stakeholder priorities. However, we move one step ahead of them by arguing that stakeholder salience would respond to crises that could be perceived as future ones too, weighing more on the contextual factors to decide which stakeholder would emerge. Furthermore, following Chernyi and Uotila (2024), we emphasise that organisational internal biases may inadvertently be put in front of the stakeholders' original purposes, which turn sustainable development into a more difficult goal to achieve, contrary to the previous literature that put all stakeholders at the same interaction level. On the other hand, linking our findings to corporate foresight, we argue that integrating prospective methods (Dadkhah *et al*., 2018; Fleener *et al*., 2025) into stakeholder management enables firms to anticipate emerging challenges and opportunities, thereby aligning stakeholder priorities with long-term sustainability goals.

Finally, following Mitchell *et al*. (1997), our findings suggest that pro-environmental concerns would be strongly dependent on the power, legitimacy, and urgency of stakeholders in Peru, showcasing highly economically valuable industries such as mining, and not mentioning some strategic ones such as fishing. This is also in line with Ahmed *et al*. (2024), regarding how firms in emerging economies could potentially use sustainable development-focused implementations to overcome the negative economic effects delivered by COVID-19, conversely to the traditionally thought about pro-environmental investments vs. firms' financial outcomes. Moreover, our findings suggest that sustainable development initiatives can contribute to organisational resilience, supporting Weber (2023) and Souza *et al*. (2017) who emphasise the critical relationship between sustainability practices and firms' adaptive capacity.

Public Policy and Managerial Implications

Policymakers would need to accurately aim for transformational public policies towards a long-term sustainability mindset, developing in businesses. Furthermore, policies towards the adaptation and mitigation of climate change need to be effective as well as extended nationally and internationally. If they are not competent enough to involve each society's group all along Peruvian territory, the harm caused would be higher than the expected benefit.

Unethical, socially legitimised practices would lead to a less feasible scenario for synergies and collaboration towards environmental commitments accomplishment, since specific groups' behaviour would tend to reinforce economic and social inequalities. By emphasising these inequalities, business elites and international firms could obtain more benefits without focusing on environmental concerns or even on social aspects.

CONCLUSIONS

The study has exhibited four future scenarios through which we have gathered the perspectives of multiple Peruvian stakeholders to provide their expectations about the recovery of businesses in the country before and during the climate change crisis. However, given the convenience sample used in the study, even though we took care to ensure a proper diversity within stakeholder groups, we also highlight potential biases due to network access towards national representativeness. Thus, future research could focus on a larger sample, in-depth interviews, and analytical comparisons with other countries.

Following our two propositions stated before, we agree with Proposition 1, since the different stakeholders in our sample were able to collaborate in elaborating and proposing paths for business recovery and climate change action. In addition to this, regarding proposition 2, we found that Peruvian stakeholders have clearly identified the government as a key stakeholder to shape the future of business recovery, being able to promote and balance regulations to support businesses, as well as the mitigation/adaptation strategies for the climate change crisis.

The study in Peru has revealed the need for the government's regulations oriented to reinforce and provide control to food supply chains, finding a balance between a fair trade within supply chains' participants and protection of the biodiversity. Moreover, the findings highlight the need for economic policies supporting renewable energy, ecosystem resilience, and culturally aligned local consumption, along with regulations and incentives for environmentally focused B companies.

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Use of Artificial Intelligence

ChatGPT was used only for synthetize and trim some of the already written ideas by the researchers within the Results section.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Managerial routines and internationalisation: Mediating role of digital capacity

Krystian Bigos, Paweł Milka

ABSTRACT

Objective: The article aims is to verify whether the adoption of managerial routines, namely, monitoring performance and setting targets and incentives, affects the probability and intensity of firms' export activity and whether digital capacities act as a mediating mechanism between managerial routines and firms' internationalisation.

Research Design & Methods: We used firm-level data from the World Bank Enterprise Surveys conducted in Poland in 2025. We applied a quantitative approach, combining logistic regression for internationalisation propensity, fractional logit regression for internationalisation intensity, and mediation analysis. We measured managerial routines with three dichotomous indicators: monitoring, target setting, and incentives. We operationalised digital capacity as firms' online presence.

Findings: All three managerial routines are positively and significantly associated with the likelihood and intensity of internationalisation. In addition, we observed that digital capacity partially mediates the relationship between managerial routines and the likelihood of internationalisation, suggesting that firms with more structured managerial routines are more likely to internationalise, partly because they are more likely to adopt basic digital tools.

Implications & Recommendations: The findings suggest that relatively managerial routines, such as systematic monitoring, target setting, and incentives, may strengthen firms' international competitiveness both directly and indirectly through digital capacity development. Therefore, managers should treat digitalisation not as a standalone technological investment, but as part of a broader system of managerial routines and governance mechanisms.

Contribution & Value Added: The research contributes to the international business literature by integrating research on managerial routines and digital transformation within an empirical framework. It also extends the resource-based view and dynamic capabilities perspective by identifying digital capacity as a mediating mechanism between internal management systems and firms' internationalisation.

Article type: research article

Keywords: managerial practices; managerial routines, internationalisation; digital capacity; export

JEL codes: F23, M16, L25, O33

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INTRODUCTION

Foreign expansion is one of the most important strategic decisions shaping firms' long-term growth and competitiveness (Daszkiewicz & Wach, 2023; Johanson & Vahlne, 2009; Wach & Daszkiewicz, 2023; Wach *et al.*, 2022). Thanks to this, companies gain access to new markets and increase their learning capabilities, while the lack of experience-based knowledge is costly for the company because it cannot determine what knowledge is useful to overcome challenges in foreign markets (Martín Martín *et al.*, 2022). In addition to external factors, internal determinants play a particularly important role in the internationalisation process. Internationalisation is a phenomenon that requires managers not only to equip firms with appropriate resources but also to provide them with effective systems of management and organisation (Bianchi & Stoian, 2024; Kaur & Kumar, 2026).

An increasing number of studies in the internationalisation literature focus on identifying management practices (Bianchi & Stoian, 2024; Sánchez-Monterrosa & Del Rio Cortina, 2025; Shen & Badulescu, 2025), understood as structured systems for monitoring performance and firms' targets, and rewarding the achievement of these targets (Bloom & Van Reenen, 2007; Doan & Vu, 2024), which significantly affect firm performance (Lamorgese *et al.*, 2024). Although the scientific literature investigates and discusses very broadly the topic of managerial routines from different multidimensional viewpoint, we adopted our process of thought to simplified definition of managerial routines complied with Doan and Vu (2024). They understand managerial routines in four dimensions: (1) targets, (2) monitoring, (3) incentives, and (4) operations (Doan & Vu, 2024). Due to the limited possibility of selecting variables and considering the fact that the measurement of managerial routines is based on World Bank Enterprise Surveys (2025) data, we restricted the operationalisation of managerial routines to three dimensions: (1) monitoring, (2) targeting, and (3) incentives.

Moreover, numerous researchers in the field of digital transformation have emphasised that digital technologies reshape coordination, information processing, and interactions with external stakeholders (Bartosik-Purgat & Rakowska, 2024; Chen *et al.*, 2025; Choczyńska *et al.,* 2024; Głodowska *et al.*, 2023; Hoblos *et al.*, 2024). However, scholars have devoted relatively little attention to the role these technologies play within the internal management systems of internationalised firms (Singh *et al.*, 2026). Accordingly, in this research, we addressed the following research questions: (RQ1) Do management practices increase the probability and intensity of firms' internationalisation? and (RQ2) Do digital capacities mediate the relationship between managerial routines and firms' international performance?

Thus, the objective of this study was, firstly, to verify whether the adoption of managerial routines translates into the probability and intensity of export activity among the firms analysed, and, secondly, to examine whether digital capacities act as a mediating mechanism between management practices and firms' internationalisation. This responds to a growing body of evidence indicating that better-managed firms are more likely to export, serve more destinations, and generate higher export revenues (Kamal, 2024; Vardarsuyu *et al.*, 2024). Furthermore, we examined whether digital capacity, captured through the implementation of a corporate website, mediates the relationship between management practices and internationalisation. In doing so, we addressed several research gaps.

Existing studies rarely integrate the literature on management practices, digitalisation, and internationalisation within a unified empirical framework; consequently, the organisational mechanisms linking internal managerial procedures with outward-oriented strategic outcomes remain insufficiently specified (Singh *et al*., 2026). Moreover, prior research often treats digitalisation as an exogenous correlate of export performance (N. Li *et al.*, 2023; Liu *et al.*, 2025) rather than as a capability shaped by internal managerial processes (Kautish *et al.*, 2025). By explicitly modelling management practices, digital capacity, and internationalisation within a mediation framework, we aimed to clarify how these elements interact.

In this study, we adopted a perspective grounded in the resource-based view and dynamic capabilities theory (Barney, 2001; Penrose, 1959; Teece, 2007; Teece *et al.*, 1997). Our findings are intended to contribute to the development of both theoretical approaches. We argue that managerial routines constitute firm-specific organisational resources that foster the development of higher-order capabilities, particularly digital capabilities (Lee *et al.*, 2025; Shen & Badulescu, 2025). These capabilities enable firms to more effectively reconfigure operations, leverage information flows, and coordinate cross-border activities (X. Du & Huang, 2025; G. Li *et al.*, 2025).

Our research strategy was quantitative and explanatory. Empirically, we relied on data from the World Bank Enterprise Survey, conducted, among others, in Poland in 2025, which provides harmonized information on firms' internal practices, digital tools, and international activities. The choice of Poland was not accidental, as it is perceived as a rapidly developing European economy strongly oriented toward export activity and digital transformation (Gaweł *et al.*, 2023; Sobczak *et al.*, 2026). Methodologically, we employed logistic regression and fractional logistic regression models to estimate the impact of management practices and digital capacity on the probability and intensity of in-

ternationalisation. We devoted particular attention to the potential mediation effect of digital capacity, which also contributes to the scholarly discussion within the frameworks of the resource-based view and dynamic capabilities (Barney, 2001; Penrose, 1959; Teece, 2007, 2018; Teece *et al.*, 1997).

The article is structured as follows. Firstly, we present the theoretical framework by reviewing the literature on management practices and their role in firms' internationalisation. In this section, we also consider the role of digital capacities as a mediating mechanism and formulate six research hypotheses. The subsequent methodological section discusses the theoretical research model and operationalises the dependent, independent, and control variables. Finally, the last section presents the econometric analysis and tests for potential mediation.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Internationalisation constitutes a phenomenon examined by researchers from different perspectives (Garncarz & Michalik, 2025; Gorynia *et al*., 2024; Milka & Garncarz, 2025; Puchalska *et al.,* 2025; Rašković & Daminova, 2025; Witek-Hajduk & Grudecka, 2024), including the theory of management (Ruzzier *et al*., 2006), as well as the theory of resource-based (Barney, 2001; Penrose, 1959). Although researchers initially concentrated on internationalisation processes in large corporations (Tsai & Eisingerich, 2010), in recent years, studies on the internationalisation of small and medium-sized enterprises (SMEs) have become significantly more prominent (Fernandes *et al.*, 2023).

For decades, scholars explained firm internationalisation predominantly sequentially, which was popularised by the Swedish scholars Johanson and Vahlne (1974), who introduced their original internationalisation model, the so-called Uppsala model of internationalisation. A breakthrough in this stream of research occurred around the mid-1990s, when Oviatt and McDougall (1994) and Cavusgil (1994), working independently, demonstrated that not all firms follow an incremental path of internationalisation; rather, some may 'leapfrog' certain stages of the process without necessarily gradually increasing their commitment to foreign markets.

Research on internationalisation of firms is gaining significance, particularly in the context of digital transformation of business, and has become an area of interest for many scholars in the field of international business (Feliciano-Cestero *et al.*, 2023; Jiang & Wang, 2024; Meyer *et al.*, 2023; Nunes *et al.*, 2025; Singh *et al.*, 2026). Internationalisation is a dynamic phenomenon in which the business practices adopted by firms play a crucial role (Jercan & Nacu, 2024), as they drive continuous changes in firms' business models to ensure ongoing adaptation to the transforming economic environment (Cruz-Sánchez *et al.*, 2026; Valentowitsch *et al.*, 2024).

The issue of measuring managerial routines in enterprises was extensively explored, among others, by Bloom and Van Reenen (2007). The researchers emphasised that managerial routines are positively associated with productivity, profitability, Tobin's Q, and firm survival indicators (Bloom & Van Reenen, 2007). Notably, concepts related to managerial routines were expanded to include new contexts, with greater attention to strategic managerial capabilities (Pocztowski & Pauli, 2023; Wrede *et al.*, 2020). Many studies indicate that managerial routines may be a predictor of a firm's propensity to internationalisation (Y.-A. Chen *et al.,* 2024; Shen & Badulescu, 2025) because managers equipped with more effective organisational skills are more likely to identify and exploit opportunities on an international dimension (Popli *et al.,* 2022).

Furthermore, we may explain the relationship between managerial routines, understood as an activities undertaken by managers on their daily basis, and internationalisation, among others, by the theory of management, especially by resource-based view (RBV; Barney, 2001; Bianchi & Mathews, 2016; Y.-A. Chen *et al.*, 2024; Penrose, 1959) and the theory of dynamic capabilities (Pitelis & Teece, 2010; Teece, 2007, 2018; Teece *et al.,* 1997). According to RBV, managerial and organisational resources are helpful to overcome barriers related to foreign operations and to identify international opportunities (Y.-A. Chen *et al.*, 2024; Penrose, 1959). Managerial routines based on performance monitoring, effective goal setting, and appropriate incentive mechanisms (Bloom *et al.*, 2019; Bloom & Van Reenen, 2007) can constitute an intangible resource that strengthens the firms' ability to coordinate cross-border operations (Shen & Badulescu, 2025).

In turn, the dynamic capabilities framework (Teece, 2007, 2018; Teece *et al.*, 1997), which extends the resource-based approach (Barney, 2001; Penrose, 1959), argues that engaging in international business activity requires flexibility, entrepreneurship, and learning – fundamental elements of the dynamic capabilities concept (Pitelis & Teece, 2010).

Recent research on the internationalisation of SMEs confirms that managerial routines can enhance the likelihood of firms' survival in foreign markets (Freixanet & Renart, 2020) and, consequently, may also influence the intensity of international involvement (Wai *et al.*, 2022). Therefore, we formulated the following hypotheses:

H1a: Monitoring performance and setting targets and incentives increase the likelihood of firms' internationalisation.

H1b: Monitoring performance and setting targets and incentives positively affect the intensity of internationalisation.

H1c: Monitoring performance and setting targets and incentives positively affect the digital capacity of firms' online presence.

Digital technologies have become central to current research on internationalisation and business practices, as they significantly alter how firms organise their production activities and engage with customers (Gaweł *et al.*, 2023; G. Li *et al.*, 2025). The ongoing digital transformation of business compels scholars to reconsider established resource-based perspectives and the theory of dynamic capabilities to the point where modifications to the theoretical foundations themselves become necessary (Valentowitsch *et al.*, 2024). As noted by Valentowitsch *et al.* (2024), updated conceptual frameworks move away from an exclusive emphasis on long-term sustainable competitive advantage and instead acknowledge the need to more accurately reflect the fluid and fast-evolving conditions characteristic of the digital environment.

Digital transformation and the development of information and communication technologies have significantly changed the conditions under which firms operate in international markets (Meyer *et al.*, 2023). Digital tools enable more efficient acquisition of market information, supply chain management, process coordination, and relationship development with foreign customers. In the literature, digital technologies can reduce different barriers in international expansion, particularly among SMEs, by lowering transaction costs and increasing access to sales channels (Brouthers *et al.*, 2016; Drori *et al*., 2024). In this context, a firm's digital capacity is perceived as a critical resource that facilitates faster and more effective internationalisation (Monaghan *et al.*, 2020) and which fundamentally reshape traditional business strategy and global business processes that enable work to be carried out across boundaries of time, distance, and function (Bharadwaj *et al.*, 2013).

According to Kastelli *et al.* (2024) digital capacity is primarily a driving force and an enabling factor for the implementation of digital transformation. In other words, the concept refers to firms' potential to adopt and leverage digital technologies and to digitalise their offerings to support business processes, strategic objectives, and value-creating activities (Kastelli *et al.,* 2024). Digital capacity includes both the technological infrastructure a company has and the organisational skills needed to use these technologies effectively (Bharadwaj, 2000).

Digital technologies (*i.e.*, artificial intelligence, virtual and augmented reality, cloud solutions) provide firms with opportunities to rethink their strategic orientations and governance models, while reshaping organisational processes, structures, roles, and boundaries. In doing so, they create new avenues for achieving and sustaining competitive advantage (Cennamo *et al.*, 2020; Kemp, 2024; Yordanova *et al.*, 2024).

The expanding use and implementation of digital technologies can constitute a fundamental internationalisation pillar for SMEs (Etemad *et al.*, 2010; Yordanova *et al.,* 2024). A growing body of research is exploring how digital technologies can help small and medium-sized enterprises (SMEs) expand internationally. These technologies offer new ways to enter foreign markets, create and deliver value to international customers, build knowledge and relationships across borders, and find new international opportunities (Yordanova *et al.,* 2024). Therefore, we proposed the following hypotheses:

H2a: Digital capacity as firms' online presence increases the likelihood of firms' internationalisation.

H2b: Digital capacity as firms' online presence positively affects the internationalisation intensity.

Numerous studies draw attention to the significance of managerial routines in shaping a firm's digital capacities (Bloom *et al.,* 2016; Held *et al.*, 2025; Heubeck, 2023). Certain researchers contend that digital transformation transcends technological advancements; it necessitates profound organisational shifts encompassing strategy, processes, and human resource management, all of which are contingent upon managerial choices (Hanelt *et al.*, 2021). Top management is crucial to a company's digital transformation, focusing on three main areas: (1) understanding digitalisation, (2) creating a formal organisational structure for digital projects, and (3) leading organisational change (Wrede *et al.*, 2020).

Managerial routines influence internationalisation not only directly but also indirectly through their impact on a firm's digital capacity (Gomes *et al.*, 2025). Higher-quality management practices contribute to the development of digital capacity, which in turn enhances a firm's ability to internationalise. Digital capacity mediates the relationship between organisational resources and the international performance of SMEs. The capabilities and resilience of digital platforms fully mediate the relationship between digital resources and SME growth (Aghazadeh *et al.*, 2024), which in turn suggests that managerial input alone may be insufficient for firms' foreign expansion without developing digital capacity. Accordingly, we formulated the following hypotheses:

H3: Digital capacity as firms' online presence mediates the relationship between managerial routines (monitoring performance and targets and incentives) and the internationalisation likelihood.

Managerial approaches and organisational assets that facilitate adaptation to international markets influence companies' internationalisation. In the context of economic digitalisation and its growing impact on global trade, digital capabilities are emerging as a vital organisational resource. This capacity allows firms to surmount challenges to international growth and expand their operations within global markets. By facilitating the seamless exchange of real-time data and supporting remote digital collaboration, digital technologies are, in essence, reducing the importance of traditional geographical constraints (Schmeisser *et al.*, 2026).

RESEARCH METHODOLOGY

Sample and Data Collection

We employed a quantitative approach and the conclusions are based on processed firm-level raw data retrieved from the World Bank Enterprise Surveys (2025). The research was explanatory in nature, aiming to verify the relationship between managerial routines and firm internationalisation, considering a mediating mechanism of digital capacity as firms' online presence. The study included Polish enterprises that participated in the survey in the 2025 edition (World Bank, 2025). Based on responses from the surveyed firms, we constructed an econometric model to test the research hypotheses derived from the literature and verify the existence of a mediation effect in the relationship between managerial routines and internationalisation. Due to limited variable selection, we applied a somewhat simplified operationalisation.

The unit of analysis comprised all firms operating in Poland that participated in the World Bank Enterprise Surveys (2025), controlled for, *e.g.*, age, experience, innovation, size and foreign capital. Most of the variables were coded dichotomously. Moreover, only firms that provided complete responses to the selected questions were included, ultimately limiting the sample to 933 Polish enterprises.

The research sample comprises 933 SMEs and large enterprises (World Bank, 2025), with small firms accounting for 3.1%, medium firms for 49.5%, and large firms for 47.4%. The surveyed enterprises represented the following industries: other services (17.4%), other manufacturing (16.4%), construction (13.0%), retail (12.2%), fabricated metal products (12.0%), food (11.8%), professional services (9.8%), and motor vehicles (7.4%).

Research Model

The research model (see Figure 1) assumed that managerial routines positively influence both the likelihood and the intensity of internationalisation. However, digital capacity was a critical factor in this context, as it clarified the mechanism by which managerial routines influence internationalisation. Therefore, managerial routines alone might not directly lead to international expansion without the support of digital capacity.

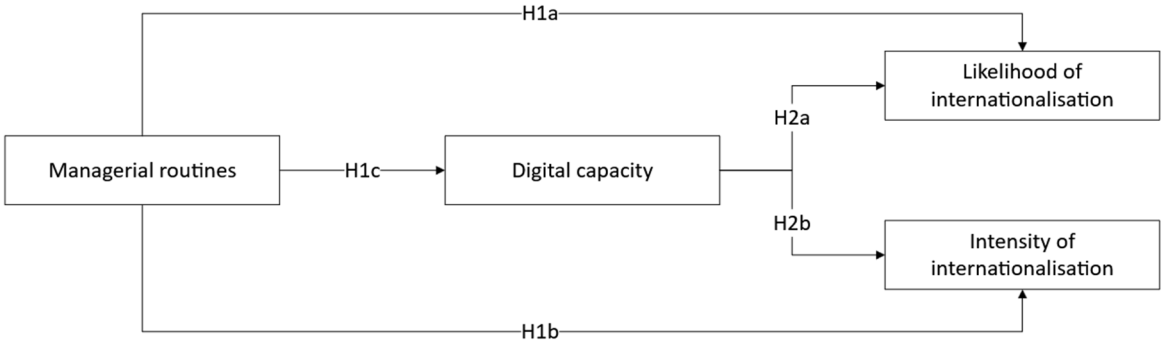

Figure 1. Proposed research model
Source: own elaboration.

We assessed internationalisation, the dependent variable through two distinct measures: (1) the likelihood of internationalisation, measured dichotomously (Bigos & Michalik, 2023, 2024; Cieślik *et al.*, 2024), and (2) its intensity, operationalised as the proportion of foreign sales relative to total sales (Cheng *et al.*, 2025). We modelled digital capacity of firms' online presence as a mediator, that is, a mechanism influencing the relationship between the exogenous variable (managerial routines measured in three dimensions: monitoring, targeting, and incentives) and the endogenous variable (internationalisation measured in two ways: dichotomously and as a share of foreign sales in total sales). The mediation structure enables verification of whether digital capacity partially or fully accounts for the impact of managerial routines on firms' international engagement.

Measures

Control Variables

In the study, we included six control variables, the first of which was firm AGE (a continuous variable), indicating the number of years the firm has been operating in the market. In line with Sous Atari *et al.* (2025), it was reasonable to posit that increased market experience correlates with enhanced managerial competencies, which may subsequently influence internationalisation outcomes. In the research, we also controlled EXPERIENCE, *i.e.*, a continuous variable referring to the number of years of professional experience of the top manager in a given industry (*e.g.*, Sánchez Pulido *et al.*, 2022). Similar to AGE, experience also translates into the ability to recognize market opportunities and may therefore influence the firm's export performance. P_INNOVATION and BP_INNOVATION were two additional dichotomous control variables relating to firm innovativeness (*e.g.*, Moreno-Menéndez, 2018; Wach, 2016). The operationalisation of the first variable refers to whether the firm has introduced a new product or service over the past three years, while the second variable was defined through the lens of business process innovation, that is, whether the firm has introduced a new or significantly improved process over the past three years. The study also controlled for R&D, a dichotomous variable understood as the fact that the firm undertakes research and development expenditures, excluding market research (*e.g.*, Fernhaber & Li, 2013). The final control variable was F_CAP (*e.g.*, Woo, 2020), a continuous variable operationalised as the percentage of foreign capital in the firm's ownership structure.

Managerial Routines

We operationalised managerial routines based on a transformed variable derived from the World Bank Enterprise Surveys (2025), which contains data on firms from numerous countries worldwide. In the research, we adopted variable similar to Doan and Vu (2024), but presented only in three dimensions: monitoring, targeting and incentives, because of the limitation to the access of all variables in World Bank Enterprise Surveys (2025) database.

We considered three independent dichotomous variables (0-1) describing managerial routines: (1) MONITOR, (2) TARGET, and (3) INCENTIVES. The first exogenous variable referred to the fact whether the firm monitors production or service performance indicators. The second variable (TARGET) indicated whether the firms' managers set production or service targets. The final independent variable, INCENTIVES, indicated whether performance incentives based on production or service targets realization were awarded to employees.

Digital Capacity

In the study, we operationalised digital capacity as firms' online presence and measured it on a dichotomous scale, with 1 assigned to companies that had their own website and 0 otherwise.

Internationalisation

In this research, internationalisation was an endogenous variable operationalised through two indicators. The first indicator (INT_LOG) was dichotomous (0-1) and could be used to construct a logistic regression model to verify the internationalisation probability[1] (Bigos & Michalik, 2023, 2024; Cieślik *et al*., 2024). The second internationalisation indicator (INT_SHARE) was continuous and referred to the share of foreign sales in total sales (Cheng *et al*., 2025) and could be used to construct a fractional logit model.

RESULTS AND DISCUSSION

The results provided strong support for H1a (see Table 1). Managerial routines were positively associated with the likelihood of internationalisation. Firms that monitor performance indicators had odds of exporting more than three times those of firms that do not (OR = 3.22, z = 6.27, $p < 0.001$). Simultaneously, those that set formal targets and used incentives showed odds ratios of 2.60 (z = 4.61, $p < 0.001$) and 1.87 (z = 3.76, $p < 0.001$), respectively, controlling for age, managerial experience, innovation, R&D, and foreign ownership. These effect sizes were substantial and robust, indicating that firms with more structured managerial routines were significantly more likely to export than otherwise similar firms lacking such routines.

The pattern of control variables reinforced a resource and capability-based interpretation of export decisions. Firm age had a small but positive effect on export likelihood (OR between 1.012 and 1.024, $p < 0.05$), suggesting that accumulated organisational experience modestly increased the probability of internationalisation (Johanson & Vahlne, 2009), whereas the top manager's industry experience was not statistically significant in any model. Product and process innovation, R&D engagement, and foreign capital share were all positively and significantly associated with exporting, with foreign ownership showing the largest effects (OR between 7.3 and 9.1), consistent with prior work stressing the role of innovation and international networks in enabling foreign market entry (Battisti *et al.*, 2021; J. Du *et al.*, 2023; O'Cass & Weerawardena, 2009; Stoian *et al.*, 2017).

Model diagnostics indicated that the estimated relationships were statistically reliable and that the logistic specifications were well behaved. Pseudo R^2 values around 0.12-0.15 and highly significant Wald chi-square statistics ($\chi^2(7) = 116.3\text{-}135.4$, $p < 0.001$) pointed to a meaningful improvement in fit over the intercept-only model, while correct classification rates of approximately 73% and ROC areas in the 0.72-0.74 range indicated acceptable discrimination between exporting and non-exporting firms. Hosmer–Lemeshow goodness-of-fit tests were non-significant in all three models (p-values be-

[1] If the company exports, we assign the number 1; otherwise, we assign the number 0.

tween 0.53 and 0.64), and link tests revealed no evidence of omitted non-linearities, suggesting that the logit functional form was adequate and that there were no major specification errors. These diagnostics lend further credibility to the conclusion that the observed effects of monitoring, target setting, and incentives on export likelihood were not artefacts of model misfit.

Table 1. Logistic regression (INT_LOG)

Variable	Model 1		Model 2		Model 3	
	Odd ratio	z	Odd ratio	z	Odd ratio	z
const.	0.111***	-8.450	0.103***	-8.510	0.138***	-8.210
	(0.029)		(0.028)		(0.033)	
AGE	1.012*	2.000	1.014*	2.430	1.014*	2.340
	(0.006)		(0.006)		(0.006)	
EXPERIENCE	0.999	-0.090	1.002	0.240	1.005	0.610
	(0.009)		(0.008)		(0.008)	
P_INNOVATION	1.831*	2.200	1.800*	2.030	1.820*	2.120
	(0.503)		(0.522)		(0.513)	
BP_INNOVATION	2.122*	2.130	2.233*	2.250	2.391*	2.360
	(0.751)		(0.798)		(0.883)	
R&D	3.120***	4.840	3.390***	5.310	3.491***	5.430
	(0.733)		(0.780)		(0.805)	
F_CAP	7.345***	5.370	9.090***	5.860	8.825***	5.870
	(2.727)		(3.422)		(3.273)	
MONITOR	3.222***	6.270	-	-	-	-
	(0.602)					
TARGET	-	-	2.595***	4.610	-	-
			(0.537)			
INCENTIVES	-	-	-	-	1.867***	3.760
					(0.310)	
Wald	135.42***		122.78***		116.30***	
Pseudo R^2	0.1448		0.1282		0.1209	
Hosmer-Lemeshow test	6.03 (p=0.6437)		6.31 (p=0.6129)		7.04 (p=0.5319)	
N	933		933		933	

Notes: Robust standard errors in parentheses; p<0.05, ** p<0.01, *** p<0.001.
Source: own study based on World Bank(2025) in STATA.

From a theoretical perspective, these findings support the view of managerial routines as organisational routines (Surdu *et al.*, 2021) that channel and coordinate firm resources in ways conducive to internationalisation. The fact that relatively basic, yet formalized practices, namely monitoring performance and explicit targets, and tying incentives to results are all associated with substantially higher odds of exporting suggests that internationalisation is shaped not only by what resources firms possess (*e.g.*, innovation capabilities, foreign capital) but also by how these resources are governed and deployed. In line with this argument, the results imply that managerial routines operate as governance mechanisms that enhance a firm's ability to identify, evaluate, and exploit foreign market opportunities (Mainela *et al.*, 2014; Muzychenko & Liesch, 2015; Zahra *et al.*, 2005), providing empirical backing for H1a and contributing to micro-foundational explanations of export behaviour.

The results for H1b showed a consistent and robust positive association between managerial routines and the intensity of firms' internationalisation (see Table 2). In the models including monitoring practices, firms that systematically tracked performance indicators exhibited significantly higher export intensity than those that did not: the MONITOR dummy was positive and highly significant in both the fractional logit model (coef = 1.004, z = 4.92, p < 0.001) and the linear regression (β = 0.07, t = 4.96, p < 0.001). Similarly, TARGET and INCENTIVES were positively related to the share of foreign sales. Target setting was associated with a coefficient of around 0.61 (z = 2.76, p < 0.01) in the fractional logit specification and 0.04 (t = 2.71, p < 0.01) in OLS (see Table 3). Simultaneously, incentives showed coefficients of 0.47

(z = 2.83, p < 0.01) and 0.04 (t = 2.72, p < 0.01), respectively. On this basis, we conclude that H1b was supported: firms that adopt more structured managerial routines tend to display higher export intensity.

Table 2. Fractional logit vs. OLS (INT_SHARE)

Variable	Model 4a (FL)		Model 4b (OLS)		Model 5a (FL)	
	Coeff.	z	Coeff.	t	Coeff.	z
const.	-3.315***	-13.99	0.017	0.81	-3.187***	-13.23
	(0.2371)		(0.0203)		(0.2409)	
AGE	0.0078	1.84	0.0009	1.53	0.0097*	2.19
	(0.0043)		(0.0006)		(0.0044)	
EXPERIENCE	0.0025	0.35	0.0002	0.21	0.0053	0.76
	(0.0072)		(0.0008)		(0.0070)	
P_INNOVATION	0.312	1.39	0.032	1.21	0.276	1.15
	(0.2246)		(0.0265)		(0.2412)	
BP_INNOVATION	0.811**	3.16	0.132***	4.00	0.886***	3.39
	(0.2565)		(0.0330)		(0.2610)	
R&D	0.689***	3.88	0.102***	4.70	0.767***	4.25
	(0.1775)		(0.0217)		(0.1805)	
F_CAP	1.823***	7.59	0.314***	10.54	1.984***	8.24
	(0.2404)		(0.0298)		(0.2410)	
MONITOR	1.004***	4.92	0.072***	4.96	-	-
	(0.2041)		(0.0146)			
TARGET	-	-	-	-	0.606**	2.76
					(0.2192)	
INCENTIVES	-	-	-	-	-	-
Pseudo R^2	0.1066		-		0.0932	
R^2	-		0.2086		-	
Adj. R^2	-		0.2026		-	
Wald	163.73***		-		146.92***	
F	-		34.83***		-	
N	933		933		933	

Notes: Robust standard errors in parentheses; p<0.05, ** p<0.01, *** p<0.001; FL – fractional logit; OLS – OLS regression.
Source: own study based on World Bank (2025) in STATA.

The pattern of control variables further clarified the mechanisms underlying export intensity. Across all specifications, business process innovation, R&D engagement, and foreign ownership were consistently positive and statistically significant predictors of INT_SHARE, with especially strong effects for foreign capital (β between 0.31 and 0.33 in OLS and coefficients around 1.82-1.98 in the fractional logit models). In contrast, the top manager's industry experience and product innovation did not reach conventional significance levels, and firm age exerted at most a weak and marginally significant effect. This configuration suggests that structural firm-level capabilities and resources, such as process upgrading, R&D activities, and international ownership, were more important drivers of export intensity than individual managerial tenure, while managerial routines amplified the translation of these capabilities into realised foreign sales (Fredrich *et al.,* 2022; Wai *et al.,* 2022).

Model diagnostics indicate that these relationships were statistically reliable and not an artefact of functional form or multicollinearity. The fractional logit models yielded pseudo R^2 values between 0.09 and 0.11 and highly significant Wald tests ($\chi^2(7)$ = 146.9-163.7, p < 0.001), whereas the corresponding OLS models explained approximately 19-21% of the variance in export intensity (R^2 around 0.19-0.21; F(7.925) around 31.8-34.8, p < 0.001). Generalised linear models with logit and probit links produced virtually identical estimates and information criteria (AIC, BIC), and variance inflation factors remained very low (mean VIF around 1.09-1.10), ruling out serious multicollinearity concerns. The con-

vergence of results across fractional logit, OLS, and alternative GLM specifications strengthened confidence that the observed effects of MONITOR, TARGET, and INCENTIVES on INT_SHARE were robust to different modelling choices for fractional outcomes.

Table 3. Fractional logit vs. OLS (INT_SHARE)

Variable	Model 5b (OLS)		Model 6a (FL)		Model 6b (OLS)	
	Coeff.	t	Coeff.	z	Coeff.	t
const.	0.018 (0.0217)	0.84	-3.041*** (0.2114)	-14.38	0.0247 (0.0209)	1.18
AGE	0.0010 (0.0006)	1.72	0.0095* (0.0043)	2.19	0.0009 (0.0006)	1.68
EXPERIENCE	0.0005 (0.0008)	0.63	0.0066 (0.0069)	0.95	0.0006 (0.0008)	0.79
P_INNOVATION	0.032 (0.0268)	1.19	0.295 (0.2403)	1.23	0.0332 (0.0268)	1.24
BP_INNOVATION	0.139*** (0.0333)	4.19	0.898** (0.2751)	3.27	0.140*** (0.0332)	4.22
R&D	0.111*** (0.0218)	5.09	0.771*** (0.1786)	4.32	0.111*** (0.0218)	5.08
F_CAP	0.331*** (0.0297)	11.13	1.958*** (0.2381)	8.22	0.328*** (0.0299)	10.97
MONITOR	-	-	-	-	-	-
TARGET	0.043** 0.018	2.71	-	-	-	-
INCENTIVES	-	-	0.467** (0.1648)	2.83	0.0384** (0.0141)	2.72
Pseudo R2	-		0.0925		-	
R2	0.1940		-		0.1940	
Adj. R2	0.1879		-		0.1879	
Wald	-		154.33***		-	
F	31.80***		-		31.81***	
N	933		933		933	

Notes: Robust standard errors in parentheses; p<0.05, ** p<0.01, *** p<0.001; FL – fractional logit; OLS – OLS regression.
Source: own study based on World Bank (2025) in STATA.

Conceptually, these findings contribute to the literature that views managerial routines as organisational routines that shape how firms mobilize and direct resources in the internationalisation process (Deng *et al.*, 2020; Vardarsuyu *et al.,* 2024). The evidence that even relatively basic, yet formalized practices, such as monitoring performance indicators and explicit targets, and tying incentives to results, are associated with higher export intensity suggests that internationalisation is not solely a function of technological assets or ownership structure, but also of the quality of internal management systems. In line with this view, our results imply that managerial routines act as governance mechanisms through which firms coordinate innovation activities and foreign capital to achieve deeper penetration of international markets, thereby providing empirical support for theoretical arguments that locate the micro-foundations of export performance in everyday management routines (Nguyen & Mort, 2021; Pfajfar *et al.*, 2024; Vardarsuyu *et al.,* 2024).

The results for H1c provide clear evidence that managerial routines were positively associated with firms' digital capacity, measured by firms' online presence (see Table 4). In all three specifications, the odds ratios for MONITOR, TARGET, and INCENTIVES were large and highly significant, even after controlling for firm age, managerial experience, innovation, R&D, and foreign ownership. Firms that monitored performance indicators were about five times more likely to have a website than those that do not (OR = 5.07, z = 8.27, p < 0.001). Simultaneously, target setting and incentives were associated with

roughly 2.9-fold and 3.7-fold increases in the odds of digital capacity, respectively (TARGET: OR = 2.92, z = 5.63, p < 0.001; INCENTIVES: OR = 3.73, z = 6.80, p < 0.001). These results strongly support H1c and suggest that firms with more formalised managerial routines were substantially more likely to build a basic digital presence through a corporate website.

Table 4. Logistic regression (DIGI_WEB)

Variable	Model 7		Model 8		Model 9	
	Odd ratio	z	Odd ratio	z	Odd ratio	z
const.	1.146 (0.3225)	0.48	1.035 (0.3043)	0.12	1.039 (0.2944)	0.14
AGE	1.028** (0.0087)	3.24	1.027*** (0.0083)	3.34	1.028*** (0.0086)	3.30
EXPERIENCE	0.995 (0.0107)	-0.44	1.003 (0.0111)	0.28	1.005 (0.0109)	0.50
P_INNOVATION	1.184 (0.5682)	0.35	1.207 (0.4935)	0.46	1.240 (0.5204)	0.51
BP_INNOVATION	1.924 (1.5503)	0.81	2.254 (1.6443)	1.11	2.275 (1.7465)	1.07
R&D	4.053* (2.6127)	2.17	5.029** (3.0940)	2.63	4.865* (3.0291)	2.54
F_CAP	4.683 (4.1174)	1.76	8.192* (7.5159)	2.29	6.420* (5.7665)	2.07
MONITOR	5.073*** (0.9965)	8.27	-	-	-	-
TARGET	-	-	2.919*** (0.5548)	5.63	-	-
INCENTIVES	-	-			3.733*** (0.7229)	6.80
Wald	90.31***		65.30***		72.17***	
Pseudo R2	0.1485		0.1013		0.1235	
Hosmer-Lemeshow test	8.11 (p=0. 4224)		7.15 (p=0. 5205)		6.35 (p=0. 6082)	
N	933		933		933	

Notes: Robust standard errors in parentheses; p<0.05, ** p<0.01, *** p<0.001.
Source: own study based on World Bank (2025) in STATA.

The pattern of control variables was broadly in line with theoretical expectations about the determinants of digital adoption. Firm age showed a small but positive and significant effect across models (OR around 1.03; model 7: p < 0.01; models 8 & 9: p < 0.001), indicating that more mature firms are slightly more likely to maintain a website, possibly due to greater resource availability and accumulated organisational experience. By contrast, the top manager's industry experience and innovation did not reach statistical significance, while R&D activity and foreign capital showed sizeable and often significant odds ratios (*e.g.*, R&D: OR between 4 and 5; F_CAP: OR between 6.4 and 8.2, p < 0.05), underscoring the role of R&D investments and international ownership ties in enabling digital infrastructure. This configuration implies that managerial routines operate alongside, and in interaction with, broader capability-related factors, rather than replacing them.

Model diagnostics for the DIGI_WEB regressions indicated acceptable fit and proper specification. Pseudo R^2 values ranged from approximately 0.10 to 0.15, and Wald chi-square tests were highly significant in each model (p < 0.001), signalling that the set of predictors as a whole provided non-trivial explanatory power beyond the intercept-only model. Hosmer–Lemeshow goodness-of-fit tests were non-significant (p between 0.42 and 0.61), suggesting no major calibration problems, and link tests revealed significant linear prediction but non-significant squared prediction, which was consistent with correctly specified logit functional forms. Areas under the ROC curve around 0.72-0.76 further indicated acceptable discrimination between firms with and without websites. Although the simple 0.5

cut-off yielded perfect sensitivity but zero specificity due to the high prevalence of website use, this was a threshold choice issue rather than a sign of poor model quality. Together, these diagnostics supported the robustness of the positive effects of managerial routines on digital capacity.

Table 5. Logistic regression vs. fractional logit vs. OLS

Variable	Model 10 (INT_LOG)		Model 11 (INT_SHARE)		Model 12 (INT_SHARE)	
	Odd ratio	z	Coeff.	z	Coeff.	t
const.	0.054***	-7.92	-4.170***	-11.65	-0.014	-0.61
	(0.0200)		(0.3580)		(0.0233)	
AGE	1.010	1.65	0.0066	1.45	0.0007	1.21
	(0.0059)		(0.0045)		(0.0006)	
EXPERIENCE	1.007	0.86	0.0079	1.16	0.0007	0.88
	(0.0085)		(0.0068)		(0.0008)	
P_INNOVATION	1.764	1.90	0.256	1.07	0.0307	1.16
	(0.5259)		(0.2403)		(0.0266)	
BP_INNOVATION	2.414*	2.50	0.900***	3.52	0.141***	4.27
	(0.8503)		(0.2558)		(0.0329)	
R&D	3.400***	5.31	0.736***	4.23	0.108***	5.00
	(0.7834)		(0.1741)		(0.0216)	
F_CAP	8.880***	5.78	1.933***	8.32	0.326***	11.04
	(3.3546)		(0.2322)		(0.0295)	
DIGI_WEB	4.746***	5.18	1.637***	5.24	0.0815***	4.54
	(1.4263)		(0.3128)		(0.0180)	
Wald	121.15***		149.57***		-	
F	-		-		34.13***	
Pseudo R2	0.1392		0.1071		-	
R2	-		-		0.2053	
Adj. R2	-		-		0.1992	
Hosmer-Lemeshow test	7.08 (p=0.5282)		-		-	
N	933		933		933	

Notes: Robust standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001.
Source: own study based on World Bank (2025) in STATA.

From a theoretical standpoint, these findings reinforce the view that managerial routines function as governance routines that enable and structure the deployment of digital technologies (Mele *et al.*, 2024; Teece, 2025). The strong associations between monitoring, target setting, and incentives systems and the probability of digital capacity suggest that digital capacity was more likely to emerge in firms where performance is systematically tracked, objectives were made explicit, and incentives were aligned with outcomes (Cosa & Torelli, 2024; Seppänen *et al.*, 2025). Rather than treating digitalisation as an exogenous technological shock, the results present how internal managerial systems condition whether and how basic digital tools are implemented (Röglinger *et al.,* 2022; Soluk *et al.*, 2021; Ye *et al.,* 2024). In this sense, the confirmation of H1c provides a micro-foundational bridge between everyday management practices and the development of digital capabilities that can later support more advanced forms of internationalisation.

Binary logistic regression showed that digital capacity was strongly associated with the likelihood of exporting (see Table 5). Controlling for firm age, managerial experience, innovation, R&D, and foreign ownership, firms with a website were about 4.7 times more likely to be internationalised than firms without one (OR = 4.75, z = 5.18, $p < 0.001$; 95% CI [2.63, 8.55]). Pseudo R^2 of 0.14, a highly significant Wald $\chi^2(7) = 121.15$ ($p < 0.001$), a non-significant Hosmer–Lemeshow test ($p = 0.53$), ROC area of 0.72, and correct classification of 74% indicated acceptable fit and discrimination, supporting the conclusion that digital capacity significantly increases the likelihood of firm internationalisation, in line with H2a.

Table 6. Mediation effect (H3)

Effect/statistics	MONITOR	TARGET	INCENTIVES
Panel A. Mediator model (DIGI_WEB)			
MR → DIGI_WEB	1.624*** (0.196) [z = 8.27]	1.071*** (0.190) [z = 5.63]	1.317*** (0.194) [z = 6.80]
Pseudo R2 (mediator)	0.1485	0.1013	0.1235
Wald chi2 (mediator)	90.31***	65.30***	72.17***
Panel B. Outcome model (INT_LOG)			
DIGI_WEB → INT_LOG	1.273*** (0.308) [z = 4.13]	1.418*** (0.304) [z = 4.67]	1.436*** (0.304) [z = 4.72]
c': Direct effect of MR → INT_LOG	0.974*** (0.191) [z = 5.11]	0.794*** (0.212) [z = 3.75]	0.447** (0.171) [z = 2.61]
Pseudo R2 (outcome)	0.1624	0.1518	0.1451
Wald chi2 (outcome)	134.22***	133.57***	125.79***
Panel C. Mediation results			
ACME1	0.0447	0.0328	0.0357
95% CI ACME1	[0.0253; 0.0657]	[0.0170; 0.0508]	[0.0209; 0.0526]
ACME0	0.0248	0.0196	0.0273
95% CI ACME0	[0.0133; 0.0385]	[0.0097; 0.0329]	[0.0155; 0.0417]
Direct Effect 1	0.1763	0.1379	0.0835
95% CI Direct Effect 1	[0.1097; 0.2424]	[0.0672; 0.2064]	[0.0205; 0.1476]
Direct Effect 0	0.1565	0.1248	0.0751
95% CI Direct Effect 0	[0.0965; 0.2168]	[0.0606; 0.1870]	[0.0187; 0.1326]
Total Effect	0.2012	0.1576	0.1108
95% CI Total Effect	[0.1390; 0.2629]	[0.0905; 0.2231]	[0.0510; 0.1721]
Average Mediation	0.0348	0.0262	0.0315
95% CI Avg. Mediation	[0.0195; 0.0514]	[0.0138; 0.0413]	[0.0183; 0.0467]
Average Direct Effect	0.1664	0.1314	0.0793
95% CI Avg. Direct Effect	[0.1028; 0.2290]	[0.0636; 0.1959]	[0.0196; 0.1401]
% of total effect mediated	17.26%	16.60%	28.45%
95% CI % mediated	[13.22%; 25.00%]	[11.76%; 28.98%]	[18.28%; 61.57%]
Type of mediation	partial	partial	partial

Notes: MR – Managerial routines (MONITOR, TARGET, INCENTIVES).
Source: own study based on World Bank (2025) in STATA.

The results also support H2b (see Table 5). Digital capacity was positively related to the intensity of internationalisation. In the fractional logit model, DIGI_WEB had a positive and highly significant coefficient (coef = 1.64, z = 5.24, $p < 0.001$), and in the linear specification the corresponding effect was $\beta = 0.08$ (t = 4.54, $p < 0.001$), implying that firms with a website, on average, a higher share of foreign sales than firms without one, net of controls. The models showed reasonable explanatory power (pseudo $R^2 = 0.11$ for fractional logit; $R^2 = 0.21$, $F(7,925) = 34.13$, $p < 0.001$ for OLS), and low VIF values (mean around 1.08) ruled out multicollinearity concerns. Taken together, these findings indicate that digital capacity is not only associated with the decision to export but also with the depth of firms' engagement in foreign markets, thereby confirming H2b.

For all three practices, there was a statistically significant partial mediation of their effect on export likelihood through DIGI_WEB, so H3 was supported (see Table 6). In the case of MONITOR, the mediator model showed that monitoring strongly increased the probability of having a website (coef = 1.62, $p < 0.001$), and DIGI_WEB, in turn, significantly increased the odds of exporting in the outcome model (coef = 1.27, $p < 0.001$). When DIGI_WEB was included, the direct effect of MONITOR on INT_LOG decreased but remained significant, and the mediation output indicated a positive and

statistically significant indirect effect (Average Mediation = 0.035, 95% CI [0.019; 0.051]) with about 17% of the total effect transmitted through the digital channel. This pattern was consistent with partial mediation, in which monitoring affects the likelihood of exports both directly and indirectly through digital capacity. For TARGET and INCENTIVES, the results were analogous. Both practices significantly increased the probability of having a website (TARGET: coef = 1.07, $p < 0.001$; INCENTIVES: coef = 1.32, $p < 0.001$), and DIGI_WEB again had a strong positive effect on INT_LOG in the outcome models. In each case, the mediation analysis yielded a significant average mediation of roughly 0.026 (95% CIs clearly excluding zero) and a significant average direct effect, with about 16-17% of the total effect of TARGET and INCENTIVES on export likelihood mediated by digital capacity. These findings indicate that managerial routines operate partly by building digital capacity -here, the presence of a website – which then facilitates firms' entry into foreign markets, while also exerting an additional direct influence on internationalisation decisions.

CONCLUSIONS

We confirmed all research hypotheses. Based on the analysis, managerial routines operationalised through three variables (MONITOR, TARGET, and INCENTIVES) were positively and statistically significantly associated with internationalisation, both in terms of the probability of its occurrence and its intensity. Therefore, we observed that the firms implementing practices based on performance monitoring, target setting, and granting incentives for achieving production or service provision demonstrate a greater propensity to internationalise. Those managerial routines also influence export intensity, meaning that the more frequently firms apply such practices, the higher the share of foreign sales in total sales. We claim that this relationship holds when accounting for control variables related to firm age, innovation, and R&D activity, as well as the share of foreign owners in the firm's overall ownership structure.

Furthermore, another important conclusion emerging from the analysis is that digital capacity, operationalised through the variable DIGI_WEB, which refers to whether a given firm has a website, plays an important role in the internationalisation process. On the one hand, digital capacity constitutes an important and statistically significant predictor of both the probability of internationalisation and export intensity. On the other hand, it partially mediates the relationship between managerial routines and the probability of exporting. This constitutes important evidence that digital capacity can serve as a mechanism by which internal management systems influence internationalisation outcomes.

The study results provide evidence for managers and policy-makers that establishing monitoring systems and managerial goals, and rewarding employees for achieving them are practices that benefit firms and may differentiate internationalised firms from those operating locally and primarily oriented toward the domestic market.

In the study, we identified several limitations. Firstly, the sample included 933 firms from Poland, meaning that not all firms in this region were examined; we investigated only a relatively small subset. This could have increased the risk of limited representativeness of the sample and of challenges to the replicability of the results. Therefore, further research should focus on increasing the sample size and verify the findings across different geographical contexts, as many managerial decisions are also influenced by the cultural conditions prevailing in a given region. Moreover, the study adopted a static approach, which makes it impossible to verify relationships over a longer time horizon. As is well known, the development of managerial attitudes and actions is dynamic. Therefore, further studies should place greater emphasis on research using panel data models, which capture relationships over time. We also identified another research limitation related to the selection of variables. We analysed the data using variables predefined by the World Bank Enterprise Surveys, which limited our ability to freely operationalise the constructs. Therefore, further studies should consider alternative operationalisations of variables that are more neutral and better reflect the realities of firms.

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Building networks in the manufacturing sector: A qualitative study of women entrepreneurs in Türkiye

Nuray Atsan, Melek Okudan Öz

ABSTRACT

Objective: The aim of the article is to explore how Turkish women entrepreneurs who own medium and large-scale manufacturing firms construct and mobilise social networks and how these networks evolve over time.

Research Design & Methods: A qualitative research design was employed. Semi-structured interviews were conducted with 17 women entrepreneurs in the manufacturing sector in Antalya, Türkiye. Due to the absence of a formal database, snowball sampling was used. The data were analysed using interpretative phenomenological analysis (IPA) to capture participants' lived experiences in relation to the research questions.

Findings: The findings show that women entrepreneurs actively engage in networking throughout the entrepreneurial process. While networks were relatively limited during the start-up phase, they expanded and diversified as ventures grew. Four main network types were identified: personal networks, influential mentors, non-governmental organisations (NGOs), and public institutions. These networks provided key benefits, including financial support, customer and personnel access, information sharing, and motivational support.

Implications & Recommendations: The results emphasise the importance of cultivating networks beyond family ties, particularly with mentors, NGOs, and formal institutions, to support venture development and sustainability.

Contribution & Value Added: By focusing on women entrepreneurs in the manufacturing sector in a developing country context, this study extends existing research on gender and social networks beyond service-sector and Western settings.

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INTRODUCTION

Women entrepreneurship has gained increasing scholarly attention in recent decades, yet important gaps remain in understanding how gender shapes entrepreneurial processes across diverse institutional and cultural environments. In particular, scholars argue that women's access to social networks, crucial for acquiring resources, legitimacy, and information, remains structurally constrained by gender norms, institutional weaknesses, and male-dominated business systems (Ahl, 2006; Brush *et al*., 2019; Moletta *et al*., 2023). While there is extensive evidence that social networks play a central role in supporting venture creation and growth, most studies focus on small-scale service firms in Western economies (Carranza *et al*., 2018), leaving significant blind spots in industries and regions where women face more pronounced barriers.

Manufacturing represents one such blind spot. Globally, women remain markedly underrepresented as owners and managers of manufacturing firms due to the sector's high entry costs, technological requirements, and entrenched gender stereotypes (Hampton *et al*., 2011; Brush *et al*., 2019;

Neumeyer *et al*., 2019). Manufacturing typically demands access to technical knowledge, skilled labour, supply chains, and institutional support; resources that are often embedded within male-dominated networks. As a result, women entrepreneurs must navigate structures that may be less accessible or inclusive than those found in service industries. Despite these challenges, empirical evidence on how women in manufacturing build and leverage networks remains limited (Hampton *et al*., 2011).

Türkiye presents a particularly compelling context in which to examine these dynamics. As a collectivist society with persistent patriarchal norms, Türkiye exhibits gendered patterns of labour participation, entrepreneurship, and access to institutional resources (Maden, 2015; Toksöz, 2016). Although women represent nearly half of the population, their labour force participation remains among the lowest in the OECD, and women-owned manufacturing firms constitute only a small share of national enterprises (TURKSTAT, 2022; Karadeniz *et al*., 2023). Research consistently shows that Turkish women entrepreneurs depend heavily on strong family ties and informal networks to compensate for limited institutional access (Ufuk & Özgen, 2001; Panda, 2018; Atsan, 2022). However, we know little about how women entrepreneurs in medium- and large-scale manufacturing firms develop, diversify, and mobilise networks over time.

Against this backdrop, social networks offer a valuable lens to understand women's entrepreneurial behaviour in culturally and institutionally complex contexts (Arregle *et al*., 2015; Poggesi *et al*., 2016; Yadav & Unni, 2016). Theories of social capital emphasise the importance of both strong ties, such as family and close friends, and weak ties, such as professional contacts, for resource mobilisation, opportunity identification, and venture growth (Granovetter, 1973; Greve & Salaff, 2003). However, much of this theorising is based on Western settings and traditional rational perspectives (Ahl, 2006; Foss, 2010). There is limited understanding of how social networks function within collectivist cultures, gendered expectations, and manufacturing-specific constraints and conditions, which likely shape network composition and evolution in distinctive ways.

Although existing studies recognise the importance of networking for women entrepreneurs, three significant gaps persist. Firstly, limited research examines women entrepreneurs in manufacturing, an industry that requires resource-intensive, male-dominated networks. Second, theories of social networks insufficiently address how they operate in collectivist, patriarchal, and institutionally constrained environments such as Türkiye. Third, little is known about how women's networks transition from strong, informal ties to more diverse and institutionalised networks as firms grow. This study addresses these gaps by providing empirical and theoretical insight into how medium- and large-scale women-owned manufacturing firms in Türkiye build, interpret, and utilise social networks across different stages of their entrepreneurial journeys. This article explores how women entrepreneurs construct and mobilise social networks while managing manufacturing firms in Türkiye, and how these networks evolve as their ventures grow. By focusing on a context where women confront both industrial and cultural barriers, the study deepens theoretical understanding of gendered networking behaviour under conditions of institutional constraint. Moreover, examining women entrepreneurs operating in a male-dominated industrial sector within a collectivist society provides rare evidence on women-owned manufacturing firms in Türkiye, illuminating a context largely absent from existing research. The study seeks to answer the following research questions:

RQ1: What types of social networks do women entrepreneurs in manufacturing rely on?

RQ2: In what ways do these social networks influence women entrepreneurs' entrepreneurial activities and decisions?

RQ3: How does the development and use of social networks vary across different stages of the venture life cycle?

LITERATURE REVIEW

Research Context: Women's Economic Participation and Cultural Position in Turkish Society

In ancient Turkish societies, there was no distinction between men and women in social life, and women actively participated in political, administrative, and economic activities (Aksoy, 2016). With

the acceptance of Islam, there has been a decline in women's rights in Turkish societies over time due to the misinterpretation of Islamic principles and the influence of anti-women foreign cultures (Sarıkoyuncu, 1999; Maden, 2015). For example, in the Ottoman Empire, women were not involved in education or professional life outside their families; education for women meant nothing more than acquiring knowledge of religious matters. Within the framework of the reform movements of the Tanzimat period, there was a slight improvement in women's participation in economic life. While the majority of women worked in agriculture, only a small number of them in large cities benefited from educational opportunities (Aksoy, 2016).

Following the establishment of the Turkish Republic by Mustafa Kemal Atatürk, aiming to become a modern, Western society, women began to regain their social and political rights. To educate all members of society, including women, the Tevhid-i Tedrisat Law was adopted in 1924. The Civil Law, enacted in 1926, prohibited men from marrying multiple wives, established equality between men and women in marriage and inheritance law, and mandated civil marriage in place of religious ceremonies. In 1930, women were able to participate in municipal elections; in 1933, they were able to be elected as mukhtars under the Village Law; and in 1934, women gained the right to vote and be elected in parliamentary elections (Sarıkoyuncu, 1999; İçli, 2003). During this period, Türkiye initially adopted a market-based economic development model, followed by an import-substitution industrialisation model in which the state played a central role (Toksöz, 2016). Agricultural production and employment continued to dominate the Turkish economy. Women usually worked as unpaid family workers in small-scale agricultural enterprises. Both the share of industrial employment and the share of women employed in the industrial sector were quite low. Almost all female industrial workers were in the tobacco, textile, and food-processing industries (Makal, 2001). Although Türkiye adopted an export-based industrialisation strategy starting in the 1980s, female workforce participation continued to decline due to inadequate investment in manufacturing. Only after becoming an EU candidate in 1999 was a low level of women's participation in the workforce recognised as a significant problem. Over the past 20 years, the current government's religious and conservative stance has emphasised the role of women within the family. Policies implemented have again led women to remain largely in the agricultural and service sectors or at home as unpaid family workers, contributing to the growth of informal employment (Toksöz, 2016).

The integration of women into Türkiye's labour market remains limited, with low labour force and employment participation rates. This issue extends to women entrepreneurs. According to the 2022 TURKSTAT Household Labor Force Survey, Türkiye's total population is 85.3 million, with women constituting 49.9%. However, the labour force participation rate in 2022 was 62.8% for men compared to only 28% for women. This contrasts sharply with the rates for women in OECD (52.9%) and EU (51.9%) countries (Ayta & Şen, 2023).

Furthermore, the proportion of female employers in Türkiye is 12%, showing improvement from 6.2% in 2007 but still significantly lower than the EU average of 27% (TURKSTAT, 2007, 2022; TURKONFED, 2017). Regarding entrepreneurial activity, women's total early-stage entrepreneurial activity (TEA) in Türkiye is 10.28%, compared to 21.05% for men. The gender gap in TEA (male-to-female ratio) is among the highest in OECD countries, indicating significant disparities in entrepreneurial participation (Karadeniz *et al*., 2023). These figures underscore the need for targeted policies to promote gender equality in employment and entrepreneurship.

Studies on the profile of Turkish women entrepreneurs consistently show that traditional gender roles are the primary barriers to women's participation in the workforce and their pursuit of entrepreneurship (Ufuk & Özgen, 2001; Karatas-Ozkan *et al.,* 2010; Maden, 2015; Kalemci Tuzun & Araz Takay, 2017; Seçkin Halaç & Seçkin Çelik, 2019). In Türkiye, care work for the children, the elderly, the sick and the disabled is generally provided within the family and almost exclusively by women (Toksöz, 2016). Family obligations are considered female responsibility. The patriarchal social structure prevents women from participating in employment and gaining a profession and career outside home. Additionally, challenges such as limited access to capital, lack of experience, low education levels, insufficient business networks, and difficulties in accessing market, financial, and technological information decrease both the inclination of women to pursue entrepreneurship and their success in it (Hisrich & Öztürk, 1999; Panda, 2018; Atsan, 2022).

Social Networks and Women Entrepreneurs

Social networks are widely recognised as important components of the entrepreneurial process, particularly in enabling access to resources, information, and early opportunities. Greve and Salaff (2003) describe networks as the relational structures that link entrepreneurs to various stakeholders, emphasising their foundational role in establishing and sustaining new ventures. Similarly, Witt *et al*. (2008) define entrepreneurial networks as the social connections that entrepreneurs draw upon for informational exchange and resource-related support. Much of the existing scholarship highlights how such networks can contribute to idea generation, opportunity recognition, and the acquisition of critical knowledge during venture formation (Brüderl & Preisendörfer, 1998; Jenssen & Koenig, 2002; Peltier & Naidu, 2012). Social ties may also facilitate the flow of explicit and tacit knowledge, enabling entrepreneurs to navigate uncertainties and overcome early-stage challenges (Anderson & Jack, 2002).

Within this broader literature, several studies suggest that strong-tie networks, particularly family ties, can be especially valuable for entrepreneurs by providing moral encouragement, emotional support, and even unpaid labour (Brüderl & Preisendörfer, 1998; Mozumdar *et al*., 2019). More generally, network engagement has been linked to enhanced venture performance, improved access to market intelligence, and increased likelihood of securing both financial and human capital (Dubini & Aldrich, 1991; Hansen, 1995; Shabsough *et al*., 2021). Some studies focusing on women entrepreneurs have indicated similar patterns: for example, business networks have been associated with positive performance outcomes among women-led ventures (Zhu *et al*., 2019; Xie & Lv, 2016), and collaborative exchanges within networks may provide essential information and resources (Tata & Prasad, 2008).

At the same time, network usage appears to be shaped by contextual factors, including institutional development and cultural norms. Research conducted in developed economies has suggested that entrepreneurs often rely more heavily on professional or institutionalised sources of support, such as venture capitalists or business associations, where such structures are well-established (Au & Kwan, 2009). By contrast, in developing or less developed countries, where formal market-supporting institutions may be less accessible or reliable, family and informal networks often play a more central role (Egbert, 2009). Studies examining women in these contexts further indicate a tendency to rely more on extended family and close personal ties (Renzulli *et al*., 2000; Greve & Salaff, 2003). Poggesi *et al*. (2016), for instance, note that women entrepreneurs in such environments frequently view networks as tools for compensating resource scarcity and navigating institutional constraints.

Existing research also points to gendered dynamics in access to networks. Some scholars observe that women may experience exclusion from male-dominated business networks, limiting access to information, credit, partnerships, or industry-specific knowledge (Winn, 2005). Ozkazanc-Pan and Clark Muntean (2017) similarly report that women technology entrepreneurs may be marginalised from influential transactional networks that often facilitate access to valuable resources such as business incubation.

In terms of network characteristics, several studies *suggest* that women entrepreneurs tend to have smaller, more homogeneous networks than men (Renzulli *et al*., 2000; Tata & Prasad, 2008; Kim & Sherraden, 2014). These networks often consist predominantly of strong ties, family members, relatives, and close friends, while weak ties such as professional acquaintances, advisors, experts, and association memberships appear less common (Brüderl & Preisendörfer, 1998; Hampton *et al*., 2011; Verheul & Thurik, 2001). Scholars have attributed this pattern, in part, to gendered expectations and caregiving responsibilities, which may limit women's time and ability to engage in broader professional networks (Munch *et al*., 1997; Renzulli *et al*., 2000).

Although these insights offer valuable guidance, it is important to note that most are derived from studies carried out in Western contexts or within service-oriented and small-scale business sectors. Much less is known about whether similar dynamics apply to women entrepreneurs in manufacturing industries within developing-country settings such as Türkiye, where institutional, cultural, and sector-specific conditions differ substantially from those typically examined in prior research. Because manufacturing ventures often require access to technical knowledge, skilled labour, and formal institutional support, women's network use in this sector may diverge from previously documented patterns.

Given these contextual gaps, the present study adopts an exploratory approach to examine how women entrepreneurs in medium- and large-scale manufacturing firms in Türkiye construct and utilise their social networks. Rather than testing predefined hypotheses, the study uses open-ended research questions to explore network patterns, purposes, and developmental trajectories within this under-researched context.

RESEARCH METHODOLOGY

Design

This study employed a qualitative research design grounded in interpretative phenomenological analysis (IPA) to explore how women entrepreneurs make sense of their social networking experiences as they manage manufacturing firms in Türkiye. IPA is well-suited for examining lived experiences and the meanings individuals attribute to them, particularly when research aims to capture complex, context-embedded interpretations rather than generalizable patterns (Smith, 2004; Goulding, 2005). Given the limited scholarly attention to women entrepreneurs in the Turkish manufacturing sector, a qualitative, phenomenological approach provided the depth and sensitivity required for understanding their nuanced networking practices.

Participants

A purposive sampling strategy was used to recruit women entrepreneurs who could provide rich, relevant insights into the phenomenon under study. Inclusion criteria were being the owner or co-owner of a medium- or large-scale manufacturing enterprise; having a minimum of five years of entrepreneurial experience, and being actively involved in strategic and managerial decision-making. Because there was no official database of women-owned manufacturing firms in Türkiye, sampling was complemented by snowball referrals, allowing participants to nominate other eligible women who met the criteria. The process was supported by collaboration with the TOBB Antalya Women Entrepreneurs Board, which facilitated initial contact with potential participants. A total of 17 women entrepreneurs participated. This sample size is consistent with IPA guidelines, which recommend relatively small samples (typically 6-20 participants) to enable in-depth, idiographic analysis (Smith, 2004).

Procedure

Data were gathered through semi-structured, face-to-face interviews, which enabled participants to articulate their experiences freely. The interview guide was developed based on the literature on social networks and women's entrepreneurship and reviewed by two academic experts, one specialising in qualitative methods and the other in gender and entrepreneurship. The interview guide comprised 10 open-ended questions. Each interview began with broad, narrative-based prompts designed to build rapport and help participants feel comfortable sharing their entrepreneurial journeys (*e.g.*, 'Could you describe your entrepreneurship story from its founding to the present?'). As the conversation progressed, more analytical and explanatory questions were introduced (*e.g.*, 'Who supported your business during the establishment and growth phases, and in what ways?' and 'Is there anyone you frequently consult about your business or seek advice from? Who are they, and how have they influenced your decisions?'). Two pilot interviews were conducted to refine clarity and flow; pilot data were excluded from the final analysis.

Interviews lasted between 45 and 60 minutes, were conducted in the participants' workplaces, and were audio-recorded with consent. Field notes were taken to capture contextual details, non-verbal cues, and reflective observations relevant to the interpretative process.

Saturation was assessed continuously during data collection. After the 14th interview, no new themes appeared, and subsequent interviews confirmed existing patterns. The final three interviews were conducted to ensure saturation had indeed been reached and to strengthen the credibility of the thematic structure. This approach aligns with qualitative standards that emphasise conceptual sufficiency over numerical thresholds (Yin, 2009).

Data Analysis

All interviews were manually transcribed verbatim before analysis. The data were examined using the systematic, multi-stage procedures of Interpretative Phenomenological Analysis (IPA) outlined by Smith *et al.* (2009). First, each transcript was read several times to allow the researchers to immerse themselves in the data and develop a holistic understanding of each participant's narrative. Second, transcripts were analysed line by line, and detailed exploratory notes were produced to capture descriptive observations, linguistic features, and conceptual reflections relevant to the research questions. Third, emergent themes were identified for each participant, clustered into meaningful categories, and examined for conceptual connections. These emergent themes were then synthesised into higher-level themes that represented the core elements of that participant's experience. Fourth, the same analytic procedures were applied to all remaining transcripts, resulting in a set of main and subordinate themes for each participant. Fifth, a cross-case analysis was conducted to explore similarities and differences across participants, enabling the development of a coherent, integrative thematic framework. Finally, the themes were interpreted in relation to existing literature on women's entrepreneurship, social capital, and gendered networks.

Participants were informed about the study's purpose, confidentiality, and voluntary nature. To ensure data accuracy and reliability, interview transcripts were shared with participants for member checking, allowing them to confirm that the transcripts accurately captured their statements. A few participants made minor adjustments, enhancing the validity of the interview data. All participants have been given pseudonyms to protect their identities.

RESULTS AND DISCUSSION

Presentation of Demographic Characteristics

Demographic characteristics of the respondents (Table 1) show that the ages of women entrepreneurs range from 27 to 50 years. Seven of them are aged between 40 and 50, seven are aged between 30 and 40, and three are aged between 20 and 30. More than half of the respondents are married and have children. Most of the respondents are highly educated, with 11 holding bachelor's degrees and 4 holding master's degrees. Only two of them are high school graduates. The sample consists of women running diverse businesses, all in the manufacturing sector.

Table 1. Demographic profile of the participants

Participants	Age	Marital status	Children	Education	Sector
P1 – Demet	35	Married	Yes	Undergraduate	Elevator manufacturing and installation
P2 – Hilal	30	Single	Yes	Graduate	Alcoholic beverage production
P3 – Zehra	42	Married	Yes	Graduate	Furniture production
P4 – Gonul	42	Married	Yes	Undergraduate	Fence production and installation
P5 – Burcu	44	Married	Yes	Undergraduate	Seed and vegetable production
P6 – Serpil	50	Married	Yes	Undergraduate	Plant/flower production
P7 – Hacer	35	Married	Yes	High school	Industrial plant product. and processing
P8 – Elif	45	Married	Yes	High School	Printing
P9 – Renan	49	Single	No	Graduate	Furniture production
P10 – Hale	46	Married	Yes	Undergraduate	Medical product manufacturing
P11 – Selin	31	Single	No	Undergraduate	Plastic products manufacturing
P12 – Nihal	25	Single	No	Undergraduate	Industrial plaster material production
P13–Zeynep	34	Single	No	Undergraduate	Steel scaffolding production
P14 – Ezgi	27	Single	No	Undergraduate	Fish farming and processing
P15 – Aylin	27	Single	No	Undergraduate	Electronic card production
P16 – İdil	35	Married	Yes	Graduate	Milk products manufacturing
P17 – Pelin	30	Married	Yes	Undergraduate	Plastic products manufacturing

Source: own study.

A Typology of Social Networks and Their Usage Purposes: Types of Social Networks Used

Various approaches have been employed to categorise the network connections between entrepreneurs and individuals. These networks can vary depending on participants' characteristics and the nature of their relationships or interactions (John, 2024). Faroque *et al*. (2017) and Hernández-Carrión *et al*. (2019) classified networks into two types: personal/social and professional/business. The study results show that women entrepreneurs use both network forms.

a) Personal or familial contacts: Among all network types, familial contacts were one of the most significant and common themes that women entrepreneurs used through their entrepreneurship process. In the excerpts below, participants explain how important the family is to them:

Hilal:

> *'My family has made serious contributions to me. My mother provides all kinds of moral support. My family also supports me financially...'*

Hacer:

> *'….My husband was very supportive; if this is called success, his support was huge. Because, leave aside his financial support, which I will somehow manage with loans, but his moral support was very important. It was very important to encourage me, guide me and trust me in a subject he knew nothing about. My husband's family also supported us a lot…'*

Serpil:

> *'…My mother's support was great. When my children were little, I would leave the house with her and go to work. My mother would even take care of the meals we would eat at home. Without her help, I couldn't have come this far…'*

These women entrepreneurs appear to receive family support in building and running their businesses. Brüderl and Preisendorf (1998) also emphasised in their study that the family network is an important mechanism for success.

b) Influential mentors: This second theme refers to experienced and respected business people in the sector who guide and protect the women entrepreneur. Women entrepreneurs called them 'abi (elder brother in Turkish)' or 'abla (elder sister in Turkish)', which means business people who are older and more experienced than themselves and with whom they have established close relationships.

Gonul explains that she benefited from an experienced and knowledgeable individual whom he describes as her 'abi' in the sector:

> *'…I have a financial advisor and an 'abi' who is very experienced in this sector. I trust his ideas and seek his advice before new investments …'*

Hilal mentioned that there are two people in the industry whose experiences she has benefited from:

> *'… I have two people in my life that I turn to for moral support, motivation, and guidance on how the business works. One is a family friend who's been in business for years, and the other is a university professor I trust deeply.'*

Zehra states the support she received from the chairman of the board of a large corporate furniture company, who always supported her with knowledge and other resources at every stage of her business life in the sector, with the following words:

> *'…The one who helped me the most was an 'abi' from a large furniture company. He (the chairman of the company) and I worked closely together for a long time. He likes to support young entrepreneurs like me.'*

c) Non-Governmental organisations (NGOs): NGOs play a distinct role as collaborative platforms for women entrepreneurs, serving as spaces for non-hierarchical networking and fostering business

collaborations among individuals (Lindberg *et al*., 2010). Participants stated that they joined different NGOs and benefited from them.

Zeynep talked about the benefits of NGOs in expanding social networks:

> *'… When I needed something done, I was able to get it done from morning to night with the support of the association members. I can say that our work has accelerated a lot thanks to this network…'*

Aylin explained with examples that she benefited greatly from the associations she was a member of:

> *'…We exchange information with other members of the association. For example, I called a friend from the association about one of our projects. I knew that they had done a similar project before. We met and got information from him…'*

İdil talked about the useful training, information exchange and trips she received thanks to the association she joined:

> *'…GOSD (an NGO) was very helpful to me. I am glad I became a member. …The training is very helpful. There are technical trips. For example, the last trip we went to was to a livestock company, a competitor of ours. I saw our shortcomings, I asked what was on my mind…'*

d) Formal institutions: The final theme refers to public authorities and governmental agents. The entrepreneurship literature widely acknowledges formalised institutional support as a critical factor influencing women's entrepreneurial endeavours (Mũnoz & Kibler, 2016). It is seen that women entrepreneurs try to develop good relations with local authorities.

Hilal explains how she created benefits for her company by using her contacts in public institutions that she met through NGOs:

> *'...For example, we use an e-invoice portal when exporting. Our goods are at the Mersin customs and will be loaded onto a ship there and sent to Cyprus. I need to log in to the system to approve the e-invoice, but our e-signature period has expired. It doesn't work without it; we can't solve it. What did we do? We have good relations with the public institutions here, and more importantly, these people know how well our company works. We immediately went to the manager of the public institution about the issue. He took care of the issue and solved it…'*

Hale explains the collaborations they have made with public institutions to receive support for the social responsibility projects they have carried out in their businesses as follows:

> *'…Annually, we carry out a very big social responsibility project. For this, we work with the Police Chief, the Governor's Office and the National Education Directorate. We now have acquaintances at these institutions through our past collaborations. Every year, we contact them and receive support for our project.'*

Social Networks Usage Patterns

It was determined that women entrepreneurs interviewed frequently gained five common benefits from their networks: financial support, customer acquisition, personnel sourcing, informational support, and motivational/emotional support.

a) Financial support: The scarcity of financial resources, a major challenge for entrepreneurs in general, poses an even greater obstacle for women entrepreneurs (Panda, 2018). In this study, it was found that women entrepreneurs sought financial support from their strong-tie contacts. While only one participant used an institutional mechanism, the other participants stated that family members were the most important source of their financial resources.

Zehra, who closed her previous business and started a new one in the city she moved to after marriage, shared that her husband provided financial support for her new venture, saying:

> *'...I closed my factory in the city of Burdur's Organised Industrial Zone. When I was reestablishing a business in Antalya, I brought only 5 machines. When my own savings were not enough for my new venture, I received capital support from my husband…'*

Research indicates that women entrepreneurs predominantly rely on their spouses, family members, and close networks to secure start-up capital for their ventures, rather than utilising support from government programs, banks, or other formal institutions (Kwong *et al*., 2012). This finding aligns with existing literature on the financing preferences and behaviours of women entrepreneurs.

b) Customer access: Social networks are regarded as a means of accessing new customers (Witt, 2004). The perspectives of Turkish women entrepreneurs reinforce this claim.

Demet explains how she gets clients through the associations, stating:

> *'…Collaboration through associations naturally brought clients once people saw our work and consistency …'*

Zehra exemplifies one of the most notable cases of customer sourcing among female entrepreneurs. She tells the story of how she expanded her network thanks to a senior manager in the military with whom she coincidentally worked, and how she grew her business and was able to establish a factory in the process:

> *'…When I quickly met the military unit's furniture needs in Burdur, I gained the commander's trust, and thanks to him, I produced furniture for the Governor's house. Then, whichever city the Governor was assigned to, he recommended me to his acquaintances. They made me produce and sell furniture all over Türkiye…'*

Burcu explains that she tried to contact a potential customer abroad with the information she received from her friends in the association:

> *'…Friends from KAGİDER (an NGO) went abroad. They told me about a tomato company they saw there. We are currently trying to establish contact to sell our products. There is such a useful exchange of information…'*

c) Staff access: Women entrepreneurs see their staff as colleagues. It is seen that they provide their staff, especially those in key positions, with references from their personal networks.

Renan noted that they always hire craftsmen with specialised skills in furniture work through referrals.

> *'…But for jobs that require expertise, we hire personnel entirely by reference, having heard from someone. Somebody says there is a master here. We negotiate with that master…'*

Hilal mentions that, in addition to the many benefits she has gained through her membership in GOSD (an NGO), the association has also contributed to the recruitment of personnel:

> *'…It can make a significant contribution to personnel supply. When you tell your friends about the qualifications of the personnel you need, there is someone in their pool who will meet that, or there is definitely someone they will recommend…'*

Zehra stated that she received help in finding staff from faculty members in her personal network and those she knew academically:

> *'I urgently needed a graphic designer for my company. I reached out to a university faculty member with whom I work in the same association. She referred me to a graphic design student. We agreed and have been collaborating for a long time.'*

d) Information access: One of the most important and valuable resources in establishing and developing a business is information. Obtaining the right information at the right time and using it effectively are major factors in the success of the business. Social networks are considered trustworthy sources of information because individuals tend to rely on information shared by people they are familiar with and trust (Hernández-Carrión *et al*., 2019).

Burcu, who is engaged in agricultural production, explains that she benefited from her mother-in-law's knowledge and experience in the early days of her venture, and later received support from NGOs when her business grew:

'…I benefited a lot from my mother-in-law's knowledge. My mother-in-law is an 'old timer'. She didn't know the scientific part, but I gave an example: when it goes into the greenhouse, you can plant it now at this temperature, or it's still too early, you shouldn't plant it.' When the leaves of my plants turned slightly yellow, I would panic. I would go to her. She would say, 'No, that won't happen honey, it will get better by evening.' It really gets better by evening. She would say, 'If you leave the plant without water, it will be stronger…'

Hacer talked about the technical support she received from her husband in her venture as follows:

'…My husband is also very knowledgeable about technical aspects, machinery, and installations. He supported me in technical matters…'

Renan;

'…If I had not joined ANSIAD (a business association), my vision would not have been this broad. …The speeches, seminars and exchanges with other businesspeople at ANSIAD support my vision and progress…'

Zehra mentions that she benefited from her strong ties, especially the support of her extended family members, when she was getting information for her initiative:

'…My husband's sister is an industrial designer. I get help from her. I consult with her and her team. There are actually very few of us in the industry. Everyone helps each other…'

It appears that women entrepreneurs primarily seek information support from individuals with whom they have strong ties. Women entrepreneurs tend to seek information directly by contacting people in their social networks whose knowledge and experience they trust, from whom they can get the information they need.

e) Emotional support: Emotional support plays a key role in sustaining and empowering women entrepreneurs, helping them navigate challenges with confidence and resilience. Below are some of the excerpts from the interview data.

Nihal described the motivational support she received from her family, fellow association members and social networks after the major disaster that resulted in financial losses for her initiative:

'… After our business burned down, we were morally down. We had insurance to cover the damage financially, but it was very sad to see all the things you had done spiritually destroyed. We got through that period thanks to the emotional support of our colleagues, customers, suppliers and friends from the GOSD group…'

Hacer;

'…My husband was very supportive. If there was any success, it was because of his support. Because, leave aside his financial support, I would have somehow managed it with loans or something else, but his moral support, encouragement and guidance were very important.'

Gonul:

'…My mother said, 'You can do it.' Even when I was working in the atelier, as a young girl and even in my childhood, my mother would say, 'You will do your own job in the future.' She would say, 'You know and have learned everything.' …..My husband also did not withhold his support both financially and morally…'

These accounts demonstrate that, beyond financial, informational and other resources, emotional support is a crucial element that empowers women entrepreneurs, reinforcing their ability to overcome difficulties and achieve long-term success.

Social Network Usage Behaviour Across Different Stages of Enterprise Development

Social networks are dynamic (Greve & Salaff, 2003), and entrepreneurs might rely on different compositions of social networks at different stages of the entrepreneurial process due to varying resource needs and resource-acquisition challenges (Klyver & Hindle, 2007). Interview data revealed that women entrepreneurs use social networks at every stage of their enterprises. However, the types of networks used and how they are used vary depending on the stage of the enterprise.
One of the participants expressed her experience as follows:

> *'My husband and family supported me both financially and morally during the establishment of my business. They volunteered to work in the business when necessary. For example, when I could not find enough staff during the harvest season, there were times when my own family and my husband's family would work with us.' (Burcu)*

As we can see from the quote below, the places where participants apply for financial support diversify during the growth phase, and they also receive support from more formal institutions.

> *'The mechanisms I applied for financial support during the establishment and growth phases changed. We were more amateur during the establishment phase. We were doing our business in a room in our house. After a while, we decided to open a store and not just sell from home. At this stage, we received financial support from formal public institutions.' (Hacer)*

As Johannisson *et al*. (1994) emphasised, at the growth stage, entrepreneurs continue to depend on networks for business information, advice, and problem-solving, with certain contacts offering multiple resources. This is what most participants emphasised in the interviews. For example, according to İdil:

> *'As our business grew, our interest in business networks also increased. During the establishment phase, we worked day and night to stay afloat. Now that things are settled, I can be more active in business associations. For example, by entering the KGK (an NGO), I found new customers, and when I was looking for employees, I could ask our member friends.'*

This evidence suggests that during the development stages of their businesses, women entrepreneurs tend to establish more professional and institutional relationships to manage and expand their ventures effectively.

Discussion

This study explored the social networks and networking practices of women entrepreneurs operating medium- and large-scale manufacturing firms in Antalya, Türkiye. By focusing on a traditionally male-dominated sector, the findings extend existing research on women's entrepreneurship by illuminating how network structures, purposes, and dynamics unfold in an industrial context that differs substantially from the service-oriented environments that dominate prior studies.

The findings indicate that women entrepreneurs in manufacturing actively engage in networking practices, with their networks expanding and diversifying as their ventures evolve. While networks were relatively limited during the start-up phase, they became more heterogeneous over time, supporting Dubini and Aldrich's (1991) and Johannisson's (1987) emphasis on learning and experience in network development. Importantly, this evolution was not linear but adaptive: different types of networks were mobilised for distinct purposes at different stages of the venture life cycle. The identification of four core network types, personal networks, influential mentors, non-governmental organisations (NGOs), and public institutions, highlights the multifunctional and dynamic nature of networking in manufacturing entrepreneurship.

Consistent with prior research, strong ties within personal networks, particularly family members, spouses, and close friends, played a central role in women entrepreneurs' ventures, especially during the establishment phase. These ties provided not only emotional and moral support but also critical financial resources, confirming findings by Greve and Salaff (2003), Brüderl and Preisendörfer (1998), and Poggesi *et al*. (2016). However, unlike some studies that emphasise the constraining

effects of strong family ties (Hite & Hesterly, 2001), the present findings suggest that in the Turkish manufacturing context, family networks function more as enabling mechanisms than as barriers. This pattern can be understood through Türkiye's socio-cultural characteristics. The collectivist structure of Turkish society (Hofstede, 1980; Sargut, 1999), combined with relatively low levels of generalised trust and weak institutional trust (Buğra, 1994; Sargut, 2003), encourages reliance on trusted, close-knit networks. In this context, strong ties compensate for institutional uncertainty and reduce perceived risk, particularly in capital-intensive manufacturing ventures where failure costs are high. This finding refines existing theories by showing that the value of strong ties is not universally constraining or enabling but is highly context-dependent.

One of the most striking findings of this study is the prominence of influential mentors, often referred to by participants as 'abi' or 'abla,' within women entrepreneurs' networks. Notably, nearly half of these mentors were male. While prior research has acknowledged the importance of mentors and role models for women entrepreneurs (Welter, 2006; Laukhuf & Malone, 2015), the present study adds nuance by situating mentorship within the gendered power structures of the manufacturing sector. The prevalence of male mentors cannot be explained solely by the male-dominated nature of manufacturing. Rather, it also reflects deeper cultural dynamics regarding authority, legitimacy, and expertise. In a sector where technical knowledge, industry experience, and informal influence are often concentrated among men, guidance from an older, well-established male figure may carry symbolic legitimacy, facilitating access to resources and reinforcing credibility in business interactions (Isakova & Stroila, 2025). These relationships function not merely as sources of advice but as mechanisms through which women entrepreneurs navigate gendered barriers and negotiate acceptance within male-dominated networks (Shaymardanov *et al*., 2023). Interestingly, mentorship relationships often evolved from initially weak ties, such as academic advisors or professional contacts, to strong ties characterised by trust and regular consultation. This finding challenges the conventional dichotomy between strong and weak ties by illustrating their fluidity and underscoring the importance of relational processes over static network categories.

Engagement with NGOs emerged as another key dimension of women entrepreneurs' networking practices. Unlike findings from service-sector studies, where professional associations are often framed primarily as instrumental networking tools, NGOs in this study functioned as hybrid spaces that combined business networking with social responsibility. Women entrepreneurs perceived participation in NGOs not only as a strategic activity but also as a moral obligation, reflecting culturally embedded notions of contribution and reciprocity. Many participants held active roles within these organisations, including board memberships, dedicating significant time and effort to sustaining these networks. This level of engagement suggests that NGOs play a critical role in fostering trust-based, peer-oriented networks that are particularly valuable in contexts where formal institutional support is perceived as limited or inaccessible (Lindberg *et al*., 2010). This finding points to the importance of policy interventions that strengthen and legitimise such intermediary organisations.

Although public institutions appeared in women entrepreneurs' networks, the findings suggest that access to these institutions was often mediated by personal connections rather than formalised support mechanisms. For example, resolving regulatory or administrative issues often depended on knowing the 'right person' within an institution rather than on systematically using government programs or SME support schemes. This distinction is important, as it indicates that institutional engagement in this context is relational rather than procedural. This pattern contrasts with much of the entrepreneurship literature from developed economies, where formal institutions are assumed to operate as transparent and accessible support systems (Busenitz *et al*., 2000; Bruton *et al*., 2010). In the Turkish manufacturing context, personal brokerage within institutions appears to substitute for formal institutional effectiveness, reinforcing the continued importance of social capital even at later stages of venture development.

Taken together, the findings suggest a dynamic and stage-sensitive model of women entrepreneurs' networking practices in manufacturing. Personal networks dominate the early stages, influential mentors and NGOs support strategic decision-making and legitimacy-building, and institutional ties, often accessed through personal relationships, become more relevant as ventures grow.

This integrative pattern highlights how different network types interact over time to meet evolving entrepreneurial needs. By explicitly contrasting these findings with service-sector–dominated literature, this study demonstrates that networking practices among women entrepreneurs cannot be fully understood without considering sectoral and cultural context. Manufacturing ventures impose distinct demands related to capital intensity, technical expertise, and legitimacy, which shape both the structure and function of entrepreneurial networks (Hoang & Antoncic, 2003). These insights not only extend existing theories of gendered networking but also underscore the need for context-sensitive approaches in entrepreneurship research.

Limitations and Future Research

Several limitations of the present study should be acknowledged, which also offer valuable directions for future research. First, as a qualitative study employing Interpretative Phenomenological Analysis (IPA), the findings are not intended to be statistically generalizable. Instead, the study aims to provide an in-depth understanding of women entrepreneurs' lived experiences with social networks within a specific institutional and sectoral context. A further limitation relates to the sampling strategy. Participants were primarily recruited through the TOBB Antalya Women Entrepreneurs Board, which may have introduced a degree of sampling bias. Specifically, the study is more likely to reflect the experiences of women entrepreneurs who are already embedded in at least one formal network or support structure and who may be relatively successful in leveraging social ties. Consequently, the perspectives of more isolated women entrepreneurs, those who are not members of business associations or who have limited access to formal and informal networks, remain underrepresented. This is an important omission, as such entrepreneurs may face distinct constraints and employ different survival strategies. The study is also subject to retrospective bias, as participants were asked to reflect on earlier stages of their entrepreneurial journeys. Recollections of start-up and early growth phases may be influenced by subsequent experiences and outcomes, potentially shaping how past networking practices are interpreted and narrated. While retrospective interviews are common and valuable in entrepreneurship research, this limitation should be considered when interpreting the findings. Finally, although the study acknowledges the broader socio-cultural context of Türkiye, including its increasingly conservative dynamics, it does not explicitly examine the role of religion or religiosity in shaping women entrepreneurs' networking behaviours. Religious beliefs and practices may influence the formation of strong family ties, participation in faith-based business networks, or perceptions of appropriate social and professional interaction. The absence of this dimension represents a further limitation and an important area for future inquiry.

Building on these limitations, several avenues for future research emerge. First, future studies could focus on women entrepreneurs in manufacturing who are not affiliated with business associations or formal support organisations to better understand the barriers to network formation and the coping strategies of relatively isolated entrepreneurs. Such research would complement the present findings by illuminating less visible or less advantaged entrepreneurial experiences. Second, longitudinal research designs could provide deeper insights into how women entrepreneurs' networks evolve. Tracking a cohort of women entrepreneurs from the start-up phase onward would allow researchers to observe network development in real time, thereby reducing reliance on retrospective accounts and offering a more dynamic understanding of network formation, transformation, and decline across different stages of the venture life cycle. Third, given the cultural context, future research could explicitly investigate how religiosity and conservative values influence the structure and use of entrepreneurial networks. Examining whether and how religious norms shape trust, legitimacy, and access to resources would contribute to a more nuanced understanding of gendered networking in non-Western contexts. Further research could also move beyond identifying *what* types of networks are used and *how* they are utilised to explore *why* certain networking patterns emerge. In particular, the informal mentorship relationships identified in this study, often described through culturally embedded 'abi/abla' dynamics, warrant closer examination. Ethnographic or process-oriented studies could shed light on how these relationships are formed, the expectations and obligations involved, and the mechanisms through which knowledge and support are exchanged. In addition, future studies might explore

the potential downsides or 'dark side' of social networks. While strong ties can provide emotional and practical support, they may also generate obligations, dependencies, or conflicts that constrain entrepreneurial autonomy and decision-making. Investigating these tensions would offer a more balanced and realistic account of networking dynamics. Finally, methodological diversification would further enrich this research stream. Combining qualitative approaches with quantitative methods, such as Social Network Analysis (SNA), could enable researchers to map the size, density, and structure of women entrepreneurs' networks, complementing in-depth qualitative insights with structural network data.

CONCLUSIONS

This study examines how women entrepreneurs operating in medium- and large-scale manufacturing firms in Türkiye construct and utilise social networks throughout the entrepreneurial process. By focusing on a male-dominated industrial sector within an underexplored institutional context, the study addresses important gaps in the literature on gendered networking practices, which have largely concentrated on service sectors and Western economies. The findings show that women entrepreneurs' networks are dynamic and evolve in response to changing venture needs. In the early stages, strong personal ties, particularly family and close relations, play a central role by providing emotional support, financial resources, and practical assistance. As ventures grow, networks expand to include influential mentors, NGOs, and public institutions, enabling access to legitimacy, specialised knowledge, skilled labour, and strategic opportunities. Rather than replacing one another, different types of ties coexist and interact over time, highlighting an adaptive and strategic approach to networking.

The study contributes to entrepreneurship and social capital literature in several ways. First, it demonstrates that strong ties can function as enabling resources rather than constraints in collectivist and institutionally limited contexts. Second, it extends existing network theories by showing how mentorship relationships, often embedded in culturally specific 'abi/abla' dynamics, blur the boundaries between strong and weak ties. Third, it emphasises the importance of sectoral context, illustrating how the capital intensity and technical demands of manufacturing shape both the structure and function of entrepreneurial networks.

These findings have important implications for policy and practice. Support mechanisms for women entrepreneurs in manufacturing should prioritise intermediary organisations, mentoring systems, and business associations that facilitate access to resources and legitimacy. At the policy level, strengthening formal support structures and improving institutional accessibility may reduce reliance on personal brokerage and promote more inclusive entrepreneurial ecosystems. Overall, the study offers a context-sensitive perspective on women's entrepreneurial networking by highlighting how gender, sector, and institutional conditions jointly shape network formation and use. By foregrounding women's lived experiences in Türkiye's manufacturing sector, the research contributes to a more nuanced and globally relevant understanding of women's entrepreneurship and social networks.

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Motivating Generation Z: An intergenerational and gender-based evaluation using the 9M model

Beáta Melinda Pózner, Anita Kozák

ABSTRACT

Objective: The article aims to identify and organise the key factors that motivate Generation Z (Gen Z) workers. Generation Z enters the labour market with new expectations and preferences. A key issue for companies is to understand and explore what motivates them, as the impact of motivation on performance also affects the company's overall effectiveness.

Research Design & Methods: The article looks at the situation after COVID-19. To provide a theoretical foundation and formulate the hypotheses, we conducted a systematic literature review based on the literature on Generation Z workers' motivation post-2022, published in WoS and Scopus. Moreover, the article also presents the results of a primary study (n=747) based on the analysis of data collected from a questionnaire survey using the 9M motivation model. We identified the most important factors influencing the motivations of Generation Z workers in the workplace, while also presenting these factors in an intergenerational comparison. In addition to descriptive statistics, we analysed the data using inferential methods in the statistical software SPSS and AMOS.

Findings: According to the results of the primary survey, Gen Z workers are most motivated by appreciation and incentives, followed by working conditions (including remuneration, security, support systems) and thirdly by work-life balance (WLB). Among the motivational factors of the 9M, GEN Z exhibit a positive difference compared to previous generations only in terms of WLB, with all other factors being less motivating for them. Kruskal-Wallis H test showed significant differences between generations in the perception of motivational factors, WLB measures p=0, working conditions p=0.024, and quality of work and development p=0.032. The survey also confirmed that the motivation of men and women in Gen Z differs. Women are more motivated by all 9M factors than men, except for organisational culture, which is the least relevant element for Gen Z workers overall.

Implications & Recommendations: Properly motivating Generation Z workers is essential for improving their performance and retention. The study provides an overview of the current situation, and its findings highlight a significant issue.

Contribution & Value Added: Synthesising the literature review and comparing it with the findings of the primary survey helps clarify the motivational factors of Generation Z. The results of the systematic literature review show that there is a limited amount of relevant empirical research on the topic. The study contributes to the existing body of literature on Generation Z motivation.

Article type: research article

Keywords: GEN Z; Generation Z; motivation; work-life balance; workforce

JEL codes: M51, M54, M55

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INTRODUCTION

The best companies invest in human capital (Achmad *et al.,* 2023; Salvadorinho *et al.,* 2024), recognising that attracting, motivating, and retaining a talented, creative workforce is a key management priority for business success (Over, 2016). There is a well-established relationship between motivation and performance (Taryana *et al.,* 2023), with increased motivation leading to higher performance levels (Ryan &

Deci, 2000). Motivation, whether intrinsic or extrinsic, is a driving force rooted in human behavioural theory that sustains an individual's energy to achieve goals; with engagement mediating the relationship between motivation and performance (Nusraningrum *et al.,* 2024). Consequently, work motivation is essential to company success, as it directly influences employee performance and efficiency (Vo *et al.,* 2022). However, motivational drivers differ across generations (Mahmoud *et al.,* 2021; Naim, 2022).

The post-COVID-19 'new normal' environment forces employers to adopt new motivational strategies to retain the younger generation. Hybrid and remote working, as well as the transformation of employee expectations, significantly influence how organisations respond to emerging situations (Zoellner & Sulikova, 2022). The younger generation has developed a greater demand for flexibility and autonomy, which have become important motivational factors, as personal preferences have taken precedence over organisational commitment (Surugiu *et al.,* 2025). However, men and women may interpret the advantages of working from home differently due to varying life circumstances (*e.g.*, childcare, career). Mothers working from home may face more interruptions than men, and stress levels may increase due to the perception and conflict of roles (Hartner-Tiefenthaler *et al.,* 2022). Therefore, the transformation of working arrangements may heighten gender differences and may also give rise to new patterns. Therefore, examining intergenerational and gender differences constitutes an important and relevant topic because, amid the fundamental transformation of workplaces, these differences may either promote or hinder organisational success.

Gen Z members, who have recently entered the labour market, exhibit job preferences that differ significantly from those of previous generations. As such, effectively motivating Generation Z will become increasingly important for enhancing employer attractiveness and improving employee retention (Klages *et al.,* 2023). However, several studies emphasise the lack of surveys in the academic literature on Generation Z's work motivation and expectations (Gribanova, 2024) as well as the need for further research to better understand what drives this cohort in the workplace (Ortiz *et al.,* 2020; Salvadorinho *et al.,* 2024). Moreover, much of the existing data was drawn from student populations with limited or no significant work experience (Barhate & Dirani, 2022).

The article aims to explore and systematise the factors that promote the motivation of Generation Z employees. To achieve this, we first conducted a systematic literature review, summarising the findings of previous studies published after 2022 on Generation Z's motivation in the workplace, using the Web of Science (WoS) and Scopus databases. This was followed by a quantitative questionnaire survey – based on the 9M motivational theory and covering all four generations currently present in the labour market – to allow for intergenerational comparison. A prerequisite for completing the questionnaire was that respondents had to be in active employment and have been working at their current workplace for at least three months.

We also sought to address the following research questions: Are financial incentives and remuneration indeed the most important motivational factors for Generation Z? Are work-life balance (WLB) initiatives more motivating for Generation Z than for previous generations? Are there differences in work motivation between men and women?

The study refines the understanding of extrinsic and intrinsic motivational factors related to Generation Z by examining intergenerational and gender differences. This is of both theoretical and practical interest in the current labour market, as it may support the development of HR policies and inform management decisions.

We interpret the concept of motivation at two levels. On the one hand, in a psychological sense, we treat it as a latent construct, i.e., an individual's internal driving force underlying work behaviour (Deci & Ryan, 2000). On the other hand, in the primary survey of our study, we understand it as a directly observable variable, namely as a motivational factor (an observable proxy indicator, *e.g.*, working conditions, work-life balance), measured using the 9M questionnaire, which captures the needs to live, grow, and relate as empirically measurable dimensions. The latter refers to the measurable dimensions of the motivational structure as 'motivational factors,' while the former addresses its psychological foundations as 'individual motivation.'

Following an introduction to the 9M model, the next chapter of the study conceptualises the notion of generation, presents the main characteristics of Generation Z, and provides a systematic

review of the literature on their work motivation. After outlining the methodology and the research sample, the study discusses the results of the quantitative survey based on the 9M model, presents and discusses the results of the qualitative survey based on the 9M model, and offers practical recommendations. Finally, the article concludes by summarising the key findings, suggesting future research directions, and identifying the study limitations.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The 9M Model

The 9M model, which forms the theoretical background of the preliminary survey, is one of the modern content theories of motivation. Content theories of motivation focus on the underlying reasons for behaviour; they examine what employees need and by what means they can be motivated. Content theories include Maslow's hierarchy of needs (1943), Herzberg's two-factor model (1987), McClelland's (1961) theory of affiliation-achievement-power, and Ryan and Deci's (2000) self-determination theory (SDT). Maslow's theory centres on an individual's psychological needs, arguing that human behaviour is driven by a hierarchy of needs (physiological, safety, social, esteem and self-actualisation). According to Herzberg (1987), motivators (intrinsic motivation, *i.e.*, achievement, recognition, the work itself, opportunities for advancement, personal growth and development) and hygiene factors (extrinsic motivation, *i.e.*, relations with colleagues, company policies, physical work environment, working conditions, pay and status) have different effects on motivation: motivators increase satisfaction, while hygiene factors reduce dissatisfaction. However, the absence of dissatisfaction does not lead to motivation (Thant & Chang, 2021). McClelland (1961) argues that three dominant learned motives drive behaviour: the need for achievement, the need for power and the need for affiliation. Ryan and Deci (2000) distinguish between intrinsic motivation, extrinsic motivation, and amotivation (the absence of motivation). Intrinsic motivation is driven by personal interest and enjoyment, whereas extrinsic motivation is oriented towards achieving outcomes or external rewards. According to the theory, the quality of human motivation depends on the extent to which the basic psychological needs of autonomy, competence, and relatedness are satisfied.

The 9M model places trust between the employer and the employee at its core. Developed by Mathe *et al.* (2011) (see Figure 1), the 9M model (Motivation Spectrum) is structured around three fundamental needs: to live, to grow, and to connect, each of which is associated with three organisational core factors that influence motivation.

- The LIVE dimension encompasses measures aimed at promoting work-life balance (WLB), along with working conditions such as salary, benefits, and job security. It also includes the working environment, which refers to the physical workplace, access to technological and communication tools, cleanliness, safety, ergonomics, and catering facilities.
- The GROW dimension refers to meaningful work and development opportunities, including career advancement, training, and professional growth within the organisation. It also includes recognition and incentives for behaviour that supports organisational goals, such as performance-based rewards; and the setting of clear goals and feedback, *i.e.*, specific, challenging yet achievable targets, deadlines, actions, and performance evaluations provided during and after task completion.
- The CONNECT dimension covers all workplace relationships, including those with supervisors, colleagues, and clients. It also encompasses identification with the organisation's vision and mission, as well as the culture (*i.e.*, the shared mindset and beliefs) that unite and inspire employees.

Some concepts may require further clarification. *Quality work*, *i.e.,* high-standard, well-executed work can itself be a reward for the employee, increasing feelings of self-efficacy and satisfaction (Deci & Ryan, 2000). *Incentives* can be regarded as external motivators linked to tangible or financial rewards (*e.g.*, salary increases, bonuses, benefits). By contrast, *recognition* is a socio-psychological construct that strengthens motivation through appreciation or verbal feedback. Although both originate from external sources, recognition primarily influences the employee's need for competence and relatedness, and therefore enhances intrinsic motivation when provided in a supportive manner (Deci & Ryan, 2000), whereas incentives target the instrumental aspect of motivation.

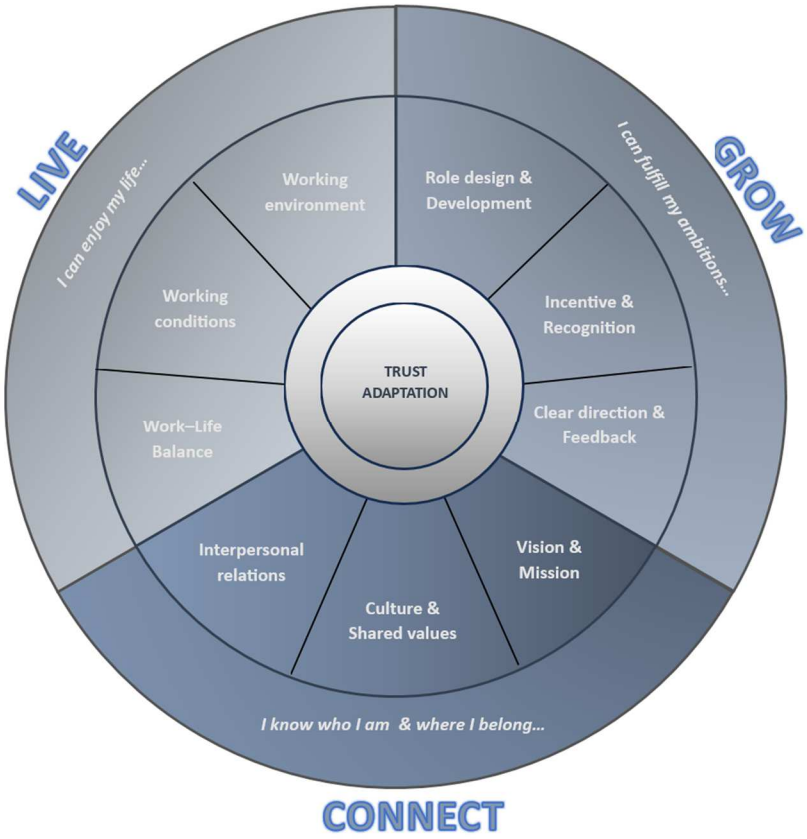

Figure 1. 9M Motivational model
Source: own elaboration based on Mathe *et al.* (2011)

The 9M motivational model is novel in that it synthesises the insights of earlier theorists and facilitates simpler organisational adaptation. It functions as a motivational mix that helps organisations design more effective and efficient motivational systems (Balogh & Nagy, 2023). In the 9M model, unlike Maslow's theory, motivation appears as a multidimensional organisational system, where motivating factors operate not hierarchically but in parallel. The model also incorporates Maslow's levels of needs, but interprets them at a systemic level (*e.g.*, Maslow's social need corresponds to the *personal relationships* dimension in the 9M model). Likewise, the 9M model includes Herzberg's motivators and hygiene factors, but it deconstructs Herzberg's duality: according to the concept, management must place strong emphasis on all nine motivational factors to achieve high motivation. McClelland's learned needs also appear within the 9M model, as the nine motivational factors are structured around three needs: *to grow*, *to connect*, and *to live*. The need *to grow* corresponds to the achievement motive, the need *to connect* to the affiliation motive, while the need *to live* – extended to include the need for safety and control – parallels the power motive. However, while McClelland treats these needs as individual motives, the 9M model positions them within the organisational framework of work conditions.

Likewise, Ryan and Deci's self-determination theory appears in the 9M model. While SDT describes from a psychological perspective how intrinsic motivation arises from the satisfaction of three basic needs (autonomy, competence and relatedness), the 9M model maps these needs to organisational dimensions. In this way, one may interpret the 9M model as a management-implementation model of SDT.

Generations

We attribute the contemporary interpretation of the generational concept to Karl Mannheim. According to the Hungarian-born sociologist, individuals born within a particular period tend to share similar characteristics, ways of thinking, attitudes, values, beliefs, and behaviours, which distinguish them

from other cohorts (Mannheim, 1952). While there are variations among researchers regarding the delineation of generational boundaries, this study adopts the classification proposed by McCrindle and Wolfinger (2010). At present, the human capital present in the labour market comprises four generations: the Baby Boomers (1946-1964), Generation X (1965-1979), Generation Y (1980-1994), and the youngest, Generation Z (1995-2009). Notably, we should not see generational boundaries as rigid distinctions but rather as indicative guidelines (PRC, 2015); useful for categorising cohorts and conducting behavioural and attitudinal analyses (Mahmoud, 2021).

In what follows, the study focuses specifically on Generation Z, both in the presentation of the theoretical framework and throughout the analyses.

Key Labour Market Characteristics of Generation Z

Members of Generation Z were born into the digital age (Rachmatdianto *et al.,* 2023), so they bring advanced technological expertise with them as they enter the labour market (Bhore & Tapas, 2023). They utilise digital technologies and social networks (Magano *et al.,* 2020) for both information gathering and communication. Social media platforms influence not only employer attractiveness but also the Generation Z candidates' application intentions (El-Menawy & Saleh, 2023). When seeking information about an organisation's culture and the employment conditions, Generation Z tend to rely on independent sources (Ling & Lew, 2024).

The online world connects and globalises this generation. They are capable of performing a wide range of tasks (Rosdiana, 2020), which can be an advantage in the workplace.

Their attitude towards work differs significantly from that of previous cohorts (Grigore & Elbers, 2023), and they exhibit unique work values and behaviours (Chillakuri, 2020). Their expectations are high, and they are often difficult to motivate (Kozák & Pózner, 2024). Generation Z tends to be more impatient, not only in their private lives but also in the workplace (Smolka, 2019), and they often struggle to accept criticism, which can lead to increased conflict (Bencsik *et al.,* 2016).

Higher rates of turnover are characteristic of this cohort; they frequently change jobs without strong loyalty or emotional attachment (Nieżurawska & Galaś, 2021). They generally do not plan to remain long-term with a single employer, but instead seek organisations that align with their preferences (Bucovetchi *et al.,* 2019). To retain Generation Z employees, it is essential to focus on their motivation (Barhate & Dirani, 2022); without sufficient attention to this, turnover rates are likely to rise (Shah & Asad, 2018).

In the case of intrinsic motivation, employees are significantly more likely to be motivated and perform well compared to when they are extrinsically motivated. In fact, internally motivated individuals are generally less influenced by financial incentives (Ryan & Deci, 2000). Extrinsic motivators, beyond financial rewards, include working conditions, recognition, work-life balance (WLB), and career opportunities, although some studies suggest that career development can foster intrinsic motivation (Springer, 2023).

Research findings indicate that members of Generation Z are generally more sensitive to motivational factors, and external rewards can be effective tools for encouraging them (Lašáková *et al.,* 2023). However, their intrinsic motivation contributes to their work engagement to a greater extent than is the case for the previous two generations (Mahmoud *et al.,* 2021).

Ichsan *et al.* (2021) further emphasise the importance of intrinsic motivation. They state that passion is of greater importance to Generation Z, and that they work not solely for material compensation. According to Autin *et al.* (2022), a sense of meaningful work is a decisive factor in their work motivation. While salary and professional development are also important to them, Generation Z places a higher value on work-life balance compared to earlier cohorts (Vieira *et al.,* 2024). They prefer jobs that offer flexibility in terms of both working hours and location (Minahan, 2021). Work-life balance is particularly critical, as its absence can lead to higher turnover rates (Pulevska-Ivanovska *et al.,* 2017). Generation Z prioritises their private life (Bińczycki *et al.,* 2023) and typically resists working overtime. They do not want to make additional efforts for the sake of their managers or for their job (Baša *et al.,* 2023).

The motivation of Generation Z: A Systematic Literature Review and Hypothesis Development

The existing literature has already identified factors that can effectively motivate Generation Z. However, a systematic synthesis and thematic summary of these findings offers a more objective understanding of their motivational drivers. To this end, we conducted a systematic review of 19 relevant studies, drawing from the WoS and Scopus databases. We present the findings thematically: the first subsection explores studies related to the 9M motivation model, including generational and gender differences, while the second subsection highlights insights into flow experiences, autonomy, and development.

Motivational Factors and Preferences: Generational Differences

Table 1 lists the studies included in the analysis in connection with the 9M motivational model, grouped by motivational factor.

Table 1. The most important motivational factors mentioned

9M factors	Motivating factors	Bibliography
Work-Life Balance	Free time	Machova *et al.,* 2022; Jackel & Garai-Fodor; 2024; Gribanova, 2024
	WLB, flexible working hours	Baša *et al.,* 2023; Revuru & Bandaru, 2024; Ling & Lew 2024; Gribanova, 2024; Surugiu *et al.,* 2025
Working conditions	Salary	Machova *et al.,* 2022; Baša *et al.,* 2023; Jackel & Garai-Fodor, 2024; Revuru & Bandaru, 2024; Ling & Lew 2024; Gribanova, 2024; *Surugiu et al.,* 2025
Working environment	Well-being	Surugiu *et al.,* 2025
Role design & Development	Realising own vision, career	Jackel & Garai-Fodor, 2024; Ling & Lew 2024
	Sensible work	Revuru & Bandaru, 2024
	Skills development	Surugiu *et al.,* 2025,
Incentive & Recognition	Bonus	Machova *et al.,* 2022; Surugiu *et al.,* 2025
	Praise, recognition, appreciation	Machova *et al.,* 2022; Baša *et al.,* 2023; Surugiu *et al.,* 2025
Clear direction & Feedback	Feedback	Plakhotnik, 2024
Vision & Mission	–	–
Culture & Shared values	–	–
Interpersonal Relations	Good working atmosphere	Baša *et al.,* 2023

Source: own study based on systematic literature review.

In terms of preferences, among the motivational factors encouraging better performance, Jäckel and Garai-Fodor's (2024) study found that for Generation Z, the top priority is a higher salary, followed by more free time, and then the opportunity to realise their own ideas. Career advancement ranks only sixth behind a modern working environment and teamwork. These findings are supported by the results of a survey involving 2 153 Generation Z IT professionals living in EU countries, which showed that work motivation among these young specialists is primarily driven by fair remuneration and the freedom to organise their own working hours; they place greater value on freedom, fairness and tolerance than on convenience or career advancement (Gribanova, 2024).

The most recent study in the systematic literature review also confirms that salary remains the primary motivator for Generation Z, followed by other financial benefits and, in third place, flexible working arrangements (Surugiu *et al.,* 2025). Surugiu *et al.* (2025) have identified four key factors as central elements of motivational strategies: high levels of recognition, support for skill development, management recognition that increases productivity, and employee well-being.

Dwivedula (2025) emphasizes intrinsic motivation; according to his research, the nature of the work, the task, support, future opportunities, references, opportunities to gain experience, and career development are the primary factors explaining Generation Z's motivation to work. Similarly, a survey of Indian Generation Z members found that meaningful work is the top motivator, followed

by work-life balance, managerial credibility, and efforts to fine-tune gender balance – these being the most important motivational tools (Revuru & Bandaru, 2024).

However, motivators evolve (Ling & Lew, 2024). Intergenerational research indicates that financial incentives (such as salary increases and bonuses) motivate all generations, but Generation Z is particularly driven by bonuses, praise, and increased free time. Moreover, the research also revealed that they are less satisfied with job security and do not feel their knowledge and skills are being fully utilised (Machova *et al.,* 2022). Other studies indicate that, alongside higher salaries, a positive workplace atmosphere and recognition are the most motivating factors for Generation Z, who prefer to work with flexible hours in a private or medium-sized company, and they are also particularly inclined to consider employment opportunities abroad (Baša *et al.,* 2023).

Ling and Lew's (2024) intergenerational study also shows that hygiene factors (*e.g.*, salary, career opportunities) matter more to Generation Z than to previous generations. Nevertheless, workplace flexibility emerges as the most important motivational factor for this generation. Ludviga and Sluga's (2023) study identified seven value dimensions: performance, supervision, comfort, altruism, independence, excitement, and technology with the latter two being more significant for Generation Z. We could explain this by the fast-paced, technology-oriented nature of Generation Z. Plakhotnik *et al.* (2024) highlighted that, compared to previous generations, Generation Z prefers regular feedback from the workplace, while working conditions are less motivating for them.

Several studies suggest that Generation Z considers higher salaries and fair compensation as the most important financial incentives (Baša *et al.,* 2023; Jäckel & Garai-Fodor, 2024; Gribanova, 2024; Surugiu *et al.,* 2025), while also highlighting flexible working hours (Surugiu *et al.,* 2025), and the freedom to plan work schedules (Gribanova, 2024), more freetime (Jäckel & Garai-Fodor, 2024), both of which support work-life balance. Some studies even identify work-life balance as the most important motivational factor (Ling & Lew, 2024), while career progression is ranked lower in two studies (Gribanova, 2024; Jäckel & Garai-Fodor, 2024). However, it remains unclear to what extent the differences between Generation Z and previous generations manifest, or which factors employers should prioritise to effectively motivate them.

These prior empirical results support the formulation of the following research hypotheses:

H1: Generation Z is most motivated by financial incentives and fair pay, i.e., working conditions, according to the 9M model.

H2: WLB measures are more motivating for Generation Z than for previous generations.

There are also differences in motivational factors between genders: for Generation Z women, personal relationships, successful work, external recognition, and low levels of stress are the key motivators. In contrast, for men, a happy private life, stress-free living, and leisure time are the driving forces (Lašáková *et al.,* 2023). Ganguli and Padhy's (2023) study highlights the significance of gender differences: they argue that work motivation significantly impacts retaining Generation Z employees, a factor that gender can moderate.

Gender-based fine-tuning is one of the most important motivational tools (Revuru & Bandaru, 2024), yet it remains unclear what differences exist between men and women's motivation. Generation Z shows stronger intrinsic motivation compared with previous generations (Machmoud *et al.,* 2021). Therefore, it would be important to examine which motivational factors are preferred by men and women to provide insights for one of the key HR challenges: retaining Generation Z members.

This led us to the following research hypothesis:

H3: Generation Z men and women differ in their motivational drivers.

Flow Experience, Development, and Autonomy

Salvadorinho *et* al*.* (2024) identified six motivational factors related to Generation Z: autonomy, competence, affiliation, purpose, flow state, and performance. 'Flow is the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it' (Csikszentmihalyi, 1990, p. 4). 'Autonomy refers to being the perceived origin or source of one's own behaviour.' (Deci & Ryan, 2000, p. 231).

According to Berke and Balázs (2023), the flow experience is more prevalent among new entrants, individuals in lower positions, and those working remotely. However, women's experience of flow is disrupted by unexpected, new tasks, while men's flow is hindered by the stress associated with multitasking. These findings suggest that Generation Z more consciously seeks flow in the workplace, making it essential for them to have clear expectations regarding their specific tasks.

Motivation influences happiness. In turn, happiness significantly impacts performance and improves job satisfaction. Astuty *et al.* (2025) explored the mediating role of satisfaction between motivation and performance. Based on the concept of workplace happiness known as Hygge, Nieżurawska *et al.* (2023) recommend the establishment of the Chief Happiness Officer (CHO) position and the development of a 'self-managed motivation structured, multi-dimensional model.'

Examining the relationship between gamification and productivity, Tayal and Rajagopal (2024) found that gamification enhances both motivation and productivity, with autonomy acting as a key mediating factor. Autonomy is strongly linked to the intrinsic motivation of Gen Z employees, and there is also a significant relationship between intrinsic motivation and retention (Lee *et al.,* 2022). Yang *et al.* (2024) have demonstrated the positive impact of mentoring on the proactivity of new employees.

Flow experiences make individuals happier (Berke & Balázs, 2023), and happiness in turn enhances performance (Astuty *et al.,* 2025). An autonomous environment can facilitate an individual's entry into a flow state and strengthen intrinsic motivation, as external control or coercion reduces the likelihood of experiencing flow (Nakamura & Csíkszentmihályi, 2009). The nature of the work itself is also crucial for the development of flow: individuals need to be able to work autonomously and make their own decisions.

Autonomy is directly linked to the intrinsic motivation of Generation Z, which is significantly associated with retention (Lee et *al.,* 2022). Based on the reviewed studies, we may state that the experience of flow can be considered a motivational factor (Salvadorinho *et al.,* 2024) and that Generation Z actively seeks opportunities to experience flow (Berke & Balázs, 2023). The question remains how important these factors are for them, and to what extent they may enhance their performance.

These empirical findings indicated the following research hypothesis:

H4: The most crucial factors for Gen Z are those that provide a flow experience and autonomy, such as quality work and professional development.

RESEARCH METHODOLOGY

Research Purpose and Background

This research aimed to identify the motivational factors of Generation Z using the 9M model. By employing an abductive research methodology — which integrates both inductive and deductive approaches — it bridges theoretical concepts with empirical data, thereby providing stronger evidence for addressing the research question (Hurley *et al.,* 2021).

As part of the deductive approach, we conducted a systematic literature review (SLR) focusing on academic sources related to the work motivation of Generation Z. These secondary data informed the development of the theoretical framework concerning Generation Z's motivation. From an inductive perspective, we conducted a primary online survey in Hungary using LimeSurvey. The survey sample included respondents from all four generational cohorts currently active in the labour market: Baby Boomers, Generation X, Generation Y, and Generation Z.

The national context may significantly influence the results interpretation and their transferability to other countries. Social norms, national values and economic conditions can affect motivational factors. Post-socialist countries, including Hungary, display high uncertainty avoidance scores according to Hofstede's cultural dimensions (Hofstede Insights, 2024). Although the economic and social changes following the political transition increased individual autonomy, distrust and risk aversion have remained more pronounced in both employer and employee behaviour than in Western European contexts, which may influence perceptions of work-life balance and other motivational factors (Bakacsi *et al.,* 2002; Hofstede Insights, 2024). Therefore, we may generalise findings primarily to the Hungarian

employee population; further validation studies would be required to confirm their applicability in other cultural environments.

Systematic Literature Review

We based the literature review on the motivation of Generation Z employees on publications found in the Web of Science (n = 48) and Scopus (n = 70) databases, covering the period from 2022 to 20 February 2025. We conducted the search using the following keywords and settings, without restrictions on document type or language:

Abstract: 'Z GEN' OR 'GEN Z' OR 'Z Generation' OR 'Generation Z'
AND Abstract: 'workforce*' OR 'workplace*' OR 'employee*'
AND Topic/Article Title, Abstract, Keywords: „motivation' OR „motivat*'

In the Web of Science database, the 'Topic' field included searches within publication titles, abstracts, and keywords. The screening and selection process followed a modified version of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, adapted for dual-database screening, as shown in Figure 2. After removing 35 duplicate records, we reviewed the abstracts of the remaining 83 sources. Of these, we deemed 20 publications relevant. However, we excluded one article due to a lack of full-text access, resulting in a final sample of 19 studies for in-depth analysis.

Identification	Documents identified via database searching in WoS (n=48)	&	Documents identified via database searching in Scopus (n=70)
	↓		↓
Screening	WoS documents after language screening (n=48)	&	Scopus documents after language screening (n=70)
		Documents after discarding duplications (n=35)	
		↓	
Eligibility	**Abstracts screened opposite to criteria (n=83)**	–	**Documents discarded as not adequately suitable (n=63)**
		↓	
Screening	**Full document source, availability screening (n=20)**	–	**Documents deemed inappropriate or unavailable (n=1)**
		↓	
Eligibility	**Main content determinded for acceptability (n=19)**	–	**Documents removed as not compatible on full reading (n=0)**
		↓	
Included		**Studies included in qualitative synthesis (n=19)**	

Figure 2. Flowchart of the screening process for the systematic literature review
Source: own elaboration based on the PRISMA framework (Page *et al*., 2021), adapted and extended to two databases.

Primary Survey Based on the 9M Model

We conducted the primary survey in 2024 using an online questionnaire created with LimeSurvey, applying the snowball sampling method. We used the snowball sampling method because an initial sample with a relatively broad and nationwide network distributed the questionnaire specifically to individuals with labour market experience. This method allowed us to reach a relatively large sample with wide geographical coverage and was aligned with our aim of exploring motivational patterns among employees working in organisations and coming from diverse backgrounds. The sample is not repre-

sentative, but the respondents came from varied groups in terms of gender, age, educational attainment, organisational size, sector and other socio-demographic characteristics (Appendix 1). The questionnaire began with an introduction outlining the study purpose, instructions for completion, and details about anonymity and the voluntary nature of participation. A prerequisite for participation was that respondents had prior work experience. To enable generational comparisons, the questionnaire included sociodemographic questions that allowed for the identification of generational cohorts. The survey also incorporated validated items based on the 9M motivation model, each accompanied by detailed explanatory notes to ensure clarity and consistency in interpretation. In total, we collected and analysed 747 valid responses (see Table 2).

Table 2. Sample characteristics

Generation				Gender*		Highest level of education**		
BB	X	Y	Z	Male	Female	Basic / Secondary	Higher (BA/BSC)	Master's / PhD
33	185	353	176	359	386	239	320	178

Note: *2 respondent did not specify their gender or chose not to answer (Gen Z is not affected), **10 respondents chose not to answer, or only had a primary school education.
Source: own study based on the research results (n = 747).

Participants responded to the 9M motivation model items using a 7-point Likert scale (polytomous), where: 1: Not motivating at all, 2: Not motivating, 3: Rather not motivating, 4: Neutral, 5: Rather motivating, 6: Motivating, 7: Fully motivating.

We analysed data using SPSS 29.0 and IBM SPSS Amos 26.0 statistical software. We tested the normality of the distribution of values using the one-sample Kolmogorov-Smirnov test. According to the null hypothesis, the sample followed a normal distribution. However, for all factors examined, the significance value was $p < 0.001$, indicating that the sample was not normally distributed. Therefore, we conducted Kruskal-Wallis H tests and Mann-Whitney U rank-sum tests to examine the relationships between the grouping variables and the questionnaire items (Field, 2018).

Due to the self-reported nature of the questionnaire data collection, we examined the potential presence of common method bias (CMB). The validity of the 9M model in a Hungarian sample was previously assessed by Balogh and Nagy (2023). We conducted a principal component analysis (PCA) on the nine elements of the model; the results showed that the structure fully reflected the original nine components, although the PCA grouped the elements differently based on the responses of the present sample. This was likely because, although most participants in Balogh and Nagy's (2023) sample (n = 121) had work experience, they were students at the time of completing the questionnaire. For this reason, in the present study, we applied a factor-analytic procedure to the items measuring the nine dimensions of the 9M model to assess its structural validity.

We verified the data suitability for factor analysis using the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value exceeded 0.8 (0.887), which is considered excellent (Kaiser, 1974), and Bartlett's test produced a significant result ($p < 0.001$), confirming that the data were appropriate for factor analysis (Bartlett, 1954).

To uncover the underlying dimensions of the variables, we performed an exploratory factor analysis (EFA) using the principal component analysis (PCA) method. In Harman's single-factor test (Podsakoff *et al.,* 2003), we entered all variables into a single unrotated factor analysis. A potential CMB issue is indicated if the first factor accounts for more than 50% of the total variance.

According to the results of Harman's single-factor test, the first factor explained 52.8% of the total variance, which is close to the threshold but does not indicate substantial bias. The rotated factor structure confirmed this result, as two clearly distinct components emerged. After rotation, the first component explained only 38.9% of the variance, allowing us to conclude that no serious common method bias was present (Podsakoff *et al.,* 2003).

Based on the Varimax rotation (Kaiser, 1958) shown in the Rotated Component Matrix, seven variables associated with work-related aspects loaded on the first component, while two variables (culture and mission), reflecting organisational values and identification, loaded on the second component

(Appendix 2). Thus, we could describe the construct along two clearly distinguishable dimensions. The results suggest that the items of the 9M model did not cluster along the original three needs (to live, to grow, to relate), but rather form two more dominant factors. The motivational patterns of the examined population, therefore, exhibited a more aggregated and generic structure.

For the evaluation of model fit indices in the confirmatory factor analysis (CFA), we used the threshold values recommended by Hu and Bentler (1999), Kline (2016), Byrne (2016), and Hair *et al.* (2019). According to these guidelines, CFI, TLI and GFI values above 0.90, RMSEA below 0.08, and χ^2/df values below 5 were considered acceptable. The CFA results indicated an acceptable model fit: χ^2/df = 7.18, GFI = 0.946, AGFI = 0.906, CFI = 0.951, TLI = 0.932, NFI = 0.943, IFI = 0.951, RMSEA = 0.091 (90% CI = 0.079-0.104). Although the χ^2/df and RMSEA values deviated slightly from the ideal range, the overall fit indices indicated that the model was structurally valid and the fit could be considered adequate (CFI, TLI, GFI > 0.90). The analysis supported the empirical credibility of the study. Minor modifications (*e.g.*, correlating certain item error terms) could further improve model fit. The Hoelter index (N = 156) and AIC value (224.67) also fell within the acceptable range, indicating that the sample size was sufficient.

We employed both descriptive and inferential statistical methods to examine the relationships between variables. To determine whether statistically significant differences existed among generational cohorts, we used the Kruskal-Wallis H test, applying a significance level of 0.05.

To explore gender-based motivational differences within Generation Z, we employed the Mann-Whitney U test, along with an approximation of the Z normal distribution, also using a 0.05 significance threshold.

RESULTS AND DISCUSSION

Intergenerational Analysis

We conducted the Kruskal-Wallis H test to assess potential differences between generational groups at the 0.05 significance level (Asymptotic Significance) regarding the evaluation of the 9M motivational factors. The test indicated statistically significant generational differences in the importance of work-life balance (p = 0.000), working conditions (p = 0.024), and the motivational factor of quality work and development (p = 0.032) (see Table 3). (df refers to degrees of freedom, calculated as the number of groups minus one).

Table 3. Intergenerational differences in 9M motivation factors

Spectrum	9M Motivation Factor	Kruskal-Wallis H	df	Asymp. Sig.
LIVE	Work-Life Balance	25.097	3	**0.000 ***
	Working conditions	9.455	3	**0.024 ***
	Working environment	7.679	3	0.053
GROW	Role design & Development	8.835	3	**0.032 ***
	Incentive & Recognition	4.248	3	0.236
	Clear direction & Feedback	1.022	3	0.796
CONNECT	Vision & Mission	3.309	3	0.346
	Culture & Shared values	4.792	3	0.188
	Interpersonal relations	5.715	3	0.126

Note: * Statistically significant at the 0.05 level.
Source: own study in SPSS (n = 747).

We measured the dependent variables using a Likert scale and treated them as interval-level variables (based on a Likert scale), enabling the calculation of mean values. As the primary objective of the study was to map and analyse the motivational preferences of Generation Z, Figure 3 presents the elements of the 9M model in the order of ratings assigned by the Generation Z sample. The columns in the figure, arranged from left to right, display the average response values for each of the four generation cohorts (Baby Boomers, Generation X, Generation Y, and Generation Z).

For Generation Z, the most motivating factor was *Incentive & Recognition* (5.95), which involves acknowledging behaviours that support organisational goals and performance-based rewards. *Work-*

ing conditions ranked second (5.90), covering remuneration, job security, and support systems. However, in comparison to Generations X and Y, *Working conditions* were relatively less motivating for Generation Z. In third place was *Work-Life Balance* (5.88), which was notably more motivating for Generation Z than for the three preceding generations.

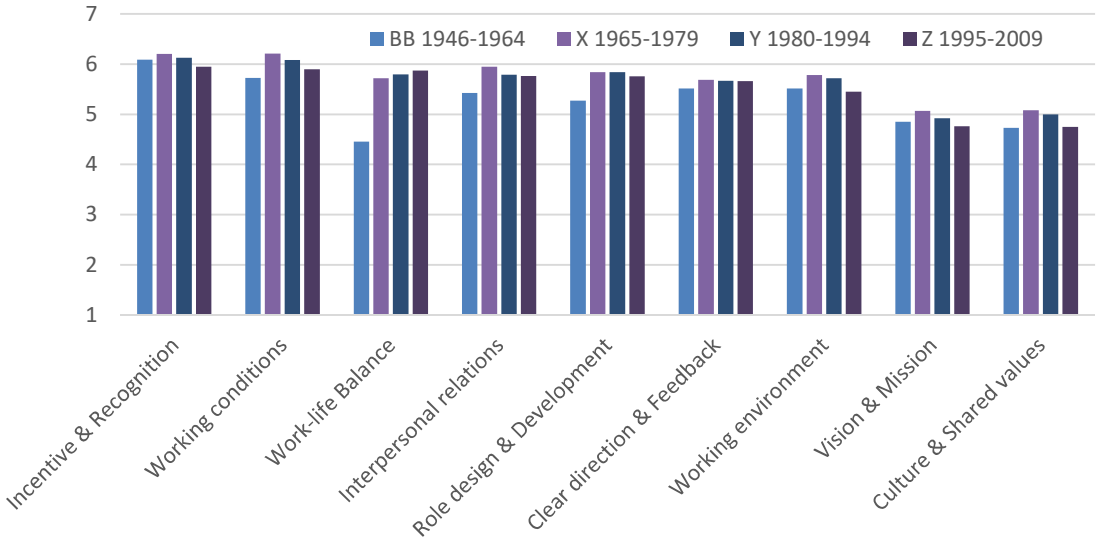

Figure 3. Intergenerational variation in 9M factors
Source: own elaboration (n = 747).

These results align with the findings of Surugiu *et al.* (2025), who identified salary, additional financial benefits, and flexible working arrangements as the three most motivational factors for Generation Z. The current study also reinforces the conclusions of Gribanova (2024), Jäckel and Garai-Fodor (2024), and Baša *et al*. (2023). Gribanova (2024) emphasised fair compensation and autonomy in work schedule planning as the key motivating factors among Generation Z. Similarly, in the 2024 survey by Jäckel and Garai-Fodor, salary ranked as the most important motivator, followed by increased free time. Baša *et al.* (2023) identified higher pay and flexible working hours as the most significant motivational factors for Generation Z. Thus, we only partially confirmed the first (H1) hypothesis stating that *Generation Z is most motivated by financial incentives and fair pay, i.e., working conditions, according to the 9M model*. It is significant, but it does not motivate them more than previous age groups.

Following *Incentive & Recognition* – the most motivating factor for Generation Z –, *Working conditions,* which include aspects such as pay, rank second. At the same time, both factors are less significant motivators for Generation Z compared with the two preceding generations, although we observed a statistically significant difference only for *Working conditions*. *WLB* ranks third.

This result contradicts several previous studies. For instance, Vieira *et al.* (2024) found that WLB is more important than salary, while Ling and Lew (2024) identified WLB as the single most important factor for Generation Z. However, the findings are consistent with those of Gribanova (2024) and Surugiu *et al.* (2025), who emphasised salary, financial benefits, and flexible work arrangements, including the autonomy to plan one's working hours, as key motivators for this generation. This suggests that although material factors remain important for Generation Z, the drivers of their motivation are shifting towards non-material needs.

Nevertheless, when examining the elements of the 9M model, it becomes evident that only *Work-life Balance* (*WLB*) is the only factor rated more highly by Generation Z than by previous generations. Therefore, we accepted the second (H2) hypothesis.

WLB refers to working practices that help individuals maintain equilibrium between their professional and personal lives. These include flexible working arrangements, adaptable schedules, autonomy in planning working hours, and extended holiday entitlement. Within the reviewed literature, WLB is explicitly addressed only in the study by Revuru and Bandaru (2024), where it is identified as a core work value highly appreciated by Generation Z.

Importantly, both financial incentives and *WLB* are considered external motivational factors (Springer, 2023). This partially supports the findings of Link and Lew (2024), who argued that Generation Z places greater importance on hygiene factors than previous generations, as a positive difference is observed only in relation to *WLB*.

Interestingly, Generation Z rated eight out of the nine motivational factors as less motivating, except *WLB*. This suggests that Generation Z may be more intrinsically motivated than prior cohorts, though this assumption requires further empirical investigation.

Among Generation Z respondents, *Interpersonal relations* (5.77) ranked fourth, while *Role design & Development* (5.76) placed fifth. Both were perceived as less motivating compared to the two preceding cohorts; however, we found a statistically significant difference only for *Role design & Development*. Based on these findings, we rejected the fourth (H4) hypothesis.

Conditions that support flow experiences and autonomy, such as quality work and development opportunities, are not the most important for Generation Z. These results contradict the conclusions of Berke and Balázs (2023), who suggested that Generation Z consciously seeks flow experiences in the workplace. In contrast, quality work and development opportunities appear to be more significant for Generations Y and X than Generation Z.

We found *Clear direction & Feedback* (5.66) to be equally motivating for Generation Z as for previous generations. By contrast, *Working environment* (5.45) and *Vision & Mission* (4.76) were among the least motivating factors for Generation Z. Notably, *Culture & Shared values* (4.75) was the least motivating factor, both in comparison to Generations X and Y and within Generation Z's own motivational profile.

Interpreting the generational and gender differences observed in the results requires careful consideration of the socio-economic context in Hungary. Generation Z entered the labour market at a time characterised by economic uncertainty, accelerated digitalisation and inflationary pressure (OECD, 2024).

Regarding hypotheses H1, H2 and H4, the results partially contradict earlier theoretical expectations. For Generation Z, external motivational factors (*e.g.*, *Incentive & Recognition*) may still play a more significant role in employee motivation than conditions supporting intrinsic motivation. This suggests that although autonomy and flow are psychologically advantageous, experiencing these states does not yet necessarily become a central source of motivation for younger employees. The emphasis on autonomy and self-realisation reported in Western European and Asian studies may be attributable to different cultural patterns.

Notably, Plakhotnik (2024) noted that Generation Z prefers regular feedback more than previous generations. Although *Incentive & Recognition* (recognition of behaviours that support organisational goals and performance-based rewards) proved to be the strongest motivational factors for the surveyed Generation Z group, based on the present findings, their motivational effect is weaker than among older generations. This may be rooted in economic, cultural and generational specificities.

Many young people face financial insecurity at the start of their careers. Therefore, external motivators such as feedback and rewards gain greater significance (Deci & Ryan, 2000). In addition, the post-COVID socio-economic context may also have reshaped young employees' priorities. Wages have not kept pace with inflation (Pózner & Kozák, 2024), and the combination of rising living costs and economic uncertainty may have elevated the importance of financial factors. This could explain why *Incentive & Recognition* and the stability and security provided by *Working conditions* (including remuneration, safety and support systems) emerged as key motivators for Generation Z.

The expectation for continuous reinforcement and immediate feedback may be a natural consequence of growing up in a digital culture characterised by instant reactions (*e.g.*, likes and emojis). In workplace environments that offer limited autonomy, appreciation and incentives may remain the primary motivation source. This aligns with self-determination theory (SDT), which states that recognition, when informational rather than controlling, can support the need for competence and thereby strengthen intrinsic motivation (Deci & Ryan, 2000). Generation Z's intrinsic motivation is stronger than that of the preceding two generations (Mahmoud *et al.,* 2021).

The importance of these factors may also be reinforced by Hungary's cultural context, which is characterised by high uncertainty avoidance (Hofstede Insights, 2024), as security is a crucial element of individual motivation (Hofstede, 2001).

Young people seek stability not through long-term loyalty but through moral and financial recognition of their performance and the security provided by *WLB*. The higher value placed on *WLB* reflects Generation Z's preference for flexible, autonomy-supportive work environments, which aligns with the importance of intrinsic motivational needs (Deci & Ryan, 2000).

For Generation Z, flexibility, adaptability to change, and readiness to start anew are common experiences, shaped not only by digitalisation but also by the economic fluctuations characteristic of recent decades. Similarly, Twenge *et al.* (2012) observed that young generations' motivational patterns adapt flexibly to economic and social conditions. Generation Z enters a labour market in which security and financial recognition have once again become central values.

In the context examined here, Generation Z employees appear to be characterised by a dual orientation towards external recognition and self-assertive security-seeking. While relying on both financial and social feedback, they also expect working conditions that ensure a balanced work-life interface and support personal development. When these needs are not met, they do not hesitate to leave the organisation. This behaviour may be reinforced by the tight Hungarian labour market, which reduces the risks of job change, and the high uncertainty avoidance may be compensated by the pursuit of roles that better meet their expectations.

Among the 9M model's motivational factors, *WLB* is the only factor rated more highly by Generation Z than by previous generations. In a previous Hungarian survey, HR professionals and executives observed positive differences in seven out of the nine factors (Kozák & Pózner, 2024), meaning they perceived them to be more motivating for Generation Z than for prior cohorts. This indicates a discrepancy between professional perceptions and the actual motivational patterns, highlighting the need for HR specialists to address this perception gap.

The analysis of generational differences shows that motivational factors carry different weights across generations. While *Incentive & Recognition* and *Working conditions* rank highest in all groups, what follows varies: for Generation Z, *WLB* is particularly salient; for Generation Y, high-quality work and development opportunities stand out; and for Generation X, personal relationships play a stronger motivational role. Except *WLB*, all factors exhibit a declining trend across generations. This suggests that younger generations' motivational structures increasingly emphasise individual well-being, autonomy and quality of life, whereas for older generations, factors linked to traditional expectations (development, personal relationships) remain more motivating. Overall, the generational motivational patterns indicate a gradual value shift in the world of work: although the need for external recognition and security remains important, younger generations are increasingly driven by intrinsic well-being, autonomy and the preservation of life quality as core sources of workplace motivation.

Gender-based Analysis

We conducted a non-parametric Mann-Whitney U test (Table 4) to examine potential gender differences within Generation Z regarding the 9M motivational factors. In this analysis, gender served as the dichotomous independent variable, while the 9M motivational factors functioned as the dependent variables. For a large number of elements, it is also recommended to look at the approximation to the normal distribution. The absolute value of a Z-score, denoted by $|Z|$ indicates the result of the approximation to the normal distribution.

We found a statistically significant difference between genders in the *Clear direction & Feedback* factor. The second largest difference appeared in *Work-life Balance* factor, although this difference was not statistically significant. Figure 4 illustrates the extent of these gender differences using average values, with a horizontal line indicating the overall mean score for the Generation Z sample.

Men and women ranked motivational factors differently. Among male respondents, *Working conditions* ranked first, followed by *Incentive & Recognition* in second place, and *Role design & Development* (which includes career opportunities) in third. In contrast, female respondents ranked *Incentive & Recognition* as the most important factor, followed by *Work-Life Balance* initiatives in second place and *Working conditions* in third. Notably, *Role design & Development* ranked only sixth among women.

Table 4. Gender difference in 9M motivation factors

Spectrum	9M Motivation Factor	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)
LIVE	Work-Life Balance	3237.5	-1.860	0.063
	Working conditions	3830.0	-0.005	0.996
	Working environment	3277.5	-1.698	0.090
GROW	Role design & Development	3791.0	-0.126	0.900
	Incentive & Recognition	3298.0	-1.685	0.092
	Clear direction & Feedback	3102.5	**-2.254****	**0.024***
CONNECT	Vision & Mission	3676.0	-0.471	0.637
	Culture & Shared values	3621.0	-0.638	0.523
	Interpersonal relations	3538.0	-0.912	0.362

Note: * Statistically significant at the 0.05 level; **The absolute value of Z exceeds the critical value of 1.96 at the 0.05 significance level, so the difference between the two samples is considered statistically significant.
Source: own study in SPSS (n = 176).

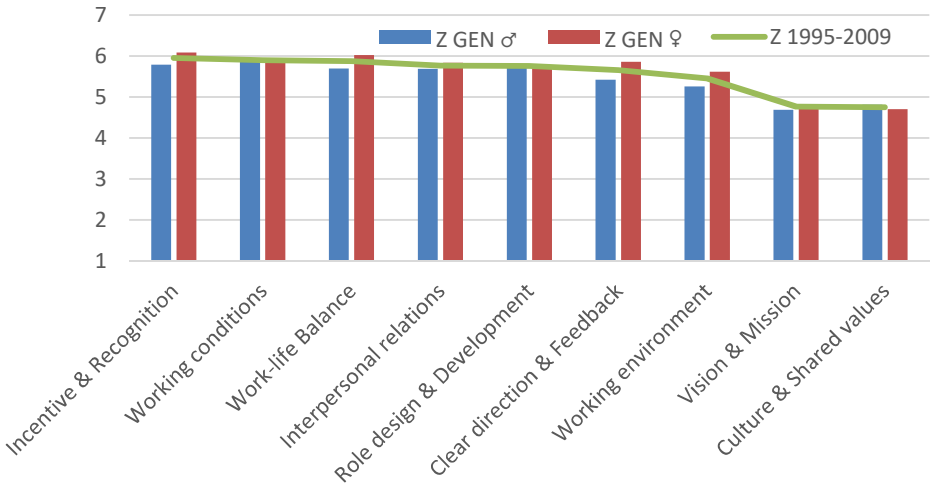

Figure 4. 9M gap between GEN Z males and females
Source: own elaboration (n=176).

This divergence is particularly noteworthy, as the results suggest that female respondents tend to be more strongly motivated across nearly all factors, except *Culture & Shared values*, which both genders ranked lowest. Therefore, we accepted the third (H3) hypothesis.

Nevertheless, it is important to highlight that *Incentive & Recognition* and *Working conditions* appeared among the top three most motivating factors for both genders, indicating some degree of commonality.

During the systematic literature review, only one study – conducted by Lašáková *et al.* (2023) – included a gender-based comparison. Their findings revealed that Generation Z men are primarily motivated by a happy personal life, a stress-free work environment, and leisure time, whereas women are more driven by interpersonal relationships, intrinsic aspects of work, variety, and recognition. In contrast, the current study found that women place greater importance on *Work-life Balance* measures, while men are more strongly motivated by *Role design & Development*.

Ganguli and Padhy (2023) emphasise the importance of gender, which can moderate the effect of work motivation on retention among Generation Z. Regarding hypothesis H3, the results of the present study confirm the existence of gender differences and highlight the importance of examining them. They also support the view of Revuru and Bandaru (2024) regarding the need to fine-tune motivational factors according to gender. However, the findings contradict the results of Lašáková *et al*. (2023), based on a Czech sample, concerning WLB and high-quality work.

Gender differences in the ranking of motivational factors reflect variations in work values and career preferences. For men, the prioritisation of *Working conditions, Incentive & Recognition*, and opportunities for development within the motivational hierarchy indicates a stronger focus on performance goals and career orientation. Meanwhile, for women, the most salient aspect is the primacy of *Incentive & Recognition* and *WLB*, reflecting a need for connection and harmony. This is consistent with the findings of Konrad *et al.* (2000), who found that women are more sensitive to positive workplace relationships.

We may partly explain the greater importance of *WLB* for women by societal expectations associated with caregiving roles and the persistence of labour market inequalities (ILO, 2024), as well as the mobility of young people, who often move away from family support networks, increasing vulnerability. Women's overall higher motivational levels may reflect stronger emotional engagement and the presence of intrinsic motivational resources (Gagné & Deci, 2005). In the case of Generation Z, organisational values and norms are primarily perceived as external conditions rather than internalised drivers of motivation.

CONCLUSIONS

Theoretical Contribution

An organisation's most valuable asset is a competent, motivated, and loyal workforce (Varga, 2021). In this context, the retention of Generation Z employees, the newest entrants to the labour market, has become crucial for long-term organisational success. As motivation plays a key role in shaping both performance and retention, understanding its underlying factors is essential for minimising turnover costs and enhancing overall organisational effectiveness.

A systematic review of international literature on Generation Z's work motivation, conducted using the WoS and Scopus databases, yielded 83 relevant studies. However, only five studies addressed employee motivation through generational comparisons (Machova *et al.,* 2022; Lee *et al.,* 2022; Baša *et al.,* 2023; Ludviga & Sluka, 2023; Plakhotnik *et al.,* 2024). This study not only contributes to the expansion of empirical literature on this topic but also helps to update the current state of research regarding motivational factors across generations. Of the four hypotheses formulated based on the literature, one was partially confirmed, two were confirmed, and one was rejected.

Our primary research, which investigated four generations, *i.e.*, Baby Boomers, Generation X, Generation Y, and Generation Z, with a focus on Generation Z, revealed the following key insights from the 9M model: The top three motivational factors for Generation Z are: (1) *Incentive & Recognition*; (2) *Working conditions*; (3) *Work-Life Balance* (WLB). These results suggest that external motivational tools are particularly influential for Generation Z. While *WLB* is not the foremost motivating factor, it is notably more important to Generation Z than to earlier generations, and features among the top three motivational drivers for women within the cohort. The study also confirmed significant gender differences in motivation among Generation Z. Women reported higher motivational ratings across eight of the nine 9M factors compared to men. This higher receptiveness to motivation could imply greater performance potential and enhanced retention among female employees. Still, consistent with the findings of Kozák and Pózner (2024), Generation Z is overall challenging to motivate, underlining the importance of targeted strategies.

As Williams (2015) emphasised, understanding generational differences is critical to managing work motivation effectively. Our study further highlights the importance of recognising gender-based differences, which remain underexplored. The differences may stem from the distinct functioning of intrinsic and extrinsic motivational mechanisms, and they also justify the development of differentiated, group-specific organisational motivation systems. At the HRM level, this means that it is advisable to design flexible and differentiated incentive and retention strategies that consider variations in the cultural and economic context as well as generational value differences.

Practical Implication

The findings of this study draw attention to a real and pressing issue regarding the motivation of Generation Z employees. While there is a notable alignment with previous research, especially in regard

to the relevance of external motivational factors, further exploration is warranted, particularly concerning the hierarchical ranking of motivational preferences. Future research should incorporate contemporary content theories of motivation, which could contribute to a more unified and theoretically grounded scientific consensus on generational differences in workplace motivation.

Drawing from both the systematic literature review and the primary survey results, it is evident that human resource management strategies must be adapted to meet the needs and preferences of Generation Z. Doing so will be essential for enhancing long-term commitment, reducing turnover costs, and leveraging the unique capabilities of this emerging workforce to strengthen organisational competitiveness.

From a practical perspective, the discrepancy between HR professionals' perceptions and the actual motivational patterns suggests that motivation systems and value propositions should be redesigned based on empirical data. It is recommended that HR conduct regular generation-focused employee focus group interviews to accurately identify and understand the real needs and expectations of younger employees. This is particularly important because, as the empirical results indicate, national cultural context also influences motivational factors.

Although fair pay remains a relevant factor, it does not occupy the top position in Generation Z's motivational hierarchy. We may attribute its heightened salience in recent years to the decline in real wages due to high inflation. In contrast, recognition and performance-based financial incentives currently play a more prominent motivational role.

Among the 9M motivational factors, *Work-life Balance* emerges as the most distinctive preference of Generation Z compared to earlier generations. Beyond contributing to a state of flow, *WLB* plays a crucial role in preventing burnout and supporting employee retention. Therefore, organisations should tailor their workplace policies accordingly, introducing measures such as:

- Flexible working hours and locations.
- A shortened workweek.
- Remote work and telecommuting options.
- Expanded paid leave entitlements.
- The reduction or elimination of mandatory overtime.

Importantly, Generation Z's efficient work style offers potential productivity gains for organisations but only if companies respect the cohort's aversion to overtime. Perceptions of excessive work demands, especially if discovered via platforms like social media, may discourage potential applicants from considering a role.

The study also reveals gender-based motivational differences. Women within Generation Z appear to be more easily motivated than men, rating eight of nine motivational factors higher. For male employees, *Working conditions* are the top motivator, followed by *Incentive & Recognition and opportunities for development*. In contrast, female employees place the highest value on *Incentive & Recognition*, followed by *Work-Life Balance*. These findings suggest that men may prioritise career advancement, whereas women place greater emphasis on personal life and holistic well-being. Consequently, motivational strategies should consider both generational and gender differences.

Given that Generation Z attributes greater importance to *WLB* than previous cohorts, it is crucial to focus on enhancing their intrinsic motivation. Approaches such as mentorship programmes can promote independence and competence, which are key to intrinsic drive. Furthermore, the introduction of a CHO, inspired by the Hygge concept, can help foster well-being, positive workplace culture, and flow experiences. This role could play a pivotal part in amplifying motivation, enhancing employee satisfaction, and boosting performance and retention among Generation Z.

From the perspective of Hungarian HR practice, the results indicate that retaining and engaging younger generations cannot rely solely on financial incentives. For Generation Z, flexible working arrangements, regular feedback, and personal recognition are at least as important as remuneration. Figure 5 summarises the key factors identified around the three needs of the 9M model that support Gen Z motivation.

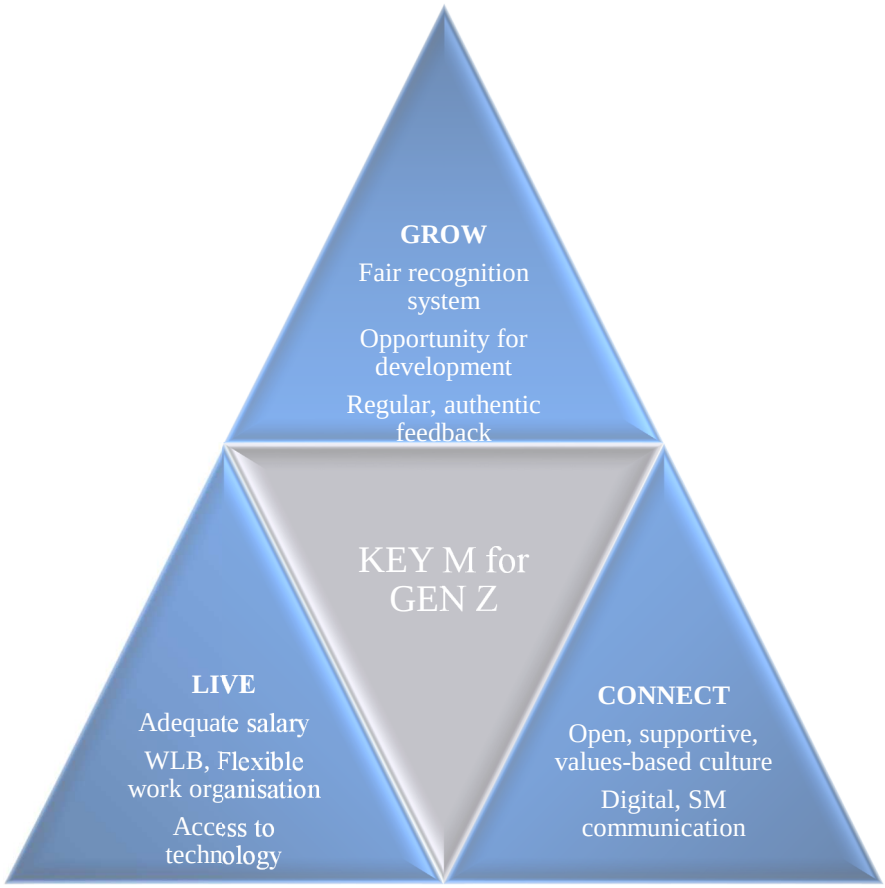

Figure 5. Key factors supporting the motivation of Generation Z employees
Source: own elaboration.

Based on the results, we may formulate several guidelines for designing HR incentive systems to sustain the motivation of younger employees:

- Performance-based, fair recognition system: Rewards acknowledging individual performance and value creation can enhance the sense of competence (Moller & Deci, 2014) and increase intrinsic motivation (Cameron *et al*., 2005).
- Flexible work arrangements: Remote work, hybrid models, and flexible schedules can support the fulfilment of autonomy and work-life balance needs (Krajčík *et al*., 2023; Surugiu *et al*., 2025).
- Provision of regular, authentic feedback: For Generation Z, prompt and constructive feedback can increase self-efficacy and a sense of competence (Bandura, 1977; Ryan & Deci, 2000; Surugiu *et al*., 2025).
- Development of organisational culture: A values-driven, open, and supportive environment can satisfy the need for relatedness (Deci *et al*., 2017), which should be aligned with the technologies used for interaction (Greiner *et al*., 2024).
- Use of digital and social communication channels: Reaching and engaging young employees requires modern, interactive tools (Schroth, 2019; Zhong *et al*., 2023).
- Integration of development and learning opportunities: Career planning, internal training, and mentoring programmes can contribute to long-term commitment (Pandita, 2022; Vieira *et al*., 2024).

Amid high turnover and labour shortages, organisations should redesign or design motivation systems that account for generational differences and, over the long term, are built on trust, recognition, and work-life balance.

Limitations and Future Research

This study is subject to several limitations that readers should acknowledge when interpreting the findings.

The study limitations include the self-reported nature of the data, the cross-sectional research design, the sample being restricted to Hungary, and the absence of control variables.

There is an inconsistency in the classification of Generation Z across the studies included in the systematic literature review. The generational boundaries used by different researchers vary, which may impact the comparability and the generalisability of conclusions regarding Generation Z's motivational preferences.

Second, the systematic literature review was limited to publications indexed in the WoS and Scopus databases. While these are highly reputable academic sources, it is possible that relevant studies published in other databases or grey literature were excluded. This limitation may have led to a partial view of the existing research landscape.

Among the 19 studies included in the final analysis, 15 were peer-reviewed journal articles classified within the Q1-Q4 quartiles. Although these contribute to a credible academic foundation, the relatively small sample size and limited number of generationally comparative studies restrict the ability to draw broad generalisations. Nonetheless, the findings offer a tentative but valuable picture of the motivational factors influencing Generation Z, which future research can further validate or refine.

As generational values and expectations are dynamic and shaped by ongoing social, political, economic, and technological developments, it is critical to continuously update our understanding of the workforce, especially as new cohorts enter the labour market.

In the current literature, several motivation models, including the 9M model, exhibit conceptual overlaps and contradictions in how we interpret motivation, motivational factors, and work-related attitudes. Therefore, future research may benefit from examining motivation within a more integrated theoretical framework.

In its present form, the 9M model essentially treats motivational factors as a universal framework, yet the findings indicate that their meaning and relative weight may vary across generations and national cultures. Thus, refining the model is warranted in order to better reflect the distinctive characteristics of different generational profiles and cultural contexts. Further development of the model could contribute to a more flexible interpretative framework, capable of responding to the continuously changing conditions of the world of work, including digitalisation, flexible forms of work, and the transformation of employee value orientations.

Future studies could refine the 9M model by subdividing its nine dimensions, allowing a deeper understanding of individual motivational factors and a more accurate exploration of generational specificities. Theoretical guidance could be strengthened if subsequent research were to apply structural modelling methods to distinguish between different levels of motivation (factors, attitudes and behaviours) and to uncover causal relationships. Such developments may contribute to the conceptual fine-tuning and international comparability of the 9M model, and support its more precise interpretation across diverse cultural and generational contexts.

Future research may also focus on cross-cultural studies to reinforce and validate the results, as well as longitudinal research that enables the exploration of causal links. Another direction could involve comparing different motivation models, which may support the development of a unified measurement tool and thereby enhance the comparability of motivational findings across countries and generations.

Future studies could examine the discrepancy between professional perceptions and employee attitudes using both quantitative and qualitative methods, for example, paired HR-employee surveys, as well as longitudinal research to explore how Generation Z's motivational preferences evolve across different stages of their careers. Furthermore, international comparisons of post-pandemic and inflationary environments could contribute to a deeper understanding of cultural specificities.

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Appendix A: Socio-demographic characteristics

Variable	Category	Frequency (n)
Gender	Male	359
	Female	386
	Prefer not to say	2
Generation	Baby Boomers (1946-1964)	33
	Generation X (1965-1979)	185
	Generation Y / Millennials (1980-1994)	353
	Generation Z (1995-2009)	176
Education	Prefer not to say	6
	Primary	4
	Secondary (A-levels / equivalent)	239
	Tertiary (Bachelor's degree)	320
	Postgraduate (Master's + PhD)	178
Total Work Experience	<1 year	16
	1-3 years	55
	3-6 years	101
	6-15 years	252
	>15 years	323

Variable	Category	Frequency (n)
Employment History	Prefer not to say	3
	First employer	116
	Second employer	162
	Third employer	161
	Fourth or subsequent employer	277
	Self-employed business owner	22
	Freelancer	6
Tenure in Current Position	Prefer not to say	4
	<1 year	122
	1-3 years	193
	3-6 years	188
	6-15 years	165
	>15 years	75
Type of Employment	Prefer not to say	5
	Full-time	674
	Part-time (<20 hrs/week)	12
	Part-time (20-39 hrs/week)	41
	Contractor / assignment-based	15
Home Office Ratio	Prefer not to say	3
	Home office <20%	140
	Hybrid 20-80%	189
	On-site >80% (incl. 100% on-site & none)	415
Position Level	Prefer not to say	8
	Blue-collar employee	80
	White-collar employee (non-manager)	408
	First-line manager	79
	Middle/senior manager	106
	Executive/top management	45
	Owner	21
Company Size	Prefer not to say	23
	Micro (1-10 employees)	72
	Small (11-49 employees)	97
	Medium (50-249 employees)	184
	Large (250+)	371
Ownership Structure	Prefer not to say	19
	Cannot assess	36
	100% Hungarian-owned	387
	100% foreign-owned	226
	Mixed ownership	79
Industry Sector	Prefer not to say	28
	Industry	355
	Services	345
	Agriculture	19
Employment Sector	Prefer not to say	38
	Public sector	141
	Non-profit sector	31
	Private/for-profit sector	537

Source: own elaboration based on the research results (n = 747).

Appendix B: Rotated Component Matrix

Rotated Component Matrix*		
	Component	
	1	2
Working conditions	0.852	
Incentive & Recognition	0.764	
Working environment	0.698	
Work-life Balance	0.692	
Role design & Development	0.663	
Interpersonal Relations	0.627	
Clear direction & Feedback	0.572	0.518
Vision & Mission		0.905
Culture & Shared values		0.894

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The contribution share of authors is equal and amounts to 50% for each of them.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Impact of innovation and economic structure on CO_2 emissions in Poland and Spain: Evidence from Bayesian Fourier autoregressive distributed lag modelling

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ABSTRACT

Objective: The article aims to determine the impact of innovation, the level of economic activity (measured as GDP per capita), and the added value of key economic sectors (agriculture, industry, and services) on CO_2 emissions in Poland and Spain, and to assess whether innovations could significantly reduce emissions considering economic structural differences and dynamics.

Research Design & Methods: The study employed a quantitative research design. It used Fourier autoregressive distributed lag (FARDL) and Bayesian Fourier autoregressive distributed lag (Bayesian FARDL) econometric models to analyse data from 1995 to 2022. The sample encompassed macroeconomic data for Poland and Spain.

Findings: The study revealed significant differences between Poland and Spain. In Poland, despite a higher number of patent applications, technological innovations did not significantly affect CO_2 emissions, indicating limited application in high-emission sectors. Conversely, in Spain, innovations positively impacted CO_2 emissions, particularly in energy-intensive sectors. Energy consumption strongly influenced emissions in both countries, with Spain showing a more pronounced long-term effect. GDP negatively affected CO_2 emissions in Poland over the long run, whereas the study did not identify such relationship for Spain. The industrial and service sectors significantly impacted emissions and innovation in Poland, while in Spain, the industrial sector and patent activity were crucial determinants.

Implications & Recommendations: The findings highlight the need for tailored economic and energy policy adjustments in both countries, especially focused on innovation, to enhance the effectiveness of their green transitions.

Contribution & Value Added: This article contributes by providing a comparative analysis of Poland and Spain using advanced econometric methods, identifying country-specific dynamics between innovation, sectoral structure, the level of economic activity, and CO_2 emissions, thus providing novel insights for policymaking in the context of sustainability. Moreover, the study applied a relatively new and advanced Bayesian Fourier ARDL modelling, enhancing the analysis' methodological rigour.

Article type: research article

Keywords: CO_2 emissions; innovation; economic development; sectoral analysis; Bayesian ARDL

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INTRODUCTION

Contemporary global economic challenges related to global warming, but also other economic, environmental, social, political and military problems, are forcing European Union (EU) countries and their economic entities to seek innovative solutions in many areas. These innovations will allow for taking the necessary measures against the negative consequences of global warming and reducing greenhouse gas emissions (as envisioned in the European Green Deal and other international agreements

(Kabeyi *et al.*, 2021). These challenges require implementing green technologies in all areas of the economy (Olaleru *et al.*, 2021). According to Yusuf *et al.* (2018), technological environmental innovations are the way forward for Malaysia's sustainable development that will help reduce global risks. They will enable EU member states to make the energy transition by reducing fossil fuel reliance (oil, gas, coal, and lignite), lowering the carbon intensity of their economies, and implementing circular economy principles, all while striving to remain competitive within the EU and globally.

As Oyebanji *et al.* (2022) note, such technological innovation may result from in-country research and development, as well as the transfer of technology from abroad. However, this requires the intensification of sustainable and integrated non-market activities. The strengthening of patent protection and developing public-private partnerships are important for the development of environmental technologies that aim to solve global climate problems and reduce national or local energy and environmental risks (Oyebanji *et al.*, 2022). Recurring environmental disruptions, including climate-related hazards and ecosystem degradation, create substantial obstacles for countries striving to advance sustainable development. Therefore, ensuring economic growth while safeguarding ecological stability has become a shared priority for governments worldwide (Shin *et al.*, 2022).

There have been protracted discussions in the EU on the necessary basis for implementing the European Green Deal, and some member countries exhibit social and political resistance to the pace and scope of the green transition on account of its effects on the competitiveness of economies and the social costs of these processes (Stockmann, 2024). Additional influences are the recent changes in US policy on sustainable development and the geopolitical and military situation in the world, which represent strong threats to security in general. Altogether, these factors create a less favourable environment for a broad transformation within the EU and its member states. Sgaravatti *et al.* (2024) indicate that, to achieve a zero-carbon economy, the EU should revise its current approach.

This requires forming strategic partnerships to advance global decarbonisation, while simultaneously addressing competitiveness and strategic autonomy. The development level, economic structure, dependence on fossil fuels, carbon intensity, and innovation capacity all influence the differing positions of member states on the green and energy transition (implementation of environmentally friendly technologies and renewable energy sources to ensure sustainable development, and the development and application of strategies and practices aimed at protecting natural resources) (Tomaszewski, 2020). Characteristics of individual countries are shaped, among other things, by how long they have been members of the EU. There are development and technological gaps between Central European countries and the older EU member states. A recent International Energy Agency (IEA) report indicates that global CO_2 emissions climbed to 37.4 billion tonnes in 2023, with the majority originating from fossil-fuel combustion. To curb emissions and reduce dependence on conventional fossil energy sources, both the United States and the European Union have introduced a Government Green Fund (GGF) designed to support the expansion of emerging renewable energy sectors, including wind and solar power (Ibikunle *et al.*, 2017; Silva *et al.*, 2016).

The above issues inspired a study on the relationship between innovation, GDP, economic structure and value added of the dominant sectors in the economy and the size of CO_2 emissions in two selected countries belonging to the so-called new and old European Union. One of them was Poland, which joined the EU in 2004. The other country studied was Spain, which has been a member of the EU since 1986. These countries differ in many respects, such as their economic structure, the innovation level, but also the rate of CO_2 emissions. Spain belongs to the group of moderate innovators, while Poland has been included for years first in the group of catching up and then emerging innovators (European Commission, 2024a). The emissions of the Spanish economy are lower than those of other member countries and has been declining over the years. On the other hand, Poland is one of the leaders in CO_2 emissions in the EU, and although it has significantly reduced the carbon intensity of its economy in recent years, it is still among the highest in Europe (Łącka *et al.*, 2024). Climate mitigation efforts encompass not only lowering consumption levels but also achieving net negative emissions. Under a business-as-usual (BAU) trajectory, estimates suggest that between 640 and 950 Gt of CO_2 would need to be extracted from the atmosphere to keep global warming within the 1.5°C threshold by the end of the century (Luderer *et al.*, 2018). By 2024, five years after the launch of the European Green Deal, EU countries (including Poland) had

significantly reduced their reliance on coal and gas in favour of renewable energy sources, enabling progress in decarbonising the Polish economy (Rosslowe *et al.*, 2025).

The research aimed to understand and determine the impact of innovation, the level of economic activity (measured as GDP per capita), and the value added of key economic sectors (agriculture, industry and services) on CO_2 emissions in Poland and Spain. Furthermore, the study sought to assess whether innovation can significantly contribute to reducing CO_2 emissions, considering the differences in economic structure and development trajectories between the two countries. While working on the research problem, we formulated the following research questions:

RQ1: What are the differences in the innovation level between Poland and Spain and what factors account for them?

RQ2: Does innovation contribute to reducing CO2 emissions in Poland and Spain?

RQ3: Do specific sectors of the economy influence the development of innovation in Poland and Spain?

RQ4: Do CO_2 emissions depend on the value added generated by each economic sector in Poland and Spain?

RQ5: Do the level of economic activity (measured as GDP per capita) and energy consumption significantly impact CO2 emissions in Poland and Spain?

A literature review indicates that this issue has not yet been explored to much depth, despite its importance in the context of current economic development conditions. The findings may provide valuable insights for shaping economic policies that support innovation in EU countries facing significant challenges in the green transition with Poland being a notable example. The long-term scope of the study (1995-2022) made it possible to capture changes in the analysed variables influenced by events such as Poland's EU accession, the 2008-2013 global financial crisis, the COVID-19 pandemic, and Russia's invasion of Ukraine, along with the resulting energy crisis.

To address the research questions and objectives, we employed a range of methods, including literature review, critical source analysis, inductive and econometric techniques, including the Fourier autoregressive distributed lag (ARDL) model and the Bayesian autoregressive distributed lag model. The analysis used data on GDP per capita, CO_2 emissions per capita, energy consumption, and patent applications from the World Development Indicators (WDI) for Poland and Spain. We used patent applications as an indicator of innovation activity. We also assessed the level of innovation in both countries using the European Innovation Scoreboard and the Global Innovation Index (WIPO). To examine the impact of economic structure and transformation on CO_2 emissions, we analysed the value added by agriculture, industry, and services (as shares of GDP), enabling evaluation of the relative sectoral contributions to emissions. We sourced all structural data from the WDI database. The novelty and originality of this study lie in its comparative perspective, specifically analysing Poland and Spain, and applying advanced econometric methods (Fourier ARDL and Bayesian ARDL), which previous studies on this subject have rarely combined.

The article is structured as follows. The first section provides an introduction, and the second section presents a literature review. The third section discusses the research methods and data sources used. The fourth section presents the study results, and the fifth section includes a discussion of the results. The final, sixth section concludes the research and gives recommendations for policymakers.

LITERATURE REVIEW

Innovation, Technological Capabilities, and the European Union's Response to Global Challenges

At the beginning of the 2020s, European Union member states were facing global challenges that determined their environmental, energy, economic, social, health (*e.g.*, pandemics), digital, and geopolitical security (Balfour *et al.*, 2024). Countering these threats and turning them into development opportunities and gaining resilience to these and new unpredictable challenges are the basis for achieving prosperity, long-term sustainability and competitiveness of the community's economy

and its members (Calliari *et al.*, 2022). Achieving these ambitious goals requires the use of innovation and research and development (R&D) focused on green and digital technologies. The Oslo Manual describes innovation as encompassing both the actions undertaken to develop something new and the outcomes of these efforts. It refers to a product or process, or a combination of the two, that is substantially different from what an organisation previously used or offered, and which has been either introduced to users or implemented within the organisation (OECD, 2018). European Commission experts state that any innovation that reduces negative impacts on the environment, promotes increased resilience of that environment or increases efficiency in the use of natural resources can be called an eco-innovation. Such innovative products, services, and technological solutions are expected to help achieve the goals of the European Green Deal, *i.e.*, climate neutrality and the circular economy (European Commission, 2024a). The implementation of eco-innovation in the economy requires support from the state and its policies. Grasping the nature of these interdependencies is essential for formulating sound policies that support environmental protection and advance sustainable agricultural development (Iyke-Ofoedu *et al.*, 2024).

One widely used measure of innovative performance is the count of patent applications submitted by non-residents through the Patent Cooperation Treaty (PCT) system to national patent offices. Under this agreement, a PCT application indicates the applicant's intention to seek protection for an invention in at least three countries, and potentially in all treaty signatories. In 2025, 142 countries were members of this agreement. This is not the only measure of a country's innovation, but due to the long period of WIPO's collection of information and the large number of countries covered by the PCT, it can be used in long-term comparative analyses of countries' innovation performance and technological capabilities. The data collected by WIPO also allowed us to compare other metrics and indicators on intellectual property protection, such as trademark and design applications, geographical indications and plant varieties. Mendonça *et al.* (2004) and Flikkema *et al.* (2019) argue that trademarks constitute an important indicator of innovation and industrial dynamism.

Technological progress involves the introduction of new and improved machinery, equipment, tools and new technologies that enable more efficient use of existing and new resources. In the growth-accounting perspective, technological progress refers specifically to the discovery and adoption of more efficient production methods that increase total factor productivity. Both processes form part of broader innovation dynamics, although innovation activity and technological progress remain analytically distinct concepts. They affect economic growth and the competitiveness of the economy and its entities. The level of economic development is strongly correlated with the level of intellectual property protection and invention protection rights, as shown by Greenhalgh and Rogers (2010) and Sherwood (2019). Studies by Lundvall (2010) and Cooke *et al.* (1997) show that national and regional intellectual property protection systems and ecosystems are important factors in countries' innovation and economic success. As Squicciarini *et al.* (2013) note, these areas also improve economic productivity and growth.

A study by Su and Moaniba (2017) shows that in each country, patents for new technologies to combat climate change are determined by the amount of greenhouse gas emissions (including CO_2). A country's emissions affect inventive activity and the number of patent applications. Simultaneously, the implementation of new solutions, which are costly and resource-intensive for economic players, need protection from copying and imitation by competitors. The lack of or inadequate protection of intellectual property means that companies cannot recoup the high costs of environmental technologies, which may discourage the development and diffusion of such innovation. On the other hand, copying someone else's technology, imitating a product or process innovation by a given enterprise, may enable it to allocate its R&D resources to create other green innovations (Oyebanji *et al.*, 2022).

In contrast, a study by Musah *et al.* (2021) shows that as the economy grows, the demand for energy increases, which becomes a heavy financial and social burden in less developed and emerging economies that mainly use fossil fuels as an energy source. As countries become wealthier, societies tend to show greater support for environmental protection and for pursuing sustainable development. The existence of an inverted U-shaped relationship between environmental deterioration and economic growth is indicated by the environmental Kuznets curve (EKC) developed by Grossman and Krueger (1995). Scholars have repeatedly empirically verified this relationship over the past three decades. We may find an exten-

sive list of such analyses in the works of Genstwa (2020), Lau *et al.* (2023), Gűltekin *et al.* (2023), and Suproń (2025). These studies have provided ample evidence to support the course of EKC. Wang *et al.* (2024) conclude that due to contemporary global challenges, especially climate challenges, further research on the shape of the global EKC and understanding the determinants of its course are necessary. The results of their analysis indicate that there is an environmental Kuznets curve in the form of the letter N. Its course is determined by as many as 12 additional factors from four areas: institutions and risks, digital technologies, resource and energy use, and other social factors (omitted from EKC analysis in the past). The study by Wang *et al.* (2024) revealed six distinct groups of countries, each adopting different strategies for reducing greenhouse gas emissions among the 214 nations analysed.

According to the European Commission report assessing innovation performance in the European Union and several non-EU countries, innovation is viewed as a fundamental driver of long-term competitiveness (Koç *et al.*, 2025). It supports productivity improvements and is crucial for environmentally sustainable development, macroeconomic resilience and social fairness (European Commission, 2024b). Innovation constitutes an important factor in promoting development and convergence in the countries and regions of the European Union. Technological innovations are essential to realise the full potential of new energy.

Many researchers also focus on their impact on energy poverty alleviation from the perspective of technological innovation and its impact on the development of green technologies (Albino *et al.*, 2014; Dong *et al.*, 2022; Meka'a *et al.*, 2024). Despite significant improvements in the level of innovation in the member countries over the past thirty years, there is still a strong variation in this regard between countries and regions in Europe. For certain underdeveloped and peripheral regions of Europe, there is even talk of the existence of an innovation gap (European Commission, 2024b). This is revealed by the results of reports published by the European Commission dedicated to assessing the innovativeness of EU regions and countries, *i.e.*, the Regional Innovation Scoreboard and the European Innovation Scoreboard studies.

Innovativeness Comparison Based on Innovation Rankings

The most recent report of the European Commission (European Commission, 2024b) evaluates innovation performance across EU countries as well as a group of non-EU economies. This provides a basis for comparing Poland and Spain with respect to their innovation profiles and recent trends. WIPO's Global Innovation Index 2024 provides additional insights.

The European Commission's 2024 study shows that Poland belongs to the group of emerging innovators and ranks 23rd in the innovation ranking of the 27 member countries. For years, despite improvement in the results of the Summary Innovation Index (SII), the country has been among those countries with the lowest innovation indicators (Romania, Bulgaria, Latvia, Slovakia, Croatia). Poland's position is evidenced by its distance in terms of innovation not only from the innovation leaders in the European Union (Denmark, Sweden, Finland, the Netherlands), but also from some of the other post-communist countries that joined the EU in 2004, such as Estonia (*strong innovators),* Slovenia, the Czech Republic, Lithuania and Hungary (*moderate innovators).* In 2024, the synthetic innovation index for Poland accounted for 65.9% of the EU SII average. Analysing the components of the SII in the EU ranking, one can note that in some areas of this indicator, Poland performs better than e, and in others its achievements are much lower. Such SII components include human resources (72.2% of the EU average), digitalisation (80.1% of the EU average), use of information technologies (99.1% of the average), linkages (73.3% of the average), intellectual assets (85.9% of the EU average). Poland performs much worse in such areas of innovation as attractive research systems (37.5% of the EU average), innovators (45.5%), employment impacts (59.3%) and environmental sustainability (60.3% of the average), sales impacts (60.4%), finance and support (61.7%), and firm investments (62.2%). Examining the detailed components of the various areas that make up the synthetic innovation index, one can determine the relative strengths and weaknesses of Poland's innovation.

These analyses indicate that Poland has significant limitations in important areas that determine the innovation improvement. They account for its weaknesses in this regard. These weaknesses in-

clude: a small share of foreign doctoral students as a proportion of all doctoral students, a small number of doctoral graduates and a small number of patent applications, a small amount of spending on innovation (both public and private), a small number of SMEs introducing product and process innovations, a small amount of spending by venture capital funds, a small amount of investment in innovation per employee, a small number of SMEs entering into partnerships with other entities, low resource productivity, insufficient development and use of environmental technologies, and a small share of enterprises that earn revenues from exporting products that are new to the market or new to companies, and exporting knowledge-intensive services. Poland's relative strengths include design applications, a population with tertiary education, and enterprises providing ICT training

Spain is in a completely different position in the European Innovation Scoreboard 2024. It is ranked as *a moderate innovator* (*moderate innovators*). In the innovation ranking of the EU member countries, it ranks 14th with a score of 89.9% of the EU SII average. Spain performs well above the EU average in such innovation areas as human resources (124.3% of the average), digitalisation (144.9%), and finance and support (103.9%). By contrast, in areas such as attractive research systems (90.2% of the EU average), firm investments (61.8%), innovators (61.8%), use of information technologies (89.3%), intellectual assets (81.3%), employment impacts (61.3%), sales impacts (79.0%), linkages (92.8%) and environmental sustainability (96.8%), Spain performs worse than the EU average.

Spain's relative innovation weaknesses include knowledge-intensive services exports (33.5% of average), employment in innovative enterprises (44.6%) and SMEs introducing business process innovations (49.9%), innovation expenditures per person employed (52% of average), but also patent applications (68.7%). In contrast, Spain's innovation strengths include sales of new-to-market and new-to-firm innovations (170.5% of the EU average), individuals with above basic overall digital skills (148.7%), population with tertiary education (148.4%), resource productivity (136.9%), direct and indirect government support of business R&D (116.4%), and venture capital expenditures (114.9%)

A comparison of Poland and Spain in terms of the synthetic innovation index and its components reveals that there are both similarities and differences in strengths and weaknesses in this regard. In the context of the research problem undertaken, we may note that both countries studied are characterised by the occurrence of a lower number of patent applications than the EU average, and a small number of innovative SMEs. An analysis of the results of the Global Innovation Index 2024 (World Intellectual Property Organization) leads to similar conclusions about the positions of Poland and Spain in the innovation rankings. In this study, Poland is ranked 40th, while Spain is ranked 28th.

RESEARCH METHODOLOGY

Variables and Data Sources

In this study, we used data from the World Development Indicators (WDI) database for Poland and Spain. The maximum period for which complete data was available for both countries was 1995-2022. The dependent variable (Y) was CO_2 emissions per capita, expressed in metric tons. Among the independent variables were energy consumption (in kilograms of oil equivalent per capita), EC, GDP per capita (in constant 2015 prices, expressed in USD), GDP, and innovation activity, represented by the number of patent applications (IP). We used the number of patent applications as an indicator of innovation output rather than technological progress in the growth-accounting sense. This choice followed previous empirical studies that use patent counts as a proxy for innovative activity (Adedoyin *et al.*, 2022; Kirikkaleli & Sofuoğlu *et al.*, 2023; Kortum & Lerner, 1998; Kumaresan & Miyazaki, 1999; Samargandi, 2017; Serener *et al.*, 2023; Sohag *et al.*, 2015).

Furthermore, we considered several sectoral variables to capture the effect of economic structure on CO_2 emissions: agricultural value added, industrial value added, and services value added, each expressed as a share of GDP. However, because these variables were components of GDP, they exhibited strong collinearity and move in the same direction as GDP itself, which made their joint inclusion in the ARDL specification inappropriate. For this reason, they were not included in the ARDL estimations but served ex post in the causality analysis to explore sector-specific dynamics.

Methods and Model

The purpose of the analysis was to examine the impact of innovation, the level of economic activity (measured as GDP per capita), and the value added of key economic sectors (agriculture, industry, and services) on CO_2 emissions (the so-called ecological footprint) in Poland and Spain between 1995 and 2022. Moreover, the analysis assessed whether innovation could significantly contribute to reducing CO_2 emissions, considering differences in economic structure and development trajectories between the two countries. The model intentionally combineed variables expressed in levels (CO_2 emissions, GDP per capita, energy consumption) with a flow-type variable (annual patent applications). This specification was consistent with the ARDL framework, which allows for mixed integration orders, and reflects the aim to analyse how long-run equilibrium levels of CO_2 respond to dynamic innovation activity.

We used a Fourier ARDL model for the analysis, considering GDP and energy consumption as control variables. Equation (1) represents the empirical analysis model, which was based on the extended environmental concept of the Kuznets curve, presented in logarithmic long-term form.

$$lnCO_{2t} = \beta_0 + \beta_1 \ln\mathrm{GDP}_t + \beta_2 ln\mathrm{EC}_t + \beta_3 ln\mathrm{IP}_t + \varepsilon_t \quad (1)$$

in which:

$lnCO_2$ - the natural logarithm of carbon emissions per capita;
$lnGDP$ - the natural logarithm of GDP per capita (real based on 2015 data);
$lnEC$ - the natural logarithm of energy consumption per capita;
$lnIP$ - the natural logarithm of the number of patent applications;
ε_t - the error term.

Before estimating the ARDL models, we verified the order of integration of all variables. We examined the series stationarity using the Fourier ADF and Fourier KPSS tests, which are specifically designed to account for smooth structural breaks and low-frequency nonlinearities that may bias classical unit-root procedures (Enders & Lee, 2012). W thee selected frequency parameter k in the Fourier approximation using the Bayesian information criterion (BIC). One should interpret it solely as a flexible representation of smooth structural breaks rather than as an indicator of economic cycles. From a theoretical perspective, we expected CO_2 emissions, GDP per capita, and energy consumption to be I(1), while annual patent applications, being a flow variable – I (0). To assess practical sources of low power in unit-root/stationarity testing, we screened the innovations from the estimated UECM models for serial correlation (Ljung-Box), ARCH-type heteroskedasticity (ARCH-LM), and non-normality/outliers (Jarque-Bera; standardised residuals).

Standard cointegration tests are not applicable when variables exhibit different integration orders. To overcome this problem, Pesaran *et al.* (2001) proposed a cointegration test approach within the ARDL model. This method makes it possible to account for independent variables with different degrees of integration, provided that the dependent variable is an I (1) process. In addition, Narayan (2005) extended the use of ARDL tests in the study of cointegration by developing arrays of critical F-test values specific to small samples. The relationship of cointegration between variables is examined by comparing test statistics with lower and upper bounds labelled I (0) and I (1). The basic hypothesis that there is no cointegration is rejected if the test statistic is higher than the key upper bound values. The ARDL model automatically decomposes the relationship into long-run coefficients and short-run adjustments. Re-parameterising the ARDL into an error-correction model (ECM) made this structure explicit: the differenced variables describe short-run effects, while the error-correction term (ECT), derived from the estimated long-run equation, measures the speed at which the system corrects deviations from long-run equilibrium. A negative and significant ECT confirms cointegration. Equation (2) represents the ARDL model used in this study. We modelled all variables (CO_2, GDP, EC, IP) in natural logarithms.

$$\Delta lnCO_{2,t} = \beta_0 + \beta_1(lnCO_2)_{t-1} + \beta_2(lnGDP)_{t-1} + \beta_3(lnEC)_{t-1} + \beta_4(lnIP)_{t-1} + \sum_{i=0}^{\rho}\gamma_i'(\Delta\ln CO_2)_{t-i} + \sum_{i=0}^{\rho}\vartheta_i'(\Delta\ln\mathrm{GDP})_{t-i} + \sum_{i=0}^{\rho}\sigma_i'(\Delta\ln\mathrm{EC})_{t-i} + \sum_{i=0}^{\rho}\varphi_i'(\Delta\ln\mathrm{IP})_{t-i} + \varepsilon_t \quad (2)$$

in which:

Δ - represents the first difference;

t - represents the lag length;

ε_t - Is the error term.

We chose the optimal lag length for small samples based on Schwarz's information criterion (SC). Following the methodology of Pesaran *et al.* (2001), we determined the cointegration relationship using both the F-test and the t-test described in equations (3) and (4). Moreover, we adopted a test proposed by McNown *et al.* (2018), which was developed to evaluate the null hypothesis, as shown in equation (5).

$$H0A: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0 \quad (3)$$

$$H0B: \beta_1 = 0 \quad (4)$$

$$H0C: \beta_2 = \beta_3 = \beta_4 = 0 \quad (5)$$

The time series under study reflected numerous structural changes resulting from Poland's economic transition, the 2008 and 2013 crises, and the COVID-19 pandemic (2020-2022). To address this, we adopted an innovative approach by extending the ARDL model with Fourier functions (Eq. 7). This method captures fluctuations and breaks in the data without the need for dummy variables (Adebayo, 2020; Olayeni *et al.*, 2021). Moreover, the Fourier terms allow for capturing nonlinear patterns in the data, eliminating the need for additional tests of structural changes or modifications to the estimated model to account for these changes (Serener *et al.*, 2023; Yilanci & Pata, 2020). Equation (6) shows the full FARDL model used in the study. We selected the optimal lag length using AIC/BIC, and for both countries the preferred specification was ARDL (1,1,1,1), which corresponds to ρ = 2 in the parameterisation used in Equation (6).

$$\Delta\ln CO_{2,t} = \beta_0 + d(t) + \beta_1(lnCO_2)_{t-1} + \beta_2(lnGDP)_{t-1} + \beta_3(lnEC)_{t-1} + \beta_4(lnIP)_{t-1} + \sum_{i=0}^{\rho}\gamma_i'(\Delta\ln CO_2)_{t-i} + \sum_{i=0}^{\rho}\vartheta_i'(\Delta\ln\mathrm{GDP})_{t-i} + \sum_{i=0}^{\rho}\sigma_i'(\Delta\ln\mathrm{EC})_{t-i} + \sum_{i=0}^{\rho}\varphi_i'(\Delta\ln\mathrm{IP})_{t-i} + \varepsilon_t \quad (6)$$

$$d(t) = \alpha_1 sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 cos\left(\frac{2\pi kt}{T}\right) \quad (7)$$

in which:

K - is the number of specific frequencies selected using the Bayesian Information Criterion (BIC);

t - is the time index, and 'T' is the sample size;

T - is the sample size.

To test causality, we used the cumulative Fourier-frequency Granger causality test proposed by Enders and Jones (2016). Fourier-frequency Granger causality is a temporal causality analysis method that uses the Fourier transform to capture complex relationships between variables in the frequency domain. The technique assesses how causal relationships change over different frequency ranges and then combines the results to provide an overall picture of causality (Nazlioglu *et al.*, 2019). This approach allows for more precise modelling of nonlinear relationships and the identification of dependencies across different frequencies. Such patterns are difficult to detect using classical methods, particularly in the presence of structural breaks (Zheng *et al.*, 2023). To increase the power of test statistics in a small sample, we used bootstrapping to estimate probability values.

To confirm the results' robustness and to better capture nonlinearity and uncertainty, the study also employed a Bayesian ARDL model. In the Bayesian version of the model, we included the same Fourier (harmonic) terms as in the classical Fourier ARDL specification. Thus, the Bayesian ARDL model shares the same likelihood function and deterministic Fourier structure as the classical specification; the difference lies solely in the estimation approach, which relies on Bayesian inference using HMC/NUTS rather than classical (frequentist) estimation.

We estimated the model using the Hamiltonian Monte Carlo (HMC) algorithm, a type of Markov Chain Monte Carlo (MCMC) method. The Bayesian model, unlike frequency inference, assumes that the observed data are constant and the estimation parameters are random (Bernardo & Smith, 2009). The Bayesian model assumes that $\epsilon_t \sim N(0, \sigma^2)$ are error residuals.

We used the No-U-Turn Sampler (NUTS) algorithm to estimate the posteriori parameters. We conducted the estimation using the BRMS package in R. The number of iterations was set to 4 000 (including 1 000 warm-up iterations, the so-called burn-in), and the number of chains was set to 4. The following prior distributions were assumed for the model parameters: one for the coefficients (Equation 8) and another for the error variance (Equation 9). In the Bayesian ARDL estimation, all regression coefficients (including lagged terms) and the intercept were assigned independent Normal (0, 1) priors, while the residual standard deviation σ followed a $\theta \sim t_3(0,2.5)$ prior, consistent with the default specification in the brms package.

$$\beta 0, \beta 1, \beta 2, \beta 3, \beta 4, \gamma i', \vartheta i', \sigma i', \varphi i' \sim N(0,1) \tag{8}$$

$$\sigma \sim Student - t(3,0,2.5) \tag{9}$$

We configured the MCMC algorithm with the following control settings: *adapt_delta* = 0.8 and *max_treedepth* = 12. We assessed model fit using diagnostics including convergence statistics, trace plot analysis, and evaluation of posterior parameter distributions.

RESULTS AND DISCUSSION

Exploratory Data Analysis

Table 1 presents descriptive statistics for the time series studied for Poland and Spain from 1995 to 2022. Poland had higher average CO_2 emissions (8.48 t per capita) than Spain (6.62 t per capita) during the period studied, with a lower standard deviation (0.42 vs. 1.12). Emissions varied from 7.82 t per capita to 9.59 t per capita in Poland and from 4.58 t per capita to 8.47 t per capita in Spain, suggesting greater variability in Spain. The average GDP per capita in Spain (USD 25 110.23) was higher than in Poland (USD 10 409.08), but Poland showed greater variability in these values (standard deviation of 3 263.43 in Poland vs. 2 156.49 in Spain), indicating faster economic change in Poland during the studied period. Energy consumption in Poland (average: 1 672.97 kg oe/capita) was lower than in Spain (1 879.38 kg oe/capita), with less scatter in the data for Poland. This suggests greater stability in the country's energy consumption.

Agriculture's contribution to GDP averaged 3.11% in Poland and 3.01% in Spain. This indicates the similar importance of this sector in both countries, with greater variability in Poland. Spain had a higher share of the service sector in GDP (63.97%) than Poland (55.59%), which may indicate a more advanced service-based economy. In contrast, Poland had a higher share of industry in GDP (29.45%) than Spain (24.21%). The average level of patent applications was higher in Poland (3 102.89) than in Spain (2 580.46), but Poland was also characterised by greater variability in this indicator. The results suggest that Poland underwent a more rapid economic transition between 1995 and 2022, with a strong industrial sector, while Spain showed greater development in the service sector and more stable trends in some indicators. The high volatility of the series in Poland was due to the faster pace of economic development and economic transition during the studied period.

Figures 1-3 shows trends of selected variables for the studied countries over time. Notably, CO_2 emissions per capita remained relatively stable in Poland from 1995 to 2004, and then began to decline slightly after 2007, reaching their lowest level around 2013. In Spain, during the analysed period, emissions were higher than in Poland until 2010, reaching a value close to 10 tCO_2e per capita in the 1990s, and then decreased successively (especially after 2008), which we may link to the economic crisis and changes in the energy structure.

Figure 2 shows the per capita energy consumption of the two countries from 1995 to 2022. In Spain, energy consumption grew rapidly in the 1990s and peaked in 2004-2007 (over 2 200 kg of oil equivalent per capita). After 2008, a marked reduction in energy consumption was observed, related to the recession and a change in the approach to energy management. In Poland, energy consumption was lower than in Spain throughout the period. However, since 2004, there has been a gradual increase. This phenomenon reflects the economic development and improvement in the quality of life in Poland, especially after joining the EU. At the same time, it indicates the dominance of fossil energy sources in the country's energy mix, which influenced high CO_2 emission rates.

Table 1. Descriptive statistics for Poland

Variable	Mean		Standard deviation		Min		Max	
	Poland	Spain	Poland	Spain	Poland	Spain	Poland	Spain
CO_2	8.48	6.62	0.42	1.12	7.82	4.58	9.59	8.47
GDP	10 409.08	25 110.23	3 263.43	2 156.49	5 628.45	20 001.79	17 178.67	28 087.90
EC	1 672.97	1879.38	166.14	194.75	1 435.93	1 557.19	1 991.24	2 247.66
AGDP	3.11	3.01	0.79	0.66	2.24	2.27	5.58	4.39
SGDP	55.59	63.97	2.14	4.02	49.15	59.17	58.86	68.53
IGDP	29.45	24.21	1.52	3.54	26.64	19.87	33.48	28.33
IP	3 102.89	2 580.46	861.80	730.85	2 028.00	1 150.00	4 676.00	3 632.00

Source: own study in Stata.

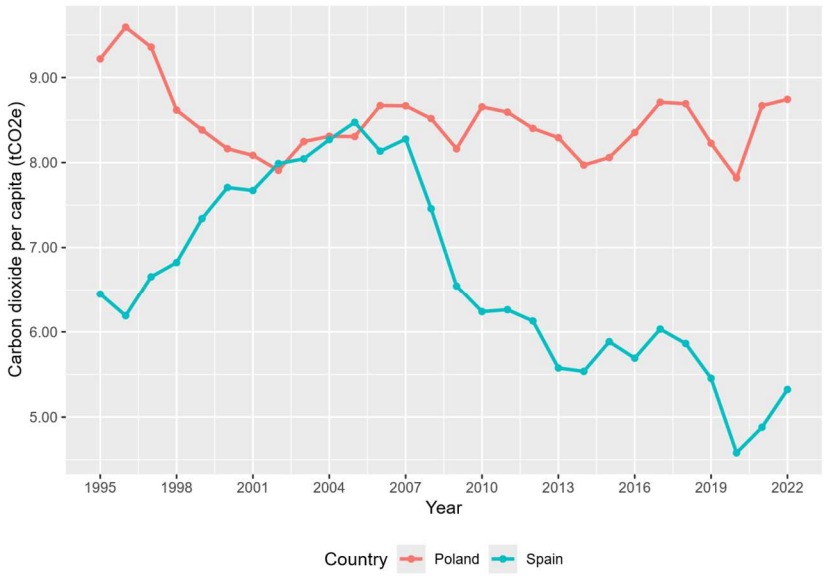

Figure 1. Carbon dioxide (CO2) per capita (tCO2e) in Poland and Spain
Source: own elaboration based on investment results.

Figure 3 illustrates trends in patent applications as an indicator of innovation activity in both countries. In Spain, the number of filings increased steadily from the 1990s, peaking between 2010 and 2013 (over 4 500 applications), before declining sharply due to financial constraints following the economic crisis. In Poland, the trend was different: the number of filings gradually increased until around 2010, reaching just over 3 000 filings, but from then on, it began a steady decline, albeit a slower one than in Spain. This indicates differences in innovation potential and economic structures between the countries.

Figure 2. Energy consumption per capita (kg of oil equivalent) in Poland and Spain
Source: own elaboration based on investment results.

Figure 3. Number of patent applications in Poland and Spain
Source: own elaboration based on investment results.

Model Results and Causality Analysis

The conventional ADF/KPSS procedures are known to exhibit low power in finite samples and to be sensitive to departures from their maintained assumptions. Notably, ADF inference depends on an appropriate specification of deterministic components (intercept and/or trend) and on sufficient lag augmentation so that innovations are approximately white noise. Meanwhile, KPSS inference depends on the correct specification of the deterministic component (level- versus trend-stationarity) and on long-run variance estimation. Given the annual sample (1995-2022), potential power losses may arise from small-sample size, MA-type dependence, heteroskedasticity, and outliers. Fourier-augmented

ADF/KPSS tests primarily mitigate deterministic misspecification by flexibly capturing smooth/low-frequency shifts without dating breaks. However, they do not fully remove potential distortions due to finite-sample size, heteroskedasticity, or non-Gaussian errors.

Given that the data exhibit numerous structural breaks, we applied the Fourier ADF unit root test (Enders & Lee, 2012) and the Fourier KPSS test (Becker *et al.*, 2006). We selected the delays and number of frequencies (k) based on Schwarz's information criterion. Tables 2 and 3 shows the tests' results. In the case of Poland, most of the variables were stationary at the level, but a few variables achieved stationarity when differentiated. In the case of Spain, most of the variables were non-stationary at the level but became stationary after the first differentiation. Thus, the data were suitable for applying the ARDL model to both countries, since the variables were both I (0) and I (1).

Table A1-A2 (Appendix A) reports the conventional ADF/KPSS results under standard deterministic specifications. The overall integration assessment was consistent with the Fourier-based evidence; whenever interpretation differed, we relied on the Fourier tests because smooth deterministic shifts were plausible for the analysed macro series.

Table 2. Fourier unit root test for Poland

Variables	k	ADF (level)	ADF (Δ, first difference)	KPSS (level)	KPSS (Δ, first difference)
CO_2	2	-4.154*	-4.992*	0.377	0.083
GDP	1	-5.060*	-4.391**	0.241*	0.095
IP	2	-2.266	-5.133*	1.053*	0.045
EC	5	-4.839*	-3.176	0.130*	0.065
AGDP	5	-4.324*	-3.389	0.067**	0.020
SGDP	5	-3.627**	-5.260*	0.125*	0.032
IGDP	5	-3.425	-4.270**	0.078*	0.033

Note: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively.
Source: own study in Aptech Gauss/tspdlib library.

Table 3. Fourier unit root test for Spain

Variables	k	ADF (level)	ADF (Δ, first difference)	KPSS (level)	KPSS (Δ, first difference)
CO_2	1	-2.944	-4.342**	0.113	0.040
GDP	3	-3.283**	-3.864**	1.332*	0.184
IP	4	-1.418	-4.590*	0.795*	0.111
EC	5	-1.529	-5.752*	0.357*	0.068
AGDP	4	-2.867***	-5.588*	0.732*	0.191
SGDP	2	-0.979	-3.870**	0.619*	0.081
IGDP	1	-2.743	-3.702**	0.808*	0.040

Note: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively.
Source: own study in Aptech Gauss/tspdlib library.

Table 4 shows the results of tests in the cointegration area conducted using the Fourier ARDL model. We selected the optimal Fourier frequency (harmonic variable k) based on Schwarz's information criterion and was set at 2.429 for Poland and 0.870 for Spain. In both Poland and Spain, there was strong evidence of cointegration between variables, which means that the Fourier ARDL model could be used to analyse the long-run and short-run relationships between variables. In addition, the results of the degeneration test (F-test) ruled out problems with the identifiability of cointegration in the model.

In the next stage of the analysis, we applied the ARDL model to examine both short-term dynamics and long-term relationships. Table 5 presents the results of the estimated Fourier ARDL model for Poland and Spain, including both short- and long-term effects, along with diagnostic test outcomes. In the final ARDL-ECM representation, we retained only statistically significant dynamic terms. We found short-run IP terms (ΔIP) and some auxiliary lagged coefficients (including ψ and selected γ-parameters) to be insignificant and thus we omitted them from the reported tables in line with standard ARDL

reduction practice. Moreover, the Fourier coefficients ($\alpha_1 j$, $\alpha_2 j$) were part of the deterministic component of the model, but we did not include them in Tables 5 and 6 because they did not affect the interpretation of the long- and short-run elasticities of CO_2 emissions.

Table 4. Bound test for Fourier ARDL

Country	Bounds F-test	Bounds t-test	Degenerate cointegration F-test
Poland	6.80*	-6.42*	8.56*
Spain	5.56*	-5.17*	12.20*

Note: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively.
Source: own study in R-studio/ARDL library.

The results of the study indicate that in both countries, energy consumption is the main determinant of CO_2 emissions in both the short and long term, with its impact being stronger in Spain in the long term. In Poland, GDP had a small but significant impact on CO_2 emissions in the long term, while in Spain there was no significance in the long term. In the short term, in both countries, GDP had a positive effect on CO_2 emissions. In Spain, the number of patent applications had a significant positive impact on CO_2 emissions in the long term, which may be related to innovation in high-carbon sectors. In Poland, this impact was not significant. ECT denotes the error correction term from the ARDL error-correction representation and captures the speed at which deviations from the long-run equilibrium are corrected. In addition, Spain had a faster rate of recovery (ECT=-0.92) than Poland (ECT=-0.74).

Table 5. Fourier ARDL-ECM model

Variable	Poland	Spain
Intercept	0.25 (0.22)	-7.62 *** (1.56)
$\ln CO_{2t-1}$	-0.74 *** (0.08)	-0.92 *** (0.15)
$\ln EC_{t-1}$	0.30 *** (0.04)	1.33 *** (0.24)
$\ln GDP_{t-1}$	-0.09 ** (0.03)	-0.20 (0.18)
lnIP	-0.01 (0.03)	0.17 *** (0.04)
ECT_{t-1}	-0.74 *** (0.08)	-0.92 *** (0.15)
ΔlnEC	0.73 *** (0.07)	0.68 * (0.29)
ΔlnGDP	0.56 *** (0.11)	0.78 * (0.30)
Error Metrics and Diagnostic Tests		
R^2 / R^2 adjusted	0.939 / 0.913	0.863 / 0.812
AIC	-153.704	-106.429
Log-likelihood	86.852	62.215
X^2 BG	7.48	10.9
X^2 LM	2.07	5.25
X^2 Ramsey RESET	0.212	0.984
W_{LR}	11.7***	6.73***

Note: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively. The column 'Variable' corresponds to the parameters defined in Equation (6): β for long-run coefficients, γ and ϕ for short-run dynamics.
Source: own study in R-studio/ARDL library.

Diagnostics confirmed that Fourier ARDL models were well fitted and stable. The absence of autocorrelation, heteroskedasticity, and specification problems indicates that the results of the models were reliable and could be used to analyse relationships between variables. In addition,

Figure A1 (Appendix A) shows CUSUM plots, which confirm the stability of the tested models over time. The UECM residual screening did not indicate strong serial correlation, ARCH effects, non-normality, or outliers (Table A3, Appendix A).

We used the estimated ARDL model to estimate the impact of innovation, measured by the number of patent applications, using the *dynardl* package. For this scenario analysis, we assumed a 15% long-term increase in patent applications for both countries. Figure 4 presents the predicted average CO_2 emission values, with error bars indicating uncertainty ranges based on confidence intervals. The estimated long-run response indicates that a change in the number of patent applications in Poland (ΔIP) induced a small decrease in CO_2 emissions in the long term (Figure 4). Figure 5 presents the estimated effect of changes in the number of patent applications (ΔIP) on the logarithm of CO_2 emissions ($lnCO_2$) in Spain. Patent applications expressing innovation in Spain had a small but positive effect on CO_2 emissions in the long run.

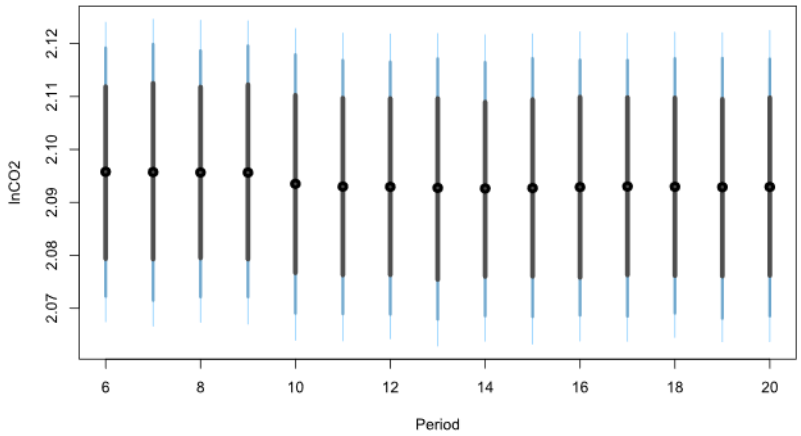

Figure 4. Impact of a 15% increase in patent applications in Poland: Scenario analysis
Source: own elaboration based on investment results.

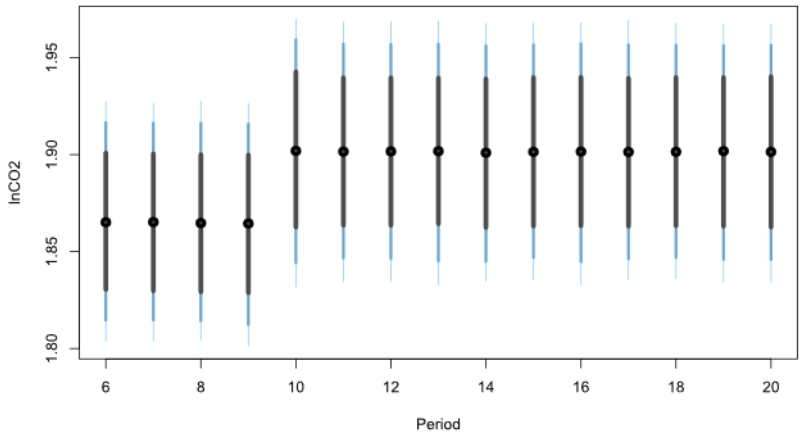

Figure 5. Impact of a 15% increase in patent applications in Spain: Scenario analysis
Source: own elaboration based on investment results.

In the next stage of the study, we used a Bayesian approach to confirm the robustness of the results obtained, to capture nonlinear patterns, and to more fully account for uncertainty in the model parameters and results. Furthermore, the Fourier Bayesian ARDL model enabled a better capture of potential asymmetric responses of CO_2 emissions to changes in energy consumption, GDP or the number of patent applications, which could be more difficult with traditional ARDL models. As with the traditional ARDL model, the Bayesian model indicated that the key driver of CO_2 emissions in both countries is energy consumption, with the effect stronger in Spain. In Poland, the level of

GDP per capita also played an important role in emissions, which may suggest the more carbon-intensive nature of the current stage of economic development (Table 6).

Table 6. Fourier Bayesian ARDL model

Predictors	Estimates	CI (95%)	Estimates	CI (95%)
	Poland		Spain	
Intercept	0.25 (0.26)	-0.27 to 0.78	-8.34 (3.09)	-14.34 to -1.82
$lnCO2_{t-1}$	-0.72 (0.12)	-0.95 to -0.24	-0.61 (0.19)	-0.95 to -0.50
$lnEC_{t-1}$	0.30 (0.08)	0.15 to 0.46	1.39 (0.47)	0.39 to 2.27
$lnGDP_{t-1}$	-0.09 (0.04)	-0.17 to -0.01	-0.20 (0.30)	-0.79 to 0.43
lnIP	-0.01 (0.04)	-0.09 to 0.06	0.21 (0.10)	-0.01 to 0.40
ΔlnEC	0.72 (0.08)	0.55 to 0.89	0.75 (0.31)	0.11 to 1.36
ΔlnGDP	0.55 (0.14)	0.26 to 0.84	0.72 (0.37)	-0.01 to 1.46
Observations	27		27	
R^2 Bayes	0.936		0.973	
MCMC iterations	4000		4000	
MCMC sample size	12000		12000	
Log (ML)	40.69		27.09	
Acceptance rate	0.85		0,83	

Note: *, **, and *** denote 10%, 5%, and 1% significance levels, respectively. The short-run IP term (ΔIP) was excluded from the final specification because it was statistically insignificant.
Source: own study in R-studio/Rstan library.

The analysis of credibility intervals for the number of patent applications in the case of Poland, presented in Figure 6, indicates that there was no significant effect of the number of patents on CO_2 emissions in Poland. The wide credibility interval confirms this. It includes both positive and negative values. The high uncertainty of the estimate indicates that there was no clear relationship between innovation activity and CO_2 emissions in Poland. The point estimate for Spain suggests that a higher number of patent applications may be associated with increased CO_2 emissions, but the credibility interval included zero, indicating that the effect was not statistically significant. The width of the CI interval indicates uncertainty in estimating the impact of the number of patent applications on CO_2 emissions. However, the concentration of the middle of the interval within positive values indicates that their impact was in a small but positive way on CO_2 emissions.

Figure 7 shows the causal relationships (Fourier Granger causality) between innovation, basic economic sectors, and CO_2 emissions in Spain and Poland. Table A4 (Appendix A) presents full data for the causality tests conducted. Before interpreting the causality results, it is important to clarify the nature of the previously mentioned collinearity. The sectoral variables (agriculture, industry, and services value added), expressed as shares of GDP, were mechanically correlated with each other because they constitute the components of GDP. However, we did not analyse them jointly nor entered them simultaneously with GDP per capita in any causality equation. Instead, we examined each sectoral variable separately, which prevented multicollinearity from influencing the direction or significance of the causality results. Therefore, the observed collinearity did not affect the validity of the Granger causality findings.

In Poland, the service sector showed causality toward technological innovation (IP) and CO_2 emissions. At the same time, like services, industry displayed bidirectional causality with innovation activity. In turn, CO_2 emissions exhibited causality toward the agricultural sector. Causality was shaped

differently for Spain. Changes in the industrial sector (IGDP) showed causality toward the number of patent applications (IP). In contrast, the number of patent applications, the industrial sector, and the service sector were significant causal factors for changes in CO_2 emissions. Moreover, in the case of Spain, in line with previously established model results, the assumption of a direct effect of innovation on CO_2 emissions showed uncertainty.

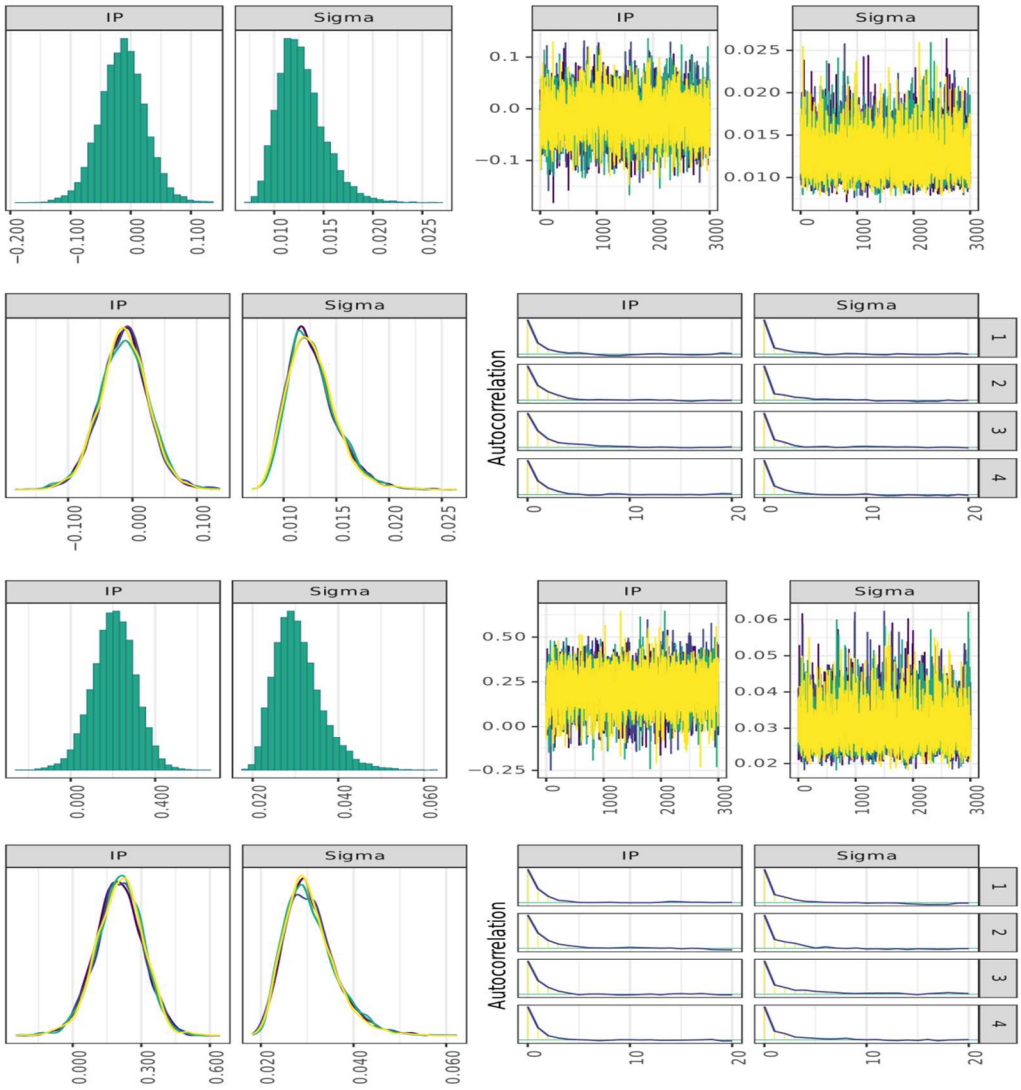

Figure 6. Fourier Bayesian ARDL for Poland and Spain: IP impact for CO2 emission, histogram, trace, density, and ACF

Source: own elaboration based on investment results.

Discussion

The findings show that technological innovations in Poland have had a limited impact on CO_2 reduction, which may be due to the low intensity of these innovations in high-carbon sectors. In contrast, in Spain, despite there being fewer patent applications, innovations have shown a positive impact on CO_2 emissions, especially in energy-intensive industries. The study confirmed the dominant role of energy consumption as a key determinant of CO_2 emissions in both Poland and Spain, although its long-term impact was more pronounced in Spain. The results also indicate differences in the way that the level of economic activity (measured as GDP per capita) affects CO_2 emissions. Namely, in Poland, higher GDP per capita was associated with a significant, long-term reduction in emissions. Meanwhile, we did not observe any such effect in Spain.

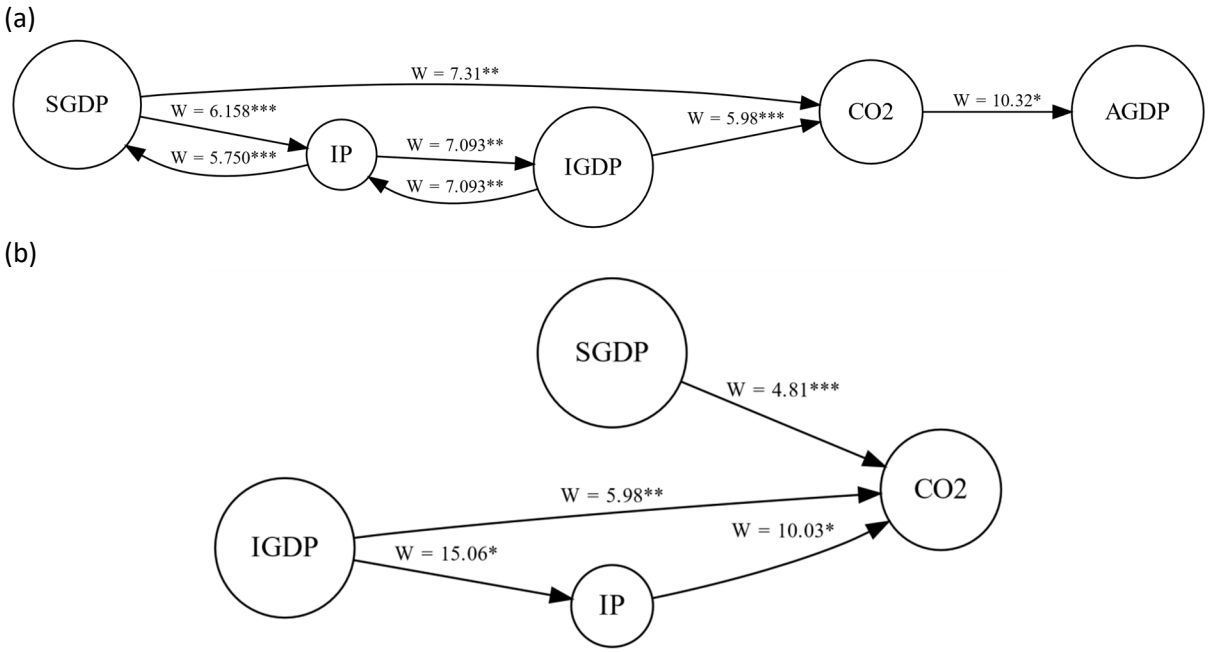

Figure 7. Fourier Granger causality test result
Source: own elaboration based on investment results.

Comparing these results with the results of previous studies is challenging for several reasons. Firstly, there is a limited number of studies that cover the effects of innovation, economic structure, and the level of economic activity on CO_2 emissions simultaneously. In addition, few of those studies were conducted in the context of the EU, which makes it impossible to directly relate to the results of other authors. Secondly, the use of Fourier ARDL methodology and Bayesian ARDL model distinguishes this study from most analyses limited to standard Granger causality tests, based on simple regression. Thirdly, the selection of Poland and Spain as countries representing different levels of innovation development and economic structure makes comparison with analyses using different criteria for classifying countries difficult.

Nevertheless, when we compare these results with other studies analysing the impact of innovation and economic structure on CO_2 emissions, we find some parallels. Ghorbal *et al.* (2024) analysed data for South Korea and indicated that a higher number of domestic patent applications contributes to environmental degradation. In contrast, in a similar study for Saudi Arabia, Samargandi (2017) indicated that technological innovation was insignificant in contributing to CO_2. Similarly, Genstwa's (2020) results provide evidence of a stable long-term association between the level of economic activity (measured as GDP per capita) and emissions, following the Environmental Kuznets Curve (EKC) theory – a pattern reflected in the results obtained for Poland. The direction of the effect of GDP per capita on the reduction of CO_2 emissions from the economy is also in line with the results obtained by Myszczyszyn and Suproń (2021) for the countries of the Visegrad Group, which includes Poland.

Other studies have arrived at divergent conclusions. Georgescu and Kinnunen (2024) analysed CO_2 emissions in Finland using the FARDL model and indicated that innovation had a significant negative impact on CO_2 emissions, but only in the long term. Kirikkaleli, Abbasi *et al.* (2023) obtained similar results for Denmark. Referring only to eco-innovations, Sadiq *et al.* (2024) indicated their positive impact on reducing CO_2 emissions in BRICS countries. Sun *et al.* (2022) confirmed similar results for China. In contrast, the FARDL model for Poland proposed by Addai and Kirikkaleli (2023) indicates that higher GDP per capita contributed to CO_2 emissions in Poland.

In attempting to reconcile the findings of this study with those of earlier studies, the conclusions of Albino *et al.* (2014) are significant. They noted that the influence of technological innovation on emissions varies according to a country's economic structure and development profile, which aligns

with the findings obtained for Poland and Spain. Gűltekin *et al.* (2023) showed a significant role for the structure of the economy in determining CO_2 emissions, especially the industrial sector, which is in line with the results for both Poland and Spain. Some differences in the results may also result from different methodologies, periods of analysis, and the specifics of the studied economies.

In conclusion, the results presented suggest that the effectiveness of innovation policies and their impact on CO_2 emissions strongly depend on the economic and structural peculiarities of individual countries. The diversity of the results obtained indicates the need for further research, especially in identifying the determinants of the effectiveness of innovation in reducing CO_2 emissions under different economic conditions.

CONCLUSIONS

We aimed to assess the dynamic impact of the level of economic activity (measured as GDP per capita), economic structure, and the level of innovation on CO_2 emissions in Poland and Spain. For this purpose, we analysed time series data from 1995-2022 using advanced econometric methods, including the Fourier ARDL model and the Bayesian ARDL model.

The analysis shows that in Poland, increases in GDP per capita are linked with lower CO_2 emissions in the long run, offering partial support for the environmental Kuznets curve (EKC) hypothesis. However, for Spain, we did not identify any statistically meaningful long-term association between economic performance and CO_2 emissions. These differences result from the specific structural conditions of the economies in both countries. Analysing the role of technological innovation, we observed that in Poland, their impact on CO_2 emissions is limited, mainly due to their low intensity in carbon-intensive sectors (*e.g.*, cement production, metal production, production of chemicals and chemical products, and production and processing of coke and refined petroleum products). On the other hand, in Spain, technological innovation contributes to an increase in emissions, which may be due to the concentration of these innovations in energy-intensive industries.

Poland is a country belonging to the group of emerging innovators in the European Union's innovation ranking, and has a lower SII than Spain, which is ranked among moderate innovators. Weaknesses of Polish innovation include unattractiveness and insufficient efficiency of innovation systems, insufficient financing of innovation from private and public funds, insufficient development of innovation support from venture capital funds, too few innovative small and medium-sized enterprises, too few patent applications, and unwillingness of business entities to cooperate in innovation processes. As previously stated, Poland's inherent weaknesses constrain its capacity to address the demands of the contemporary economic landscape effectively. Moreover, these limitations hinder Poland's potential for leveraging innovation to enhance economic sustainability and reduce carbon dioxide emissions. Spain's greater innovativeness is due to the presence of such strengths as the ability to generate revenues from the sale of innovations, *i.e.,* new products, services or technological solutions for the market or new to companies, a large share of people with digital skills, the percentage of people educated to the third level of studies, direct and indirect government support for private investment in R&D, and the use of venture capital funds to finance innovative activities. These factors positively determine the development of eco-innovation and energy transition processes. The structure of the economy has also emerged as a key determinant of CO_2 emissions. Poland, with a dominant industrial sector, faces greater challenges in reducing emissions. Spain, with a developed service sector, shows different mechanisms for affecting emissions and has a higher potential for adaptation in terms of innovation.

In conclusion, the findings of the current study suggest the need to intensify policies that support the development of environmental technologies and increase energy efficiency as key elements in the effective reduction of CO_2 emissions. Evidently, these recommendations are important for Poland, where the innovation potential is underutilised, and the process of transitioning to a low-carbon energy source is progressing at a more gradual pace. Future development strategies should account for local economic peculiarities and promote activities that support green economic transformation, emphasising innovation and sustainable sectoral practices.

The findings imply that the effectiveness of CO_2 emission reductions requires adapting public policies to the specifics of the national economic structure and innovation potential. Poland should particularly focus on increasing energy efficiency and supporting the innovation sector to accelerate the green transition and reduce emissions more effectively. In Spain, policies should incorporate the specificity of innovation, focusing on eco-innovation in high-carbon sectors, while promoting diversification and supporting innovation in low-carbon sectors. This study constitutes an element of the ongoing discourse about the need to adapt economic strategies to national particularities, with a view to the effective mitigation of greenhouse gas emissions.

Limitations of the study include the use of data relating to only two countries and a specific period of analysis. The results may not be directly transferable to other countries with different economic structures or technological conditions. In the future, we recommend expanding the analysis to include more countries and employing more complex models that capture the interactions between various structural and innovation factors. An additional direction for future research would be to use panel data and apply a panel ARDL framework, allowing for joint estimation across countries while accounting for heterogeneity.

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Appendix A:

Table A1. ADF/KPSS tests for Poland data

Variable	Test	ADF (c)	ADF (c+t)	KPSS (μ)	KPSS (τ)
AGDP	Level	-1.907	-2.774	0.665**	0.158**
AGDP	Δ (diff)	-2.842*	-2.488	0.379*	0.114
CO_2	Level	-4.086***	-3.467*	0.218	0.108
CO_2	Δ (diff)	-3.618***	-3.399*	0.150	0.052
EC	Level	-0.933	-2.410	0.719**	0.156**
EC	Δ (diff)	-2.900*	-2.797	0.190	0.058
GDP	Level	-1.174	-3.690**	1.036***	0.116
GDP	Δ (diff)	-2.931**	-3.035	0.101	0.091
GDP	Level	-2.896*	-1.578	0.178	0.131*
GDP	Δ (diff)	-4.470***	-4.502***	0.226	0.114
IP	Level	-1.419*	-0.358	0.749***	0.128*
IP	Δ (diff)	-2.038	-2.378	0.181	0.180**
SGDP	Level	-2.139	-1.461	0.299	0.138*
SGDP	Δ (diff)	-5.173***	-6.312***	0.298	0.159**

Notes: *ADF: H0 = unit root; *, **, *** denote rejection at the 10%, 5%, and 1% levels (evidence of stationarity). KPSS: H0 = stationarity; *, *, *** denote rejection at the 10%, 5%, and 1% levels (evidence of non-stationarity).
Source: own elaboration in Aptech Gauss/tspdlib library.

Table A3. Screening of model innovations: Serial correlation, ARCH effects, normality and outliers

Country	N	LB (p)	ARCH-LM (p)	JB (p)	Outliers >3σ	Outliers >2.5σ
Poland	27	0.130	0.303	0.795	0	0
Spain	27	0.183	0.490	0.610	0	0

Notes: The table reports p-values from Ljung-Box tests of residual serial correlation (LB(p), lag = 4), ARCH-LM tests of conditional heteroskedasticity (ARCH(p), lags = 4), and Jarque-Bera tests of normality (JB(p)). outliers >3σ and outliers >2.5σ count standardised-residual outliers exceeding |z| > 3 and |z| > 2.5, respectively. n denotes the number of residuals used in the tests.
Source: own elaboration in Aptech Gauss/tspdlib library.

Table A4. Cumulative Fourier-frequency Granger causality

Direction	Wald	Bootstrap p-value	Frequency	Wald	Bootstrap p-value	Frequency
	Poland			Spain		
SGDP→ CO2	8.813	0.029	2	3.015	0.102	2
CO2→ SGDP	0.219	0.901	2	4.265	0.051	2
IGDP→ CO2	5.701	0.08	2	0.097	0.759	1
CO2→ IGDP	1.277	0.541	2	2.919	0.098	1
AGDP→ CO2	0.721	0.706	2	1.671	0.211	1
CO2→ AGDP	4.313	0.155	2	1.557	0.227	1
AGDP→ IP	2.246	0.16	3	2.5	0.323	3
IP→ AGDP	0.01	0.918	3	1.688	0.453	3
SGDP→ IP	6.158	0.069	3	2.951	0.257	3
IP→ SGDP	5.75	0.086	3	0.594	0.751	3
IGDP→ IP	5.899	0.08	3	15.064	0.006	3
IP→ IGDP	7.093	0.053	3	1.936	0.405	3

Source: own elaboration in Aptech Gauss/tspdlib library.

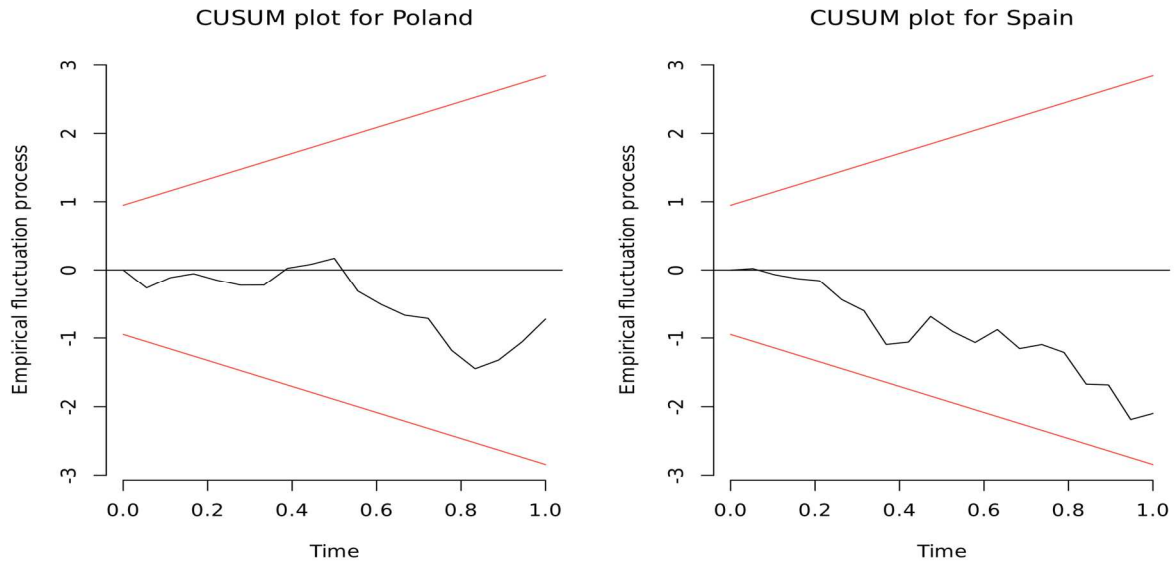

Figure A1. Fourier Bayesian ARDL for Poland and Spain CUSUM
Source: own elaboration based on investment results.

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Use of Artificial Intelligence

The authors confirm that the manuscript is free of AI/GAI-generated content. DeepL and Grammarly were used solely for language proofreading and minor linguistic adjustments. No generative AI tools were used for creating, rewriting, or analysing the scientific content.

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