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Entrepreneurship, Innovation, and Artificial Intelligence: Insights Across Industries

Edited by

Anna Ujwary-Gil

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Journal of Entrepreneurship, Management and Innovation (JEMI) ([e] ISSN 2299-7326, [p] ISSN 2299-7075) is an interdisciplinary, double-blind peer-reviewed journal, emphasizing theoretical and empirical articles on entrepreneurship, management, and innovation. The journal is published in ELECTRONIC (online first) and PRINT (occasionally) formats. See our website: http://www.jemi.edu.pl.

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Mapping the role of Artificial Intelligence in real estate: A bibliometric and case study analysis

***Alejandro Segura de la Cal*[1], *Antonio Martínez Raya*[2]**
***Gustavo Morales-Alonso*[3]**

Abstract

PURPOSE: *Accurately forecasting real estate prices presents a significant challenge due to the complex interplay of economic, social, and spatial variables. Artificial Intelligence (AI) offers a promising avenue to enhance predictive accuracy by integrating advanced analytical techniques. This study examines the role of AI in real estate pricing by identifying prevailing research trends and assessing its practical applications in cost reduction, process automation, and decision-making.* ***METHODOLOGY:*** *A two-pronged approach was employed, combining bibliometric analysis with insights from expert interviews. The bibliometric study mapped the evolution of AI-related research in real estate, highlighting key themes and methodological trends. The case study analysis provided complementary insights into how AI is applied in industry practice, particularly in streamlining construction processes, automating asset monitoring, and enhancing marketing strategies.* ***FINDINGS:*** *The study identifies a growing academic interest in AI-driven real estate research, particularly since 2018, with an increasing focus on machine learning, deep learning, and geospatial analysis. While scholarly research aligns with market needs in price forecasting and decision support, gaps remain in topics like operational efficiency and automation. Empirical evidence suggests that AI applications extend beyond price estimation, influencing profitability through process acceleration and cost optimization. However, international collaboration in the field remains low, limiting the scalability of AI-driven pricing models across different market contexts.* ***IMPLICATIONS:*** *The findings underscore AI's transformative impact on real estate by bridging research and industry applications. Theoretically, the study highlights the shift from management-oriented frameworks toward data-driven and algorithmic approaches. AI enhances price estimation by integrating diverse data sources and improving risk assessment. However, challenges persist, including data accessibility, algorithm interpretability, and the demand for specialized AI expertise. Addressing these issues could unlock further advancements in predictive modeling and real estate market efficiency.* ***ORIGINALITY AND VALUE:*** *This research provides a comprehensive perspective on AI's role in real estate pricing by integrating bibliometric analysis with case study insights. It extends existing knowledge by identifying key research gaps, emphasizing the need for interdisciplinary collaboration, and demonstrating AI's potential beyond price prediction to broader market dynamics and operational efficiencies.*

Keywords: *artificial intelligence, real estate, price prediction, hedonic pricing, bibliometric analysis, machine learning, deep learning, geospatial analysis, case study, real estate price prediction, predictive analytics in real estate, construction process automation, geospatial data analytics, AI-driven decision support systems, deep learning for property valuation, smart real estate technologies.*

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INTRODUCTION

In recent years, specific social, political, and financial stakeholders have pointed out the crucial relevance of Artificial Intelligence (AI) when setting the future course of the global economy within the changing world in terms of communications, human relations, environment, and mainly social structure of the entire population in present-day society. Today, the use of AI is massive in various human needs, and experts are evolving it in significant aspects such as early testing for decision-making business processes. Organizations have the option to apply AI in its entirety across all its strands, including Weak AI (WAI), Strong AI (SAI), machine learning (ML), Natural Language Processing (NLP), Random Forest (RF), or Artificial Neural Networks (ANN), among others.

Developers have mainly implemented most existing applications based on AI techniques for market analysis by extensively mining historical market data. Intending to make futuristic predictive analytics through machine learning, a subset of AI-related architectures, it creates models to predict market trends or business outcomes. Earlier consumption values have been habitually reflected from the actual requirements since some markets are being redefined from the data economy in unprecedented ways, thus allowing companies to access information about hyper-segmented audiences directly. Specifically, in the case of the real estate sector, this would involve taking historical data on discards from at least the last ten years into account. However, forecasting home prices through AI automation is challenging due to the many variables affecting this dynamic market.

Real estate price prediction challenges align with Hayek's (1945, 1988) argument on the dispersed nature of economic knowledge, where market participants possess localized insights that centralized models may struggle to capture. Traditional valuation approaches, such as hedonic pricing models (Can, 1992; Rosen, 1974), rely on high-quality data but face limitations in addressing market complexities (Álvarez de Linera Alperi et al., 2024). Moreover, economic shocks and regulatory effects (Gyourko & Molloy, 2015; Knoll et al., 2017) introduce further unpredictability. AI-driven methodologies, leveraging large datasets, offer a potential breakthrough by identifying patterns beyond human analytical capabilities (Rafiei & Adeli, 2015).

The paper concerns whether price training in the real estate sector can be predictable under normal market circumstances using AI techniques. Despite the increasing integration of AI into various industries, the specific role of AI in real estate pricing remains underexplored. Most existing studies focus on general market trends or individual AI applications. However, there is still a lack of comprehensive analysis of how AI-driven methodologies, particularly machine learning and automation, reshape price formation in real estate markets. This study aims to fill this gap by combining bibliometric analysis with expert insights to identify emerging research trends and real-world applications. Although previous literature in the research field is scarce, the study focused on bibliometric analysis to shed light on what has been happening in the real estate sector on an international level, particularly in those matters relating to housing problems in large cities. It is also about grouping research trends and unifying the key topics from earlier studies to classify them. In addition to previous findings, the most frequently used keywords can be identified from previous studies, thus establishing the basis for future research approaches. This study aims to analyze how AI technologies contribute to transforming real estate price prediction and market dynamics. Specifically, it seeks to identify key research trends, assess AI-driven innovations in pricing strategies, and explore their implications for entrepreneurship and management in the real estate sector.

In order to cope with this goal, the key question (Q) is how AI-based techniques are transforming real estate pricing and management. In addition to this issue, further research questions (RQs) have arisen as follows:

RQ1: What are the main AI-driven methodologies applied to real estate pricing?
RQ2: How has AI and real estate research evolved recently?
RQ3: What are the challenges and opportunities of AI in real estate pricing?

Throughout the present work, related answers are provided to motivate researchers to think for themselves about using AI techniques in predicting consumer behaviors, since the housing market is particularly sensitive to short-term supply shortfalls and house price shocks. It is interesting to note how investors seek strong profitability, which becomes more complicated as the economic deceleration is imposed in markets where supply is insufficient, especially for countries with inefficient domestic rental housing markets.

This paper has been divided into six parts. Firstly, after the abstract, the introduction shows how necessary studies on its research matter are, and they demand further approaches and willingness to improve the knowledge of the price formation in the housing market from the massive use of AI techniques. Secondly, the theoretical underpinnings describe the current knowledge about the matter studied through the analysis of findings from the most relevant works. Thirdly, the twofold methodology is presented. Fourthly and fifthly, the results from the bibliometric analysis and the case study research are summarized, respectively. Finally, the conclusions of the research paper are discussed, including the implications of this research, its limitations, and suggested avenues for further study.

THEORETICAL UNDERPINNINGS: IS PRICE PREDICTION A FATAL CONCEIT?

Is it possible to predict the prices of real estate properties? According to the conclusions of Nobel Laureate F. A. Hayek, in his seminal paper "The Use of Knowledge in Society" (1945), states that the knowledge necessary for efficient economic coordination is dispersed among individuals and cannot be centrally possessed or processed. In the context of real estate, the information needed to determine the appropriate prices for properties is decentralized and not fully accessible to any single entity or authority: market participants possess unique and localized knowledge about factors such as the condition of the property, neighborhood dynamics, future development plans, and individual preferences.

It could be argued that, while this knowledge is not available to everyone, there could be experts about certain geographic locations, such as real estate agents operating in a part of the city, a town, or a village. While experts can certainly allocate some specialized knowledge, it would still be a fatal conceit (also in the words of Hayek (1988)) to pretend to have absolute certainty of the setting of prices. Many factors influence real estate prices, including economic conditions, demographics, government policies, consumer preferences, and local supply and demand dynamics. Many of these factors are constantly changing and can be unpredictable. Additionally, individual preferences and perceptions play an important role in determining the value of a property, and these can vary widely between buyers.

In this complex landscape, companies operating in the real estate industry consider that transferring, operating, and managing knowledge plays a pivotal role in addressing uncertainties and fostering innovation. To that end, the use of AI can be an indispensable help. As highlighted in recent studies, the favorable impact of knowledge transfer on innovation underscores the importance of establishing robust systems to produce, manage, and share information effectively (Paredes-Chacín et al., 2024). Similarly, entrepreneurial agility, directly and indirectly, influences organizational performance (Haylemariam et al., 2024), which emerges as particularly relevant in dynamic environments like real estate markets. Furthermore, entrepreneurial alertness (Montiel-Campos, 2023) and agile leadership (Porkodi, 2024), characterized by digital innovation, trust, and competency, significantly improve operational outcomes, organizational growth, and team collaboration. Together, these insights highlight the critical role of adaptive strategies and innovative approaches in navigating dynamically multifaceted and ever-changing real estate markets.

Real estate prices are required by a variety of stakeholders, including real estate agents, appraisers, assessors, mortgage lenders, brokers, property developers, and investors and fund managers, among others (Pagourtzi et al., 2003), the valuation of the asset is "less a function of discounted present value than one of finding recently traded assets of comparable value" (Peterson & Flanagan, 2009). Since price is essential to many people, this information should be subject to an appropriate level of certainty. Mostly, this is because of (i) the high transaction costs that are specific from one region to another and between property types; (ii) the existence of greater information asymmetries than in the stock markets; and (iii) the high delays and longer time to complete a transaction when compared to the stock markets (Kabaivanov & Markovska, 2021). Among the stakeholders involved in the study of real estate prices are urban managers and policymakers, which means that the analysis is also linked to decision-making processes at the level of urban governance (Guarini et al., 2018; Guarini et al., 2024), helping to define the existing opportunities and barriers for urban development (Downs, 2005).

Among classic analysis models, hedonic pricing models stand out as one of the main tools for estimating and analyzing the impact of various attributes on price determination (Can, 1992; Rosen 1974). However, these models exhibit reliability levels that largely depend on the data quality used for training and analysis (Álvarez de Linera Alperi et al., 2024). Numerous studies examine the individualized impact of attributes such as green spaces (Chen et al., 2023), property views (Potrawa & Tetereva, 2022), or daylight exposure (Loro et al., 2024). Additionally, studies analyze the formation of prices in specific locations, such as Beijing (Duan et al., 2021), Turin (Loro et al., 2024), Seattle (Rodriguez-Serrano, 2025), or Xi'an (Luo et al., 2025), for both sales and rental markets. In price formation, the role of land prices is prominent (Knoll et al., 2017), both from a market perspective and as a result of regulatory effects (Gyourko & Molloy, 2015). These prices, primarily studied at

the city level, can be associated with the concept of "superstar cities" (Gyourko et al., 2013). In this context of difficulty in defining housing prices, the use of artificial intelligence becomes critically important, as it enables real-time responses to the needs of market agents by processing vast amounts of information, offering an unprecedented level of insight. Building on the traditional methods discussed by Pagourtzi et al. (2003) and incorporating machine learning tools, it is possible to advance toward a more accurate definition of housing prices through techniques such as neural networks (Peterson & Flanagan, 2009), support vector machines (Wang et al., 2013) or Random Forest models (Antipov & Pokryshevskaya, 2012), with combined approaches (Park & Kwon Bae, 2015) allowing for the validation of results. These tools are complemented by the growing importance of spatial modeling and cartography in developing pricing models and the increasing use of unstructured data such as photographs or reviews, as highlighted by Potrawa and Tetereva (2022).

Although the importance of the models themselves is significant, one of the most notable differences in the literature lies in the quantity and quality of data used. In general, machine learning models are applied again to highly localized settings, such as the case of and are also used for purposes beyond price definition. For instance, assessing methods based on Interpretable Machine Learning (IML) from decision-making that permits identifying associative relationships between related variables in greater resolution on the real state market (Lorenz et al., 2022) or even analyzing the characteristics of bare ownership (Guarini et al., 2025).

Despite the efforts made to predict real estate prices (e.g., Rafiei and Adeli, 2015), they appear to be challenging to expect in the short term because of the direct impact of economic events, changes in supply and demand, and speculative factors that can cause sudden and seemingly unpredictable fluctuations. Additionally, significant changes in the medium- and long-term complicate forecasting efforts. Some structural factors, such as demographic trends, changing government policies, and changing economic dynamics, add extra complexity, thus complicating the capabilities of traditional forecasting models. Accurately predicting the direction and extent of future changes in housing prices is difficult due to the dynamic interaction of these variables over time, underscoring the importance of sophisticated analytical methods and a deep understanding of the inherent complexities of this market. Given the complexities and limitations of traditional forecasting methods, the integration of AI emerges as a promising avenue to enhance price prediction accuracy. This raises the fundamental question that drives this research:

Q: How is AI transforming real estate pricing and management?

Addressing this question requires exploring the principal AI-driven methodologies applied to real estate pricing, analyzing recent research trends, and identifying key challenges and opportunities associated with AI adoption in real estate markets.

Nevertheless, artificial intelligence that uses vast amounts of data to extract patterns that may elude human analysts might overcome these shortcomings. Therefore, the following methodology will focus on this issue to shed light on AIs' ability to predict real estate prices effectively.

RESEARCH METHODOLOGY

The first research problem analyzed in this study is exploratory. For this reason, it is deemed that approaching literature and then completing the research with qualitative methodologies would be the most appropriate. For the sake of completeness, a two-fold research methodology is put into practice in this study. First, a bibliometric analysis was conducted using the Bibliometrix statistical package in the R program to process 3,000 articles from the Web of Science (WoS) and Scopus databases. Secondly, the motor themes and the thematic clusters obtained from the bibliometric analysis were used to design an interview protocol for its use in highly skilled and AI-knowledgeable entrepreneurs and managers of the real estate industry in Spain. Case study research tools such as interview transcription and codification allowed the authors to bridge the gap between scholars' knowledge siloed in academic publications and the hands-on vision of industry practitioners.

Bibliometric analyses have proven their validity in different settings, such as the link between business innovation, funding, and policy framework (Mallinguh & Zoltan, 2020) or social innovation (Silveira & Zilber, 2017), to cite only two. In this research, the search for bibliometric analysis covers specialized journals, conferences, and books until March 25, 2025. In addition, specific criteria have been applied to include works that address real estate price prediction using artificial intelligence techniques. Reviewed models include linear and logistic regressions, decision trees, random forests, neural networks, fuzzy models, support vector machines, or k-nearest neighbors in their application to the definition of hedonic prices.

To carry out the study, successive data downloads were performed based on the following criteria for WoS (equivalent to Scopus):

> TS=((real AND estate AND artificial AND intelligence) OR (real AND estate AND ai) OR (real AND estate AND smart) OR (real AND estate AND vector AND machine) OR (real AND estate AND random AND forest) OR (real AND estate AND fuzzy) OR (real AND estate AND neural AND network) OR (real AND estate AND decision AND tree) OR (real AND estate AND mass AND appraisal)).

The data downloaded from WoS generated 2,469 records, while the data from Scopus yielded 2,656 records. The merging of these datasets using the mergeDbSources command produced a combined database of 3,912 records, which was subsequently reduced to 3,908 after removing records dated before 1978 and discarding 1,217 duplicate entries. Once the combined database from WoS and Scopus was available, a vocabulary control process was carried out to standardize terms and enhance the clarity of the results. This involved generating a data frame containing all variants of the most frequently cited terms (e.g., "real-estates," "real estate market," "real estate prices," "house's prices," "real estate industries," "real estate investment," "real estate development") and replacing them in the merged dataset used for analysis. This process enabled a cleaner and more consistent output from the bibliometric analysis.

Subsequently, the information from the articles was analyzed with the R statistical program R (version 4.3.1), using the *bibliometrix* (version 4.1.4) package (Aria & Cuccurullo 2017). First, the data were analyzed globally. Then, the results were segmented according to the criteria of sources, authors, outstanding terms' presence, importance in literature, and evolution over time.

After obtaining the results of the bibliometric study, the second part of the research started. A multiple interview method was used to explore the results obtained through bibliometric analysis and refine the research with practitioners' responses. These methodologies allow for a better understanding of the phenomena concerning context (Ridder, 2017). The case study methodology of Eisenhardt (1989) has been followed, considering that the research question for this section was derived from the bibliometric analysis results. The cases analyzed are relevant and cross-cutting within the industry, involving participants from companies of different sizes and at various stages of the value chain in the real estate sector.

The interviewees were selected from companies operating within the same NACE category defined by the European Commission (L – Real Estate Activities). The sample included companies of various sizes (micro-enterprises, SMEs, and large firms) and professionals at different stages of their careers, including entrepreneurs, investors, department heads, and CEOs. This approach aimed at ensuring representation of the diverse circumstances and levels of exposure to AI within the real estate sector. A critical criterion for selecting participants was their direct involvement with or exposure to AI in their professional activities, significantly limiting the pool of suitable candidates. The three authors developed the interview guide collaboratively and validated it in June 2024 through consultation with another researcher in the field. This external feedback helped refine the questions and improve their alignment with the study's objectives, leading to minor adjustments in the interview protocol and facilitating a more effective capture of decision-making processes.

At this stage, the study adopts an inductive method based on cases that provide greater precision to the research, as suggested by Dubois and Gadde (2002), to investigate the adoption of AI in the real estate sector. Each interview has served as an individual case, allowing subsequent comparisons that reveal patterns and trends applicable to the industry. These data were collected through semi-structured interviews with selected industry experts who hold positions of responsibility in their companies and, therefore, require knowledge of and, in some cases, the use of AI to carry out their current tasks and make future decisions. Participation was voluntary, with complete freedom regarding their responses and their continuation in the interview. It was subject to authorization to record and anonymously publish the results, following confidentiality agreements (NDA) offered to all interviewees.

The interviews were conducted in June and July 2024, following a structured procedure based on the conclusions of the bibliometric study and the conceptual framework generated from the literature. Pilot tests were conducted to verify the validity and potential for knowledge generation of the questions and their alignment with the previously defined research questions. The interviews lasted between 25 and 45 minutes, as shown in Table 1. After being initially recorded by Author #1, they were transcribed and subsequently reviewed for accuracy by Authors #2 and #3. Text mining techniques were employed for the analysis, with the interviews being coded by Author #1 using Atlas.ti software (version 24.2.0). This tool, downloaded from https://atlasti.com/es, was selected for qualitative data analysis from research interviews. This AI-related software identifies the most relevant categories and patterns aligned with the study's objectives.

Table 1. Expert interviews general information

Expert	Company category [1]	NACE category [2]	Interview role	Experience in the industry	Duration and date of the interview
1	Micro	L	Founder - CEO	8 years	25 min (June 2024)
2	SME	L	Investor	20 years	40 min (June 2024)
3	Large-sized	L	Chief Operation Officer	25 years	36 min (June 2024)
4	SME	L	CEO	15 years	29 min (July 2024)

Note: [1] European Commission (2003); [2] NACE Rev.2 (European Commission, 2006).

RESULTS FROM THE BIBLIOMETRIC ANALYSIS

This section presents the results obtained in the analysis, starting from the general analysis of the documents and their authorship, to advance in the study associated with identifying the main tools and words that make up the evolution of the research concerning the definition of real estate prices.

First, the general structure of the documents was studied, showing that 2025 sources have been published on average at 1.93 documents per source, as indicated in Table 2. The average age of documents is 7.47 years, which should be contextualized given that documents have existed since 1978, i.e., over a period of 46 years. A total of 7,339 authors participated in the preparation of the papers, an average of 2.68 authors per document. In 1,028 cases, the authorship was the sole authorship, with a total of 863 people in this situation, which implies that in 38 cases, the authors published more than one article individually. In the case of the typology of the documents, 42.22% have been published as articles in different forms (general, book chapter, early access, research article, etc.), while 39.00% come from proceedings, conference papers, and conference reviews. There are 9.49% in the form of a dissertation/thesis and 4.07% in books, book chapters, and book reviews, 1.79% of reviews, leaving 3.43% in other formats. Finally, it should be noted that the study is mainly carried out by authors of the same nationality, with a rate of 7.7% of articles with international co-authorship.

Table 2. Summarized table of collected data for the study

Documents	3,908	Authors	7,339
Sources (Journals, Books, etc)	2,025	Authors of single-authored docs	1,028
Document Average Age	7.47	Single-authored docs	863
Average citations per doc	7.18	Co-Authors per Doc	2.68

Source: Own elaboration from *bibliometrix*.

Figure 1 shows the scientific output related to the topic of study over time. Scientific interest grew during the first decade of the 21st century, stabilizing between 2012 and 2016. From 2016 onward, a turning point was observed, with sustained growth continuing to the present. Over a period of eight years, scientific output increased more than five times.

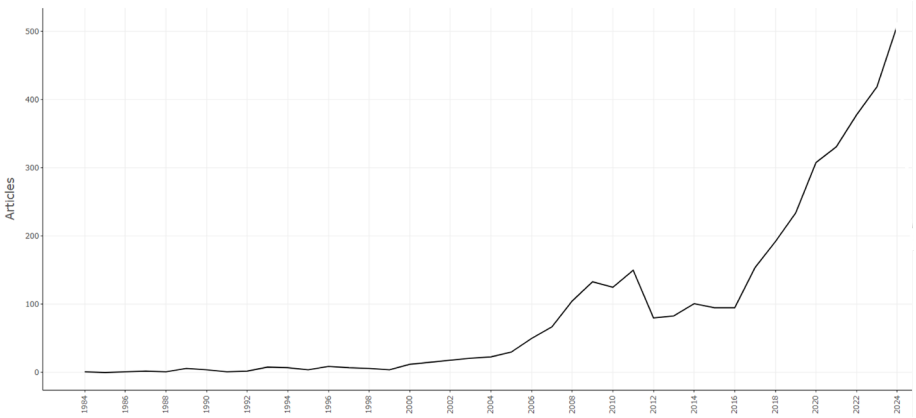

Figure 1. Evolution of the number of scientific publications included in the study from 1978 to 2025

Source: Own elaboration from *bibliometrix*.

These works are presented in different academic sources, among which the volume published in 'Lecture Notes in Networks and Systems' stands out, as shown in Figure 2. It is also observed that the concentration of sources is low, and a large majority of the published articles have no more than two publications. The importance of conferences among the available publications also stands out.

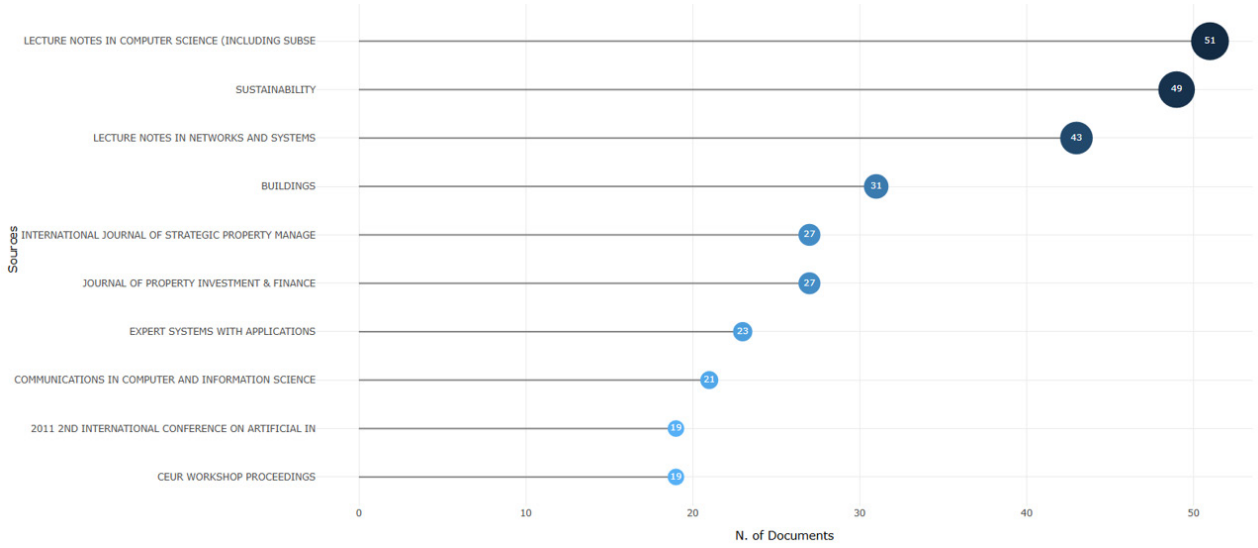

Figure 2. Main sources where contributions have been published.

Source: Own elaboration from *bibliometrix*.

Figure 3 shows the production of the top 10 authors over the last years between 2002 and the first quarter of 2025. It can be observed how the publications are widely distributed among many authors and how there is a significant link to the subject over long periods. The most prolific authors in terms of the number of publications are Trawinski B., Lasota T., and Liu Y., with 47, 46, and 42 documents, respectively. A strong collaborative pattern between Trawinski and Lasota started in 2007, with Telec joining this collaboration from 2009 onward. An initial peak in the activity of the most prominent authors is evident between 2008 and 2011, followed by a renewed surge from 2019 to the present. This trend aligns with what was observed in Figure 1 regarding the overall publication volume in the field.

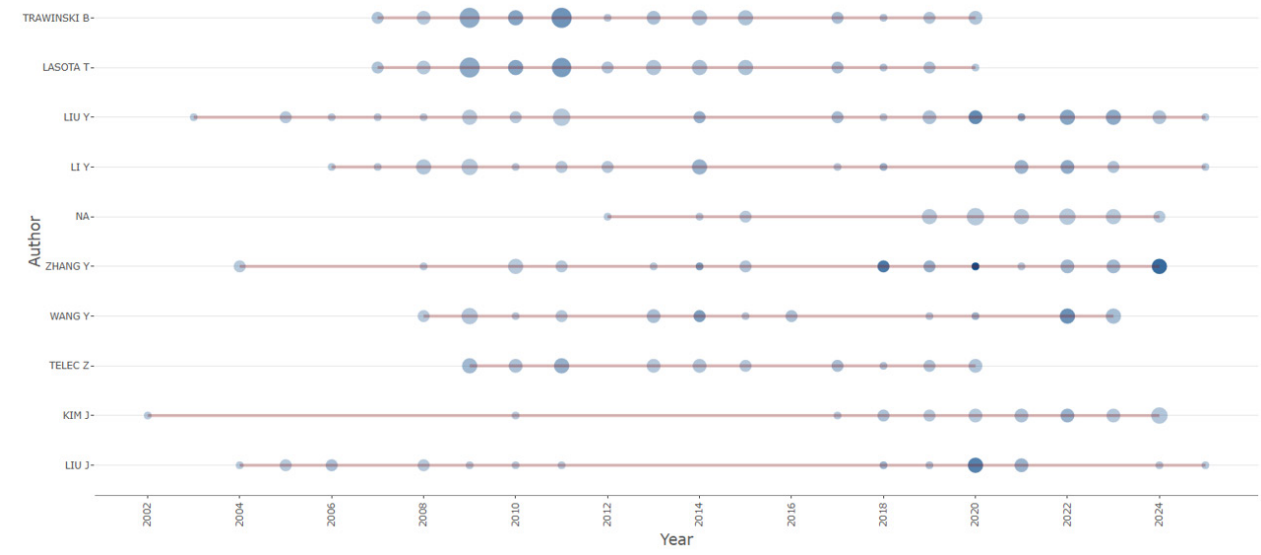

Figure 3. Publications of representative authors over time

Source: Own elaboration from *bibliometrix*.

Figure 4 shows that most of the articles are presented as papers written by researchers of the same nationality, with international collaboration being reduced to an average of around 7.7% for most countries. Regarding the number of contributions, in absolute terms, it is worth noting that Chinese authors have consistently been the main contributors to the field. Following China, the role of the United States, India, Korea, and Italy stands out, as these countries rank among the top five with significantly higher publication output than others. In contrast to the volume of publications, the United States stands out in terms of cited documents, with nearly twice as many citations as China and almost six times more than Korea, the third most cited country.

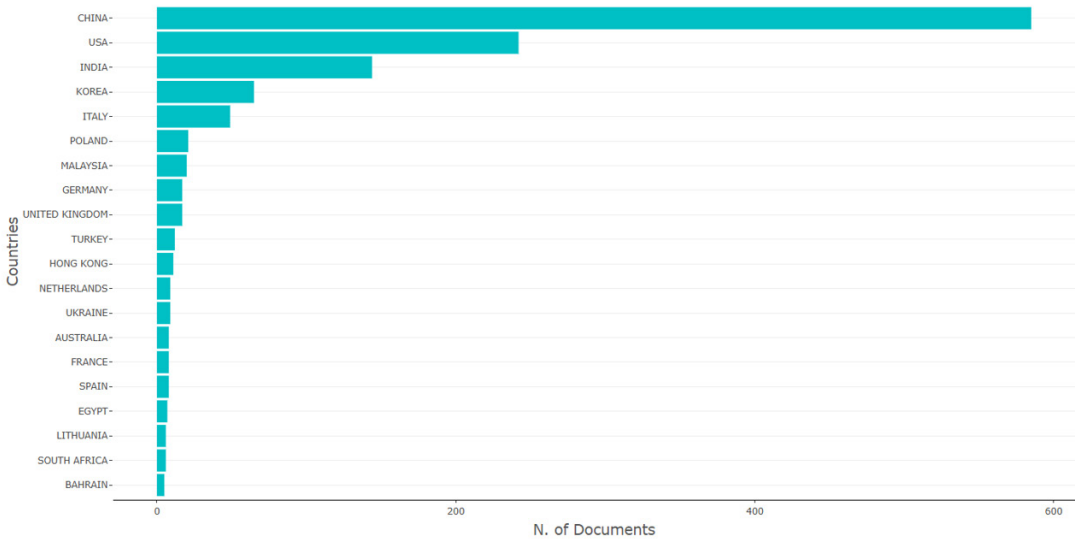

Figure 4. Location of corresponding authors by country

Source: Own elaboration from *bibliometrix*.

Figure 5 shows the geographical distribution of all the corresponding authors of the documents under study. The highest concentration of authors in the field is found in China, with 855 individuals representing 26.4% of the total authors. They are followed by the United States (416), India (298), and Italy (154), while the role of authors from South Korea (72) appears more limited. The top ten publishing countries account for 68.9% of the total, which rises to 88.88% when considering the top 30 countries. This indicates a high concentration of publications in Asia and the Americas, whereas in Europe, there is a broader participation from various countries. Within Europe, Italy stands out as the most representative country, both in terms of the number of documents and the number of authors involved.

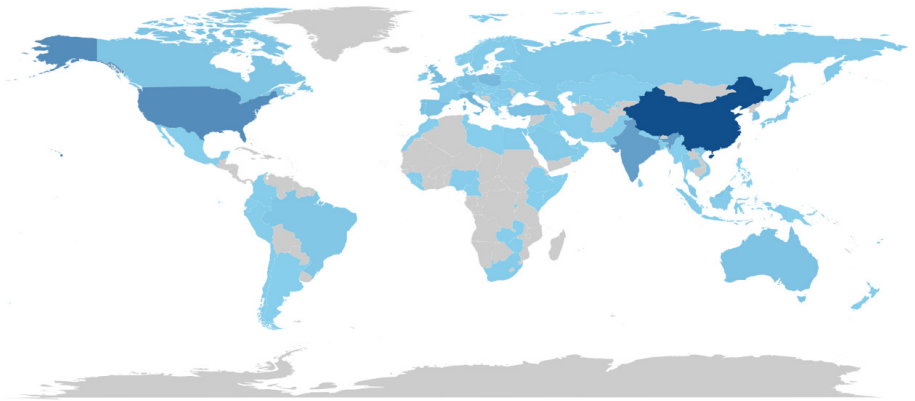

Figure 5. Distribution of publications by country

Source: Own elaboration from *bibliometrix*.

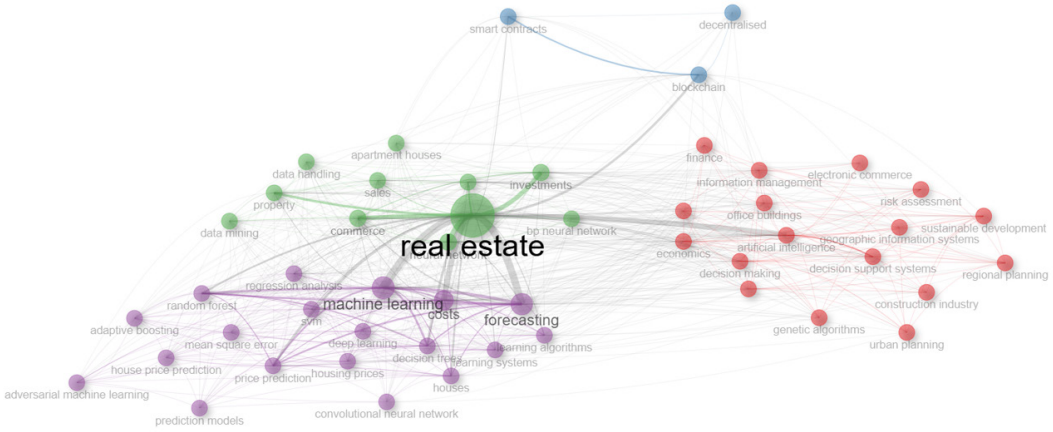

Figure 6. Representation of the co-occurrence network on the main terms analyzed

Source: Own elaboration from *bibliometrix*.

Enriched keywords were used to generate the co-occurrence map (Figure 6), with method parameters set to automatic layout and Walktrap as the clustering algorithm. A total of 50 nodes were positioned. Under these parameters, a total of four clusters were formed. In first place appears the term *Real Estate*, highlighted in green as the thematic core of the study. This cluster is dominated by traditional real estate market terms centered on concepts such as sales, housing, and investments. Below it, the purple cluster stands out, associated with using predictive models and machine learning, encompassing mainly technical concepts such as *machine learning*, *random forest*, and *forecasting*. The third cluster, shown in red, presents an interdisciplinary approach, including such issues as *urban planning*, *decision-making*, and *sustainability*, combined with technological terms like *artificial intelligence*, which serves as the core of the research. Finally, the blue cluster is related to emerging technologies such as *blockchain* and *smart contracts* in the real estate sector.

Figure 7 shows the strategic diagram, which presents research topics based on their relevance in the field (centrality) and their level of development (density). In the upper right quadrant are the Motor Themes, which lead the research line by combining a high level of relevance and development. This includes topics such as artificial intelligence, decision-making, and risk management. In contrast, the lower left quadrant contains themes that are either emerging or in decline. Here we find emerging technologies such as blockchain, smart contracts, and decentralization, along with broader terms that are only partially represented in the field, such as investments, smart cities, and sustainability. Finally, in the lower right quadrant are the Basic Themes, which include the real estate sector, neural networks, and commerce, foundational topics that are central but less internally developed.

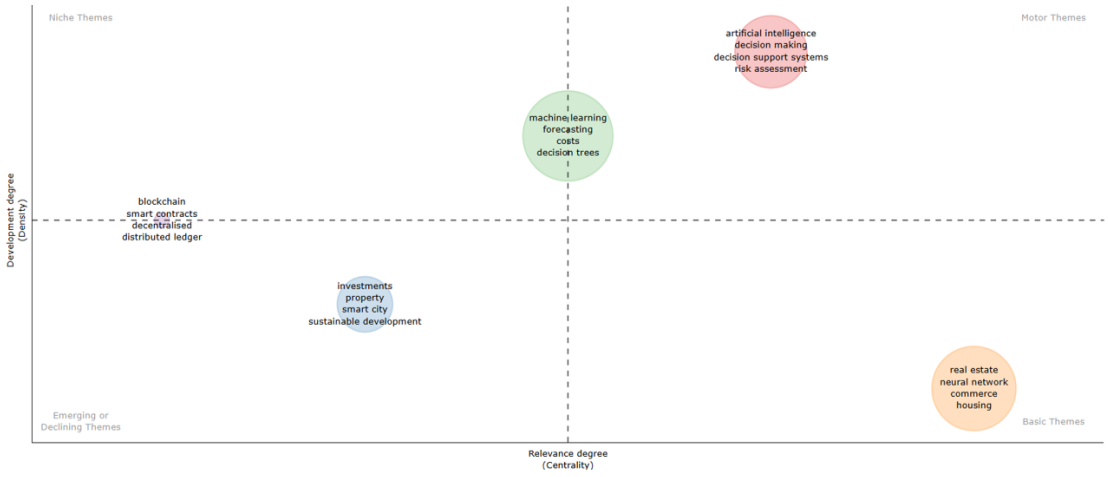

Figure 7. Overview of the density and relevance of the key terms from related papers

Source: Own elaboration from *bibliometrix*.

Figure 8 shows the change in key issues over time, including the historical density of each term's appearances. The results show a significant increase in interest in recent years and highlight what was previously noted regarding the growth from 2008 to 2012, followed by a decline in interest for many of the studied terms. The frequency peaks are found between 2023 and 2024, with continuity observed into the first quarter of 2025. Among the top five cases, three terms stand out for their extensive temporal development: "real estate," "neural network," and "artificial intelligence." "Machine learning" has also shown steady growth since the early 21st century, while "blockchain" emerged prominently starting in 2018. Emerging terms such as "random forest," "deep learning," "smart contracts," and "smart cities" are also evident, along with the consolidation of technical terms like "decision trees" and "support vector machines". However, these have not experienced the same surge in recent years as others.

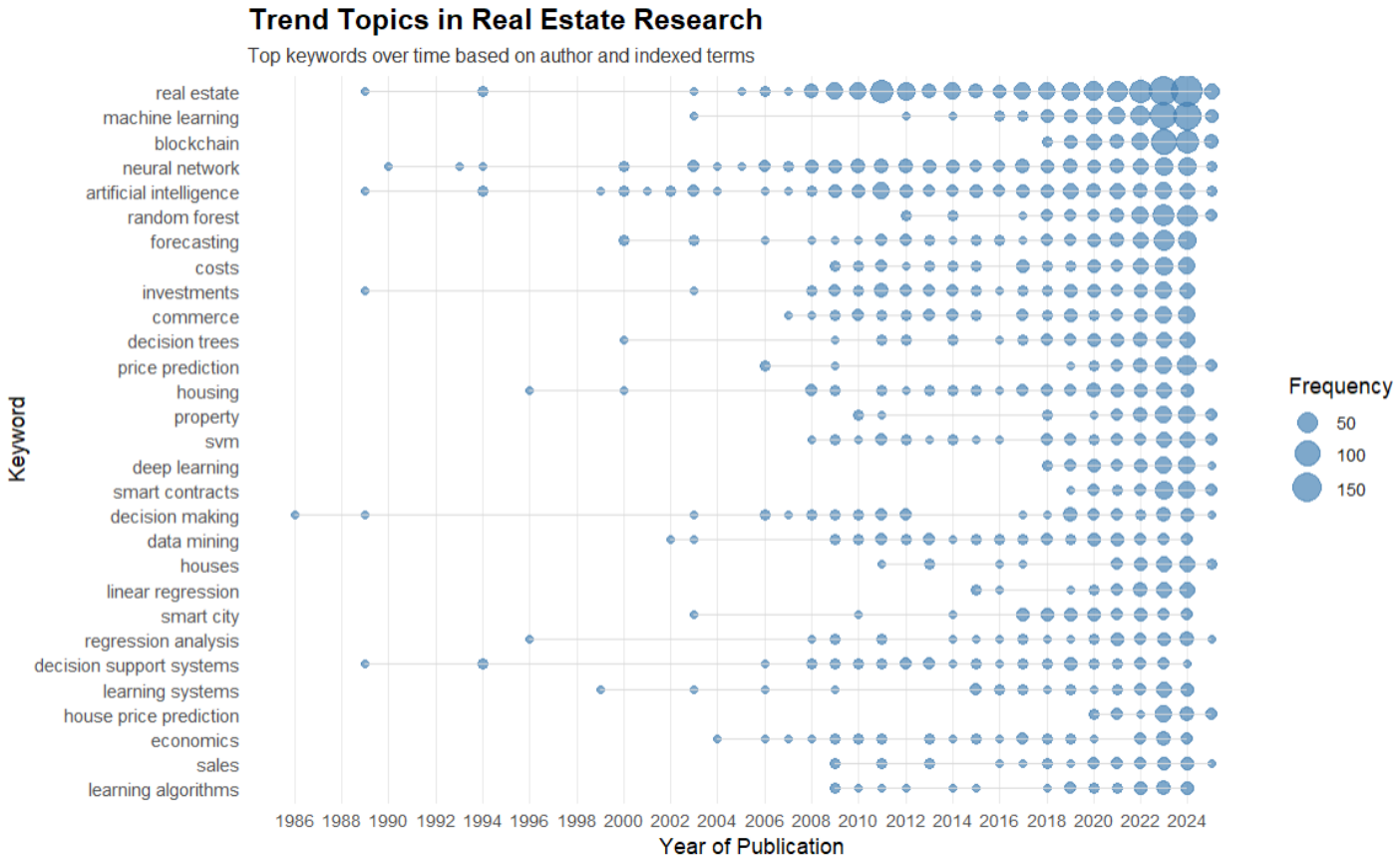

Figure 8. Temporal representation of the preponderant terms in the analyzed works

Source: Own elaboration from *bibliometrix*.

The word cloud illustrated in Figure 9 highlights the importance of the main elements associated with real estate. Terms such as costs, investments, forecasting, price prediction, commerce, decision-making, and property can be observed. However, the most prominent aspect of these terms is their association with the application of technology and artificial intelligence, as evidenced by the appearance of machine learning, neural networks, blockchain, artificial intelligence, and random forest.

Figure 9. Word cloud from those related papers from 1988 to 2023

Source: Own elaboration from *bibliometrix*.

The main articles, ordered from highest to lowest according to the number of citations, appear in Table 3. It can be seen how all of them show a similar citation range, from 365 for the first to 172 for the tenth. All the listed articles were published before 2018, with the top five appearing before 2010. It can be observed that 6 out of the 10 articles are related to real estate valuation, both in terms of market prices (Pagourtzi et al., 2003; Peterson & Flanagan, 2009; Antipov & Pokryshevskaya, 2012; Park & Kwon Bae, 2015; Rafiei & Adeli, 2016), as well as income and cost levels within the construction process (Rafiei & Adeli, 2018). Some articles use housing variables to analyze urban aspects, such as smart growth (Downs, 2005), gentrification (Quastel, 2009), and service quality (Tseng, 2009). Lastly, the study by Bourassa et al. (2003) combines housing price prediction with urban segmentation factors.

Table 3. Summary of most cited articles concerning the study

Artícle	Autores	Journal	Year	Cites
A causal and effect decision making model of service quality expectation using grey-fuzzy DEMATEL approach	Tseng, M.-L.	Expert Systems with Applications	2009	365
Smart growth: Why we discuss it more than we do it	Downs, A.	Journal of the American Planning Association	2005	299
Real estate appraisal: A review of valuation methods	Pagourtzi, E.; Assimakopoulos, V.; Hatzichristos, T.; French, N.	Journal of Property Investment & Finance	2003	296
Political ecologies of gentrification	Quastel, N.	Urban Geography	2009	276
Do housing submarkets really matter?	Bourassa, S.C.; Hoesli, M.; Peng, V.S.	Journal of Housing Economics	2003	274
Using machine learning algorithms for housing price prediction: The case of Fairfax County, Virginia housing data	Park, B.; Kwon Bae, J.	Expert Systems with Applications	2015	272
A novel machine learning model for estimation of sale prices of real estate units	Rafiei, M.H.; Adeli, H.	Journal of Construction Engineering and Management	2016	227
Novel Machine-Learning Model for Estimating Construction Costs Considering Economic Variables and Indexes	Rafiei, M.H.; Adeli, H.	Journal of Construction Engineering and Management	2018	201
Mass appraisal of residential apartments: An application of Random forest for valuation and a CART-based approach for model diagnostics	Antipov, E.A.; Pokryshevskaya, E.B.	Expert Systems with Applications	2012	184
Neural network hedonic pricing models in mass real estate appraisal	Peterson, S.; Flanagan, A.B.	Journal of Real Estate Research	2009	172

Source: Own compilation based on WoS.

The bibliometric analysis shows that technology use in the real estate sector, emphasizing asset valuation, is a topic of growing interest in academic literature. This interest experienced an initial surge around the 2007 financial crisis, later stabilizing in the mid-2010s, but has seen a renewed boom over the past seven years with the advancement of artificial intelligence. Among the results obtained, serving as a foundation for the next phase of this study in the form of case analysis, three major thematic clusters emerge: traditional real estate concepts, the application of technology to real estate assets, and the broader connection with urban planning, industry, and decision-making processes. The analysis also highlights the increasing research focus on concepts such as artificial intelligence, decision-making, risk assessment, and the recent interest in disruptive technologies like blockchain and smart contracts. Together, these elements have enabled the development of the following case study phase through expert interviews.

FINDINGS FROM THE CASE STUDY

As discussed in the Methodology section, the present research is based on a twofold strategy. After settling the academic knowledge from the field through a bibliometric analysis, practitioners' insights have been sought using in-depth interviews with five experts in the Spanish real estate industry. The interview protocol was created with thematic dimensions obtained from the bibliometric analysis. To facilitate comparison with the results of the bibliometric analysis, the insights from the interviews have been grouped into three sections. First, the direct impacts on real estate price prediction are addressed, with the analysis divided into two aspects: the first based on the process and tools of predictive analysis, and the second stemming from the importance attributed to geospatial information by the interviewees. This section concludes with an analysis of the real estate market linked to investment, profitability, and risk.

The case study analysis reveals different action lines beyond those observed in the bibliometric analysis, enriching the main research lines. There is significant interest in various topics that have a cross-sectional impact on the real estate business. These interests include using algorithms, the current and future valuation of assets, geospatial analysis, information capture and acquisition, comprehensive investment management, risk limitation, and generative AI. Despite this interest, the current use of AI varies considerably among companies; in some cases, AI serves as a complementary activity with the potential to add value to the core business, while in others, it has assumed a central role across different business areas. This role spans from enabling new capabilities offered by the tool to improving employees' ability to perform tasks more efficiently and with greater quality.

AI and housing price prediction

Predictive analysis process

The definition of housing prices emerges as a transversal element in the responses obtained; however, it takes on different nuances depending on the business profile of the cases analyzed. A more supply-oriented approach is observed in developer and construction companies, while the perspective shifts towards demand in companies focused on the real estate sector. In the first case, there is interest in valuing large housing portfolios and reducing the manual work involved; in the second, factors such as purchasing power or credit capacity stand out, closely linked to the creditworthiness of everyone. In combining both perspectives, elements related to geospatial data usage emerge, along with the ability to access both public and private information and cross-referencing these data points to obtain a more complete picture.

In this area, there is consensus on the importance of pre-analysis processes, which include data quality, cleaning, and preparation; these preparatory steps are considered more valuable than the tools used. Among the tools associated with higher precision are neural networks and random forests. The ability to efficiently process large volumes of data is unique in all cases. AI is highlighted for its ability to act intertemporally in price prediction, providing additional capabilities compared to traditional methods. Furthermore, AI use improves valuations even in areas where direct comparisons are unavailable. Regarding predictive capacity, there is an expectation that we will offer real-time valuations along with the ability to anticipate market changes. This allows AI to deliver more consistent predictions throughout the market for various properties, locations, or socioeconomic conditions, as highlighted by interviewee #2.

"AI shifts the paradigm: from analyzing a single opportunity to simultaneously evaluating 26 million properties and selecting the optimal one, fundamentally transforming the process of price determination."

In terms of achieving comprehensive asset information, as illustrated by interviewee # 4, "*even calculating how housing prices vary by proximity in meters to a bus stop*", a key challenge in price definition is identifying unique characteristics of each property that are difficult to computerize. These characteristics enable valuation experts with extensive knowledge of neighborhoods and properties to have unique market information for making these price estimates. Statements such as "*The real estate agent [...] is not going to disappear, but rather [...] they will be the ones to rely on these tools to gain more, more capability*" (Interviewee #3) highlight both the quantity and quality of valuations and clients managed.

Geospatial improvements

Geospatial analysis becomes a fundamental element for the interviewees since the real estate sector is entirely linked to location. On the one hand, every property characteristic is influenced by its location, with the asset value highly dependent on it; on the other hand, significant regulations and usage limitations are associated with each space that affect potential business and personal decisions. Digital tools for this type of analysis have evolved significantly in recent years, from the initial work with GIS to integrating modern Big Data platforms that combine technologies such as satellite imagery and the development of digital twins.

"In the real estate sector, everything revolves around georeferenced data [...] because physical location is crucial for any analysis." Interviewee #4

Regarding asset valuation, geospatial analysis allows cross-referencing of socioeconomic information, such as the risk of non-payment, as indicated by interviewee #1 *"what we are trying to propose is the ability to predict the creditworthiness of tenants entering the system"* or property occupation. Here, the ability of AI to handle geolocated data and execute large-scale evaluations of residential units across a region stands out, moving from individual cases to large-scale analysis. In this context, geospatial analysis links characteristics that facilitate urban development and foster innovation in cities, identifying factors that drive greater activity and dynamism and enabling the establishment of a "genome" of cities, achievable only through geospatial analysis. This process provides strategic value by predicting aspects such as urban flows or city socioeconomic patterns.

In general, the value of AI in using geolocated data is evident. This analysis increases the importance of elements such as proximity to services, accessibility to housing, and characteristics of the urban environment. Its potential applications include optimizing land use and, as a result, urban development, done from both public and private perspectives. In the latter case, it allows developers to maximize efficiency and effectiveness. For example, it can reduce the time needed to make decisions on the acquisition of buildable plots by automatically analyzing many possible combinations to present the "*two or three best options*," enabling one to "*make decisions about the purchase of a plot even before buying it, with far more information than we have today.*" (Interviewee #3). Additionally, AI's ability to evaluate multiple architectural combinations allows work that traditionally takes months to be completed in a matter of hours. This capability enables, among other objectives, the maximization of buildability according to urban regulations, optimizing the number of housing units and land use. Similarly, it can provide early cost estimates for renovations based on factors such as photographs, generating an assessment linked to the price in a comprehensive valuation of both elements.

A third point addressed in the case study is the relationship between AI and informed investment and risk management patterns within the real estate market. The main findings point toward a common goal: achieving safer investments and optimizing time and resources. These objectives are achieved by mitigating financial risks and conducting preventive investment analysis, which improves the precision of feasibility studies. Using artificial intelligence (AI), risk assessment incorporates specific factors derived from cross-referencing socioeconomic data, geolocation, and occupancy of properties, while also integrating macroeconomic elements that provide a comprehensive view of the risks and expected returns for each asset.

Real estate market: Investment and costs

The study reveals specific patterns based on business areas. In the case of real estate leasing, it highlights the importance of socioeconomic analysis to increase investment security by identifying tenant behavior patterns and classifying their credit quality and likelihood of default. This type of analysis is especially useful in highly regulated markets where tenants have greater protection, thus providing greater certainty for property owners.

Regarding construction and rehabilitation projects, the study identifies the value of AI in urban rehabilitation and problem detection in buildings from both socioeconomic and energy-related perspectives. It also highlights AI's ability to analyze land buildability and assess investment feasibility according to regulatory and market conditions. This technology simulates many combinations in seconds, identifying the most profitable designs before closing a purchase. In this way, AI interrelates these key points (asset valuation, geolocation, and risk) to improve the analysis of the risk-return relationship of different investments.

The expected effects of using AI are increased operational efficiency derived from process automation. This encompasses different aspects, including internal company tasks and external activities in customer relations. Internal advantages include the previously mentioned creation of simulations and the selection of optimal investment options, along with additional capabilities such as drafting and reviewing legal documents and developing technical skills to assess the need for building interventions. One example is the ability to detect issues such as dampness or cracks in properties and, based on these, estimate associated repair costs. This allows budget calculations without the need to visit the properties, thereby streamlining the decision-making process. Similarly, new capabilities have emerged for inspecting construction sites via drones, which, thanks to AI tools, can autonomously measure and document hard-to-reach elements, such as air conditioning ducts.

"With AI, we can determine the optimal architectural fit to maximize allowable buildability under the law, performing 100,000 combinations per second within hours." Interviewee #3

In terms of external advantages, these include communication tasks and customer interaction activities. In the area of communication, AI accelerates content creation by generating document drafts tailored to the company's communication preferences, which increases the efficiency of the communication team, as shown in "*the result is that instead of facing a blank page […] what you do is move on to supervising what the AI has created*" (Interviewee #3). Additionally, the use of chatbots is considered a capability already established, though constantly evolving through AI intervention. This enhances customer interaction in sales and post-sales processes, a skill believed to improve customer experience while reducing costs.

It is important to note the expected application of AI in other emerging technological fields, such as collaborative robots (COBOTS). Here, AI could improve workplace safety and health, resulting in a reduced risk of injury to employees and improved working conditions. This improvement is particularly impactful in the construction sector, given the physically demanding nature of many tasks.

Finally, it is worth highlighting the barriers and challenges the respondents identified, including personal and process-related aspects. Personal limitations stem from the difficulty of finding professionals with dual skills that combine specific technical knowledge with advanced technological competencies, which can delay the adoption of these technologies. In terms of process challenges, the complexity of sourcing information is noted. In this regard, on the one hand, there is a need to develop robust and highly automated algorithms; on the other, the reliance on private information sources is considered a barrier, contrasting with the availability of open data, which varies widely across countries.

The interviews provide insights into using terms overlooked in the bibliometric analysis, such as "real-time" and the application of knowledge to unique elements, with "unique" referring to those that lack comparable data for estimation purposes. Another key point emphasized by the interviewees is the importance of geospatial analysis, a concept that connects socioeconomic or regulatory variables. Geolocation is also used from a strategic urban planning perspective, with the idea of a "city genome" linked to artificial intelligence, elements associated with the red node seen in Table 7. As is typical in business activities, the interviewees also value applying AI solutions to profitability and investment risk concepts. In summary, the interviews offer a practical view of the research, indicating that the results of AI applications are focused on business and urban planning issues, that is, the interests of stakeholders within the real estate market.

DISCUSSION

This study provides a detailed exploration of how AI is reshaping real estate pricing and explores other possible AI applications. To that end, bibliometric analysis has been combined with insights from case studies. The present research highlights several important contributions to the field by analyzing scientific publications and market trends.

First, the bibliometric analysis reveals a marked increase in academic interest, with a notable increase in contributions since 2018. Despite this growth, the field remains localized, with international collaboration below 10%. This underscores the opportunity to advance global research that can bridge local and national studies to uncover universal pricing patterns. The geographic concentration of contributions, particularly in China, the USA, India, and Italy, also indicates international interest and development disparities.

Second, the study identifies a clear alignment between academic concerns and market needs. Real estate investment, decision-making, cost reduction, and price forecasting dominate research and case study findings. However, certain market priorities, such as operational efficiency and process automation, are underrepresented in the literature, probably due to the challenges in consolidating dispersed and proprietary business data for academic purposes.

Third, the study traced a shift in academic focus from management-oriented concepts such as "decision support systems" and "risk assessment" to technological approaches that involve machine learning, blockchain, and smart contracts. This evolution mirrors market trends, where innovation tools have become secondary to integrating multiple AI functionalities to solve complex real-world problems.

Lastly, the study highlights the ability of AI to transform business processes, from reducing construction timelines to automating asset monitoring and optimizing marketing strategies. These capabilities directly translate into cost savings and improved profitability, influencing real estate prices and market dynamics. Integrating geospatial data, socioeconomic factors, and advanced algorithms positions AI as a powerful tool to improve accuracy and efficiency in real estate valuation.

The responses obtained during the case study are not equivalently represented or adequately represented in the bibliometric analysis. Consequently, AI functionalities associated with cost reduction in business operations emerge as analysis tools and solutions that accelerate the construction process, thus reducing the timelines for real estate promotion. This could have significant implications for price setting: On the one hand, in business, time equates to costs; on the other, this acceleration could lead to greater profitability, potentially impacting land prices. Another notable aspect of cost reduction in the market is the role of AI in marketing and sales activities, particularly in content generation for communication and customer management. Although not prominently featured in the bibliometric results, these areas may significantly affect company costs and, consequently, real estate prices and associated returns. Alongside cost reduction, automation possibilities also emerge. In this case, emphasis has been placed on operations related to monitoring the condition of rental assets through artificial intelligence models. These models, which understand market dynamics, such as demand fluctuations, and individual factors, such as the risk of default, facilitate business decision-making.

The results obtained from both the bibliometric analysis and the case study align with the existing literature, highlighting the importance of data management and various machine-learning solutions for housing price analysis. Academic research findings are linked to specific locations and rely on databases focused on fields of study relating to that matter. Similarly, the responses from professionals reflect a dependency on data quality and emphasize the importance of its preprocessing before analysis. Efficient data management is critical for achieving reliable results and avoiding issues such as incorporating bias into analytical models.

The findings also converge on the availability of tools that enable a higher level of insight into decision-making, which fosters greater professionalization of the sector through access to high-quality information regarding property value and expected returns. This generates significant opportunities in the market, and it is particularly relevant to note the potential emergence of competitive barriers based on data ownership, access to technology, and the availability of the talent required to harness the power of AI in the real estate sector.

In summary, AI has great potential to improve the accuracy of real estate price estimates. This benefit results in more precise measurements and has broader implications, particularly regarding time: AI enables real-time responses and improves medium- and long-term forecasting. The analysis shows that the approach adopted to study this issue is based on the investment concept, with a strong focus on profitability and risk. Consequently, fundamental concepts such as housing or home are relegated from both business and academic perspectives.

CONCLUSIONS

The results obtained address the research questions formulated in the introduction. Firstly, they show how artificial intelligence has become a critical element in both academic research and real-world practice within the real estate sector, with a rapid increase in scholarly publications since 2018. This evolution is supported by various innovative tools and methodologies, including machine learning algorithms, among which random forest and support vector machines stand

out, and deep learning models, such as artificial neural networks. In this context, the interviews highlighted the importance of using combined methods and properly preparing databases to achieve accurate results. They also emphasized the significance of geospatial information as a key component for AI applications. Current challenges include technical aspects, such as the characterization of each property based on its unique features, which complicates modeling, as well as human resource limitations, particularly the difficulty in meeting the demand for professionals with expertise in applying AI within the sector.

The present study provides researchers with a roadmap for future studies into AI-driven innovations in real estate. Bibliographic analysis reveals significant gaps in global collaboration and operational applications, suggesting interdisciplinary and international research opportunities. Studies focusing on areas of underexplored, operational efficiency, automation, and marketing strategies could enrich academic discourse and provide actionable insights. Furthermore, the evolution of analytical objectives and technological concepts suggests a need to adapt research methodologies to reflect emerging tools and paradigms continuously. Researchers can better capture the nuances of AI's impact on real estate by integrating qualitative and quantitative approaches.

For practitioners and industry professionals, the findings highlight practical applications of AI for cost reduction, risk management, and process optimization. The ability of AI to accelerate construction timelines, improve marketing strategies, and improve decision-making processes offers tangible benefits to real estate firms. The study also underscores the importance of data quality: well-managed and cleaned datasets are critical to the effectiveness of AI models, particularly random forest and neural network algorithms. Furthermore, the need for skilled professionals becomes evident as AI adoption grows. Companies should invest in training programs to equip their workforce with the technical skills and knowledge necessary to harness the full potential of AI.

Policymakers can leverage insights from this study to create a supportive ecosystem for adopting AI in real estate. Policies that promote open data standards encourage international collaboration, and fostering innovation could accelerate the development and deployment of AI solutions. AI-driven analysis could also inform housing policies, urban planning, and interventions to ensure affordability and equitable access to housing. Finally, fostering education in the STEM domain, particularly on AI-related topics (both at university and vocational levels), can be of the greatest importance shortly.

Despite the academic contributions, this study has limitations that pave the way for future research. First, it is necessary to broaden the geographical scope of this study. The case study focuses on Spain, which could limit the applicability of its findings to other contexts. Expanding the scope to include diverse geographic regions could offer comparative insights into global and local real estate markets. Second, the bibliometric study captures only the first stages of a growing literature stream. Most likely, the many publications of the next few years will be able to enrich the results of bibliometric analysis. Third, the study highlights low levels of international collaboration in this field. Facilitating cross-border research could improve understanding of global housing trends and the role of AI in different cultural and economic contexts. Fourth and last, given the rapid pace of technological change, the study findings can quickly become outdated. Longitudinal studies that track AI developments over time could provide more dynamic insights into its evolving applications.

This study focused on using AI-related techniques in defining property indicators and exploring other possible applications in the real estate market, such as autonomous decision-making in setting prices. Through bibliometric analysis, emerging trends in price prediction can be detected, including the application of deep learning algorithms, the integration of geospatial data, and the consideration of socioeconomic factors. Understanding these trends allows us to anticipate future directions for research and development in this field of knowledge.

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Appendix

Summary of preliminary questions surveyed to respondents on questionnaires.

1) Context
   a. Could you tell us about your company/institution's role within the real estate business?
   b. Have you used AI-related tools in your work in the real estate sector?
   c. Are these tools associated with uses of deep learning, geospatial data applications, or do they integrate socioeconomic factors of the properties?
   d. What impact has the use of these tools had within your company? What impact has it had on your clients?
2) Implementation
   a. Which areas of the business initially benefited from the implementation of AI tools?
   b. What challenges did the company face during the initial implementation?
   c. What types of data are used to train AI models in the company?
3) Technical Issues and Algorithms
   a. What types of AI algorithms are used in the company?
   b. How long does it take to train a typical AI model used by your company?
   c. What platforms or technological tools do you use to implement and maintain deep learning models?
   d. How does the company handle the integration of these models into existing systems?
   e. How does the company update socioeconomic data with prior existing information?
4) Benefits and Drawbacks
   a. What have been the main advantages for the company in using AI?
   b. And the main drawbacks or challenges?
   c. Have you observed an increase/decrease in the accuracy of real estate valuations thanks to deep learning? If so, can you quantify these changes?
   d. How has deep learning improved the customer experience (e.g., in terms of property search, recommendations, etc.)?
   e. Have there been any changes in the company's operational efficiency?
5) Business Impact and Key Indicators
   a. What were the increases/decreases in gross sales (V/%) since the implementation of deep learning?
   b. How has deep learning affected the company's margins (V/%)?
   c. Has the company's ability to predict real estate market trends improved? In what way?
   d. What impact has it had on response times to customer inquiries?
   e. Are there any other Key Performance Indicators (KPIs) that evaluate the effectiveness of deep learning in your company?
6) Governance and Ethical Considerations
   a. Have you encountered any issues related to biases in data or deep learning models? If so, how did you address them?
   b. What measures are taken to ensure the transparency and interpretability of the models used?
7) Future Expectations for Business Development

a. What are the company's future plans in relation to deep learning?
b. What new areas of the business do you expect to explore with the help of deep learning?
c. How does the company plan to stay current with rapid advancements in deep learning technologies?

8) Non-use of AI variant
a. What are the reasons for not adopting AI in your company?
b. Have any obstacles been identified (excessive cost, distrust of the AI provider, difficulty in maintaining confidentiality of key information, or others)?
c. What challenges does the company face in its development without the use of AI? Are the company's competitive advantages at risk?

Biographical notes

Alejandro Segura de la Cal is an Assistant Professor in Economics and Management at the Universidad Politécnica de Madrid (UPM), specializing in the real estate sector. His research focuses on economic geography, land use dynamics, and the analysis of real estate markets through business simulation models. He has participated in national and international research projects and regularly collaborates with industry partners to bridge the gap between academic research and market practices. He is co-author of several publications focused on housing markets, urban economics, and strategic business modeling.

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Author contributions statement

Alejandro Segura de la Cal: Conceptualization, Methodology, Software, Formal Analysis, Investigation, Resources, Data Curation, Writing, Project Administration. **Antonio Martínez Raya**: Conceptualization, Methodology, Validation, Review & Editing, Supervision, Project Administration. **Gustavo Morales-Alonso**: Conceptualization, Methodology, Validation, Investigation, Resources, Review & Editing, Supervision, Project Administration.

Conflicts of interest

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Hierarchy of factors shaping entrepreneurs' choice and change of SME legal form

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Abstract

PURPOSE: *While the factors influencing entrepreneurs' choice and change of legal form for their businesses are widely recognized, their relative importance remains unclear. This study aims to systematically examine and hierarchize these factors, providing a dynamic understanding of entrepreneurs' decision-making across the business lifecycle. Using Poland – a post-transition economy with EU-driven modernization yet path-dependent business structures – as the research setting, we explore how legal form decisions evolve beyond the static, one-time decision commonly presented in existing literature.* ***METHODOLOGY****: This study employs a mixed-method approach comprising three components. First, we conducted semi-structured in-depth interviews with 34 entrepreneurs strategically selected from three groups: sole proprietors, company shareholders, and former sole proprietors who transitioned to corporate structures, capturing decision-making at different business stages. Second, participants completed a criteria ranking survey of factors identified in the literature or by themselves. Third, we applied the Analytical Hierarchy Process (AHP) to quantitatively assess and prioritize the relative importance of each factor.* ***FINDINGS****: Entrepreneurs' decisions regarding legal form are iterative rather than one-time choices, shaped by a complex interplay of business and personal factors. Ultimately, business considerations prevail, with fiscal efficiency, fund disposition flexibility, liability limitation, legal conditions, and business continuity emerging as the top determinants. Entrepreneurs typically start with simpler legal forms before transitioning to limited liability companies as their businesses grow and mature.* ***IMPLICATIONS****: This study offers valuable insights for entrepreneurs, policymakers, and scholars. Entrepreneurs gain a structured understanding of key decision-making factors, allowing for more informed legal form choices. Policymakers can design regulatory frameworks that better support business growth and transition. Scholars can refine existing theories by incorporating the fluid nature of legal form decisions in transitioning economies.* ***ORIGINALITY AND VALUE****: The study makes three distinctive contributions. First, it breaks from the fragmented perspective in existing literature by examining how entrepreneurs holistically assess both tax and non-tax factors when making legal form decisions. Second, it challenges the static view of legal form selection by empirically investigating the dynamic nature of these decisions over the business lifecycle. Third, by focusing on Poland's unique economic context, it extends entrepreneurship theory beyond Western market assumptions, offering novel insights into how institutional settings in post-transition economies shape entrepreneurial decision-making processes.*

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INTRODUCTION

Choosing a legal form is the first strategic decision every entrepreneur must make when formally starting their business (Khandekar & Young, 1985). Legal form determines how a business is organized, operated and regulated as well as how much and how fast it grows (Bagley, 2008; Davidsson et al., 2002; Storey, 2016). Legal form should be tailored to the potential of the business, and should enable entrepreneurs to fulfill their long-term goals and needs (Gielnik et al., 2014). It should also help reduce uncertainty and risks associated with the entrepreneurial process (Osuszek & Ledzianowski, 2020). Entrepreneurs may prefer to run their business alone or with partners, leading them to choose between sole proprietorship, a partnership, or a corporate legal form. Sole proprietors and general partners retain full control of a business and can manage it at low cost, but their liability in raising capital is unlimited. Corporate owners, on the other hand, benefit from limited liability and easier access to capital, but they share control of a business, where important decisions may take longer due to formality and legal requirements (Baik et al., 2015). Each type of legal form has its own advantages and disadvantages (Baik et al., 2015; Hertz et al., 2009), but ultimately, each contributes to the performance and success of the business (Fitza & Tihanyi, 2017).

Among the most important factors influencing an entrepreneur's decision on business legal form are liability protection (Hertz et al., 2009), tax considerations (Bergner & Heckemeyer, 2017; Can, 2022), access to financing (Beck et al., 2013; Chen & Qi, 2016), governance and administrative costs (Demirguc-Kunt et al., 2006), as well entrepreneur's behavior and personal characteristics (Braidford et al., 2017). Other relevant factors include transparency (Gassen & Muhn, 2025), the liquidity of own contributions and agency costs associated with the potential separation of management and control (Fama & Jensen, 1983b; 1983a). The regulatory environment, institutional framework and institutional quality are also of great importance (Capelleras et al., 2008; Demirguc-Kunt et al., 2006; Khurana et al., 2020). However, most studies examine these dimensions separately. In particular, there is a clear distinction between studies that focus on tax-related incentives (e.g., income shifting or legal form arbitrage) and those that address non-tax issues, such as control, governance, or compliance costs. This fragmented perspective obscures how entrepreneurs assess these factors holistically, often weighing fiscal efficiency against regulatory restrictions or long-term strategic objectives (Chen et al., 2018; Elschner, 2013). Moreover, legal form choice is usually treated as a static, one-time decision made at the start of a business, despite growing evidence that entrepreneurs revise this decision as their businesses grow (Bilicka & Raei, 2023; Levine & Rubinstein, 2017) In reality, legal form is not fixed but subject to change in response to growth opportunities, succession needs, or shifts in the tax and regulatory environment (Bloemen-Bekx et al., 2023; Tazhitdinova, 2020). Despite this, few empirical studies have explored the dynamic nature of legal form transitions over time. Additionally, most existing evidence is drawn from mature Western economies, offering little insight into how entrepreneurs make these decisions in post-transition environments like Central and Eastern Europe (Fritsch et al., 2022). In these institutional settings, legal form decisions may reflect a distinct set of priorities, such as adaptation to transnational funding regulations, path-dependent regulatory norms, or avoidance of formalization costs (Zygmunt, 2020). These gaps highlight the need for an integrated, context-sensitive approach to understand which of these factors entrepreneurs prioritize when deciding to choose or change the legal structure of their business.

This study aims to better understand how entrepreneurs hierarchize factors when choosing and changing their business's legal form. Following the entrepreneurial decision-making framework proposed by Shepherd et al (2015), we investigate entrepreneurs as individuals who make the decision about legal form after assessing business opportunities – either at the startup stage or during later growth phases. Not only do we ask entrepreneurs which factors they consider when making these decisions, but also explore the relative importance of each factor. To achieve this, we conducted semi-structured in-depth interviews with three groups of habitual entrepreneurs: sole proprietors, company shareholders, and former sole proprietors who transitioned their legal forms to corporate structures. Organizational lifecycle theory suggests that businesses start with a simpler legal structure and transition to more complex forms as they mature (Miller & Friesen, 1983, 1984). This explains why sole proprietorship is the most dominant form of business ownership in emerging economies, while incorporated businesses are more common in mature economies (Baik et al., 2015). However, our study challenges this assumption by examining Poland, a young yet structurally mature economy, where sole proprietorships

still dominate despite the country's significant economic development. Although Poland ranks among the world's largest economies, its business structure is more characteristic of an emerging market.

Poland represents a unique economic environment that contrasts with the path of Western developed markets and reflects the transitional dynamics of Central and Eastern Europe (CEE) (Fritsch et al., 2022). Its post-communist transformation – from the "shock therapy" reforms of the early 1990s that swiftly transitioned from central planning to a market economy – has created institutional and entrepreneurial conditions different from those in well-established market economies. Since joining the European Union, Poland has become the leading recipient of EU structural and cohesion funds, receiving one in every four euros of the 2014–2020 EU budget, which has significantly expedited its economic convergence with Western Europe (Michałek & Hagemejer, 2024). These EU funds come with stringent legal and institutional requirements tied to the EU's acquis communautaire – from competition policy to company law as well as the rule-of-law and governance standards. Compared to entrepreneurs in stable Western markets, entrepreneurs in Poland have to comply with more intricate regulatory requirements and administrative processes. As a result, they frequently modify legal forms of their companies to comply with these standards and be eligible for EU-supported programs (Zygmunt, 2020). At the same time, the history of Poland's transition and ongoing institutional growth has fostered an entrepreneurial culture that is used to ongoing regulatory changes and adaptation. Over the last two decades, Polish businesses have operated in a fluid policy context marked by evolving laws, new institutional frameworks, and periodic reforms aligned with EU directives, necessitating a high level of flexibility and resilience from entrepreneurs. In sum, Poland provides a compelling case of how a post-socialist economy, aided by EU integration, can develop a unique legal-institutional framework for business. Its combination of EU-driven modernization and path-dependent post-communist characteristics results in a business climate markedly different from that of Western Europe, with legal form decisions and entrepreneurial behavior distinctly shaped by both the imperatives of supranational funding and the country's transformative historical legacy.

The remainder of this paper is structured as follows. Section 2 provides a theoretical framework on the factors influencing business legal form choice. Section 3 presents the context of Poland as the study's setting. Section 4 describes the methodology and data collection. Section 5 presents the results, Section 6 discusses their implications, and Section 7 provides final conclusions.

LITERATURE REVIEW

The literature on entrepreneur's decisions about legal form is well developed, and it concentrates on various issues related to running a business and its functioning within a given organizational and legal framework. This framework may become an opportunity or a limitation for business development, which entrepreneurs must consider when deciding on its legal form. Prior research has identified numerous factors that entrepreneurs weigh when selecting an ownership structure, with the most often mentioned: governance/control considerations and administrative burden, liability (risk exposure), taxation, access to finance, long-term strategic goals, and personal characteristics of the owner/founder.

The flexibility of operational structure described in the regulations determines operational efficiency of a business (Handoyo et al., 2023). For instance, corporations typically have a more formal management structure with a board of directors and officers, while sole proprietorships and partnerships allow for more informal decision-making. Entrepreneurs often evaluate the extent to which a particular legal form allows them to adapt to changing market conditions, accommodate growth, and efficiently manage the decision-making process. This process is influenced by compliance costs, reporting obligations, and administrative burdens associated with specific legal forms. This includes, for example, registration fees, expenses for keeping accounting records and preparing financial statements. A general rule is that the simpler the legal form of a business activity, the lower the registration and reporting requirements, which generate lower costs (Bergner & Heckemeyer, 2017). More complex legal forms require keeping full books and preparing financial statements. In this situation, the size of the enterprise and simplifications provided in the accounting law for SMEs (Beuselinck et al., 2023) or the type of activity conducted – e.g. innovative activity, may be of importance (Breuer et al., 2019)

Another well-documented factor is liability and risk management. Different legal forms offer different levels of liability protection, and this can impact the entrepreneur's financial well-being. Legal forms that assume less liability protection and therefore higher entrepreneurs' exposure to risk are sole proprietorships and partnerships. Limiting personal liability can protect an entrepreneur's private assets and is a well-known motive for incorporating (Hertz et al., 2009). Indeed, the appeal of the corporate form is often the shield it provides against personal financial risk. However, this benefit comes with

trade-offs: relinquishing some control and facing greater reporting obligations. Entrepreneurs weigh their tolerance for risk against these costs. In high-risk industries or those requiring significant debt financing, the corporate form (offering limited liability) is more attractive (Khurana & Dutta, 2021).

Legal form also affects how the business is taxed (Bergner & Heckemeyer, 2017; Can, 2022; Elschner, 2013). For example, sole proprietorships and partnerships pass the business profits and losses directly to the owner(s), who report them on their personal tax returns. Corporations, on the other hand, are taxed separately from their owners. Choosing the right legal structure can optimize tax efficiency and minimize an entrepreneur's tax obligations (Abdul Wahab & Holland, 2012; Hanlon & Heitzman, 2010; Trad et al., 2024). Lejour and Massenz (2020) underline that entrepreneurs choose a legal form that is the least taxed one. Tazhitdinova (2020) shows that different tax liabilities across different organization forms affect business entry and income shifting margins. Can (2022) finds that reducing entrepreneur's personal income tax rates increases overall self-employment activity. Higher personal income tax rates encourage incorporated entrepreneurship but discourage unincorporated entrepreneurship. Elschner (2013) shows that tax incentives and tax reduction favor incorporation. On the other hand, Chen et al. (2018) find that the corporate income tax can distort the choice of legal form of organization and cause inefficiency by leaving some high-marginal-return-to-capital firms without sufficient access to capital. Therefore, tax distortion has strong effects on a firm's choice to be corporate or non-corporate (Edmark & Gordon, 2013).

According to Raei (2018), incentives induced by the tax structure are as important for the organizational form of a business as the external financing. The ability to attract external investment and the ease of transferring ownership interests can influence the decision to adopt a specific legal structure (Maurer et al., 2022; Zott & Huy, 2007). Complex legal forms may unlock financing opportunities, albeit at the cost of higher initial requirements. Conversely, simpler forms are chosen when funding needs are modest or reliant on personal funds, aligning with evidence that many entrepreneurs remain unincorporated unless seeking substantial outside capital (Cole & Sokolyk, 2022). Chen et al. (2018) confirm that different legal forms offer varying degrees of access to financing options such as loans, venture capital, and public offerings. Pass-through entities in the USA are subject to legal restrictions on access to capital. A pass-through entity can have no more than 100 shareholders and no foreign, institutional, or corporate shareholders. Additionally, Bracht et al. (2021) find that entrepreneurs who choose a legal form with low paid-in minimum capital requirements acquire substantially lower debt levels than their high-capital counterparts. The authors confirmed that this effect results from the default risk signal associated with a firm's legal form.

The issue of legal form is also very important for long-term strategic goals, especially business growth, including family businesses, which must deal with the continuity of the business and succession planning (Bloemen-Bekx et al., 2023; Meier & Schier, 2014; Michel & Kammerlander, 2015; Widz & Kammerlander, 2023). The great majority of family firms are private (Stewart & Hitt, 2012). It is well-known that owners of family businesses are relatively less eager to go public and become listed companies than non-family firms, as they are concerned about losing control of the company. Firms that face a succession need to choose a proper legal form to preserve their legacy (Ip & Jacobs, 2006; Vassiliadis & Vassiliadis, 2014). A legal form that eases ownership transfer or adding partners (e.g., a corporation) facilitates business continuity and saleability, which is vital for long-term success and succession planning (Bloemen-Bekx et al., 2023).

The difference in owners' attitudes, thinking, and strategizing are also closely reflected in how they actually run their businesses (Braidford, Drummond, and Stone, 2017a). The more ambitious the owners of the firm, the higher the probability that they will grow and expand their business (Hansen & Hamilton, 2011). The owners who tend to present a growth-resistance disposition will have a propensity to avoid change by exaggerating the difficulties involved (Braidford et al., 2017a). On the other hand, the owners whose ventures underperform try to persist, since it may lead them to pursue and exploit business opportunities that bring long-term economic returns (Adomako, 2020; Caliendo et al., 2020). Such investors, independently whether their decisions are rational or not, are likely to put more emphasis on retrospective factors (period and degree of underperformance, personal investments) and less on prospective factors (risk of going into default, potential for growth, personal options) when deciding whether to persist with an underperforming venture (Lin et al., 2022). Considering entrepreneur's personal characteristics, Cole and Sokolyk (2022) observe that the initial legal form of organization is best suited to pursue the owner's growth objective and complexity of the business. They find that owners who are more educated and have a higher number of prior start-ups are more likely to choose a more complex initial legal form of organization. Edmark and Gordon (2013) confirm this and notice that individuals with higher expected income are more likely to be corporate. Additionally, Parker (2004) finds that younger entrepreneurs adjust their expectations significantly faster in response to new information than older entrepreneurs do.

Despite this rich body of research, apparent gaps remain. First, much of the existing literature examines these factors in isolation or focuses on a binary tax-versus-non-tax narrative, without offering an integrated view of how entrepreneurs prioritize a combination of factors when choosing a legal form. Recent tax-centric studies, for instance, demonstrate the impact of tax policy on legal form preferences (Bilicka & Raei, 2023; Can, 2022), but give less attention to non-tax considerations. Conversely, studies of governance or finance seldom incorporate insights from tax policy changes. Secondly, prior research has essentially treated legal form choice as a one-time, initial decision, often assuming that once a business is established under a specific form, it remains in that form (Levine & Rubinstein, 2017). This overlooks the dynamic nature of entrepreneurship – as businesses grow, accumulate experience, or face new external conditions, entrepreneurs may re-evaluate and change their enterprise's legal form. Third, there is a contextual gap: most evidence comes from Western economies (Bilicka & Raei, 2023; Braidford et al., 2017; Cole & Sokolyk, 2022; Edmark & Gordon,2013) with mature institutional frameworks, where incorporated forms are the norm for growth-oriented firms. Far less is known about how entrepreneurs decide on legal form in post-transition contexts like CEE countries, where historical, institutional, and economic factors might lead to different priorities. In CEE countries, for example, even as the economy matured, informal forms remain prevalent, suggesting unique local determinants at play. Existing theories derived from Western settings may not fully explain this phenomenon.

Thus, the literature lacks a comprehensive, up-to-date synthesis of the full spectrum of factors influencing legal form choice and change, especially one that captures a transitioning economy's perspective. This study addresses these gaps by systematically identifying a broad set of factors from both the literature and exploratory interviews, and then hierarchically evaluating their importance through a mixed-method approach. By explicitly focusing on how entrepreneurs prioritize these factors and how decisions evolve over time, our research provides a novel, holistic understanding of legal form choice. In doing so, we also respond to calls for more context-sensitive insight by examining the Polish case, thereby shedding light on how Western-centric paradigms hold up in a different institutional environment.

The context of Poland

Entrepreneurship was illegal under the socialist regimes that governed Central and Eastern Europe (CEE) after World War II and only began to develop after independence was obtained in the early 1990s. Consequently, research on entrepreneurship is somewhat new to the region and certainly insufficient to diagnose the reasons for choosing the legal form of the enterprise. Building on Western models, CEE countries developed i.e. freedom of enterprise. The transition to a liberal democracy and a market economy based on private property unleashed the spirit of entrepreneurship in many people whose knowledge and skills were not suited to the new economic conditions (Rugina & Ahl, 2023).

Development of the Polish nation is placed in a historical context of successive invasions, border changes, and domination by neighboring 'empires'. Before 1989, when Poland transited from centrally planned to market economy, some form of entrepreneurship was allowed (Stoica, 2004), but the country still had a very substantial agricultural sector, largely based on relatively small-scale farms. After 1989, there was a shift from trade and other ties to Russia and the former Soviet bloc towards greater interaction with Western European and other developed market economies.

As the Iron Curtain lifted, a wave of market-oriented economic reforms swept the country, leading to significant changes in the business landscape. The first years after 1989 were the time of entrepreneurship explosion. During this period, companies were created as a result of two dominant processes: either through the establishment of new business entities or through the capital and liquidation privatization of state-owned enterprises. Micro and small businesses, often family-owned, played a crucial role in the initial stages of entrepreneurship development. Between 1989 and 1994, the number of companies almost doubled, and by 1994 it exceeded 2 million. This transformation period was characterized by high unemployment, high inflation, limited access to capital, a lack of business expertise, as well as extensive and lengthy registration procedures, but fast introduction of regulations suitable for a market economy. In 1991, the Warsaw Stock Exchange was opened, and tax laws were enacted, including the Personal Income Tax Act (1991), Corporate Income Tax Act (1992), VAT and Excise Tax Act (1993), and Accounting Act (1994). The financial and banking sector was transformed, with considerable foreign capital participation. Foreign direct investments increased substantially, associated with major changes to the main productive sectors, higher labor productivity, and increases in income per capita.

The years 1995-2003 marked a stage of market self-regulation. There has been substantial adoption of market reforms along the lines of contemporary economic neoliberalism, but consistent with a Western European model, including a significant role for state regulation and intervention in the economy. Towards the end of the 20th century, legal regulations began to evolve to meet the requirements of joining the European Union. Notable changes included the Constitution of the

Republic of Poland (1997), the reform of the social and health care systems (1998), and the Commercial Companies Code (2000). At the same time, Poland took actions to attract foreign capital, gradually reducing the Corporate Income Tax (CIT) rates from 40% in 1992 to 19% in 2004 (which is still in effect). However, Poland had a system of double taxation on dividends, so a tax on income ranging from 19-20% (depending on the period) had to be settled upon their distribution. In 2004, a change also occurred for entrepreneurs conducting business in personal forms, when a linear Personal Income Tax (PIT) of 19% was introduced as an alternative to the gradual tax scale with a symbolic tax-free amount. This stage was characterized by a significantly more stable growth rate in the number of companies, which continued to increase, but much slower than before 1995.

In 2004, Poland joined the European Union. Poland became a part of the EU Common Market without any restrictions on the flow of goods and services within its territory while simultaneously experiencing a significant influx of subsidies, acting as an economic growth catalyst. This period saw a shift toward innovation and technology-driven entrepreneurship, start-ups, particularly in the IT and manufacturing sectors (Millward, 2020). Poland's economic landscape was diversifying, and the entrepreneurial spirit was gaining momentum.

The global financial crisis (2008-2009) presented a challenge to Poland's economic resilience. However, the country weathered the storm better than many of its European counterparts. Entrepreneurship became a key driver of recovery, as small businesses demonstrated agility and adaptability. The crisis prompted a reevaluation of risk management strategies and a renewed focus on innovation (Rae, 2013). During this period, government support programs and financial incentives aimed at fostering entrepreneurship gained prominence. Policymakers recognized the role of small businesses in economic recovery and have taken actions to improve the functioning of businesses, especially small ones, such as preferences in social insurance, tax benefits for so-called small taxpayers, raising limits for full bookkeeping as well as creating a "single window" (the ability to register business activity in one place without the need to visit numerous offices, including electronically), and the option to suspend business operations.

However, the measures to tighten the tax system were burdensome for many entrepreneurs, requiring increased expenses and time to adapt to new rules. Starting from 2015, due to the dismantling of the Polish legal system and growing uncertainty, entrepreneurs significantly reduced investment expenditures. The sharply criticized reform of the tax system called the "Polish Deal", introduced in 2022, was additionally unbearable for many enterprises, especially the smallest ones. Just within a year, the "Polish Deal" rules were improved, and the entrepreneurship uncertainty went down.

The development of entrepreneurship in Poland from 1989 until today reflects a remarkable journey marked by resilience, innovation, and adaptability. Poland belongs to a group of countries that update their national provisions on taxes and accounting in accordance with arrangements and norms promoted and adopted in the world. Thanks to the updates, the Polish act on accounting includes modern trends in decisions concerning accounting and does not lag behind the world solutions in this field. From the early days of economic reforms to the challenges of the global financial crisis or pandemic time and the opportunities presented by EU integration, Polish entrepreneurs have demonstrated a capacity to evolve with changing uncertain economic conditions (Millward, 2020). Today, there are over 5 million registered economic entities in Poland. The most popular forms of conducting business are sole proprietorships within personal forms (70% of the economic entity structure), and in the case of capital forms, limited liability companies (over 10% of the total number of registered entities in the national economy).

METHODOLOGY

Participants and sampling

This study involved 34 entrepreneurs (business founders) in Poland, selected through purposive snowball sampling. Participants were required to be founders/owners of small or medium enterprises (SMEs) in Poland who had experience in choosing and/or changing the legal form of their business. We initiated recruitment via multiple entry points – for example, contacting entrepreneurship support organizations and personal business networks – to identify initial respondents. Each initial participant was then asked to refer other entrepreneurs meeting the criteria. This snowball sampling approach was necessary due to the difficulty of accessing busy entrepreneurs. We mitigated potential selection bias by using diverse seeds (from different industries, regions, and age cohorts) and monitoring sample diversity as recruitment progressed. As a result, the final sample encompassed a cross-generational and experience-diverse group: it included entrepreneurs who started businesses during the early 1990s economic transition as well as those who founded companies in the last few

years. Specifically, the 34 interviewees fell into three categories reflecting their legal form experience: (1) sole proprietors or general partners (14 participants), (2) owners of companies (10 participants, operating limited liability or joint-stock companies), and (3) entrepreneurs who had transformed their firm from a sole proprietorship into a company (10 participants). This composition ensured that we captured a wide range of perspectives on legal form decisions, from those who had never changed their business form to those who had undergone a legal form transition.

The sample size of 34 was justified on the basis of data saturation and precedent in qualitative research. We conducted interviews until we observed that no new themes or factors were emerging from the discussions – the point of saturation, where additional interviews yield diminishing new information. In our study, thematic saturation was reached approximately at the 30th interview, as participants began to reiterate similar factors for legal form choice. We conducted a series of additional interviews (up to 34) to confirm that saturation had been achieved. The number of interviews falls within the range commonly recommended for qualitative studies. For instance, Creswell (2014) suggests that 20–30 interviews are often adequate in studies aiming for saturation. Similarly, prior research indicates that qualitative samples typically consist of between 20 and 30 interviews (and usually fewer than 50) when researchers aim to capture all relevant themes (van Rijnsoever, 2017). Thus, our sample of 34 entrepreneurs is sufficient to provide a comprehensive understanding of the phenomenon while ensuring the reliability of insights. We acknowledge that snowball sampling may introduce some selection bias (as respondents refer others from their networks); however, by starting chains in different circles and deliberately seeking variation in participant characteristics, we sought to reduce homogeneity in the sample.

The demographic and business characteristics of our sample size are presented in Table 1.

Table 1. Demographic and business characteristics of interviewed entrepreneurs

		Sole proprietors and general partners*	**Companies**	**Transformed from sole proprietors to companies****
gender	male	12	7	8
	female	2	3	2
age (years old)	20-30	3	3	0
	31-40	6	1	1
	41-50	4	5	4
	51+	0	1	5
	range	29-54	21-54	37-65
	average	38	38.1	52.7
education	secondary	2	1	n/a
	higher	12	9	6
business inception	> 2004	1 (1998)	1 (2002)	6
	2004-2009	0	1 (2008)	2
	2010-2015	5 (2011,2013, 2015)	4 (2010, 2011)	2
	2016-2019	3 (2016)	1 (2019)	0
	2020 <	5 (2020, 2021)	3 (2020, 2022)	0
	range	1988-2021	2002-2022	1990-2011
sales				
micro firms	≥ 2 Mio EUR	6	7	5
small firms	≥ 10 Mio EUR	0	1	3
medium firms	≥ 43 Mio EUR	1	2	2
	*range****	20,45 K - 6,82 Mio EUR (90 K - 30 Mio PLN)	113,63 K - 34,10 Mio EUR (500 K - 150 Mio PLN)	101,60 K - 34,55 Mio EUR (447 K - 152 Mio PLN)
	*average****	1,462 Mio EUR (6,43 Mio PLN)	6,40 Mio EUR (28,16 Mio PLN)	7,02 Mio EUR (30,88 Mio PLN)
sector	industrial	2	2	5
	services	12	8	4
	trade	0	0	1

Note: * In this group, 7 entrepreneurs did not want to provide information about their sales; ** In this group, 4 entrepreneurs did not want to provide information about their education; *** 1 EUR = 4,40 PLN.

Delving into their educational background, a robust 27 out of the 34 respondents have secured a university-level education. In contrast, a modest three culminated their formal education with a high school diploma. Interestingly, four respondents opted for discretion, not revealing their educational degree.

Transitioning to the business characteristics, the businesses we studied span a wide establishment timeframe, from the early 1990s to the recent startups of 2022. It's noteworthy to mention the apparent surge in entrepreneurial undertakings post-2009, as almost half of the represented businesses were founded in this period. The revenue streams, although undisclosed by 7 respondents, painted a diverse financial picture. Ranging from the more modest revenue brackets of EUR 20,000 (PLN 90,000) for sole proprietors and partners, they escalated to impressive summits of around EUR 34.5 million (PLN 152,099,763) for a company that was transformed by its owner from a sole proprietorship. This spectrum reinforces the variance in scale, success, and possibly the scope among our business respondents.

From a sectoral lens, the services sector emerged as the dominant arena, claiming 23 of our respondents. This was followed by the production sector, which consisted of 10 respondents, while the trade sector was represented by a single participant.

The broad mix of ages, sectors (industrial, service, and trade), and legal forms experienced in our cohort attests to the heterogeneity of the sample, supporting the transferability of the findings and mitigating concerns that any one subgroup might dominate the results.

Data collection: Interviews and survey

We employed a three-stage, mixed-method data collection process, comprising semi-structured interviews (Stage One), a follow-up ranking survey (Stage Two), and an Analytical Hierarchy Process evaluation (Stage Three).

In Stage One, we conducted in-depth semi-structured interviews with each of the 34 entrepreneurs. An interview guide (see Appendix 1) was used to ensure all relevant topics (e.g., initial legal form choice rationale, experiences with changing legal form, perceived important factors) were covered systematically, while still allowing flexibility for respondents to elaborate on their unique experiences. Each interview lasted between 30 and 120 minutes. To enhance the quality of the interviews and reduce interviewer bias, each session was conducted by a two-person research team: one researcher acted as the primary interviewer who led the conversation, and a second researcher served as an observer/note-taker. The presence of a secondary interviewer allowed detailed field notes to be taken and provided a cross-check on the content of the interview, improving the accuracy of data capture and interpretation. Interviews were conducted in the participants' native language (Polish), in settings chosen for their convenience and comfort. Approximately half of the interviews took place in-person (at the entrepreneur's office or a neutral location), and the other half were conducted virtually via video conferencing (using Zoom, MS Teams, or Google Meet), which facilitated participation from various regions of Poland.

All interviews were audio-recorded (with prior consent from participants) to ensure verbatim data capture. The recordings were transcribed word-for-word by an external professional transcription service. Using an independent transcription provider helped prevent interviewer influence on how responses were recorded, thereby mitigating transcription bias and ensuring that the textual data was accurate and faithful to participants' own words. Following transcription, we carried out a qualitative content analysis to identify the factors that entrepreneurs consider in legal form decisions. We utilized a hybrid inductive–deductive coding approach (as outlined in Appendix 2). First, based on our extensive literature review, we prepared an initial codebook of anticipated factors (deductive codes) relevant to choosing or changing a business's legal form. Next, two researchers independently reviewed the interview transcripts and applied these codes while remaining open to new themes. As the analysis progressed, new codes were added inductively for factors that emerged from the data but were not captured in the initial codebook. After coding a subset of interviews, the researchers compared their coding to ensure consistency in how codes were applied. Any differences in coding were discussed and resolved, and the code definitions were refined as needed. This process established a high level of inter-coder reliability and a shared understanding of the codebook among the research team. Once all 34 transcripts were coded, we compiled a list of all distinct factors mentioned as influencing legal form choice or change. In total, the interviews revealed 17 unique factors deemed important by entrepreneurs (e.g., liability concerns, cost of operation, succession possibilities, access to finance, fiscal issues, etc.). We carefully reviewed these factors with attention to their contexts in the interviews, ensuring that each factor was grounded in participant quotations (see Appendix 5 for representative quotes illustrating each factor).

In Stage Two, we sought to validate and prioritize the factors identified from the interviews by collecting quantitative rankings from the same participant group. We designed a short criteria ranking survey (Appendix 3), which was distributed to all 34 interviewed entrepreneurs. In this survey, we listed the factors uncovered in Stage One and asked

participants to select and rank up to 10 factors they found most important in their decision-making about legal form. The purpose of this self-ranking exercise was to see which factors each entrepreneur personally deemed most salient, and to narrow the focus onto a core set of top factors for the next, more in-depth comparison stage. We received 17 completed responses to this survey (some entrepreneurs did not respond, which we attribute to time constraints and the voluntary nature of the follow-up). The survey results indicated that certain factors (such as fiscal/tax efficiency, flexibility in managing funds, limiting personal liability, regulatory requirements, and business continuity planning) were consistently ranked as highly important by many participants. These findings reinforced the qualitative insights and helped us identify a refined subset of key decision criteria that resonated across the respondents. The aggregated survey results were used to inform the design of the Stage Three pairwise comparison task, ensuring it focused on the factors considered most significant by the entrepreneurs.

Application of Analytical Hierarchy Process (AHP)

In Stage Three, we applied the Analytical Hierarchy Process (AHP) to systematically hierarchize the decision factors by relative importance. AHP is a multi-criteria decision-making technique that uses pairwise comparisons to derive priority weights for each criterion. For our study, AHP provided a structured way to quantify each factor's importance in the choice of legal form, as perceived by the entrepreneurs. Using the set of factors identified and refined in the earlier stages (the factors from Stage One, with an emphasis on those highlighted in Stage Two), we constructed a pairwise comparison questionnaire (Appendix 4). Each participant was presented with all possible pairs of factors and asked to compare the two factors in terms of their importance to the legal form decision. We employed a 9-point rating scale for these comparisons: for any given pair of factors A and B, the respondent would assign a score indicating how much more important one factor is over the other (Saaty & Vargas, 2000). A score of 1 meant the two factors are equally important for the decision, a score of 3 indicated that one factor is slightly more important than the other, 5 denoted a strong importance of one over the other, 7 indicated a very strong importance, and 9 meant an extreme importance of one factor over the other. Intermediate even values (2, 4, 6, 8) could be used if the respondent's judgment fell between the defined levels. For clarity, the questionnaire provided examples and definitions for each scale point, and the researchers were available to answer any questions during the exercise. Most participants completed this pairwise comparison exercise independently via a provided worksheet, although a few chose to do it in a follow-up meeting where we could clarify the process in real time.

Each entrepreneur's set of comparisons was used to populate an individual pairwise comparison matrix, where the factors were arranged along both rows and columns, and each cell entry represented the relative importance of the row factor to the column factor as given by that participant. From each participant's matrix, we computed a priority weight for every factor using the standard AHP algorithm (Eigenvalue method). Specifically, we employed an AHP calculation tool (an Excel-based template by Goepel, 2013) to derive the normalized principal Eigenvector of each comparison matrix, which yields the priority weight of each factor for that participant. This weight can be interpreted as the respondent's subjective importance score for the factor, on a ratio scale, relative to the other factors.

Crucially, we also assessed the consistency of each participant's judgments. Human comparisons can sometimes be inconsistent (e.g., preferring A over B, B over C, but C over A, which is logically contradictory). To ensure reliable data, the AHP method provides a Consistency Index and Consistency Ratio (CR) to check the coherence of the pairwise comparisons. A CR value of 0 denotes perfect consistency (no deviation from transitive judgments), whereas higher values indicate increasing inconsistency in the respondent's pairwise evaluations (AHP Consistency Ratio). We initially expected respondents to achieve CR values ≤ 0.1, since a CR of 0.10 or less is widely regarded as an acceptable consistency level in AHP analysis. However, even CR values above the 0.1 threshold are useful for observing general patterns of relative importance among factors, even if the fine-grained consistency of individual judgments is imperfect. In other words, the AHP data provide directional insights – they indicate which factors tend to be rated as more important or less important on average.

By keeping the AHP results, we leverage the principle of triangulation in our mixed-methods design. Each method contributes a different perspective: interviews reveal the factors in entrepreneurs' own words, the ranking survey gauges their perceived importance in a simple format, and the AHP offers a forced-choice comparison that can highlight subtle preferences or conflicts. The inconsistencies observed (high CRs) are explicitly acknowledged as a limitation, but they do not invalidate the overall patterns discernible in the AHP data. Instead, we treat those patterns with appropriate caution. We integrated the AHP findings with the qualitative results, cross-checking whether factors that ranked highly in AHP (despite inconsistencies) were also emphasized in interviews and the survey.

RESULTS

Semi-structured interviews

From the conducted interviews, it was observed that participants highlighted a total of 17 diverse factors influencing their choice or change of a business's legal structure (Table 2). 12 of those 17 are directly based on the literature, and the remaining 5 were identified through interviews. Appendix 5 shows representative examples of quotes for each factor.

Table 2. Factors of legal form choice by entrepreneurs – results of the semi-structured interviews

Code	Factor	Frequency: X times out of 34	Literature based (Y/N)
F1	Limiting personal and property liability in business relationships	18 (53%)	Y
F2	Cost of operation and the simplicity of conducting business	14 (41%)	Y
F3	Potential for business continuity (succession/sale/change of partners)	12 (35%)	Y
F4	Ownership structure at the beginning and during the company's growth	11 (32%)	Y
F5	Capability to secure capital/financing	10 (29%)	Y
F6	Fiscal efficiency	10 (29%)	Y
F7	Scale and geographic scope of operation	9 (26%)	Y
F8	Prestige in relations with contractors and other institutions	8 (24%)	N
F9	Type of business	8 (24%)	N
F10	Formal and legal conditions of operations	4 (12%)	Y
F11	Fund disposition flexibility	4 (12%)	N
F12	Ability to access public funds	3 (9%)	Y
F13	Formalism of doing business	2 (6%)	Y
F14	The need for personal involvement	2 (6%)	Y
F15	Possibility to build larger organizational structure	1 (3%)	Y
F16	Data for managerial accounting and controlling	1 (3%)	Y
F17	Ease of securing clients	1 (3%)	N

The most prevalent factor, mentioned 18 times, was the importance of "limiting personal and property liability in business relationships" (F1). Participants expressed sentiments such as:

"I've reiterated to the point of monotony: the issue of security"
or *"I was apprehensive about the potential implications if something in the company went awry"*

indicating a strong preference for risk mitigation.

The next frequently noted factor, mentioned in 14 instances, was the "cost of operation and the simplicity of conducting business" (F2). Participants' comments such as:

"This form was easy, simple, and quick"
or *"we chose a civil partnership solely because it was the most cost-effective,"*

underscored the significance of economic feasibility and ease of management in their choice.

The third recurring theme, appearing 12 times, was the "potential for business continuity" (succession/sale/change of partners) (F3). Respondents highlighted their concern about succession, sale of shares, or potential exit scenarios, and how these considerations influenced their choice of business form. Respondents indicated that, for example:

"One other element, I just remembered, was the question of succession. And the issue of succession or possibly the fact that I could be gone was causing the whole company to close, and that then really paralyzes the whole business."

or *The main reason was to secure also a little bit of me as a daughter in terms of succession*"

and *"Actually also in the context of say in the future, if, for example, it turns out that we want to sell, the form of, say, exit or sale of shares, is also a very important factor for us."*

and *"Today I know that this form of running the company is the best, and then it was a little bit by chance. I know that what I have built will be inherited. So, I'm sort of building a fishing rod for my children. Maybe my children won't want to be accountants, but they may always want to sell it, cash it in and start something new."*

A group of factors was largely contingent on the entrepreneurs' unique circumstances. A prominent example of this was the "ownership structure at the beginning and during company's growth" (F4) mentioned 11 times. Participants discussed the dynamics of their partnership and strategic business decisions, emphasizing the impact of these considerations on their choice of legal structure. It was pointed out, for example, that

"And these two entities, the limited liability companies, wanted us to function in the formula of a limited liability company only, while that partner there was also very much asking and persuading, however, that the limited partnership he already had there, to keep it in that formula,"

or *"then the company came to the conclusion that the Polish market was large enough, promising enough, that it was worth investing more in that market, to create a subsidiary, just to set up a subsidiary, and hence the idea that it was necessary to set up a company, a limited liability company."*

Other factors, each mentioned 10 times, were the "capability to secure capital/financing" (F5) and "fiscal efficiency" (F6). Entrepreneurs indicated that their choice was influenced by opportunities for grants, subsidies, or low-interest loans, and the potential for tax savings. Under the first of these factors, entrepreneurs indicated, for example, that the choice of legal form was dictated by:

"applying for various types of grants, subsidies or low-interest loans"
or *"the choice of this legal form was a condition for receiving a grant at all."*

In the case of fiscal efficiency participants reported situations where the decision was driven by employers seeking cost reductions:

"the main reason was that there was a low-income tax"
or *"basically, starting a business was not my idea, it was the idea of my employers at the time to reduce costs"*.

Particularly the latter is a common case, where it is the employers who, as it was, force the employee to switch to B2B cooperation.

Three more factors appearing relatively often (9, 8, and 8 times respectively) were "the scale and geographic scope of operation" (F7), "prestige in relations with contractors and other institutions" (F8), "type of business" (F9) and "formal and legal conditions" (F10). Specifically, when exploring the role of scale and geographic scope of operation (F7), which pertains to market perception and strategic expansion, respondents highlighted a nuanced yet significant motive. One participant articulated,

"An additional motive, not so important but also visible, is the issue of perception in the market, because [removed company name] mainly serves foreign customers, i.e. European markets, but especially the German and Scandinavian markets."

This viewpoint underscores a strategic orientation towards enhancing market presence, particularly in European markets. Echoing this sentiment, another respondent noted,

"That was one of the premises of this transformation, which is the growth of the company. Entering foreign markets as well."

The transition to catering to an international clientele was further elucidated by an individual's reflection on achieving substantial financial success abroad:

"On the other hand, later on we actually started to reach such a level as a result of our sales activities, export activities, that we were generating quite a high turnover there, several million euros."

The narrative of growth and expansion was complemented by insights into organizational scaling,

"Partners joined the company. We got bigger and the projects we were doing got much bigger, more demanding. It was safer to do it under a different legal form."

In the case of prestige (F8), respondents conveyed that transformations in legal structure were not merely reactionary measures to challenges but were strategic moves to bolster the company's image. This is captured by the assertion,

"the change is not due to problems or threats, it's just image-wise (...). What we have seen in the market is that these legal forms are nevertheless better perceived."

The pursuit of a more prestigious corporate identity was a recurring theme, as evidenced by remarks such as,

"we were able to show that the company is growing, and we are transforming ourselves into a more prestigious form like this"

and

"... it is more forward-looking, the company is better perceived in the market."

Moreover, the preference for certain legal structures over sole proprietorships was linked to perceptions of credibility and esteem within the professional community, as one respondent articulated,

"Companies are, so to speak, better perceived than sole proprietorships in the context of such, let's say, company esteem."

Lastly, the discussions extended into considerations specific to type of business (F9), regulatory and operational constraints (F10), and fund disposition flexibility (F11), especially in professions and industries with strict ownership and operational requirements. A poignant example provided was,

"Currently, pharmacies can only be run by a pharmacist or as part of pharmacists' partnerships, pharmacies newly established. I am not a pharmacist, so I would not be able to run such a pharmacy and in the event of the death of my mother I would have to sell it."

This highlights the intersection of professional regulations and personal circumstances in business decision-making. Additionally, personal risk assessments played a role in the choice of business model, as one individual noted,

"my business is not so risky, I mean, I have some risks, some penalties, well in the sense from my perspective it is not so risky."

The selection of a business structure was also influenced by the nature of the industry and the scale of operations, with one respondent stating,

"For activities like property development in such a small scope - ideal."

The remaining factors were mentioned significantly less frequently and often pertained to the specific circumstances of the individual entrepreneur.

In this place, one more thing must be underlined. Entrepreneurs indicated that individual factors connected to their businesses were important in the context of their personal lives. For example, factors related to risk reduction are of greater importance for those who have started a family and no longer consider only their own situation, but also that of their loved ones. Similarly, issues of succession and business continuity, among others, are related to having children and approaching the age at which the business will be passed on to descendants. This leads to the conclusion about the interconnection between factors related to the entrepreneurs' private lives and those related to their business. We bear it in mind when moving to the next steps of the study.

Criteria ranking survey

Considering the wide range of entrepreneurial experience among our interviewees – some having embarked on their business ventures several decades ago, others only within the current year – we anticipated some discrepancies in recall of significant factors. To account for this, we compiled a comprehensive list of factors derived from both our interview data and relevant literature. We then utilized this list in a survey format, asking participants to identify the factors they considered significant in their decision-making process. We got responses from 17 entrepreneurs. They are presented in Table 3.

Table 3. Factors of legal form choice by entrepreneurs– results of the survey

Code	Factor	Frequency: X times out of 17
F1	Limiting personal and property liability in business relationships	11 (65%)
F9	Type of business	10 (59%)
F11	Fund disposition flexibility	9 (53%)
F3	Potential for business continuity (succession/sale/change of partners)	8 (47%)
F7	Scale and geographic scope of operation	8 (47%)
F4	Ownership structure at the beginning and during the company's growth	7 (41%)
F6	Fiscal efficiency	7 (41%)
F10	Formal and legal conditions of operations	7 (41%)
F2	Cost of operation and the simplicity of conducting business	6 (35%)
F13	Formalism of doing business	5 (29%)
F16	Data for managerial accounting and controlling	5 (29%)
F5	Capability to secure capital/financing	4 (24%)
F14	The need for personal involvement	4 (24%)
F8	Prestige in relations with contractors and other institutions	3 (18%)
F15	Possibility to build larger organizational structure	3 (18%)
F17	Ease of securing clients	3 (18%)
F12	Ability to access public funds	2 (12%)

The survey results provide further validation and enrichment to the insights obtained from the interviews. Most prominently, limiting personal and property liability in business relationships (F1) was considered a vital factor by 65% of the survey respondents, aligning with the interview findings, where this was the most commonly cited reason. Similarly, the type of business (F9) was marked by 59% of the respondents, which corresponds with the interview data, where this factor was also in the top 10 of the most important factors.

The survey highlighted some factors with increased importance compared to the interviews. For instance, fund disposition flexibility (F11) was marked by 53% of the survey respondents, indicating a strong consideration not previously emphasized in the interview data. Likewise, potential for business continuity (F3) and scale and geographic scope of operation (F7) were also marked by almost half of the respondents, shedding light on the value these entrepreneurs place on long-term strategic planning and scalability of their businesses.

Interestingly, factors like the cost of operation and the simplicity of conducting business (F2), which was the second most common factor in the interviews, were marked by only 35% of the respondents in the survey. Similarly, fiscal efficiency (F6) and ownership structure at the beginning and during the development of the company (F4), which were both highlighted during the interviews, were marked by less than half of the survey respondents. These differences

underscore the variability of entrepreneurial decision-making, possibly influenced by unique individual circumstances, business models, or market conditions.

From the initial list of 17 factors that were identified during the analysis of the interviews, the first 9 were selected for the last stage of our study. This was decided because the 10th and further factors were mentioned as important by less than 30% of our respondents.

Pair comparison and hierarchy of factors

The paired comparison results from the 17 respondents suggest a somewhat different prioritization of factors influencing the choice and change of business's legal form, compared to the findings from both the interviews and the survey (see Table 4 and Figure 1 for visualization of factor weights). Responses of all respondents can be found in Appendix 6. The matrix of the values of the normalized principal Eigenvector is presented in Appendix 7.

Table 4. Factors of legal form choice by entrepreneurs – hierarchy after the pair comparison (consolidated)

# in hierarchy after pair comparison	Code	Factor	Weights	Top 1 choice	Top 3 choice
1	F6	Fiscal efficiency	23.3%	8	10
2	F10	Formal and legal conditions of operation	13.7%	2	5
3	F11	Fund disposition flexibility	12.8%	0	7
4	F1	Limiting personal and property liability in business relationships	11.4%	3	7
5	F3	Potential for business continuity (succession/sale/change of partners)	9.2%	3	7
6	F7	Scale and geographic scope of operation	8.7%	0	5
7	F4	Ownership structure at the beginning and during the company's growth	7.5%	0	5
8	F2	Cost of operation and the simplicity of conducting business	7.3%	0	2
9	F9	Type of business	6.2%	1	4

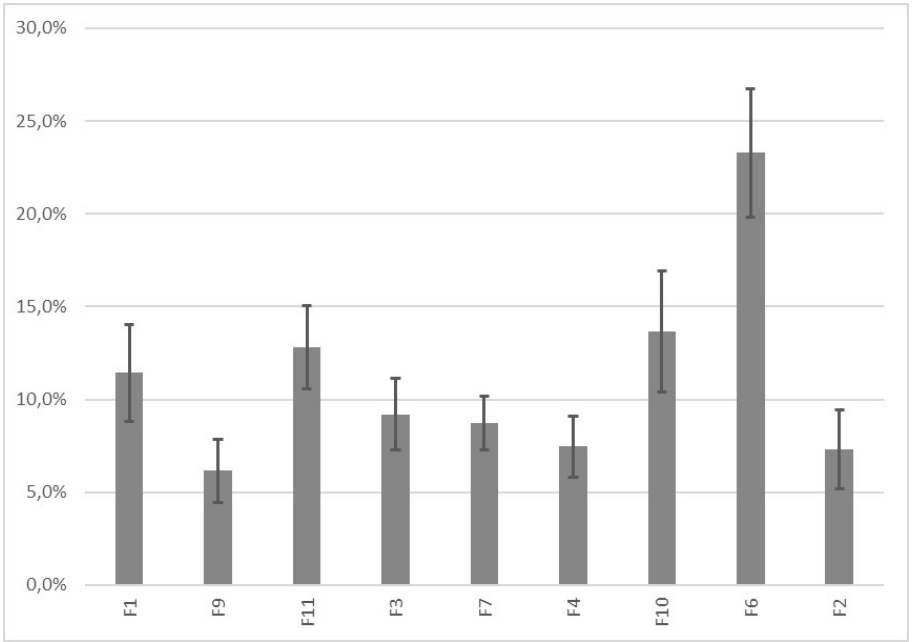

Figure 1. Values of normalized principal Eigenvector for factors – consolidated results

The comprehensive data obtained from the third stage of our study provides further insights into the decision-making process of entrepreneurs. Fiscal efficiency (F6) remained uncontestably dominant with criterion weight equal to 23.28% (normalized principal Eigenvector) and being marked as one of the top three factors by 10 respondents, and

most notably as the primary factor for 8 respondents. This overwhelming preference indicates the paramount importance of fiscal considerations for entrepreneurs in their decision-making. This result is in line with previous findings from mature economies (Byrd & Richey, 1998; Goolsbee, 1998, 2004; Richardson, 2006) state that choosing a legal form of organization based only on the tax considerations, rather than economic features of an organizational form, creates inefficiencies, leads to misallocation of capital and as a consequence lowers aggregate output for the economy. Such a statement supports our results that entrepreneurs do not base their decision about legal form choice only on one factor but rather on a number of factors.

The second place in the hierarchy of factors is secured by the formal and legal conditions of operation (F10), with a weight of 13.7% of points, emphasizing the importance of regulatory aspects, especially as it was among the top three factors for 5 participants. Such result is not a surprise, since it is well-proved in the literature that the rules, regulations and constraints set by formal institutions often influence entrepreneur's decision to establish a business (Aidis et al., 2008; Khurana et al., 2020; Khurana & Dutta, 2021; Sambharya & Musteen, 2014).

Fund disposition flexibility (F11) with a weight of 12.8% had a high score but no respondent ranked it as their primary concern. This contrasted with its prominence in the earlier stage of our study, suggesting that while financial flexibility is of significant importance, it may not be the principal one when entrepreneurs are scrutinizing their options.

Limiting personal and property liability in business relationships (F1) once again solidified its relevance with 11.4% weight and top three considerations for 7 participants. However, a surprising revelation was its ranking as the primary concern for 3 respondents, marking a shift in its importance from the initial stages. This oscillation in rankings underlines the intricacies of decision-making, where perceived priorities might alter when juxtaposed directly with other factors.

The next factor – potential for business continuity (F3), which encompasses concerns related to the succession, sale, and changes in a partnership, ranked in the intermediate range of the factors with the weight of 9.2%. Intriguingly, it secured a position within the top three considerations for seven respondents, reflecting its pervasive importance in shaping the entrepreneurial decision-making process. Further, it stood out as the primary factor for three of these entrepreneurs. Such a pattern suggests that while continuity might not always take precedence over fiscal or immediate operational concerns, it remains a substantial undercurrent in shaping the long-term vision of many entrepreneurs. A stable business future, encompassing predictable succession paths and the flexibility to adapt to changing partnership dynamics, resonates with a significant subset of our sample. The emphasis on business continuity underscores the foresight of entrepreneurs who are not just establishing businesses but building enduring legacies.

The cost of operation and the simplicity of conducting business (F2), which previously held substantial weight in the interviews, were placed lower in the hierarchy in this stage, with weights of 7.3%. Its position, especially with no respondent ranking it in their top three, further exemplifies the complexity of entrepreneurs' priorities and how direct comparisons can bring forth unexpected preferences. Other factors, such as scale and geographic scope of operation (F7), ownership structure at the beginning and during the company's growth (F4), and type of business (F9), were also of relatively low importance to respondents.

In conclusion, the expanded dataset from the third stage of our study strengthens the notion that choosing a business's legal form is a nuanced, multi-faceted decision-making process. Entrepreneurs traverse a labyrinth of factors, with each consideration potentially shifting in importance based on direct comparisons and individual circumstances. They distinguish two primary groups of factors: those related to their personal lives and those connected to their business. However, when ranking the most critical factors, they prioritize business-related determinants. Some differences between the groups of studied entrepreneurs can also be seen. In Figure 2, there is a comparison of the weightings of the factors by sole proprietorship and general partners (Group 1), companies (Group 2), and sole proprietorship transformed into companies (Group 3).

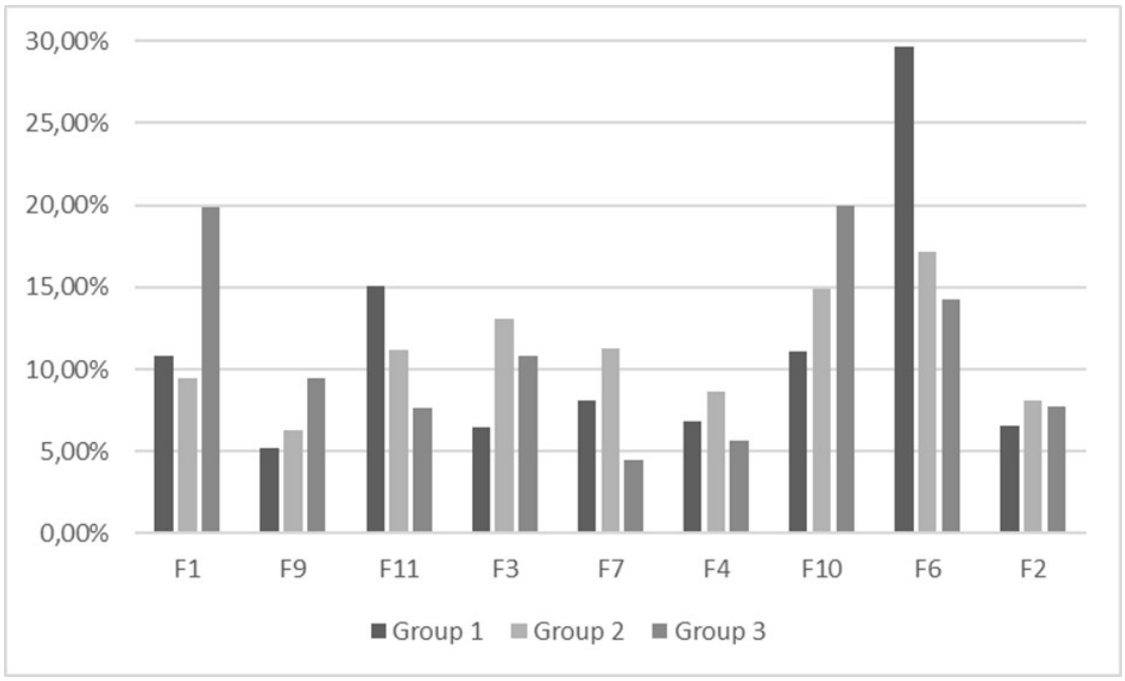

Figure 2. Factor weights for different groups of entrepreneurs

It is noteworthy that the biggest differences can be seen for limiting personal and property liability (F1; # 4 in hierarchy). This confirms the findings from the interviews that entrepreneurs making the change from a sole proprietorship or a partnership to a company primarily want to reduce their personal liability. It is also clear that fiscal efficiency (F6, # 1 in hierarchy) is primarily influenced by a sole proprietorship, but it is also valuable for other studied groups of businesses. Similarly, formal and legal conditions of operation (F10, # 2 in hierarchy) can influence the change. In sum, from the top-5 factors, fiscal efficiency and legal conditions are equally significant for all entrepreneurs, while fund disposition flexibility is particularly important for sole proprietors. Liability limitation is the top priority for shareholders of companies, whereas business continuity is the primary driver for sole proprietors transitioning to corporate legal forms. Entrepreneurs do not necessarily avoid incorporation but prefer civil legal forms when their businesses are small and young. As their businesses grow or they plan for expansion, they predominantly choose a limited liability company.

It is important to note that the individual AHP responses underlying these consolidated results often exhibited consistency ratios above the recommended 0.1 threshold. In many of the 17 cases, the CR exceeded 0.1, which signals a notable level of inconsistency in those participants' pairwise judgments. In practical terms, this means that some respondents gave pairwise rankings that were not perfectly transitive or logically consistent across all factor comparisons. Such inconsistency can occur when participants find certain comparisons difficult or when their preferences are context-dependent. Given these elevated CR values, the AHP-derived rankings must be interpreted with caution. We do not treat the exact weights or the precise rank ordering from the AHP as ironclad or definitive findings. Instead, we interpret them as an approximate, exploratory indication of which factors tend to be more influential relative to others. For example, the fact that fiscal efficiency (F6, # 1 in hierarchy) achieved the highest weight in the AHP analysis is taken as a general confirmation that financial considerations are very salient to entrepreneurs – a conclusion that aligns with our qualitative data – rather than as a precise quantification that "Fiscal efficiency is exactly 23% of the decision." The presence of high CR values underscores that respondents sometimes struggled with the pairwise comparison task, so any one individual's AHP data may be noisy. However, when aggregated, the directional trends in the AHP results still offer useful insights that complement the findings from interviews and surveys.

Drawing upon the findings from the interviews and two surveys, it can be inferred that the selection of a business's legal form exemplifies a hierarchic multi-factor decision-making process. The complex array of considerations that potential entrepreneurs navigate underscores the simultaneous use of numerous factors, each carrying a different weight and relevance depending on the individual's unique circumstances. It can be represented in the form of the decision tree (Figure 3).

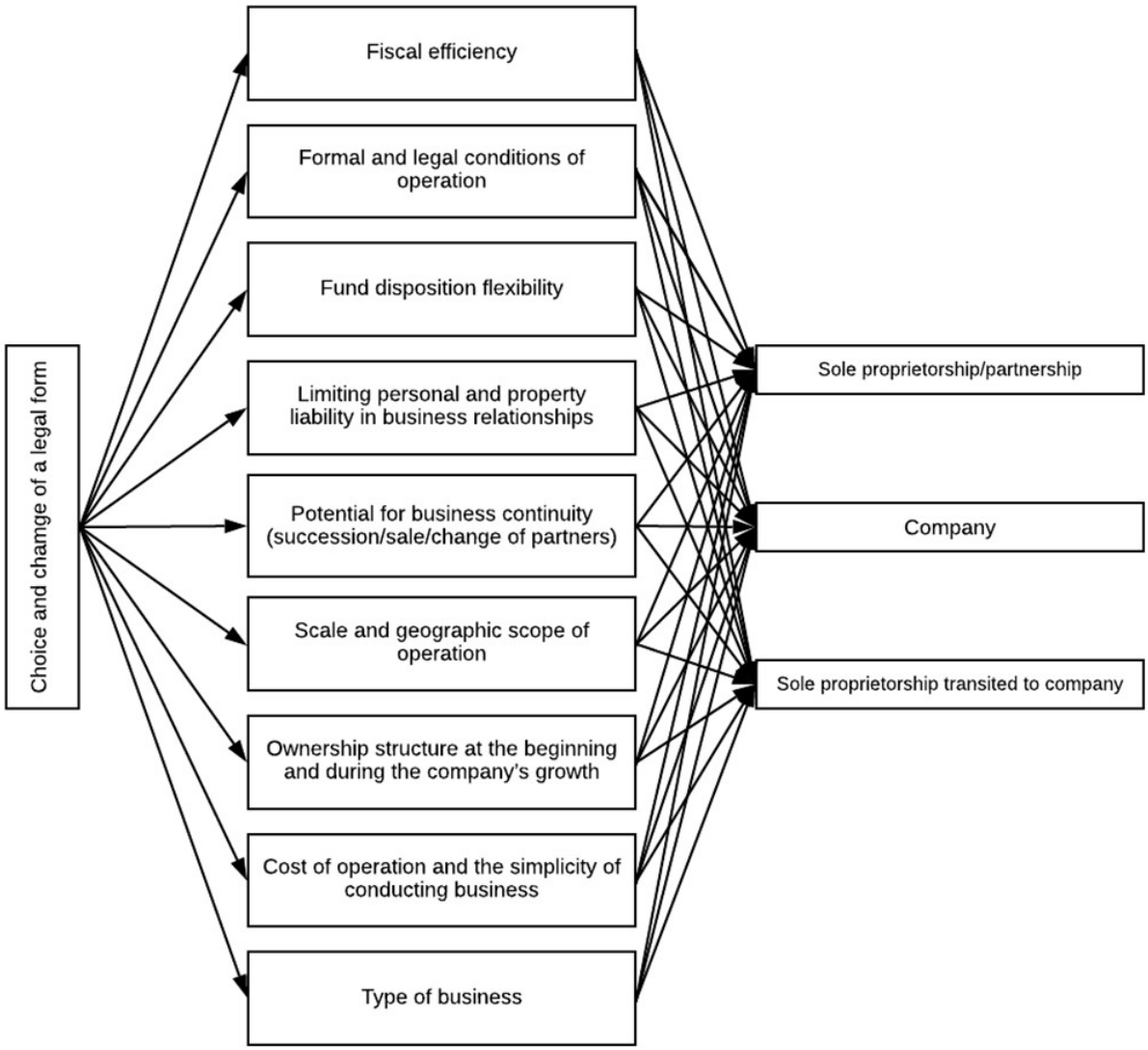

Figure 3. Hierarchic multi-factor decision-making tree for choosing and changing legal form

Our findings confirm that the choice of a legal form does not hinge on a single criterion; rather, entrepreneurs integrate multiple factors in their decision-making process. Interestingly, no entrepreneur solely based their choice on a single factor, highlighting the composite nature of this decision. Furthermore, this multi-faceted decision-making process is not a one-time event. Entrepreneurs continually reassess the same criteria throughout the lifecycle of their business. This ongoing evaluation can lead to decisions about changing the business's legal form, should the current structure no longer align with the evolving needs and circumstances of the enterprise. Thus, the decision-making process regarding the legal form of a business remains dynamic and responsive to an enterprise's situational demands.

DISCUSSION

This study contributes to the academic literature on entrepreneurial decision-making processes in three significant ways. First, it extends current knowledge by investigating how entrepreneurs simultaneously evaluate a broad range of factors when choosing and changing the legal form of their business – factors which are often studied separately (Baik et al., 2015; Bergner & Heckemeyer, 2017; Bilicka & Raei, 2023). Second, it shows that these decisions are dynamic, evolving over time as businesses grow or face new regulatory, financial, or succession-related pressures. Third, it does so in a post-

transition economy, where institutional legacies and ongoing reforms shape entrepreneurial behavior in distinct ways not yet fully captured in the literature. Our results confirm that entrepreneurs' decisions about legal form are multi-faceted and context-sensitive. In contrast to many Western-focused studies that treat legal form choice as a largely static event (Levine & Rubinstein, 2017), our findings show that in Poland, this decision is often revisited. Entrepreneurs typically start with simpler forms (i.e., sole proprietorships) due to lower entry costs and greater flexibility. Still, as their businesses grow, new priorities, such as limiting liability, securing financing, or planning for succession, begin to outweigh those initial advantages. This pattern aligns with organizational lifecycle theory (Jirásek & Bílek, 2018; Miller & Friesen, 1983) and supports prior work on the rising complexity of legal structure as firms mature (la Rocca et al., 2011; Lester et al., 2003).

Among the most critical factors, fiscal efficiency emerged as the top-ranked determinant for entrepreneurs in Poland when selecting or changing their legal form. This reinforces findings from prior studies (Goolsbee, 1998; Richardson, 2006) and reflects the Polish context where legal form decisions are often shaped by differences in income tax regimes, especially the favorable flat-rate tax available to sole proprietors. In the United States and Western Europe, differential tax treatment has been shown to significantly influence whether entrepreneurs incorporate. Bilicka and Raei (2023) demonstrate that when pass-through entities enjoy tax advantages, businesses gravitate towards those forms, even at some cost to productive efficiency. Our findings resonate with this: Polish business owners clearly weigh tax burdens, favoring the sole proprietorship or partnership when it offers lower effective taxation. In fact, several interviewees cited Poland's flat 19% personal income tax for self-employed individuals and the avoidance of double taxation on corporate dividends as key reasons for remaining unincorporated in early stages. This emphasis on taxes is in line with Can (2022), who found that entrepreneurs respond elastically to tax incentives when deciding on incorporation status. We found that Polish entrepreneurs exhibit high tax morale, indicating that they recognize the necessity of taxation but prefer a more transparent and predictable fiscal policy. However, when choosing a legal form for their business, they do not consider taxation alone – a nuance sometimes overlooked in tax-centric analyses. Entrepreneurs were keenly aware of tax advantages, yet they often balanced them against other factors like fund disposition flexibility, liability protection, and business continuity. This suggests that while Western and CEE entrepreneurs alike seek tax efficiency, Polish entrepreneurs might prioritize it up to a point where other needs (e.g., liability protection) become more pressing.

The second most critical factor influencing entrepreneurs' legal form choices was the role of legal and regulatory conditions of operation. This factor reinforces the broader literature on regulatory burden as a constraint on formalization, particularly in emerging and transitioning economies (Aidis et al., 2008; Khurana et al., 2020; Sambharya & Musteen, 2014). Although Poland has made administrative reforms in recent years, many entrepreneurs in our study still associate company registration and operation with high compliance costs, which discourages them from incorporating unless clearly justified by other strategic needs. These findings are consistent with early evidence from emerging markets (Djankov et al., 2002) and more recent evidence from developed economies (Cordier & Bade, 2023), which shows that administrative complexity and procedural demands continue to discourage formal business entry. At the same time, our data suggest a generational shift: younger entrepreneurs reported fewer concerns about formalization procedures, suggesting that perceptions may gradually align with improved institutional conditions.

A noteworthy contribution of our study is the identification of fund disposition flexibility as a high-ranking factor, particularly for sole proprietors who value direct access to business-generated funds without corporate governance constraints. This refers to the freedom to use business-generated income without complex legal or accounting procedures – an advantage of simpler legal forms that has received little attention in prior literature. In transitional economies like Poland or Slovakia (Belanová, 2023), where many businesses are still tightly intertwined with personal finances, this flexibility can significantly influence legal form decisions. It also demonstrates a divergence from Western contexts, where corporate governance norms and institutionalized financial separation between owners and firms are more established. We found no direct contemporary Western study focusing on this exact issue, indicating that our result may point to a context-specific gap. Nonetheless, this factor intersects with known themes of control and simplicity – entrepreneurs want to avoid "red tape" when accessing their own profits. Thus, while Western entrepreneurs also dislike bureaucracy, the relative weight given to immediate financial flexibility appears higher in our Polish sample.

Limiting personal and property liability was a key driver for entrepreneurs transitioning from sole proprietorships or partnerships to corporate legal forms. This finding aligns with earlier research emphasizing the protective role of incorporation (Chen & Qi, 2016; Hertz et al., 2009). Entrepreneurs in our study expressed concerns about the risks associated with unlimited liability, particularly as their businesses grew and became more exposed to financial and legal risks. In comparing across contexts, we did not find significant differences in the fundamental desire for asset protection – it

appears to be a universal motive. What differs slightly is timing: in Poland, owners might delay incorporating (remaining sole proprietors longer) due to higher relative compliance costs or a historically ingrained comfort with informality, whereas in countries like the U.K. or Germany, entrepreneurs anticipating growth incorporate sooner as a standard practice.

Business continuity and succession planning also emerged as significant considerations in entrepreneurs' legal form choices, especially those nearing retirement or managing family firms. Entrepreneurs, particularly those who had been in business for decades, spoke about the future: whether to pass the company to their children, bring in new partners, or eventually sell the business. Those considerations naturally favored more formal structures that allow ownership transfer and perpetual existence (a corporation can outlive its founder, unlike a sole proprietorship that is legally tied to an individual). This echoes findings from family-business research (Bloemen-Bekx et al., 2023; Meier & Schier, 2014; Michel & Kammerlander, 2015; Widz & Kammerlander, 2023), which stress the role of legal form in enabling succession or long-term ownership transfer. In Western economies with longer traditions of multi-generational businesses, this behavior is well-known; our study confirms that it is emerging in Poland as the first generation of post-1990 entrepreneurs approaches retirement. Notably, one interviewee who had operated as a sole trader for twenty years converted his firm into a limited liability company specifically to prepare for a potential sale, stating that buyers "feel more secure purchasing a company than a one-man business". Such insights echo the Western experience that corporatization can be a step toward exit or transition (Wennberg et al., 2011). A similar phenomenon occurs in relatively younger market economies, where entrepreneurs are also forward-looking about legacy and longevity. This finding dovetails with our theme of dynamism: early-stage entrepreneurs may give little thought to succession, but as their enterprise matures, ensuring continuity becomes salient, prompting a reevaluation of the legal form. Thus, in comparing contexts, succession-driven legal form changes might be a phenomenon that gains prominence as CEE entrepreneurial ecosystems mature and as more business owners face generational transition.

What appeared to be contradictive to the literature on Western economies was the access to finance. This factor is often emphasized in the Western literature as a reason to incorporate. For example, incorporated startups can tap equity markets or appear more legitimate to banks (Axelson et al., 2013; Beck et al., 2013). Our findings reveal that it was a secondary consideration for many Polish entrepreneurs. Most respondents relied on retained earnings or bank financing available to sole proprietors and saw incorporation as beneficial only after reaching a certain level of growth. This finding reflects the limited presence of equity financing in Poland's SME sector, implying that incorporation for financing purposes may be a late-stage decision rather than a founding strategy. In essence, while Western evidence stresses "form follows finance", our study suggests that in Poland, "finance follows form choice at a later stage" – entrepreneurs first choose form for tax, control, and risk reasons, and only later do the capital-raising benefits of that choice become relevant. This difference underscores the importance of stage and context when comparing findings internationally.

The case of Poland offers broader insights into the relationship between economic maturity and legal form choice. Despite Poland's economic development and its position as one of the largest EU economies, its business landscape remains dominated by sole proprietorships, a characteristic more typical of emerging markets (Belanová, 2023). This contradicts existing research that associates economic maturity with increased adoption of corporate legal forms (Baik et al., 2015; Bilicka & Raei, 2023). Poland's historical context – transitioning from a centrally planned economy to a market-based system – has influenced entrepreneurs' attitudes toward legal structures. Older entrepreneurs, who started their businesses in the early 1990s, often prefer simplified legal forms, reflecting institutional memory shaped by economic instability and bureaucratic inefficiencies. Meanwhile, younger entrepreneurs, who have operated in a more stable regulatory environment, are more open to corporate legal forms. This generational divide highlights how past institutional constraints continue to shape entrepreneurial behavior even as economic conditions evolve.

In drawing the above comparisons, it is evident that our study both corroborates and extends the current understanding of SME legal form choice. We corroborate the importance of factors like taxation, liability, and regulatory burden that are well-documented in prior studies across various countries. At the same time, we extend the literature by highlighting how entrepreneurs prioritize these factors when faced with trade-offs, and by illuminating context-specific factors such as fund disposition flexibility. Moreover, by situating our findings in a CEE context, we provide a counterpoint to Western-centric research. For example, while incorporated forms are generally associated with better performance and growth in established economies (Baumol et al., 2007), our research shows that remaining unincorporated for longer can be a rational choice in an environment like Poland, given the tax regime and perceived administrative hurdles. Eventually, however, the trajectories seem to converge: successful firms in Poland tend to incorporate once they scale – much as they would in Western countries – suggesting a universal aspect to the evolution of firm structure with growth.

CONCLUSION

This study provides a comprehensive analysis of how entrepreneurs choose and change their business legal forms, revealing that this decision is not a one-time event but an evolving strategic process. Entrepreneurs continuously reassess their legal structures based on a hierarchy of interrelated factors, with business considerations ultimately outweighing personal preferences. The findings confirm that fiscal efficiency, legal and regulatory conditions, fund disposition flexibility, liability limitation, and business continuity are the most critical determinants in this process. While entrepreneurs may initially select simpler legal forms such as sole proprietorships for their flexibility and ease of operation, they often transition to more structured entities like limited liability companies as their businesses grow and their strategic priorities shift.

The study highlights the dominant role of fiscal efficiency in shaping legal form decisions, particularly in the context of a transitioning economy like Poland, where frequent tax reforms and regulatory changes have created an environment of uncertainty. Entrepreneurs prioritize tax optimization not only to minimize costs but also to enhance financial predictability and business sustainability. Alongside fiscal concerns, regulatory clarity and legal conditions significantly influence business formalization, with entrepreneurs demonstrating a strong preference for legal structures that reduce administrative burdens and enhance operational stability. The ability to freely manage business funds is particularly important for sole proprietors, whereas entrepreneurs transitioning to corporate structures place greater emphasis on liability protection and succession planning. The findings suggest that while entrepreneurs do not inherently avoid incorporation, they often delay or resist the transition due to perceived bureaucratic complexity and financial constraints.

The insights from this study have important theoretical and practical implications. First, our work contributes to the literature by offering a nuanced, updated perspective on how entrepreneurs choose and change the legal form of their business, blending well-established factors with new context-driven insights, and thus helping to bridge the gap between Western and CEE-centric understandings of entrepreneurial decision-making. Second, we confirm that a legal and regulatory environment that is stable, transparent, and supportive of entrepreneurial growth can facilitate business formalization and improve overall economic resilience. Simplifying tax structures, reducing administrative barriers, and providing clear transition pathways between legal forms can encourage businesses to adopt structures that align with their long-term growth potential. Third, entrepreneurial education and advisory services should also emphasize the strategic implications of legal form choices, equipping business owners with the knowledge necessary to make informed decisions that balance financial efficiency, risk management, and sustainability. Finally, the findings of this study challenge the assumption that economic maturity naturally leads to the widespread adoption of corporate legal structures. Poland's case demonstrates that even in a structurally mature economy, entrepreneurial preferences may still reflect characteristics typical of emerging markets. This suggests that institutional history, regulatory environments, and cultural factors play a significant role in shaping business legal form choices. Understanding these dynamics can inform policy approaches that better support entrepreneurs in navigating legal structures that align with their business objectives.

Despite its contributions, this study has certain limitations that temper the generalizability of the findings. First, the sample size is modest, and although it provided rich qualitative and quantitative insights, it may not capture the full heterogeneity of all Polish SMEs. The sample was not statistically representative – it over-represented growth-oriented firms by design – so the relative importance of factors might differ in a broader population of businesses (for instance, lifestyle businesses might weigh growth-related factors less). This sampling limitation means our hierarchy of factors should be interpreted as illustrative of our respondents' priorities, rather than a definitive ranking for all entrepreneurs. Second, our mixed-method approach, though a strength in exploring a new area, may introduce method biases. The factors were identified and ranked based on self-reports (interviews and surveys) from entrepreneurs. There is a possibility of retrospective rationalization, where owners justify past choices with convenient explanations (e.g., overstating tax motives ex post). We attempted to mitigate this by triangulating interview data with factual questions in the survey, but some bias may remain. Third, the single-country focus on Poland enables contextual depth but limits transferability. Differences in legal and fiscal systems across countries mean our hierarchy may not apply elsewhere without adaptation. We encourage caution in extrapolating results to other settings without consideration of context.

Despite these limitations, we believe our study provides valuable exploratory evidence and theoretical insights. By being transparent about these constraints, we enhance the credibility of our conclusions and outline clear avenues for future research – such as longitudinal studies tracking legal form changes over time, or comparative studies between Poland or other CEE countries and Western economies – to build on our initial findings.

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APPENDICES

The appendices below are arranged according to the order in which they appear in the text of the article. The appendices numbered 1 to 4 contain the forms used at each stage of the research, while appendices 5 and 6 provide a summary of the results obtained.

Appendix 1. Interview agenda

Date:
Location:
Interviewer:
Name of respondent:
Age of respondent:
The year the company was founded:
Legal form of business:
Form of record keeping:

Before starting questions:

Assurance (if truthful) that the answers will be anonymous, so we care about the honesty of the respondents. Obtaining permission to record the interview and possibly assuring that the recording will be deleted after transcription.

Main questions	Supporting questions	Information to be obtained
1. Tell us about yourself	1.1 What kind of education do you have? 1.2 Tell us about your previous business experience	• gender of an entrepreneur • age of an entrepreneur • education and education profile • previous experience in operations and business in general • ability to delegate authority
2. Tell us about your company	2.1 How did you come up with this name? 2.2 What markets do you operate in? 2.3 What is the average annual revenue in your company?	• one person's venture or company • scale of operations
3. Tell us about how you started your business	3.1 What made you decide to choose this legal form? 3.2 Have you changed or are you considering changing your form of business and why 3.3 What impact can legal form have on relationships with contractors and institutions? 3.4 Have you used entrepreneurship support programs/ institutions?	• type of activity • what made them decide to choose this legal form • property liability of partners • freedom of disposition of funds • liquidity of own contributions
4 What is the management process of your company?	4.1 How do you record working time? 4.2 What particularly hindered/interfered with your business? 4.3 How do you think the problems presented can be remedied?	• use of tools/methods (e.g., CRM). • is there already a solution available in the system (e.g., tax) but it works/doesn't work well?
5. How do you see the company in the next 3-5 years?	5.1 What could make you change your form of business? 5.2 How do you plan to finance the company's growth in the future? 5.3 What projects do you plan to implement in this horizon?	• type of activity • ability to raise public funds • ability to raise foreign capital • country of origin of the investor • ability to carry out R&D projects • the possibility of going public • access to other sources of funding
6. What do you think of the current tax system?	6.1 How you use or plan to use the tax system for your business? 6.2 What do you think the ideal tax system should look like?	• the amount of tax burden • transparency of the system • the level of complexity of the tax regime • financial reporting requirements • availability of tax credits • ability to choose simplified forms of tax and accounting simplifications
7. What else could we ask to better understand what influences the choice of legal form of doing business?		

Appendix 2. Code book

Code	Factor	Codes
F1.	Limiting personal and property liability in business relationships	division of private and company assets, liability (property, financial, personal), protection/security (private assets, company capital, legal and others), risks (personal, economic)
F2.	Cost of operation and the simplicity of conducting business	formalities/cost/time of company registration, simplified/no accounting rules, level of financial and non-financial reporting, administrative duties, amount of capital invested in the company
F3.	Potential for business continuity (succession/ sale/change of partners)	security of cooperation with counterparties, undisturbed continuity of operations, business continuity
F4.	Ownership structure at the beginning and during the company's growth	limited trust in the shareholder(s), security of shareholders, flexibility/ease of incorporation, ease/transparency of cooperation in the company, simplicity of control over the company, tax optimization
F5.	Capability to secure capital/financing	transparency/security of raising capital; investor, external capital, loan, credit, leasing, share/bond issue (public, private), grants
F6.	Fiscal efficiency	tax structure, tax level, contribution burden, avoidance of double taxation, tax optimization, tax benefits/reductions
F7.	Scale and geographic scope of operation	company size/growth/competitiveness, large/small scale of operations, local/national/ international operations, security of capital

Code	Factor	Codes
F8.	Prestige in relations with contractors and other institutions	transparency of operations, perception of the company, credibility of the company
F9.	Type of business	the level of risk of the business, the degree of regulation, the imposed approvals, authorizations, etc. imposed;
F10.	Formal and legal conditions of operations	the degree of formalization of the organizational activity, formal conditions, legal conditions, regulations, rules, formal principles
F11.	Fund disposition flexibility	flexibility in the management of funds, transfer of funds over time (fast/slow)
F12.	Ability to access public funds	grants, subsidies
F13.	Formalism of doing business	formalism, formal requirements, audit, report
F14.	The need for personal involvement	decision-makers and decision-executors, building an organization's structure horizontally and vertically
F15.	Possibility to build larger organizational structure	higher stage of company development, company transformation
F16.	Data for managerial accounting and controlling	clarity, control of information
F17.	Ease of securing clients	client, acquiring, marketing

Appendix 3. Post-interview survey

Dear Madam/ Sir,
thank you very much for your participation in the interviews! With your help, we were able to identify 17 most common factors that may influence the decision to choose a particular legal form of doing business.
The second stage of our study is to create a ranking of these factors. We are therefore asking you to complete 2 short questionnaires (10 minutes maximum in total!).
Survey 1 (the one you are reading now) is designed to select a maximum of 10 of 17 factors identified that are important to you.
Survey 2 (which you will receive within a maximum of 2 weeks) will be to rank these factors from the perspective of your preferences.
From the following 17 factors, select up to 10 that were important to you.

Code	Factor	Important	Not important
F1	Limiting personal and property liability in business relationships		
F2	Cost of operation and the simplicity of conducting business		
…	……		
F16	Data for managerial accounting and controlling		
F17	Ease of securing clients		

Appendix 4. Pair-comparison

Dear Madam/Sir,
thank you very much for your participation in the interviews! With your help, we were able to identify 17 most common factors that may influence the decision to choose a particular legal form of doing business. In the second stage, again with your help, we selected 10 factors that were most frequently indicated by you.

The final stage of our survey is to create a hierarchy of these factors. We are therefore asking you to complete this final survey. In this stage, we ask you to compare the two factors in pairs and indicate your preference.

The task is to mark the importance of the criteria on a scale, where the middle (1) means that they are equally important, and the closer a criterion is to the more important it is in that pair, respectively: 3 - slightly preferred, 5 - strongly preferred, 7 - very strongly preferred, 9 - extremely preferred. In short: the closer a factor is to the one on this scale, the stronger its preference over the other in the pair, and the closer to the middle, the more equal the perception of the factors.

Example:
- Scale of operations is an equivalent factor as ownership structure
- Formal and legal conditions of the business are slightly preferred compared to the scale of the business
- Tax efficiency is extremely preferred compared to scale of business
- Scale of operations is strongly preferred compared to administrative and accounting service costs

Example	9	7	5	3	1	3	5	7	9	
Scale and geographical scope of operations					x					Ownership structure
						x				Formal and legal conditions of the business
									x	Tax efficiency
		x								Cost of operation and the simplicity of conducting business

Thank You!

	9	7	5	3	1	3	5	7	9	
Personal and property liability										Type of business
										Fund disposition flexibility
										Potential for business continuity (succession/sale/change of partners)
										Scale and geographic scope of operation
										Ownership structure at the beginning and during the company's growth
										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Type of business										Fund disposition flexibility
										Potential for business continuity
										Scale and geographic scope of operation
										Ownership structure at the beginning and during the company's growth
										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Fund disposition flexibility										Potential for business continuity
										Scale and geographic scope of operation
										Ownership structure at the beginning and during the company's growth
										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Potential for business continuity										Scale and geographic scope of operation
										Ownership structure at the beginning and during the company's growth
										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Scale and geographic scope of operation										Ownership structure at the beginning and during the company's growth
										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Ownership structure at the beginning and during the company's growth										Formal and legal conditions of operation
										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Formal and legal conditions of operation										Fiscal efficiency
										Cost of operation and the simplicity of conducting business
Fiscal efficiency										Cost of operation and the simplicity of conducting business

Appendix 5. Representative quotes

	Factor	Representative quotes
F1	Limiting personal and property liability in business relationships	"Well, and the liability issues arising from the fact that the running of the entire business went to a sole proprietorship. And the personal risks of me running the business caused us to want to exclude and secure some of the private assets by having the houses, the real estate, **not having the risks of running the business**, because in a sole proprietorship that's the consequence" "At this point it was not decisive, but **it certainly gives some mental comfort**, well, because business is what it is. There's always the possibility that a foot can go wrong there regardless of trying and doing due diligence on that business, well, that there's always the possibility of protecting that private property, so that's certainly a positive aspect of it, that if it doesn't work out, you even file that bankruptcy petition and that's it." "Trying to keep a simple form of taxation, an accessible form of taxation**, you have to protect the capital earned so far**" "I didn't want to **tie the activities of this company to myself**"
F2	Cost of operation and the simplicity of conducting business	"Having a choice between a joint-stock company and a limited liability company, well, **we know what the costs and inconveniences of operating a joint-stock company are**, besides, well, it wasn't even planned to be so large to create a joint-stock company." "We decided to establish a civil partnership, solely because **it was the cheapest** to run." "**Simplest, easiest, fastest**." "The easiest to use. (...). It had to be the **simplest, easiest, cheapest** to maintain. These were the criteria that determined my choice"
F3	Potential for business continuity (succession/sale/change of partners)	"**And the issue of succession** or possibly the fact that I would be gone was causing the whole company to close down, and this then really paralyzes the whole business. Meanwhile, in the case of a company, the situation is completely different, so that was one more reason, because a one-person business cannot continue without me, without the person who owns it." "the main reason was to also secure a little bit of me as a **daughter in terms of inheritance**" "First and foremost was the issue of security in the broadest sense, that is, the issue of what happens to a sole proprietorship in the event of **inheritance issues and the issue of taking over the company**. This was the main motive, the primary motive, in terms of changing the organization from a sole proprietorship to a company."
F4	Ownership structure at the beginning and during the company's growth	"There were a few of us - now by going public it's a different situation - but at the beginning there were six of us, six colleagues - two major and four minor ones. The capital company **formula gives more security to each of us as shareholders.**" "Krzysztof and I studied computer science together at the Poznan University of Technology and we did projects together and worked well together, so we came to an agreement that we would continue this after graduation as well and **try to approach it commercially. We decided to form a civil partnership**." **"**Well, me and my partner we knew each other, but nevertheless there was probably an element of risk, and also this limited liability company seems to me the most such a clean and transparent form of business, especially when the partner to run this business is not someone 100% trusted" „I also found partners to whom I offered cooperation"
F5	Capability to secure capital/ financing	"It's certainly **easier to talk to the banks**." "Issues related to financing some project, investment, or participation in some project was also **clearer and is still clearer and safer for financial institutions**." "so that there is the possibility of a **resale to investment funds, possibly the participation of these companies to raise capital for financing.**"
F6	Fiscal efficiency	"That's where the idea of starting a limited partnership came from. It was **quite low-taxed** at the time and it was fairly easy to access capital" "The main reason was that there **was a low income tax**" "**The financial aspect**, of course, is higher for those people who work on B2B. (...) As I said, first of all, I envied my colleagues, of course the salary, but not only that." "Let's not fool ourselves, **the amount of taxation and also the number of obligations** that a sole proprietorship has - health contribution on income and so on - made me simply conclude that it doesn't make much sense."
F7	Scale and geographic scope of operation	"Partners joined the company. **We got bigger and the projects we were doing got much bigger,** more demanding. It was safer to do it under a different legal form." "I mean, at the beginning I thought it would just be a limited one-person business, which would give me full freedom. On the other hand**, later on we actually started to get to such a level as a result of our sales**, export activities, that we were generating quite a high turnover there, several million dollars." "In terms of also **the growth of the company** and such security of this capital, the fact that this must be in a different form"
F8	Prestige in relations with contractors and other institutions	"We were able to show that the company is growing and we are transforming ourselves into a form that is more **prestigious**" "and on the other hand, however, **such prestige of a company** compared to a sole proprietorship is greater. Well, and since we are doing serious business, we therefore made the decision to change this activity". "it's more forward-looking, the **company is better perceived in the market**."
F9	Type of business	"**For such activities** as development in such a small range - ideal." "**my business is not so risky**, I mean, I have some risks, some penalties, well, but in the sense from my perspective it is not so risky". "The answer is that this transformation was caused by the **start of other activities**".

	Factor	Representative quotes
F10	Formal and legal conditions of operations	"**And there are even more reports, various types of audits, more and more problems where we have to employ additional people just to meet the requirements that we face here**. It's not getting easier, it's definitely not getting easier, it's getting harder and harder when it comes to this environment that we're operating in here as a business"
F11	Fund disposition flexibility	"The main challenge that I see from a manager's perspective, and that you have to show to owners, is learning that in a sole proprietorship **it's a particular person's money, because it's one person, and in a company it's the company's money.** This is certainly a very big challenge." "So when choosing a form of accounting, a legal form in general, **think about what kind of cash flow you have, because as a paid person you can always take something out, put something in, borrow something.** It's simpler so that there is a turnover. As there is a company, on the other hand, it requires documents." "In this context, of course, **it is more difficult, because so to speak colloquially, there was one pocket,** but now it is a separate entity and you can not take money from the cash register and then give it back just like that, there must be a document for everything, well, and a title to all flows."
F12	Ability to access public funds	"primarily because that **was the condition for receiving the grant** at all" "And why transformation? **The opportunity to grow, to raise capital, that is, to access the capital market.**" "And now at least **applying for various grants or subsidies, or low-interest loans** that are on the market and allow you to develop your business." "this transformation was caused by the start of another business, but **taking into account the possible recapitalization of this company by third parties"**
F13	Formalism of doing business	"**More formalized, more structured.** We have environmental, quality and standard ISO, FST, i.e. certificates that are required for pharmaceutical companies that audit us. They also control organizational structures, so as you noticed, it was forced, but necessary."
F14	The need for personal involvement	"The owners saw through the fact that the company has grown, **they are not able to take part in every decision and make every decision.**"
F15	Possibility to build larger organizational structure	„The company has grown a bit, [Company name] is the head of a small group, it came out of the ICT business. [Company name] itself is transforming all the time into a more IT company.... maybe not so much an IT company, but, unfortunately in English, an IT company - the distinction being that it's not a software company, and that's what [Company name] does. And besides that, we have a couple of companies that deal with other things somewhere there - one is, as we mentioned, a distributor of IT equipment, we have a small call center that belongs to us, we have a company from maintenance services located in Lodz. Everything revolves around our industry. And for the last five years, we also have a piece of companies that are involved in real estate development as a part of investing some surpluses and taking advantage of opportunities."
F16	Data for managerial accounting and controlling	"also accounting and financial issue, for me there will always be such greater transparency of **these data in the company simply**. It is more readable for me" "**It's easy to analyze the costs** it's more difficult to do it one-person business, for the reason that there is no breakdown there. **Often there is no such analysis**. I do analysis for myself every month from the data that I have, and based on that it's easier to manage the company."
F17	Ease of securing clients	We opened this business as [Company name] to make it look to potential customers that a large foreign company has simply entered Poland. And we also set up the eu website, the com website, so that it would look like the company is already active on other markets and is just entering Poland.

Appendix 6. Pair comparison results

Factors (F)/Respondents (R)	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	**Sum**
F6: Fiscal efficiency	60	13	26	16	11	15	19	25	4	10	45	13	15	39	15	30	4	360
F10: Formal and legal conditions of operation	3	17	22	33	36	47	2	11	9	18	9	6	24	4	15	5	26	287
F11: Fund disposition flexibility	9	18	14	19	18	10	34	1	15	13	0	7	7	5	0	4	8	182
F1: Limiting personal and property liability in business relationships	22	12	24	14	4	30	15	19	26	26	44	24	23	22	11	38	11	365
F3: Potential for business continuity	3	15	23	12	5	39	24	4	38	14	11	17	16	6	15	5	19	266
F7: Scale and geographic scope of operation	2	3	13	4	11	39	1	7	23	27	9	7	2	5	20	30	15	218
F4: Ownership structure at the beginning and during the company's growth	1	16	15	18	28	24	31	4	51	31	20	6	29	22	19	10	12	337
F2: Cost of operation and the simplicity of conducting business	40	15	20	34	6	21	38	24	45	24	58	52	45	72	23	72	5	594
F9: Type of business	12	6	0	1	3	0	34	11	12	14	37	14	6	7	22	7	8	194

Appendix 7. Matrix of criteria weights (values of normalized principal Eigenvector)

# in hierarchy	#4	#9	#3	#5	#6	#7	#2	#1	#8	
matrix	F1	F9	F13	F3	F7	F4	F10	F6	F2	normalized principal Eigenvector
F1	1	1 1/2	1 1/6	1	1	1 1/7	1	1/2	2	11.42%
F9	2/3	1	2/5	1/2	5/8	2/3	2/5	3/8	1 1/4	6.17%
F11	6/7	2 3/5	1	1 1/6	1 5/6	1 1/2	1	1/2	2	12.80%
F3	1	2 1/6	6/7	1	5/6	1	1/2	1/3	1 1/4	9.20%
F7	1	1 3/5	5/9	1 1/5	1	1 1/3	1/2	3/8	1	8.73%
F4	7/8	1 1/2	2/3	1	3/4	1	2/5	1/3	5/7	7.46%
F10	1	2 3/7	1	1 5/6	2	2 4/7	1	5/9	1 1/5	13.65%
F6	2	2 5/7	1 5/6	2 7/9	2 5/7	3 1/8	1 5/6	1	4 1/6	23.28%
F2	1/2	4/5	1/2	4/5	1	1 3/8	5/6	1/4	1	7.29%

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Katarzyna Perez: Conceptualization; Literature Investigations, Methodology, Funding; Project Administration; Supervision; Writing Original Draft and Review & Editing. **Marta Kluzek**: Conceptualization; Literature Investigations, Formal Analysis; Methodology; Validation, Writing Original Draft. **Marcin Bielicki**: Conceptualization, Formal Analysis, Data Curation, Methodology, Writing Original Draft. **Katarzyna Schmidt-Jessa**: Conceptualization; Literature Investigations, Formal Analysis; Methodology; Validation, Writing Original Draft. **Tomasz Gabrusewicz**: Conceptualization, Formal Analysis.

Conflicts of interest

The authors declare no conflict of interest.

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Bridging bricolage and effectuation: The mediating role of innovative behavior in student entrepreneurial action under resource constraints

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Abstract

PURPOSE: *The purpose of this article is to examine how entrepreneurial bricolage enables student entrepreneurs to overcome resource constraints and uncertainty, fostering entrepreneurial action. Specifically, it investigates the mediating role of innovative behavior in translating entrepreneurial bricolage into discovery and exploitation activities.* ***METHODOLOGY:*** *A quantitative research design was employed, grounded in effectuation and bricolage theories. Data were gathered from 101 student entrepreneurs in the United Kingdom using a structured survey. We employed PLS-SEM to examine how student entrepreneurs use resourceful practices to promote innovative behavior. This approach supports our dual aim: explaining underlying mechanisms and assessing predictive relevance within a complex, hierarchical model.* ***FINDINGS****: The results reveal that entrepreneurial bricolage has a positive influence on both discovery and exploitation activities, which together constitute entrepreneurial action. Innovative behavior fully mediates these relationships, enabling student entrepreneurs to transform resource limitations into actionable entrepreneurial outcomes. Four dimensions of innovative behavior were identified to facilitate this process: questioning assumptions, observing resource-use patterns, experimenting with resource combinations, and networking for resource mobilization.* ***IMPLICATIONS:*** *This study reveals how effectuation and bricolage work together as complementary approaches. Effectuation provides a strategic framework for navigating uncertainty, while bricolage offers a tactical approach to resource mobilization. Innovative behavior bridges these theories, transforming available means into entrepreneurial action. By identifying innovative behavior as the link between resourcefulness and entrepreneurial action, this study deepens the understanding of cognitive-behavioral mechanisms in effectuation and resource transformation. The findings reinforce the role of innovative behavior in shaping opportunities rather than merely recognizing them. Practically, student entrepreneurs should refine their ability to question assumptions, observe resourceful practices, experiment, and network strategically. Universities should focus on fostering experimentation, peer learning, and mentorship to enhance innovative behavior. Given its mediating role, entrepreneurship programs should prioritize capability-building over direct resource allocation.* ***ORIGINALITY AND VALUE****: This study provides a novel integration of effectuation and bricolage theories, demonstrating their interaction as complementary rather than independent frameworks, unlike prior studies. This study contributes to opening the 'black box' of effectuation by explaining the cognitive and behavioral mechanisms through which resourceful and innovative actions lead to*

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entrepreneurial action, and by evaluating their ability to predict entrepreneurial outcomes. Additionally, it extends bricolage theory by highlighting its behavioral dimensions, shifting its focus from improvisation to a dynamic problem-solving process. These contributions provide a richer theoretical perspective on how student entrepreneurs navigate uncertainty and leverage limited resources to drive venture creation.
Keywords: *entrepreneurial bricolage, effectuation theory, innovative behavior, student entrepreneurship, resource constraints, entrepreneurial action, discovery and exploitation, cognitive-behavioral mechanisms, means-driven logic, resource mobilization.*

INTRODUCTION

In an entrepreneurial landscape in which intentions account for only 30 percent of venture creation behaviors (Shirokova et al., 2016; Van Gelderen et al., 2015), entrepreneurial action —i.e. the concrete activities by which individuals create new ventures through discovery and exploitation activities (Botha & Pietersen, 2022)— bridges aspirations and actionable strategies that generate market value (McMullen & Shepherd, 2006). Scholarship on entrepreneurship has emphasized the need to move beyond descriptive approaches and better understand the cognitive and behavioral fundamentals driving entrepreneurial action patterns (Arend et al., 2015). This focus is especially pertinent for student entrepreneurs who have to simultaneously cope with their academic studies and the development of their new ventures (Gupta & Gupta, 2017; Hägg & Kurczewska, 2019), as demonstrated in a recent systematic review of student entrepreneurship by Passavanti et al. (2023), which also highlights the role of students as entrepreneurs and the evolving recognition of their entrepreneurial potential. This dual context places them in a unique position to examine entrepreneurial action, as they navigate heightened uncertainty and significant resource constraints while at the same time pursuing their business ventures (Politis et al., 2012; Shirokova et al., 2016).

To date, research on student entrepreneurship has centered primarily on entrepreneurial intentions (Fernández-Pérez et al., 2019; Martins et al., 2023; Saeed et al., 2018; Wasilczuk & Licznerska, 2024). However, far less attention has been given to their concrete actions (Alshibani et al., 2024; Harima et al., 2021). This gap is particularly significant given that these nascent entrepreneurs play a pivotal role in addressing societal challenges and driving innovation by leveraging fresh perspectives, unencumbered by traditional industry norms, to generate novel and disruptive solutions (Ferrante et al., 2019; Kickul et al., 2018; Wright et al., 2017). However, traditional entrepreneurship literature, which sees resource mobilization as linear and expertise-driven, struggles to explain how students launch ventures with limited resources. Yet, many do—25.7% are starting businesses, and 11.1% already own one—suggesting resource mobilization emerges through resourceful behaviors and innovative capabilities (Sieger et al., 2024). This discrepancy poses a challenge to existing frameworks, suggesting that resource mobilization may emerge through a more nuanced relationship between resourceful behaviors and innovative capabilities.

To address this theoretical challenge, we draw on effectuation theory as a foundational lens for exploring entrepreneurial action in such conditions. Effectuation theory—defined as a non-predictive logic that emphasizes controlling an unpredictable future rather than predicting an uncertain one (Sarasvathy, 2001)— was originally developed to explain the behaviors of expert entrepreneurs, but its application has since expanded to include nascent entrepreneurs, such as students, who leverage available means and stakeholder commitments to overcome constraints and pursue opportunities (Chandler et al., 2011; Jiang & Tornikoski, 2019; Reymen et al., 2015). Effectual logic fosters resourceful behaviors through flexible goal adaptation and creative resource use, enabling entrepreneurs to seize emerging opportunities. Empirical evidence shows that student entrepreneurs frequently adopt effectual approaches, allowing them to innovate and act adaptively without rigid, plan-driven strategies (Passavanti et al., 2023). Despite its promise, scholars have argued that effectuation research must move beyond treating these processes as a "black box" and instead reveal how their various elements interact to drive entrepreneurial action (Jiang & Rüling, 2019).

Building on the foundation of effectuation, we examine entrepreneurial bricolage as a tactical approach that operationalizes effectual thinking (Fisher, 2012; Servantie & Rispal, 2018). Entrepreneurial bricolage—defined as the ability to "make do with whatever is at hand" (Baker & Nelson, 2005; Levi-Strauss, 1966), bricolage complements the strategic logic of effectuation by focusing on resource mobilization in uncertain conditions by enabling creative resource recombination, turning stakeholder commitments into resources, and allowing flexible goal adaptation (Scazziota et al., 2023; Vasconcelos-Scazziota et al., 2020; Welter et al., 2016). Empirical evidence highlights how student entrepreneurs who adopt entrepreneurial bricolage can effectively leverage their resourcefulness to overcome challenges (Politis et al., 2012). Nevertheless, research on bricolage in the context of student entrepreneurship remains scant, particularly its role in driving concrete entrepreneurial actions.

Effectual entrepreneurs favor flexibility, collaboration, and leveraging means over fixed plans. This approach encourages bricolage, as entrepreneurs resourcefully combine and repurpose resources to overcome constraints. Through stakeholder collaboration, they gain access to diverse inputs that further enhance their ability to experiment and innovate. As a result, innovative behavior—defined as the creation and implementation of new ideas (Tidd & Bessant, 2020)—naturally emerges, enabling them to adapt and generate value in uncertain environments. Whereas prior studies emphasized the role of innovative behavior in organizational contexts (Salam & Senin, 2022), current literature tends to focus on individual traits and contextual factors (e.g. Acar & Tuncdogan, 2019; Kim & Lee, 2018; Kistyanto et al., 2022), ignoring ways in which innovative behavior enables entrepreneurs to transform resource constraints into meaningful actions. This oversight is particularly significant given the emphasis in effectuation research on understanding the mechanisms that facilitate entrepreneurial action (Arend et al., 2015).

This study, grounded in effectuation and bricolage, addresses these gaps through the following research questions (RQ):

RQ: Does the application of entrepreneurial bricolage facilitate entrepreneurial action among student entrepreneurs?
To what extent does innovative behavior enable student entrepreneurs to transform entrepreneurial bricolage into entrepreneurial action?

This study makes a number of contributions to the literature on entrepreneurship. First, it examines the way in which entrepreneurial bricolage operates as an operational-level behavior within the effectuation framework, responding to recent calls for its integration (Scazziota et al., 2023; Vasconcelos-Scazziota et al., 2020; Welter et al., 2016). Second, it advances the debate on resourcefulness by clarifying how bricolage facilitates the translation of intentions into entrepreneurial action (Williams et al., 2021; Zahra, 2021). Third, it helps open the "black box" of effectuation (Grégoire & Cherchem, 2020; Jiang & Rüling, 2019) by identifying innovative behavior as a key mechanism driving entrepreneurial action. Fourth, it expands research on student entrepreneurship by exploring how effectual processes manifest in early-stage ventures (Choi, 2023; Frederiksen & Brem, 2017; Furlotti et al., 2020; Laskovaia et al., 2017). Finally, the study provides practical insights for student entrepreneurs, educators and policymakers, offering evidence-based strategies for nurturing resourcefulness and innovation capabilities.

The remainder of this article is structured as follows: First, we present the literature review and develop hypotheses regarding the relationships between entrepreneurial bricolage, innovative behavior, and entrepreneurial action. Next, we outline our methodology, including sample characteristics, measurement approaches, and analytical procedures. We then present our findings and discuss their theoretical and practical implications. The article concludes with a consideration of limitations and directions for future research.

LITERATURE REVIEW AND HYPOTHESES

Effectuation and entrepreneurial action

There has been a significant transformation in the conceptualization of entrepreneurial action, evolving from its traditional economic roots to a perspective that includes cognitive, behavioral, and social dimensions (Johnmark et al., 2016; Michaelis et al., 2021; Randerson et al., 2016; Simon & Shrader, 2012). Effectuation theory emphasizes entrepreneurial action as a dynamic process driven by the creative use of available means, iterative experimentation, and stakeholder collaboration, rather than the pursuit of predefined goals (Sarasvathy, 2001). Instead of relying on prediction, entrepreneurs shape outcomes by working with what they have and making decisions based on five key principles: bird-in-hand (starting with available means), affordable loss (focusing on what can be risked rather than expected returns), crazy quilt (co-creating opportunities through strategic partnerships), lemonade (leveraging contingencies), and pilot-in-the-plane (emphasizing control over uncertainty). This action-oriented perspective views entrepreneurship as a process of "doing" rather than merely planning (Gielnik et al., 2015), in which entrepreneurs actively combine and reconfigure personal traits and cognitive skills, experiences, expertise, and existing resources to create previously unanticipated opportunities (Kwasi Mensah et al., 2021; Weerakoon et al., 2019). This approach underscores the importance of individual agency and shifts entrepreneurial focus from prediction to the creative shaping of outcomes through existing means.

Effectuation theory posits that entrepreneurial action emerges through five key principles: bird-in-hand (starting with the means), affordable loss, crazy-quilt (strategic partnerships), lemonade (leveraging contingencies), and pilot-in-the-plane (focusing on controllable aspects) (Sarasvathy, 2001).

Entrepreneurial action stresses two forms of activity —discovery and exploitation— which entrepreneurs engage in iteratively (Botha & Pietersen, 2022). Discovery activities involve generating ideas and identifying market opportunities (Vogel, 2017). From an effectual perspective, opportunities are not pre-existing but rather emerge from creative recombination of means at hand, a process that is particularly valuable in uncertain or resource-scarce environments (Chinyoka, 2020; Welter et al., 2016). Exploitation activities focus on transforming these ideas into actionable ventures and in doing so encompass resource acquisition, organizational structuring and market entry (Choi & Shepherd, 2004). They follow an effectual perspective by leading continuous adaptation, leveraging stakeholder commitments, and assuming affordable loss (Chinyoka, 2020).

Empirical evidence shows that nascent entrepreneurs who employ effectual logic display superior opportunity identification than those using conventional search methods (Zhu et al., 2021). This relationship is particularly evident among student entrepreneurs, where numerous empirical studies have shown that prioritizing existing resources enhances entrepreneurial action (Choi, 2023; Furlotti et al., 2020; Laskovaia et al., 2017). This effectual approach leads to higher implementation effectiveness under uncertainty, fostering an iterative relationship between discovery and exploitation (Smolka et al., 2018).

Entrepreneurial bricolage and discovery activities

Student entrepreneurs frequently encounter significant resource constraints during their entrepreneurial journey, including limited financial capital, underdeveloped skills, and restricted access to professional networks (Longva, 2021). To navigate these challenges, entrepreneurial bricolage has emerged as a critical resourceful behavior, enabling individuals to leverage whatever they do have to overcome limitations. Entrepreneurial bricolage refers to "making do with resources at hand, recombining resources for new purposes, refusing to enact constraints, and predisposing to action" (Davidsson et al., 2017, p. 116). This behavior comprises a distinct cognitive approach to resource utilization and opportunity creation (Busch & Barkema, 2021; Kang et al., 2023). It operationalizes the "bird-in-hand" principle of effectuation, emphasizing practical actions that transform constraints into opportunities through the systematic repurposing and recombination of resources and facilitating the creation of new value despite inadequacies and constraints (Senyard et al., 2014).

The relationship between entrepreneurial bricolage and opportunity discovery operates through four interconnected paths: First, cognitive flexibility enables entrepreneurs who practice entrepreneurial bricolage to develop creative problem-solving skills, allowing them to recognize the potential of overlooked materials and opportunities (An et al., 2018; Busch & Barkema, 2021). This enhanced cognitive flexibility is aligned with an entrepreneurial mindset framework, strengthening their ability to evaluate and pursue novel opportunities (Chang & Fan, 2017).

Second, entrepreneurial bricolage cultivates heightened environmental scanning abilities through what we might call "resource-oriented alertness." While the classical concept of entrepreneurial alertness, as propounded by Kirzner (1979), focuses on opportunity recognition without deliberate searching, entrepreneurial bricolage enhances this by adding a resource-centered dimension. This process involves both active and passive scanning modes, i.e., systematic evaluation of immediate environments for usable resources (Fisher, 2012) and unconscious pattern recognition of resource-opportunity fits (Desa & Basu, 2013). By recombining resources and gaining experiential knowledge, student entrepreneurs can develop heightened pattern recognition abilities, improving their capacity to identify emerging trends and opportunities (Corbett, 2005).

Third, entrepreneurial bricolage enables entrepreneurs to apply available resources creatively to address gaps in the market. This behavior facilitates the identification of consumer needs that remain unfulfilled by leveraging existing resources in innovative ways (Kang et al., 2023). For example, Zorina (2021) observed that the flexibility inherent to entrepreneurial bricolage allows entrepreneurs to repurpose limited resources to meet demands that would otherwise remain unaddressed, thus creating value in overlooked niches.

Fourth, entrepreneurial bricolage supports systematic experimentation through "low-cost probing" (Andries et al., 2013) — a structured approach to testing opportunities with minimal resource commitment. This path involves rapid prototyping using readily available resources, iterative testing with potential customers, and continuous refinement based on feedback (Bezhovski et al., 2024; Kaffka et al., 2021). Drencheva et al. (2022) demonstrate how this approach enables student entrepreneurs to validate assumptions and refine their strategies before committing significant resources.

By facilitating early engagement with stakeholders, entrepreneurial bricolage enhances opportunity validation even in resource-constrained environments.

These paths work together to enhance opportunity recognition, as entrepreneurs' resourceful approaches to constraints lead to novel ways of identifying and validating potential opportunities. Based on this theoretical foundation and empirical evidence, we posit the following hypothesis:

H_1: The total effect of entrepreneurial bricolage positively impacts the development of discovery activities in student entrepreneurs.

Entrepreneurial bricolage and exploitation activities

The relationship between entrepreneurial bricolage and exploitation activities is a critical area of inquiry in entrepreneurship research, particularly in understanding how entrepreneurs transform identified opportunities into viable ventures under resource constraints (Mateus & Sarkar, 2024). Effectuation theory provides the overarching principles that explain entrepreneurial decision-making through concepts such as affordable loss (focusing on what entrepreneurs can afford to lose rather than their expected returns) and stakeholder commitments (building partnerships to reduce uncertainty) (Sarasvathy, 2001), while bricolage demonstrates how entrepreneurs operationalize these principles to create value under constraints (Baker & Nelson, 2005). This alignment is particularly salient for student entrepreneurs, since resourceful behaviors enable them to develop strategies that transform constraints into opportunities (Klyver & Schenkel, 2013; Politis et al., 2012).

The effectiveness of entrepreneurial bricolage in exploitation activities stems from its dual capacity to help entrepreneurs navigate uncertainty while simultaneously overcoming resource limitations. By integrating existing knowledge with insights gained from resource experimentation, entrepreneurs engage in a dynamic process that enhances their adaptability (Dothan & Lavie, 2016). This resourceful behavior, guided by effectuation principles, enables entrepreneurs to turn unexpected challenges swiftly into opportunities for growth (Chinyoka, 2020).

Empirical research has identified four distinct yet interrelated characteristics through which entrepreneurial bricolage facilitates exploitation activities. First, the creative recombination mechanism focuses on building unique resource portfolios from available means. For student entrepreneurs, this is manifested in resourceful integration of resources, personal networks, and facilities to launch and sustain ventures (Politis et al., 2012). This characteristic is compelling in the university context, where diverse resources can be repurposed in unexpected ways to support the development of ventures.

Second, the action-oriented approach promotes rapid market entry and iterative refinement of venture ideas. This is in line with effectuation's focus on affordable loss and enables entrepreneurs to develop and adjust their strategies without requiring significant resource commitments (Fisher et al., 2021). This characteristic is especially valuable for student entrepreneurs who have to balance venture development with academic commitments.

Third, the continuous resource reconfiguration characteristic represents a central aspect of entrepreneurial bricolage in exploitation. It entails dynamically adapting resource combinations based on market feedback and stakeholder interactions, supporting the emphasis placed by effectuation on leveraging contingencies (Yu & Wang, 2021). This attribute enables student entrepreneurs to maintain flexibility while building sustainable venture structures.

Fourth, strategic flexibility enables entrepreneurs to pivot their business models and strategies in response to dynamic market conditions. This adaptability is particularly crucial during the exploitation phase, where the speed of implementation is often a determinant of success, facilitating rapid responses to market feedback while maintaining academic progress (Epler & Leach, 2021).

These mechanisms function as an integrated system in which resource recombination leads to stronger action orientation and enhanced resource reconfiguration capabilities. This adaptive capacity enables student entrepreneurs to optimize exploitation activities and maximize value creation. Based on this theoretical foundation and empirical evidence, we posit the following hypothesis:

H_2: The total effect of entrepreneurial bricolage positively impacts the development of exploitation activities amongst student entrepreneurs.

The mediating role of innovative behavior in the relationship between entrepreneurial bricolage and entrepreneurial action

Innovative behavior, defined as the generation and implementation of novel ideas (Tidd & Bessant, 2020), is crucial to understanding how entrepreneurs transform resources into concrete actions. Research suggests that entrepreneurial bricolage, while effective for resource mobilization and recombination (Baker & Nelson, 2005), requires specific behavioral mechanisms to translate into entrepreneurial action due to the implicit limitations faced by students in generating high quality solutions (Kickul et al., 2018; Lanzara, 1999; Stinchfield et al., 2013).

The potential relationship between innovative behavior and entrepreneurial action is deeply embedded in effectuation theory. Rather than following predetermined paths, entrepreneurs act by creatively leveraging available means, managing risk through affordable loss, forming partnerships, embracing contingencies, and focusing on controllable aspects (Sarasvathy, 2001). Each of these effectual processes requires innovative behavior to transform uncertainty into actionable opportunities. For instance, starting with available means—who they are, what they know, and whom they know—necessitates innovative behavior to recombine resources in novel ways and create opportunities. Likewise, leveraging contingencies demands adaptability and creativity to turn unexpected challenges into entrepreneurial advantages (Sarasvathy, 2008).

Moreover, effectuation theory emphasizes that entrepreneurial action emerges through an iterative cycle of stakeholder interactions and commitment building (Weerakoon et al., 2019). This connection is particularly relevant for understanding how the resourceful behavior of bricolage operationalizes the means-driven approach of effectuation through resource combination (Fisher, 2012) and might relate to entrepreneurial action through innovative behavior. This relationship appears to be influenced by the way in which resource constraints shape cognitive processes and behavioral responses, leading entrepreneurs to develop enhanced capabilities for recognizing and implementing novel resource combinations (Baker & Nelson, 2005).

Innovative behavior is manifested through four distinct but interrelated behavioral dimensions: observing, questioning, experimenting, and networking (Dyer et al., 2008). These dimensions may help explain how entrepreneurial bricolage facilitates the transformation of available resources into value, ultimately leading to entrepreneurial action. From this perspective, innovative behavior is not only an output of cognitive processes but also a key enabler of opportunity enactment. This perspective is particularly relevant given the documented intention-behavior gap in student entrepreneurship (Harima et al., 2021).

The observing dimension facilitates pattern recognition in bricolage experiences, potentially enabling entrepreneurs to identify opportunities within existing resource constraints (Dyer et al., 2008). This capability is relevant for identifying opportunities within resource constraints (Osman, 2008). The questioning dimension enables entrepreneurs to challenge existing assumptions about resource limitations, fostering creative thinking about potential resource combinations (Raine & Pandya, 2019). This cognitive ability plays a critical role in effective opportunity recognition, enhancing entrepreneurs' capacity to identify novel applications for available resources (Peljko et al., 2016). Beyond recognizing opportunities, the experimenting dimension provides a practical mechanism for testing and refining ideas developed through bricolage (Kerr et al., 2014), enabling both discovery and exploitation activities. Supporting this view, Senyard et al. (2014) emphasize that actively experimenting with resource combinations can strengthen entrepreneurs' capabilities in opportunity implementation. In addition to experimentation, networking can be seen as a complementary dimension that facilitates knowledge exchange and resource mobilization through stakeholder engagement (Richez-Battesti & Petrella, 2020). Extending this argument, Klyver and Schenkel (2013) suggest that effective networking behavior might enhance entrepreneurs' ability to transform bricolaged resources into concrete venture outcomes.

In discovery activities, innovative behavior might contribute through questioning and observing behaviors, potentially helping student entrepreneurs to transform their capabilities into concrete discovery activities (Kim et al., 2018). For exploitation activities, experimenting and networking behaviors appear to be particularly relevant, facilitating real-world implementation (Harima et al., 2021; Lee et al., 2019).

Although the literature on entrepreneurship has not extensively examined innovative behavior as a mediating mechanism, empirical studies in employee-focused research lend support to its mediating role. For instance, Aryee et al. (2012) found that innovative behavior mediates the relationship between transformational leadership and task performance through work engagement. Likewise, Naranjo-Valencia et al. (2017) showed that innovative behavior mediates the relationship between organizational culture and radical product innovation in firms. Based on this theoretical foundation and empirical evidence, we posit the following hypotheses and the theoretical model (Figure 1).

H_3: Innovative behavior positively mediates the relationship between entrepreneurial bricolage and discovery activities among student entrepreneurs.

H_4: Innovative behavior positively mediates the relationship between entrepreneurial bricolage and exploitation activities among student entrepreneurs.

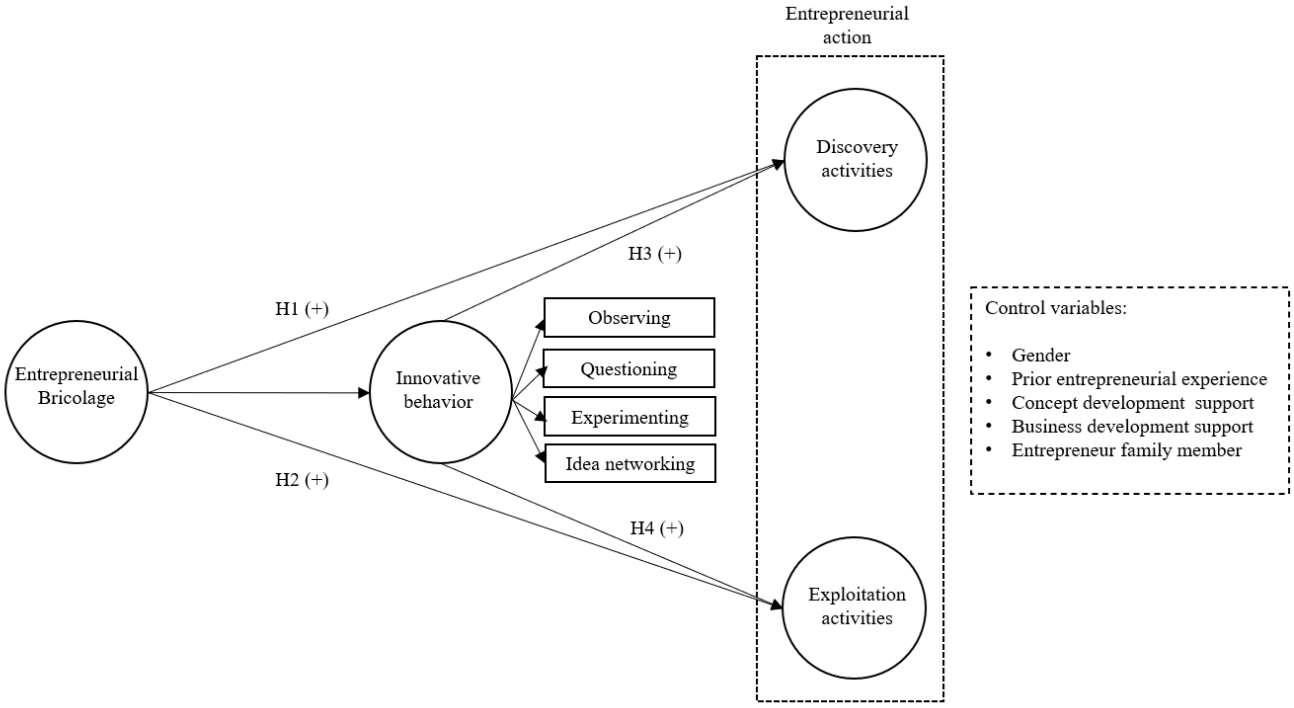

Figure 1. Theoretical model

METHODOLOGY

This study adopts an explanatory–predictive approach, using a cross-sectional design with a sample of student entrepreneurs from the United Kingdom. The explanatory component aims to explore how resourceful behaviors are associated with entrepreneurial action and to examine the mechanisms through which these relationships unfold, particularly through the mediating role of innovative behavior. Rather than testing a fully specified or previously validated theoretical model, we rely on effectuation theory to propose and assess new pathways of influence in this context. The predictive component evaluates the model's ability to forecast discovery and exploitation activities using out-of-sample prediction techniques. Our analysis involves assessing measurement and structural models, performing robustness checks, and applying procedures for mediation analysis and predictive validation.

Sampling strategy and participants

This study focuses on students actively engaged in venture creation while pursuing higher education. These student entrepreneurs operate at the intersection of academic and entrepreneurial contexts (Bergmann et al., 2016) and face greater resource constraints than established entrepreneurs (Nielsen & Gartner, 2017). Research on entrepreneurial processes such as effectuation and causation has widely relied on student entrepreneur samples due to their unique context and variability in resource usage (Laskovaia et al., 2017; Smolka et al., 2018). (Politis et al., 2012) further demonstrated that data from student entrepreneurs provide valuable theoretical insights, reinforcing their suitability for academic inquiry.

Given the specificity of our target population—students simultaneously balancing academic studies and entrepreneurial ventures—we employed a convenience sampling approach. This method was the most appropriate due to the accessibility and feasibility of recruiting student entrepreneurs actively engaged in business creation within our institutional setting.

Convenience sampling has been widely used in entrepreneurship research, particularly when studying niche populations with limited availability and clear inclusion criteria (Etikan, 2016).

The study was conducted within the UK higher education sector, specifically at the University of the West of England, Bristol (UWE Bristol). In the UK, student entrepreneurs play a crucial role in driving innovation and economic growth (Hannon, 2005; Wright & Mustar, 2019). The sample includes students from two undergraduate programs: the BA (Hons) in Business (Team Entrepreneurship) at Frenchay campus and the BA (Hons) in Sports, Business, and Entrepreneurship at Ashton Gate campus. The students were selected because of their high engagement levels in venture creation, ensuring the inclusion of individuals actively involved in running projects and developing ventures, rather than merely studying entrepreneurship theory. It is important to clarify that they are student entrepreneurs, not students of entrepreneurship. To enhance the representativeness of the sample, we incorporated students from three different years of study and various venture stages, gender and age, ensuring a diversity of perspectives.

Data collection procedures

Surveys were administered online and self-administered by the participants using the Qualtrics platform. Prior to the main data collection, we conducted a pilot test with 12 student entrepreneurs to validate the survey instrument's clarity, comprehensiveness, and technical functionality. Based on pilot feedback, we adjusted and clarified some of the instructions and terms.

To ensure that all participants were qualified student entrepreneurs, we applied a screening question: "During your studies at the university, have you individually or in a team undertaken at least one concrete action to create a start-up or an organization in its initial phase?" (Yes/No). If the answer was "Yes," they could continue with the survey; if the answer was "No," the survey ended. This screening approach ensured that our data specifically captured experiences from active student entrepreneurs rather than those merely interested in entrepreneurship. Of the total surveys received, 3 did not agree to participate in the study, 6 were incomplete, and 3 answered "No" to the filter question on whether they considered themselves to be student entrepreneurs. After data cleaning and validation, our final sample consisted of 101 valid responses. Characteristics of the final sample are shown in Table 1. Although the sample is not gender-balanced, its demographic profile is broadly aligned with the prevailing composition of the student population enrolled in these programs, which is approximately 85% male.

Table 1. Sample characteristics

	Sample	Gender			Age		
		Male	Female	Other	< 20	20 - 25	> 25
Frenchay Campus	77	59	17	1	16	60	1
Ashton Gate Campus	24	19	4	1	1	23	0
Total	**101**	**78**	**21**	**2**	**17**	**83**	**1**

The required sample size was determined through a priori power analysis using G*Power 3.1.9.7 software (Faul et al., 2009), as recommended for PLS-SEM studies (Hair et al., 2022). The analysis suggested a minimum sample size of 98 for 0.8 statistical power and a medium effect size of 0.15. Our final sample consisted of 101 valid responses, which meets and slightly exceeds this requirement.

Measurements

We used scales of measuring variables that have been validated in prior studies. The dependent variables were obtained from the conceptualization of entrepreneurial action, which encompasses two main types of activities: discovery and exploitation (Botha & Pietersen, 2022; Shane & Venkataraman, 2000). Discovery activities (referred to hereinafter as "discovery") involve generating initial venture ideas and identifying market opportunities at an early stage (Vogel, 2017), whereas exploitation activities (hereinafter "exploitation") focus on executing these concepts by acquiring resources, establishing an organizational structure, and entering the market (Mueller et al., 2012). The two dependent variables were assessed using the scales for discovery activities (six items) and exploitation activities (eleven items), respectively, as proposed by Botha and Pietersen (2022). The scale for the independent variable, entrepreneurial bricolage (EB) (eight items)

was adopted from Senyard et al. (2014) and further validated by Davidsson et al. (2017). The mediator variable, innovative behavior, was measured using a scale developed by Dyer et al. (008), which consists of four dimensions: questioning (six items), observing (four items), experimenting (five items), and idea networking (four items). These scales were measured using a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

On the recommendation of Memon et al. (2024) and Shiau et al. (2024), we included five relevant control variables to assess potential effects on the dependent variables: i) Gender: previous research has shown that gender influences access to and management of resources, entrepreneurial innovation, and entrepreneurial action (Saiz-Álvarez & Rodríguez-Aceves, 2019; Vamvaka et al., 2020). It is represented here as a dummy variable (1 = male, 0 = female); ii) Prior entrepreneurial experience (P_ENT_EXP): This binary variable (1 = yes; 0 = no) captures whether the student has prior experience in starting or running a business. Such experience influences the ability to identify and exploit opportunities and mobilize resources (Grežo, 2024); iii) Concept development support (CON_DEV_SUP): university assistance for early-stage business ideas (Kraaijenbrink et al., 2010), influencing opportunity discovery (Ho et al., 2014). Measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) (four items); iv) Business development support (BUS_DEV_SUP): university-provided activities for expanding ventures (Kraaijenbrink et al., 2010), impacting growth and opportunity exploitation (Guerrero et al., 2020). Measured on a 7-point Likert scale (three items) (Guerrero et al., 2020); v) Entrepreneur family member (ENT_FAM_MEM): family members who are entrepreneurs serve as role models, provide resources, and shape perceptions of entrepreneurship (Tarling et al., 2016)—measured as binary (1 = yes, 0 = no).

Data analysis method

We used structural equation modeling (SEM) to evaluate our hypotheses, allowing us to examine relationships between observed and latent variables simultaneously (Chin, 1998). SEM is particularly advantageous when dealing with multiple dependent and exogenous variables, which require concurrent estimation of several regression equations (Hair et al., 2022). Specifically, we applied PLS-SEM, as it supports both explanatory modeling and predictive analysis, making it appropriate for our aim of examining the mechanisms behind resourceful and innovative behaviors and assessing their ability to predict discovery and exploitation activities. Another key reason for choosing PLS-SEM is the complexity of our model and its use of composites, which align with the nature of our constructs. This approach is particularly suitable in contrast to covariance-based SEM techniques such as LISREL, which require larger samples, distributional assumptions, and are generally confirmatory in nature (Hair et al., 2022). Moreover, PLS-SEM is better suited for estimating variables that are not unidimensional, especially when dealing with high-order composites (Guenther et al., 2023), helping to prevent significant residual values and biased results resulting from factor estimation (Sarstedt et al., 2023).

Following the two-step procedure recommended by Hair et al. (2022), we first assessed the measurement model to evaluate the reliability (e.g., indicator loadings, internal consistency) and validity (e.g., convergent and discriminant validity) of each construct. In addition, to estimate the second-order construct of innovative behavior, we applied the disjoint two-stage approach as recommended by Becker et al. (2023) and Hair et al. (2024). This technique allows for robust assessment of higher-order constructs by estimating lower-order components in the first stage and using them as indicators in the second stage. Once the measurement model met the required criteria, we proceeded to analyze the structural model to test the hypothesized relationships and assess explanatory and predictive power.

Following Hair et al. (2022), all constructs were modeled as mode A composites. While AVE, composite reliability, and Cronbach's alpha were originally designed for reflective models, recent literature (Guenther et al., 2023) supports their interpretive use as informative quality diagnostics for mode A composites when indicators are conceptually similar and strongly correlated. Significance testing for parameter estimation (e.g., loadings and path coefficients) was conducted using a bootstrap procedure based on 10,000 subsamples to obtain p-values (p) and 95 percent bias-corrected confidence intervals (CI) (Chin, 1998). To perform our data analysis, we used SmartPLS 4.1.0.6 software (Ringle et al., 2024).

Common method bias

To address and mitigate common method bias (CMB), we followed the recommendations of Podsakoff et al. (2024). Our approach involved both ex ante (study design) and ex post (statistical) procedures. In designing our study, we implemented several procedural remedies: a) we created a perceived psychological separation between predictor and criterion variables by using different response formats; b) we assured respondents of the anonymity and confidentiality of their responses, in order to reduce social desirability bias and evaluation apprehension; c) we randomized the order of questions relating

to different constructs to control for priming effects and item-context-induced mood states. We also employed statistical remedies to assess the presence of CMB. First, we employed the full multicollinearity test (Kock, 2015). Second, we assessed the Variance Inflation Factor (VIF) values obtained from the full collinearity assessment, which ranged between 1.22 and 3.10, and found all values to be below the threshold of 3.30 (Table 2). Based on these measures and results, we consider this study not to be affected by CMB.

Table 2. Measurement model assessment

Composites/Dimension/Indicator	VIF	Mean	SD	Loadings	Weights	ρ_c	ρ_a	AVE
Discovery activities (Mode A)						0.832	0.763	0.501
DISCO2: I have identified market opportunities	1.223	5.767	0.783	0.622	0.296			
DISCO3: I have prepared a business plan	1.660	5.525	0.651	0.759	0.267			
DISCO4: I have developed models or procedures for a product/service	1.788	5.521	0.585	0.811	0.327			
DISCO5: I have selected a business name	1.372	4.904	0.749	0.663	0.246			
DISCO6: I am devoted full time to the business	1.326	5.102	0.742	0.671	0.276			
Exploitation activities (Mode A)						0.866	0.816	0.518
EXPLOT2: I have created a legal entity	2.386	4.767	0.745	0.668	0.244			
EXPLOT3: I have registered with the tax authorities	3.105	4.433	0.655	0.756	0.195			
EXPLOT 5: I have requested for and received financial assistance to start my business	1.950	4.821	0.664	0.748	0.210			
EXPLOT7: I have purchased or leased major items, like equipment, facilities, or property	1.698	4.913	0.682	0.731	0.267			
EXPLOT9: I have started marketing or promotional activities	1.709	5.858	0.719	0.695	0.247			
EXPLOT11: I have appointed employees	1.732	4.703	0.700	0.714	0.226			
Entrepreneurial bricolage (EB) (Mode A)						0.901	0.883	0.505
EB1: I am confident of my ability to find workable solutions to new challenges by using my existing resources	1.800	5.421	0.690	0.724	0.170			
EB2: I gladly take on a broader range of challenges than others with my resources would be able to	1.785	5.217	0.685	0.728	0.185			
EB3: I use any existing resource that seems useful to respond to a new problem or opportunity	2.593	5.175	0.664	0.747	0.151			
EB4: I deal with new challenges by applying a combination of my existing resources and other resources inexpensively available to me	1.984	5.254	0.785	0.619	0.142			
EB5: When dealing with new problems or opportunities, I take action by assuming that I will find a workable solution	1.932	5.333	0.671	0.741	0.138			
EB6: By combining our existing resources, I take on a surprising variety of new challenges	1.896	5.188	0.681	0.697	0.154			
EB7: When I face new challenges, I put together workable solutions from my existing resources	1.867	5.217	0.717	0.722	0.173			
EB8: I combine resources to accomplish new challenges that the resources were not originally intended to accomplish	1.691	4.938	0.692	0.675	0.110			
Innovative behavior (IB) (HOC Mode A)						0.844	0.787	0.579
Observing (Composite Mode A)	1.743			0.834***	0.374***	0.884	0.827	0.657
OBS1: New business ideas often come to me when directly observing how people interact with products and services	1.559	5.125	0.656	0.754	0.290			
OBS2: I have a continuous flow of new business ideas that comes through observing the world	3.055	5.021	0.500	0.866	0.314			
OBS3: I regularly observe customers' use of our company's products and services to get new ideas	1.540	4.821	0.620	0.785	0.340			

Composites/Dimension/Indicator	VIF	Mean	SD	Loadings	Weights	ρ_c	ρ_a	AVE
OBS4: By paying attention to everyday experiences, I often get new business ideas.	2.787	5.000	0.555	0.832	0.291			
Questioning (Composite Mode A)	1.234			0.585***	0.207***	0.882	0.895	0.558
QUEST1: I am always asking questions	1.974	5.346	0.699	0.715	0.160			
QUEST2: I am constantly asking questions to get to the root of the problem	2.307	5.467	0.635	0.773	0.185			
QUEST3: Others are frustrated by the frequency of my questions	1.469	4.417	0.810	0.586	0.097			
QUEST4: I often ask questions that challenge the status quo	2.137	4.871	0.588	0.809	0.212			
QUEST5: I regularly ask questions that challenge others' fundamental assumptions	2.147	4.971	0.529	0.849	0.332			
QUEST6: I am constantly asking questions to understand why products and projects underperform	1.406	5.304	0.692	0.722	0.321			
Experimenting (Composite Mode A)	1.645			0.811***	0.363***	0.856	0.822	0.602
EXP1: I love to experiment to understand how things work and to create new ways of doing things	1.435	5.371	0.785	0.619	0.199			
EXP2: I frequently experiment to create new ways of doing things	1.617	4.729	0.647	0.763	0.334			
EXP3: I am adventurous, always looking for new experiences	2.293	5.392	0.594	0.805	0.322			
EXP4: I actively search for new ideas by experimenting	2.686	4.921	0.451	0.892	0.406			
Idea networking (Composite Mode A)	1.522			0.785***	0.345***	0.850	0.790	0.588
IN1: I have a network of individuals whom I trust to bring a new perspective and refine new ideas	1.403	5.196	0.707	0.707	0.298			
IN2: I attend many diverse professional and/or academic conferences outside of my industry/ profession	1.318	3.708	0.751	0.660	0.247			
IN3: I initiate meetings with people outside of my industry to spark ideas for a new product, service, or customer base	1.679	4.654	0.582	0.813	0.366			
IN4: I have a large network of contacts with whom I frequently interact to get ideas for new products, services, and customers	2.005	4.388	0.495	0.869	0.378			

Note: *VIF*: variance inflation factor; ρ_c: Jöreskog's composite reliability, ρ_a: Dijkstra- Henseler`s composite reliability; *AVE:* Average variance extracted; HOC: Higher order construct; DISCO: discovery activities; EXPLOT: exploitation activities; EB: entrepreneurial bricolage; OBS: observation; QUEST: questioning; EXPE: experimentation; IN: idea networking; ***P<.001, **P<.01, *P<.05 based on percentile bootstrapping (n = 10,000; two-tailed test).

RESULTS

Measurement model

Our assessment of the measurement model sought to establish the reliability and validity of the constructs. To this end, we followed the steps and criteria outlined by Hair et al. (2022). First, we assessed the reliability and validity of the Composites in Mode A, including the control variables CON_DEV_SUP and BUS_DEV_SUP. We obtained loadings exceeding the value of 0.7 for both indicators and dimensions, with only a few exceptions (Table 2). To ensure that the Average Variance Extracted *(AVE)* was above the 0.5 threshold, we removed specific items that had the lowest loadings (DISCO1, EXPLOT1, EXPLOT4, EXPLOT6, EXPLOT8, EXPLOT10). Applying the bootstrapping procedure, all item loadings were significant, including the control variables CON_DEV_SUP and BUS_DEV_SUP. We then established composite reliability by using *Cronbach's alpha*, *rho_a,* obtaining values of over 0.7 for all first-order and higher-order composites in Mode A (Table 2). Lastly, we assessed the discriminant validity, employing both the *Fornell-Larcker* and

HTMT criteria. For the latter, we obtained indicator values below the (conservative) threshold of 0.85 (Table 3). For Entrepreneurial bricolage - Innovative behavior, the *HTMT* value is slightly higher (0.877) but still lower than the more liberal threshold of 0.9. Hence, discriminant validity is established.

Table 3. HTMT results for the first-order and second-order models

	Discovery	EB	Exploitation	IB
Discovery	0.707	0.494	0.588	0.607
EB	**0.581**	0.710	0.549	0.722
Exploitation	**0.768**	**0.625**	0.720	0.686
IB	**0.785**	**0.877**	**0.839**	0.761

Note: EB: entrepreneurial bricolage; IB: innovative behavior. The *HTMT* criterion appears below the diagonal in bold. The *Fornell-Larcker* criterion appears above the diagonal.

Robustness checks

To guarantee the reliability and credibility of the PLS-SEM results related to the structural model, we followed the recommendations of Sarstedt et al. (2020) for examining nonlinear effects, endogeneity, and unobserved heterogeneity.

Nonlinear effects

To explore the possibility of non-linear effects in our model, we employed the two-phase method proposed by Hair et al. (2024). Initially, we computed scores for the predictor variables. We then examined the quadratic effects within five specific paths of our model to identify any non-linear relationships. We obtained the following effects: Entrepreneurial bricolage on discovery (β = 0.023, p = 0.797, f^2 = 0.000); entrepreneurial bricolage on exploitation (β = -0.002, p = 0.976, f^2 = 0.000); entrepreneurial bricolage on innovative behavior (β = 0.016, p = 0.780, f^2 = 0.002); innovative behavior on discovery (β = 0.039, p = 0.630, f^2 = 0.000); innovative behavior on exploitation (β = 0.002, p = 0.966, f^2 = 0.000). The findings indicate that the quadratic effect is not significant in any of the relationships, and the effect sizes are minimal. We therefore consider a linear relationship in our model.

Endogeneity

Although endogeneity testing is not required for predictive modeling, we included it to reinforce the explanatory rigor of our analysis. As recommended by Hult et al. (2018), accounting for potential endogeneity strengthens the causal interpretation of path relationships in explanatory PLS-SEM models.

In assessing our model for endogeneity, we followed the method recommended by Hult et al. (2018). Initially, we evaluated the appropriateness of using Gaussian copulas (Park & Gupta, 2012), following the guidelines proposed by Becker et al. (2022). After performing Cramer-Von Mises and Anderson-Darling tests for normality, we found the independent latent variables entrepreneurial bricolage (*CVM* = 0.040, p = 0.676 / *AD* = 0.243, p = 0.760), and innovative behavior (*CVM* = 0.055, p = 0.430 / *AD* = 0.338, p = 0.495) not to be non-normally distributed. These results indicate that the Gaussian copula approach was not appropriate. Thus, as recommended by Becker et al. (2022), we considered other methods.

We evaluated the suitability of using the instrumental variable (IV) technique, but this proved unfeasible since we lacked a suitable extraneous variable that would correlate with the endogenous variable but not with the model's error term (Rutz & Watson, 2019). Therefore, as recommended by Hult et al. (2018) we adopted the control variable analysis, as supported by Bernerth and Aguinis, (2016). After incorporating five control variables —gender, P_ENT_EXP, CON_DEV_SUP, BUS_DEV_SUP, and ENT_FAM_MEM— into our analysis, we found seven of the eight effects analyzed not to be significant: gender -> discovery (β = 0.225, p = 0.118); gender -> exploitation (β = -0.120, p = 0.271); P_ENT_EXP -> discovery (β = 0.151, p = 0.198); P_ENT_EXP -> exploitation (β = -0.118, p = 0.145); CON_DEV_SUP -> discovery (β = 0.004, p = 0.485); BUS_DEV_SUP -> exploitation (β = -0.014, p = 0.451); ENT_FAM_MEM -> discovery (β = 0.115, p = 0.231); ENT_FAM_MEM -> exploitation (β = 0.290, p = 0.039). Given these results, we determined that endogeneity does not pose a problem for our model, although we recognize the possibility of further improvements in this approach.

Unobserved heterogeneity

To assess unobserved heterogeneity, we followed the recommendations of Sarstedt et al. (2017) and applied the finite mixture partial least squares (FIMIX-PLS) method using SmartPLS. We evaluated model fit across segment solutions using the criteria proposed by Hair et al. (2016), including AIC, BIC, and entropy. Unobserved heterogeneity was calculated, analyzed, and presented to demonstrate that the model is robust, following the recommendations of Gudergan et al. (2025). Starting with five different groupings (due to our sample size of 101), our analysis used the procedures suggested by both Sarstedt et al. (2011) and Hair et al. (2016). To determine the optimal segment number, we carefully considered the following criteria: i) *CAIC* (consistent AIC) and *AIC3* (modified *AIC* with Factor 3); ii) *AIC3* with *BIC* (Bayesian information criterion); and iii) *BIC* with *AIC4* (modified *AIC* with Factor 4). However, these results indicated different segment numbers. As shown in Table 4, these comparisons fully favor a one-segment solution. Furthermore, the standardized entropy statistic (*EN*) is above 0.5, proving clear classification of the data. These findings suggest that our data is not affected by unobserved heterogeneity.

Table 4. Unobserved heterogeneity results

	Segments		
	1	**2**	**3**
AIC	688.508	684.633	**679.023**
AIC3	**696.508**	701.633	705.023
AIC4	**704.508**	718.633	731.023
BIC	**709.428**	729.09	747.016
CAIC	**717.428**	746.09	773.016
EN	0	0.947	0.674

Note: AIC: Akaike's information criterion, AIC3: modified AIC with factor 3, AIC4: modified AIC with factor 4, BIC: Bayesian information criterion, CAIC: consistent AIC, EN: normed entropy statistic.

Structural model

To evaluate the structural model, we followed the guidelines of Hair et al. (2022) for assessing the size and significance of the parameters and path coefficients. Initially, we examined collinearity through the Variance Inflation Factor (*VIF*). As mentioned, the results showed that all VIF values remained below the threshold of 3.3 (Table 2), indicating the absence of multicollinearity issues. We then calculated the values of R^2 to determine the percentage of variance accounted for by the endogenous variables. The R^2 value for discovery was 37.3 percent (through entrepreneurial bricolage 5.7 percent and innovative behavior 31.6 percent); for exploitation, it was 47.5 percent (through entrepreneurial bricolage 6.0 percent and innovative behavior 41.5 percent). According to Chin (1998), the two values represent a moderate level of explained variance.

We then proceeded to assess our hypotheses. The resulting analyses are shown in Table 5. First, we tested the total effect of entrepreneurial bricolage on discovery activities (H_1). The results show a positive and significant effect ($\boldsymbol{\beta}$ = 0.494, p = 0.000), therefore the data support H_1. We then continued to test the total effect of entrepreneurial bricolage on exploitation activities (H_2). The results show a positive and significant effect ($\boldsymbol{\beta}$ = 0.548, p = 0.000), thus the data results support H_2. We continued by testing the specific indirect effect of entrepreneurial bricolage on discovery through innovative behavior, which corresponds to H_3. The analysis shows a significant indirect effect ($\boldsymbol{\beta}$ = 0.377, p = 0.000). Considering that the direct effect of entrepreneurial bricolage on discovery is not significant ($\boldsymbol{\beta}$ = 0.116, p = 0.160), this implies that the influence of entrepreneurial bricolage on discovery through innovative behavior is a full mediation. Thus, the data support H_3. With respect to H_4, regarding the specific indirect effect of entrepreneurial bricolage on exploitation through innovative behavior, the results show a positive significant indirect effect ($\boldsymbol{\beta}$ = 0.437, p = 0.000). Since the direct effect of entrepreneurial bricolage on exploitation is not significant ($\boldsymbol{\beta}$ = 0.111, p = 0.138) this also represents a full mediation. Therefore, H_4 is empirically supported. Finally, following the recommendations of Cohen (1988), we calculated the f^2 for effect sizes.

We also assessed the significance of the five control variables (gender, P_ENT_EXP, CON_DEV_SUP, BUS_DEV_SUP, and ENT_FAM_MEM). The results show that seven of the eight effects on the dependent variables were non-significant; only the ENT_FAM_MEM on exploitation was significant.

Table 5. Structural model assessment and mediation analysis

Direct effects	β	CI	p-value	SD	t-value	R^2	f^2	Support
EB -> Discovery	0.117^{ns}	[-0.069 0.315]	0.160	0.117	0.996	0.057	0.010	
EB -> Exploitation	0.111^{ns}	[-0.057 0.279]	0.138	0.102	1.089	0.060	0.011	
EB -> IB	0.722***	[0.647 0.799]	0.000	0.046	15.559		1.092	
IB -> Discovery	0.523***	[0.338 0.706]	0.000	0.113	4.623	0.316	0.209	
IB -> Exploitation	0.606***	[0.460 0.756]	0.000	0.090	6.752	0.415	0.335	
Gender -> Discovery	0.225^{ns}	[-0.080 0.536]	0.118	0.190	1.184			
Gender -> Exploitation	-0.120^{ns}	[-0.435 0.202]	0.271	0.610	0.196			
P_ENT_EXP -> Discovery	0.151^{ns}	[-0.147 0.445]	0.198	0.181	0.850			
P_ENT_EXP -> Exploitation	-0.118^{ns}	[-0.402 0.160]	0.145	0.70	0.691			
CON_DEV_SUP -> Discovery	0.004^{ns}	[-0.114 0.195]	0.485	0.096	0.038			
BUS_DEV_SUP -> Exploitation	-0.014^{ns}	[-0.216 0.163]	0.451	0.113	0.124			
ENT_FAM_MEM -> Discovery	0.115^{ns}	[-0.138 0.384]	0.231	0.157	0.735			
ENT_FAM_MEM -> Exploitation	0.290*	[0.009 0.553]	0.039	0.164	1.717			
Indirect effects								
EB -> IB -> Discovery (H_3)	0.377***	[0.239 0.535]	0.000	0.090	4.209			Yes
EB -> IB -> Exploitation (H_4)	0.437***	[0.324 0.577]	0.000	0.077	5.700			Yes
Total effect								
EB -> Discovery (H_1)	0.494***	[0.387 0.620]	0.000	0.071	6.993			Yes
EB -> Exploitation (H_2)	0.548***	[0.450 0.659]	0.000	0.063	8.688			Yes

Note: β = beta coefficient, *CI*: confidence interval; *SD*: standard deviation. R^2 = explained variance; f^2 = effect size. EB: entrepreneurial bricolage; IB: innovative behavior; P_ENT_EXP: prior entrepreneurial experience; CON_DEV_SUP: concept development support; BUS_DEV_SUP: business development support; ENT_FAM_MEM: entrepreneur family member. ***P<0.001, **P<0.01, *P<0.05, ^{ns}= non-significant (based on t(10.000); one-tailed test).

Predictive model

We evaluated the predictive power of our model to generate accurate predictions (Shmueli & Koppius, 2011) using cross-validation with a hold-out sample (Shmueli et al., 2019). Discovery and exploitation were defined as key target constructs, and we applied the PLSpredict tool with 10 folds. The positive $Q^2_{predict}$ values (Table 6) indicated predictive relevance.

To assess out-of-sample predictive performance, we calculated two standard error metrics: Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE). RMSE penalizes larger prediction errors more heavily by squaring them, making it sensitive to outliers. MAE, in contrast, provides a more robust estimate by averaging the absolute differences between predicted and actual values, treating all errors equally (Shmueli et al., 2019). Using both metrics allows for a comprehensive evaluation of prediction accuracy. We compared the RMSE and MAE values from the PLS-SEM model against those from a naïve linear model benchmark (LM). In our results (Table 6), the MAE–LM values were negative for both constructs, indicating that the PLS-SEM model provided more accurate predictions on average. However, the RMSE–LM values were slightly positive, suggesting that a few larger errors occurred under the PLS-SEM model. This divergence implies that while the PLS model performed better overall, it was more sensitive to occasional extreme values.

To further assess out-of-sample predictions, we used the more restrictive CVPAT (Liengaard et al., 2021), comparing the model to a mean-value benchmark (Sharma et al., 2023). The results showed no significant difference for discovery (*PLS-IA* = -0.161; p = 0.052), but a significant difference for exploitation (*PLS-IA* = -0.510; p = 0.005), confirming high predictive validity for exploitation but uncertain predictive power for discovery.

Table 6. Predictive model assessment

Discovery				**Exploitation**		
PLS-Predict assessment	***Q²predict***	***RMSE***	***RMSE – LM***	***Q²predict***	***RMSE***	***RMSE – LM***
	0.209	0.912	0.703	0.274	0.869	0.595
		MAE	***MAE – LM***		***MAE***	***MAE – LM***
		0.715	-0.506		0.702	-0.428
CVPAT (PLS-IA)	**Average loss difference**	***t*-value**	***p*-value**	**Average loss difference**	***t*-value**	***p*-value**
	-0.161	1.969	0.052	-0.510	2.903	0.005

Note: *RMSE:* Root Mean Square Error; *LM:* linear model.

DISCUSSION

The relationship between entrepreneurial intentions and actions has posed an enduring challenge in the entrepreneurship ecosystem, with studies showing that only about 30 percent of entrepreneurial intentions translate into actual venture creation (Shirokova et al., 2016; Van Gelderen et al., 2015). While previous scholars have examined this intention-action gap from a variety of angles, including cognitive approaches (Blank & Gabay-Mariani, 2023; Van Gelderen et al., 2015), behavioral perspectives (Dlamini & Botha, 2023), and the contextual role (Bogatyreva et al., 2019), our findings offer a more integrated understanding. First, by examining student entrepreneurship through the combined lens of effectuation and bricolage theories, our study shows how these theoretical perspectives work together in practice: effectuation theory's emphasis on leveraging available means and embracing uncertainty (Reymen et al., 2015; Sarasvathy, 2001) provides the strategic framework for opportunity development, while bricolage can be seen as the tactical approach, with its focus on hands-on resource recombination and creative problem-solving (Baker & Nelson, 2005; Fisher, 2012). This strategic/tactical complementarity enables entrepreneurs to identify possibilities using effectual logic and, at the same time, implement solutions through bricolage actions. This theoretical integration addresses what Welter et al. (2016) identified as a critical gap between theories of resource utilization and theories of opportunity creation.

Moreover, combining these theories helps explain the varying outcomes of resourceful behaviors: when entrepreneurs apply effectual reasoning to guide their bricolage activities, they maintain strategic adaptability while making tactical resource decisions, avoiding purely reactive approaches. Although some studies have shown that bricolage enables venture creation through creative resource combinations (Baker & Nelson, 2005; Senyard et al., 2014) and innovative solutions (Davidsson et al., 2017), other studies have found that it leads to suboptimal outcomes (Kickul et al., 2018; Stinchfield et al., 2013) and compromised quality (Lanzara, 1999). Similarly, while Welter et al. (2016) and Fisher (2012) found that bricolage supported opportunity creation, studies by Servantie and Rispal (2018) and An et al. (2020) identified risks of path dependencies and resource constraints becoming self-perpetuating. These contradictions in the literature may stem from different theoretical approaches to studying bricolage, with some focusing solely on resource combinations (Baker & Nelson, 2005), while others examine cognitive and behavioral processes independently (e.g., Davidsson et al., 2017; Kickul et al., 2018; Senyard et al., 2014; Stinchfield et al., 2013).

Our findings also demonstrate that innovative behavior acts as the catalytic mechanism whereby entrepreneurs transform entrepreneurial bricolage practices into entrepreneurial action. Importantly, although innovative behavior is more commonly conceptualized as an outcome in entrepreneurship research, we argue for its role as a mediator based on its behavioral nature and enabling function within entrepreneurial processes. This perspective is supported by studies in organizational contexts that empirically validate the mediating role of innovative behavior between antecedent factors such as leadership or organizational culture and outcome variables like performance or radical innovation (Aryee et al., 2012; Naranjo-Valencia et al., 2017). While these studies are situated in employee behavior contexts, they lend theoretical plausibility to our model, reinforcing the logic that innovative behavior can act as a behavioral conduit through which resourceful strategies like bricolage lead to entrepreneurial action.

Specifically, innovative behavior enables the effective implementation of entrepreneurial bricolage through specific behavioral dimensions: questioning, observing, experimenting, and networking. Building on the work of Scazziota et al. (2023) on cognitive processes in resource reinterpretation, our findings suggest that these behavioral dimensions serve as key mechanisms through which entrepreneurs convert cognitive insights into tangible actions. This is particularly

significant in light of the fact that while the importance of cognitive flexibility in student entrepreneurship has been increasingly recognized (Hägg, 2021; Ou & Kim, 2024), understanding how cognitive insights translate into entrepreneurial action remains elusive. Our findings expand on Politis et al.'s (2012) work by demonstrating how these specific behavioral dimensions enable entrepreneurial thinking to be transformed into concrete discovery and exploitation activities.

Our results particularly challenge and extend current theoretical understanding of how effectuation operates in practice. While Sarasvathy (2001) saw effectuation as leveraging available means under uncertainty, and scholars such as Read et al. (2016) and Reymen et al. (2015) have explored its application in various contexts, the specific mechanisms enabling effectual processes have remained unclear (Grégoire & Cherchem, 2020; Jiang & Rüling, 2019). Our findings show that innovative behavior serves as this crucial enabling mechanism, explaining how entrepreneurs transform available means into new ends. This insight helps address the theoretical tension noted by Arend et al. (2015)regarding how effectuation creates new value. Specifically, innovative behavior enables entrepreneurial action through four key mechanisms: observing recognizes untapped value in resource combinations, questioning identifies novel applications for existing resources, experimenting validates these novel applications through market testing, and networking mobilizes stakeholders to support resource transformation.

This understanding of how innovative behavior enables effectuation is particularly relevant for student entrepreneurs, as it reveals a pathway to success that challenges traditional assumptions about entrepreneurial expertise. While effectuation theory traditionally emphasizes the role of expertise in transforming means into ends (Sarasvathy, 2001), our findings align with studies that highlight the effectiveness of effectual strategies among nascent entrepreneurs (Chandler et al., 2011; Weerakoon et al., 2019). This suggests that student entrepreneurs can effectively engage in effectual processes through innovative behavior, even in the absence of extensive industry knowledge. Moreover, our findings reveal that innovative behavior enables student entrepreneurs to overcome what Longva (2021) identified as their key constraints—limited market knowledge and professional networks—by leveraging their freedom from industry conventions (Ferrante et al., 2019; Wright & Mustar, 2019) in unique ways. While previous research has shown superior opportunity identification capabilities among student entrepreneurs (Zhu et al., 2021) and attributed this either to cognitive factors (Grégoire et al., 2011) or experiential learning (Motta & Galina, 2023), our results suggest a more nuanced mechanism: innovative behavior provides the crucial link between their resourceful thinking and actionable outcomes. This finding extends effectuation theory by demonstrating how it operates in early-stage entrepreneurial contexts, addressing a key limitation identified by Reymen et al. (2015) in the current understanding.

Significant too is our finding on the limited impact of traditional support factors (control variables), with only family entrepreneurial background shown to have a significant influence on exploitation activities. This challenges prevailing assumptions in the literature on the importance of institutional support (Doanh Duong et al., 2024) and prior experience (Grežo, 2024) in student entrepreneurship. Rather, our results are in keeping with new emerging perspectives that emphasize the role of behavioral capabilities and family role models (Edelman et al., 2016; Tarling et al., 2016) in enabling successful venture creation. These findings suggest that the development of innovative capabilities might be more crucial than traditional entrepreneurial prerequisites, challenging conventional wisdom on entrepreneurial support mechanisms.

This study makes several important contributions to entrepreneurship theory. First, we advance understanding of entrepreneurial theory by demonstrating how effectuation and bricolage function in practice as complementary theoretical perspectives, rather than parallel theories (Fisher, 2012; Servantie & Rispal, 2018). While effectuation provides the strategic framework for navigating uncertainty through available means, entrepreneurial bricolage offers a tactical approach for resource mobilization within those uncertain conditions. This complementarity is made operational through innovative behavior, which enables student entrepreneurs to translate both effectual principles and bricolage practices into concrete outcomes. Building on prior work examining the relationship between effectuation and bricolage (Chinyoka, 2020; Scazziota et al., 2023), our study shows innovative behavior to be a key mechanism through which these complementary theories operate in practice. This integration not only addresses the challenge posed by Arend et al. (2015) regarding the differentiation between effectuation and other entrepreneurial theories but also responds to calls for research on ways in which effectuation and bricolage can be integrated in practice (Vasconcelos-Scazziota et al., 2020). In particular, our findings shed light on ways in which student entrepreneurs overcome resource constraints through the relationship between effectual logic and bricolage behavior, with innovative behavior acting as the key mechanism enabling them to be integrated.

Second, we contribute to opening the "black box" of effectuation (Jiang & Tornikoski, 2019) by identifying innovative behavior as the key mechanism linking resourceful behaviors to entrepreneurial action. While previous research has

explored contextual factors influencing effectuation among student entrepreneurs, such as academic environment (Politis et al., 2012), entrepreneurial education programs (Nabi et al., 2017), and resource constraints (Shirokova et al., 2016), our study reveals how entrepreneurs transform available means into ends within effectual processes. Specifically, the full mediation effect shows that innovative behavior bridges cognitive and behavioral aspects of resource transformation; questioning and observing enable cognitive reinterpretation of resources; and experimenting and networking facilitate the behavioral implementation of these insights. This integration of cognitive and behavioral mechanisms addresses the theoretical gap in understanding how the effectual transformation of means occurs (Grégoire & Cherchem, 2020; Jiang & Tornikoski, 2019).

Third, we advance the ongoing debate about means-driven approaches versus predictive strategies (Read et al., 2016) by demonstrating how innovative behavior enables the transformation of means into ends. Our findings reveal a process in which resourceful behaviors, catalyzed by innovative behavior, lead to effective resource mobilization and entrepreneurial action (Williams et al., 2021; Zahra, 2021). This contributes to an understanding of how effectuation and entrepreneurial bricolage operate at the intersection of opportunity creation (Welter et al., 2016), where bricolage's emphasis on creative resource resignification (Scazziota et al., 2023) enables effectual principles for controlling—rather than predicting—the future.

Finally, we extend understanding of discovery and exploitation activities within entrepreneurship by demonstrating how innovative behavior enables both types of activity. Our results show that discovery and exploitation both emerge through the interaction of effectual logic and bricolage behaviors, mediated by innovative behavior. This supports the effectual view that opportunities are not pre-existing entities to be discovered (Alvarez & Barney, 2010), but rather emerge through dynamic interactions with available means and stakeholders (Baron & Ensley, 2006; Zhu et al., 2021). This contribution is particularly relevant for student entrepreneurs, who may lack the resources and experience traditionally associated with opportunity discovery and exploitation but can successfully engage in both activities through effectual approaches.

For student entrepreneurs, our research reveals that venture creation depends primarily on developing specific innovative capabilities. Students should focus on systematically questioning assumptions about resource requirements, observing how others succeed under constraints, conducting small-scale experiments to validate assumptions, and using networking strategically for resource mobilization and knowledge acquisition. These innovative behaviors are particularly crucial when transitioning from opportunity identification to venture implementation.

As for university support programs, our findings suggest that they should shift their focus from merely providing resources to fostering capability development. Programs should create environments that facilitate experimentation and learning through peer communities, problem-solving workshops, and mentoring systems focused on innovative capability development. Given that innovative behavior mediates the relationship between bricolage and entrepreneurial action, such programs should give greater priority to developing these capabilities than providing direct resources.

For entrepreneurship support organizations, our results indicate that there is a need to provide differentiated support according to the stage of the venture. Support at the discovery phase should focus on cognitive flexibility and systematic experimentation, while exploitation-phase support should emphasize strategic flexibility and resource-reconfiguration abilities, reflecting the different way in which innovative behavior operates across these stages.

CONCLUSION

This study examined how student entrepreneurs leverage entrepreneurial bricolage and innovative behavior to overcome resource constraints and engage in entrepreneurial action. Our findings show that the total effect of entrepreneurial bricolage is positive for both discovery and exploitation activities, and innovative behavior fully mediates these relationships, challenging conventional views about bricolage's direct impact on entrepreneurial outcomes. This study expands understanding of the way in which effectuation is manifested in practice by shedding light on the behavioral mechanisms whereby student entrepreneurs transform limited resources into concrete actions. Through the lens of effectuation and bricolage frameworks, we demonstrate how entrepreneurial bricolage operates through innovative capabilities to enable entrepreneurial action. Our results contribute to bridging the gap between entrepreneurial intentions and actions by revealing specific mechanisms that enable student entrepreneurs to overcome resource constraints. The study also offers practical insights for universities and support units on how they can better facilitate student entrepreneurship by focusing on developing innovative capabilities rather than just providing resources.

Whilst our study provides valuable insights into student entrepreneurship, it is not without its limitations. Nonetheless, these very limitations also furnish opportunities for future research. First, while our study provides meaningful insights

into the behavioral mechanisms underlying student entrepreneurship, it is important to acknowledge the limitations associated with our sampling approach. Specifically, we employed a non-probability convenience sample, which may limit the statistical generalizability of our findings to a broader population. Future research using probability-based sampling or replication in different populations would strengthen the external validity of the proposed model.

Second, the cross-sectional design limits causal inferences. While we establish relationships between entrepreneurial bricolage, innovative behavior, and entrepreneurial action, we cannot definitively determine causality. Future research could address this limitation using longitudinal studies, tracking student entrepreneurs over time to observe how their capabilities evolve and impact venture outcomes. Such studies would provide deeper insights into the dynamic nature of capability development and its long-term effects on entrepreneurial success.

Third, while our study focused on positive outcomes of entrepreneurial bricolage and innovative behavior, future research might investigate potential negative consequences in student entrepreneurship. These could include limited scalability of bricolaged solutions, a short-term focus that might hinder long-term strategic planning, or overdependence on the founder's skills. Exploring these potential downsides could provide a more balanced understanding of entrepreneurial bricolage in student entrepreneurship and help identify strategies that would mitigate these risks.

Fourth, while we have monitored a number of variables, there may be other factors influencing the relationships we studied. Future research could explore additional moderating or mediating variables, such as psychological factors (e.g., entrepreneurial self-efficacy), institutional factors (e.g., university support systems) and environmental factors (e.g., industry dynamism). Furthermore, to enhance robustness, future research could estimate the same model using covariance-based SEM (e.g., AMOS) to compare the performance of reflective and composite modeling approaches.

Finally, future studies could benefit from using instrumental variables (IVs) as an alternative method for evaluating endogeneity, especially when the Gaussian Copulas approach is not applicable due to the non-normal distribution of data for the latent independent variables.

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Author contributions statement

Mario A. Manzi-Puertas: Conceptualization, Methodology, Investigation, Data Curation, Formal analysis, Writing - Original Draft. **Izaskun Agirre-Aramburu:** Conceptualization, Methodology, Formal analysis, Writing - Review & Editing. **Berrbizne Urzelai:** Investigation, Writing - Review & Editing. **Sain Lopez-Perez:** Conceptualization, Writing - Review & Editing.

Conflicts of interest

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What shapes entrepreneurial activity in the European Union?

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Abstract

PURPOSE: *The aim of the article is to identify the factors influencing entrepreneurial activity in the European Union (EU) countries. In addition, to achieve the research goal, the authors provide answers to two research questions: (RQ1) What sets and types of variables influence entrepreneurial activity in the EU Member States? and (RQ2) Based on the defined factors influencing entrepreneurial activity, is there a difference between the old and new EU Member States?* ***METHODOLOGY:*** *Using panel regression analysis on the data from the 2009-2018 period, the article attempts to identify factors influencing entrepreneurial activity among EU countries. Furthermore, an examination of possible differences in entrepreneurial activity between the old and new EU Member States is conducted. By using variables that statistically significantly explain entrepreneurial activity, a heatmap was created. This made it possible to visualise differences between countries within each variable, as well as the impact of each variable on the analysed group of old and new EU Member States.* ***FINDINGS:*** *Our research indicates that entrepreneurial activity is higher in new EU Member States than in older ones, influenced by factors categorized into Human Capital and Institutional Conditions. Regarding Human Capital, higher entrepreneurial activity is associated with lower employment in the high-tech sector, higher HDI, greater participation in non-formal education, and a larger share of periodically employed individuals. Conversely, lower entrepreneurial activity correlates with a higher proportion of young people not in employment, education, or training and emigration. Notably, advanced digital skills impact on entrepreneurial activity, but their absence does not constitute a barrier to business creation. Among the Institutional variables, higher entrepreneurial activity is linked to tax burden, EU membership duration, and eurozone membership length. However, the Business Freedom indicator does not significantly affect entrepreneurial activity.* ***IMPLICATIONS:*** *Considering the EU's strategy and the importance of entrepreneurial activity across EU Member States, policy implications emphasize the need for tailored policies that support business activity, aiming to minimize inter-country differences and boost economic growth.* ***ORIGINALITY AND VALUE:*** *Unlike prior studies that mainly compare entrepreneurship between broad economic regions, our research uniquely distinguishes between new and old EU Member States, revealing significant disparities in entrepreneurial activity and its determinants.*

Keywords: *entrepreneurial activity, determinants of entrepreneurship, European Union, human capital, institutional conditions, new and old EU member states, panel regression, panel data analysis, business environment, entrepreneurship determinants, EU integration, economic disparities, new business registrations.*

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INTRODUCTION

The importance of exploring entrepreneurship was first recognized in the early works of Cantillon in 1755 and was later expanded by A. Smith and J. Schumpeter, who viewed entrepreneurs as innovators (Ahmad & Seymour, 2008). Over the last four decades, growing academic interest, driven by globalization, financialization, and deregulation, has led organizations like the World Bank, OECD (2012-2017), and European Commission (2013) to examine and evaluate policies to foster entrepreneurship, acknowledging its role in promoting economic growth, employment, innovation, and productivity.

In the past seventy years, academic interest and research have intensified, particularly regarding the determinants of entrepreneurship and entrepreneurial activity. A simple title search in the Web of Science (WoS) for the terms "entrepreneurship" and "determinants" or "factors" yields over 300 results addressing these aspects together. Whether studies are regional (e.g., Rusu & Roman, 2017; Maciejewski & Wach, 2019) or country-specific (e.g., Bruno et al., 2013) or employ different econometric techniques (e.g., OLS, Time Series, Panel, Cross-Section, Pooling Data), as summarized in Urbano et al. (2019), they generally include variables intended to assess their effect on entrepreneurship.

Determinants are not grouped uniformly, as their classification adapts based on research focus. Consequently, factors are grouped into categories such as individual, institutional, legal, (macro)economic, socio-demographic, human capital, technological, or cultural influences (Wennekers et al., 2005; Wong et al., 2005; Simón-Moya et al., 2014; Arin et al., 2015; Aparicio et al., 2016; Rusu & Roman, 2017; Almodóvar-González et al., 2020). A comprehensive literature review on institutions, entrepreneurship, and economic growth is provided by Urbano et al. (2019), which analyzed the past 25 years and argued that institutional antecedents impact entrepreneurial activity, potentially leading to economic growth. This topic remains relevant, as recent research emphasizes the complexity and interdependence between entrepreneurial activity and economic growth (Rusu & Roman, 2017; Rusu et al., 2022).

Our research focuses on investigating and evaluating determinants of entrepreneurial activity among the European Union (EU) countries, aiming to expand the current understanding of the factors influencing entrepreneurship in this region. Unlike previous studies that utilized Global Entrepreneurship Monitor (GEM) data, our analysis employs panel data covering 28 EU countries from 2009 to 2018, using data from Eurostat, the Heritage Foundation, and the United Nations Development Program (UNDP).

The study enhances existing research by examining established determinants while also identifying novel factors that may influence entrepreneurial activity in the EU. The findings contribute to both academic discourse and to the EU and national policymakers. In this paper, we examine the variables influencing entrepreneurial activity in the EU Member States and investigate whether there are differences in entrepreneurial activity between the old and the new EU Member States. The paper is organized as follows: following the introduction, Section 2 presents a literature review, Section 3 outlines the research design, data, and methodology, and Section 4 discusses the primary results of the empirical analysis, which uses a panel regression model. In Section 5, the findings are analysed, and the study concludes with a summary of key insights, limitations, and directions for future research.

LITERATURE REVIEW

Scholars widely acknowledge that entrepreneurship is a multifaceted concept observable from multiple perspectives, including individual, business, local, regional, industry, and national levels (Freytag & Thurik, 2007; Wosiek et al., 2021). In academic discourse, the terms "entrepreneurship" and "entrepreneurial activity" are often used interchangeably, as the two are closely linked (Ahmad & Seymour, 2008). Wosiek (2021) clarifies this relationship by suggesting that entrepreneurship can be conceptualized in two ways: broadly, as entrepreneurial activity—a scope to which we aim to contribute in this research—or narrowly, focusing on entrepreneurial behaviors, attitudes, or occupational roles (Wennekers, 2006).

Regarding the determinants of entrepreneurship, researchers continue to examine factors that either stimulate or hamper entrepreneurial activity, though a definitive consensus has yet to be reached (Rusu & Roman, 2017; Urbano et al., 2019). Research on the determinants is exhaustive, addressing numerous aspects of entrepreneurship or entrepreneurial activity, including identification and comprehensiveness of determinants of entrepreneurship, identification of different types of entrepreneurship/entrepreneurial activity, and the mutual relationships between entrepreneurship and economic growth (e.g., Wennekers & Thurik, 1999; Urbano et al., 2019). In this section, based on our research purpose, we contribute to the evaluation of determinants of entrepreneurial activity in the context of EU countries. The literature review section is therefore divided into two subsections: Measures of entrepreneurial activity (as dependent variable) that have been used

in previous research are defined, followed by the factors or groups of factors that have been assessed as determinants of entrepreneurial activity in prior academic studies.

Measures of entrepreneurial activity

Academic literature indicates several methods for identifying and measuring entrepreneurship or entrepreneurial activity. Focusing on the interactions among institutional variables, entrepreneurship, and economic growth, Urbano et al. (2019) in their systematic literature review highlight that entrepreneurship functions as a multifaceted conduit between institutions and economic performance or growth. Entrepreneurship encompasses diverse forms, including nascent entrepreneurial activity, startup density, productive versus unproductive entrepreneurship, self-employment, motivation-driven activity, corporate entrepreneurship, female and immigrant entrepreneurship, entrepreneurial universities, as well as innovative, social, sustainable, and growth-oriented entrepreneurship.

Years of research into entrepreneurship as a phenomenon have underscored the challenge of gathering suitable data and establishing reliable measures of entrepreneurship. To address this, the literature indicates that entrepreneurial activity – regardless of the study's geographic scope or type of entrepreneurship examined – is commonly evaluated through the Total Entrepreneurial Activity (TEA) index, derived from Global Entrepreneurship Monitor (GEM) data. TEA has thus become one of the most prevalent measures (dependent variables) of entrepreneurial activity. However, due to the lack of complete annual GEM data coverage for all EU countries, this study examines entrepreneurial activity levels using Eurostat panel data for the EU countries over the period 2009–2018. This timeframe was chosen to mitigate potential influences from both the Global Financial Crisis (GFC) and the more recent COVID-19 pandemic, as well as the geopolitical impact of the Russian-Ukrainian war.

It is noteworthy that recent research has also explored the reverse effect-namely, the influence of economic growth on entrepreneurship (Stoica et al., 2020; Rusu et al., 2022). In these studies, GDP per capita or the global competitiveness index are employed as dependent variables, while various entrepreneurial activity metrics, such as TEA, opportunity-driven early-stage entrepreneurship (OEA), or enterprise birth and death rates, are used as independent variables.

Factors affecting entrepreneurial activity

Research on factors influencing entrepreneurial activity has evolved, yet ambiguity remains concerning the specific factor groups involved. Early work by Grilo and Thurik (2004) assessing European entrepreneurship determinants through the Eclectic Framework, which includes both demand- and supply-side factors, highlighted the importance of demographic variables along with survey-based explanatory variables such as administrative complexities and financial support availability. Giannetti and Simonov (2004), in their study of Swedish municipalities, found that individual, economic, and social environment factors significantly influence entrepreneurship. In a sample of 36 countries from 2002, Wennekers et al. (2005) found that nascent entrepreneurship correlates with economic development level (per capita income and an index of innovative capacity) as well as factors such as business ownership rates, population growth, aggregate taxes (positive effect), and social contributions (negative effect). This study confirmed a U-shaped relationship between nascent entrepreneurship rates and economic development levels. Wennekers (2006) further examined economic and non-economic determinants of nascent entrepreneurship, finding that technological, economic, demographic, cultural, and institutional factors impact entrepreneurial activity.

Using GEM micro- and macro-level data, Acs and Szerb (2007) summarized studies linking entrepreneurship, economic growth, and public policies. Their findings suggest that developed countries should focus on reducing entry barriers, while middle-income countries should emphasize human capital enhancement, technology accessibility, and enterprise development. In a cross-country study, Klapper et al. (2006) found that entry and legal regulations have significant negative effects on entrepreneurship. Their results indicate that business environment factors, such as costly entry regulations, access to finance, and informal sector influence, are key determinants impacting entrepreneurship in both developed and developing countries.

In a regional analysis of 127 regions across 17 European countries between 2001 and 2006, Bosma and Schutjens (2011) found that economic, institutional, and demographic factors influence entrepreneurial attitudes and activities. Nițu-Antonie et al. (2017) conducted a study in 33 European countries, assessing the simultaneous and lagged effects of entrepreneurial behaviour – including attitudes, activities, and aspirations – on GDP, imports, exports, and employment rates. Simón-Moya et al. (2014) grouped 62 countries based on their economic and institutional environments to analyse

their impact on entrepreneurial activity and innovation performance. They confirmed Aidis et al.'s (2008) findings that countries with higher economic freedom and robust formal institutions support greater opportunity-driven entrepreneurship. Simón-Moya et al. (2014) found that entrepreneurial activity and necessity-driven entrepreneurship are higher in countries with lower development levels, greater income inequality, and higher unemployment rates. Their study also emphasized the positive influence of informal institutions, particularly human capital, on entrepreneurship.

Autio & Fu (2015), using a sample of 18 Asia-Pacific countries from 2001 to 2010, examined the impact of institutional quality on formal and informal entrepreneurship. They found that higher economic and political institutional quality correlates negatively with informal entrepreneurship entry and positively with formal entrepreneurship entry. Aparicio et al. (2016) studied 43 Latin American countries from 2004 to 2012, concluding that informal institutions, such as control of corruption and confidence in skills, significantly impact opportunity-driven entrepreneurship more than formal institutions do.

In their study of 18 EU countries from 2002 to 2015, Rusu and Roman (2017) identified macroeconomic factors – including inflation, foreign direct investment, access to finance, and tax rates – as determinants of entrepreneurship. They also found that individual factors (fear of failure, entrepreneurial intentions, perceived capabilities, and opportunities) and business environment factors (start-up costs, time to start a business, and number of procedures) significantly influence entrepreneurial activity. Roman et al. (2018) confirmed these findings in a subsequent study of 18 EU countries from 2003 to 2015, highlighting the positive effect of the EU sovereign debt crisis on entrepreneurship.

Almodóvar-González et al. (2020) investigated the causality between economic growth and entrepreneurship, finding bidirectional causality that suggests the positive impact of entrepreneurship on economic growth may vary by country development level (developed vs. developing). Wosiek (2021) examined economic factors, such as the effect of unemployment on entrepreneurship, and found a positive relationship between rising unemployment and an increase in new service businesses in Poland between 2003 and 2018, particularly in knowledge-based, business-oriented services.

While many studies have sought to identify and categorize the factors influencing entrepreneurship, Dvouletý (2018) provides a summary of cross-country determinants, classifying them into legal and institutional frameworks, economic determinants (demand-side), and population characteristics (supply-side), along with entrepreneurship, R&D, and innovation policies. Regardless of the measure of entrepreneurship or self-employment used, Dvouletý (2018) finds that at the country level, determinants (independent variables such as the unemployment rate, FDI inflows, economic freedom index, and start-up procedures) show consistent directional impacts, a finding also supported by Szaban and Skrzek-Lubasińska (2018).

Regarding the recent impact of COVID-19 on entrepreneurship, Gavrila and de Lucas Ancillo (2021) found that the pandemic accelerated entrepreneurship, innovation, and digitalization, as illustrated by a surge in Spanish Internet domain registrations.

Due to the exploratory nature of entrepreneurial activity determinants, classification of such determinants is not unanimous. However, institutional variables are consistently recognized as key factors influencing entrepreneurial activity. Systematic literature analysis over the past 25 years of research summarized in the works of Urbano et al. (2019) provides a most comprehensive classification of institutional variables. The study examines the interplay between institutional variables, entrepreneurship and economic growth and classifies institutional variables that affect entrepreneurship as formal (political structure, procedures-regulations, contracts, property rights, others), informal (social norms-culture, cognitive dimension, beliefs systems, others), institutional dimensions (regulative, normative, cultural-cognitive) and others. Studies that use GEM and TEA as a baseline for research on the determinants of entrepreneurial activity also highlight the significance of institutional variables. For example, the most recent research from Kara et al. (2024) further classifies institutional variables into cognitive, normative, and regulative institutions.

So, apart from institutional variables as defined in the works of Urbano et al. (2019), we expand the research along the lines of the study by Arin et al. (2015), which builds upon the comprehensiveness of Baumol's (1996) and Kirzner's (1997) understanding of the aggregate level of entrepreneurial activity. Therefore, we evaluate and contribute to the interplay of three identified groups of variables: human capital (population, education, and unemployment), level of development (GDP per capita, financial development, and technological progress), and previously defined institutional variables (Arin et al., 2015, p. 615). Taking into account the current stance in the literature, our objectives are twofold and thus add value to the research: firstly, we wish to contribute towards current literature by examining if several groups of variables impact the entrepreneurial activity, and secondly, to establish a possible differences in the entrepreneurial activity between groups of old and new EU countries.

METHODOLOGY

Research design and data description

The aim of the study is to identify the factors influencing new business registrations per 10,000 people of working age among EU countries. This measure of entrepreneurial activity was selected due to its inclusion in Eurostat's official data as a unit of measurement. For this purpose, annual data from Eurostat as well as the Heritage Foundation and the United Nations Development Program (UNDP) on EU countries for the period from 2009 to 2018 were collected. The UK is included in the dataset, as it was a part of the EU in the observed sample. The available time span is a result of trying to collect datasets for every country over an observed period. The selected time period is characterized by a relatively stable economic situation in the studied area without significant turbulence that could have a strong impact on the scope of the study and significantly distort the analysis results. Variables included in the analysis are listed in Table 1, along with their abbreviations used throughout the study, as well as a description of each variable. The dependent variable is the growth rate of new registered enterprises. To control for various potential effects that could affect the results, different types of variables are included in the analysis: human capital, level of development as well as institutional variables. Table 1 indicates and summarizes variables used in the model, including the expected sign to be estimated, or whether the variable is expected to stimulate or hinder the growth rate of new registered enterprises.

As a result of the literature review and previously conducted empirical research, the estimated model that allows us to achieve the research goal is presented in the methodology section. Determining the entrepreneurial activity among EU countries within the research model was carried out with the use of the variables grouped in Table 1.

Table 1. Description of variables

Abbreviation	Groups of variables	Description	Stimulant (S) / Hamper (H)	Source
y	Entrepreneurial activity	Number of new registrations per 10,000 people of working age (y = Var1/Var2)	Not applicable	Own calculations
var1	Not applicable	Births of enterprises in t - number	Not applicable	Eurostat
var2	Not applicable	Population on 1 January in working age 15-64	Not applicable	Eurostat
var3	Human capital	Duration of working life - annual data	S	Eurostat
var4	Level of development	Monthly minimum wage as a proportion of average monthly earnings (%)	H	Eurostat
var5	Institutional	Property rights (0-100 pts.)	S	The Heritage Foundation
var6	Institutional	Tax burden (0-100 pts.)	S	The Heritage Foundation
var7	Institutional	Business freedom (0-100 pts.)	S	The Heritage Foundation
var8	Level of development	Final consumption expenditure of households by consumption purpose – total (% of GDP)	S	Eurostat
var9	Human capital	Emigration (number)	H	Eurostat
var10	Level of development	Curative care beds in hospitals (Per hundred thousand inhabitants)	S	Eurostat
var11	Human capital	Young people neither in employment nor in education and training (NEET rates) aged 15-34 (%) Not employed persons	H	Eurostat
var12	Human capital	Long-term unemployment aged 20-64 (% of unemployment)	H	Eurostat
var13	Human capital	Employment in high-technology sectors (high-technology manufacturing and knowledge-intensive high-technology services) - % of total employment	H	Eurostat
var14	Human capital	Human Resources in Science and Technology - Scientists and engineers as % of active population	S	Eurostat
var15	Human capital	Human Development Index (0-100 pts.)*	S	UNDP
var16	Human capital	Employees by type of employment contract (Limited duration) - % of employment aged 15-64	S	Eurostat

Abbreviation	Groups of variables	Description	Stimulant (S) / Hamper (H)	Source
var17	Human capital	Participation rate in job-related non-formal education and training in age 35-54 (%)	S	Eurostat
var18	Human capital	Individuals who have above basic overall digital skills aged 25-64 (% of individuals)	S	Eurostat
var19	Institutional	Length of membership in the EU (number of years) - measured since the official establishment of the EU in 1993	S	EU official website[5]
var20	Institutional	The membership in the euro area (1=Yes, 0=No)	Not applicable	EU official website[6]

Note: *The original HDI scale is 0-1. The transformation to the 0-100 scale was made for the purpose of evaluating the regression model, specifically for interpreting the assessed coefficient.
Source: Own authors' draft based on data from Eurostat (2023), The Heritage Foundation (2023), United Nations Development Programme (UNDP) (2023). Retrieved 8 November 2024, from https://european-union.europa.eu/principles-countries-history/eu-countries_en[5] and https://european-union.europa.eu/institutions-law-budget/euro/countries-using-euro_en[6]

Human capital factors

The directions of changes in the analyzed variables, as indicated in Table 1, and their perception in terms of stimulating or hindering effects on entrepreneurship need to be explained. First, we will focus on human capital. The high percentage of long-term unemployed individuals in the population structure is, on the one hand, a problem in itself, and on the other hand, often leads to the risk of poverty or social exclusion. Skica (2020) proves that the problem of unemployment is accompanied by directing local government policies to current expenses, which include social transfers. The greater the saturation of the local labour market with unemployed persons, the more decisive the focus on current expenditure, and thus the lower the focus on activities conducive to creating conditions for entrepreneurship development (Niedzielski & Domańska, 2005).

In the study, we have also selected one variable regarding digital competences and their role in entrepreneurship. This variable refers to people of working age (25-64) who have above basic overall digital skills. Literature shows that there is a strong positive relationship between digital skills and entrepreneurship (Huđek et al., 2019; Oggero et al., 2020), which is why, the low level of digital competences in communities, expressed by a relatively high percentage of people who have never used a computer in the population structure, is a factor that reduces involvement in entrepreneurship. This fact is of particular importance in light of phenomena such as the digital economy (D'Souza & Williams, 2017; Barefoot, 2018) and digital entrepreneurship (Kraus et al., 2019; Sahut, 2021).

Kelley et al. (2012) show that countries with a longer average working life have a higher rate of new business creation (suggesting a positive correlation between working life and entrepreneurial activity). Shane and Venkataraman (2000) proved that the length of working life is among a number of factors influencing the creation of new businesses. Acs et al. (2013), examining the theory of entrepreneurship based on knowledge resources, take into account the influence of a long working life on the increase in the number of businesses. The authors found that a factor stimulating their creation is the use of experience gained during their professional career.

One of the variables illustrating human capital is the number of young people (aged 15-34) who are neither in employment nor in education or training (NEET). Bell and Blanchflower (2011) showed that prolonged NEET status may limit the ability to acquire skills, reduce the desire for entrepreneurship and start new businesses. Similar conclusions were reached by Scarpetta et al. (2010), who argued that young people who have been out of school or training for an extended period may lack the necessary skills and resources to start a business.

The percentage of employment in high-tech sectors in total employment in a country is also an indicator of human capital. Decker et al. (2016) point out that while employment in the high-tech sector(s) may stimulate growth in large, established firms, it sometimes correlates with fewer new business entries. The reason is that the concentration of resources and talents in established firms may block smaller business ventures. Hathaway (2013) also fits into this narrative. The author notes that although high-tech industries contribute to job creation in existing firms, this effect does not necessarily translate into higher rates of new firm creation. Instead, high-tech sectors may consolidate talent and investment in existing firms, reducing the likelihood of new firm formation despite overall employment growth in the sector.

In contrast to employment in high-tech sectors, we argue that the saturation of local and regional ecosystems with specialists (scientists and engineers) translates into a higher rate of new firm creation. This is confirmed by Zucker et al. (1998), who show that regions with a higher concentration of scientists and engineers are characterized by a greater

likelihood of high-tech firm creation. Moreover, the authors indicate that the presence of these human resources is a predictor of entrepreneurial activity in science-based sectors.

The state and changes of human capital are also influenced by emigration. It is inextricably linked to the outflow of human factor resources from the country, and thus has a negative impact on the creation of new companies in it (Anelli et al., 2019, 2020). Migrants have a competitive advantage in the supranational space and are generally more entrepreneurial (Brinkerhoff, 2016; Vandor & Franke, 2016). Thus, their outflow means a decrease in the entrepreneurial potential of the country from which they emigrate.

The group of variables expressing human capital also includes: Human Development Index (in line with Sterward et al. (2018), it was assumed that an increase in HDI leads to economic growth, supporting the creation of new businesses, as social development policy encourages the creation of incentives to start businesses), participation rate in job-related non-formal education and training (according to Shelest-Szumilas (2016), it was assumed that such activities reflect the readiness to start one's own business), as well as short-term employment (here we share the position of Audretsch and Keilbach (2004) who emphasize the relationship between short-term employment opportunities and starting new businesses, showing that the flexibility of the labour market, which includes a higher level of short-term employment, encourages individuals to start businesses due to the skills and experience gained during these periods).

Institutional factors

The second group of variables represents institutional factors. The size and the number of public levies (taxes and social security contributions) play a role in making decisions about entering into business (Kugler & Kugler, 2002). The higher the social security contributions (quasi-taxes) and the tax burden, the lower the propensity to start a business. A higher level of fiscal burdens determines the cost that an entrepreneur must incur when deciding to set up and run a business (Harden & Hoyt, 2003; Wasylenko, 1997). The study's tax burden indicator measures the level of economic freedom in tax terms. The higher its value, the greater the economic freedom in tax (i.e., fiscal) terms. This means that the fiscal burdens of current and potential entrepreneurs are smaller (The Heritage Foundation, 2023).

Business freedom and time required to start a business are a derivative of regulatory conditions for business (Kochmańska, 2007). A lower level of bureaucratization in the economy, procedural simplification (including shortened registration procedures), and deregulation should be perceived as factors favoring the setting up of a business (Tirapani, 2011; Fogel, 2006).

Property rights are also important for the creation of new businesses. Haydaroğlu (2015) confirms that a legal framework providing private property rights stimulates the creation of new firms by reducing transaction costs and promoting market stability. A similar point of view can be found in a slightly older work by Feder and Feeny (1991). According to their findings, a strong property rights system contributes to economic stability and promotes the formation of new firms.

The last set of explanatory variables among institutional factors (which determine entrepreneurship) are: the length of a country's membership in the EU (and, simultaneously, its status as an old or new EU Member), and the use of the Euro currency (i.e., the length of membership in the Euro area). The period of membership in the EU was considered a positive factor. The European Union, utilizing financial instruments, aims to enhance the competitive position and development of regions and Member States, particularly by supporting entrepreneurship. Therefore, the length of membership in the EU should be considered positively. The last variable in this group, i.e., the Euro currency and length of membership in the Euro area, was considered a control variable (therefore, no information about its expected stimulating or hampering nature was provided). Its role is to verify to what extent the differences in entrepreneurial activity in the studied countries are determined by factors other than the objectively recognized determinants of entrepreneurial activity.

The last, third group of variables consists of three selected parameters describing the level of economic development of the countries studied. These include: final consumption expenditure of households as a measure of economic well-being (in line with Reddy (2023), and Carree and Thurik (2010), it was assumed that it is positively related to a higher probability of engaging in new business ventures), medical infrastructure expressed by the number of hospital beds (following Byszek et al. (2018) and expressing well-being through the prism of the quality of health care in a given country, it was assumed that countries with better developed health care systems are characterized by a higher standard of living and economic well-being), and finally also the amount of the monthly minimum wage referred to the average monthly earnings (sharing the position of Kong et al. (2021), it was assumed that a high minimum wage has negative effects on entrepreneurship – high minimum wage enhances the threshold of starting a new business).

All of these variables differentiate the analysed countries in many respects. One of them (in the opinion of the authors of this article) is the entrepreneurial activity. The purpose of this article is to verify this position and to establish the above-mentioned factors describing the countries studied as positive or negative for the development of economic activity. To achieve the purpose of the paper and based on the literature review, the following research questions (RQa) were formulated:

RQ1: What sets and types of variables influence entrepreneurial activity in the EU Member States?
RQ2: Based on the defined factors affecting entrepreneurial activity, is there a difference between the old and new EU Member States?

METHODOLOGY

The usual approach for modelling panel data is panel regression. The most important modelling features highlighted by Greene (2003) and Wooldridge (2002) are presented below. The basic static panel model is the pooled one:

$$y_{i,t} = \alpha + \sum_{k=1}^{K} \beta_k x_{i,t,k} + \varepsilon_{i,t}, \varepsilon_{i,t} \sim i.i.d.\left(0, \sigma_\varepsilon^2\right), \text{cov}(x_{i,t,k}, \varepsilon_{i,t}) = 0 \ \forall i,t,k \quad (1)$$

where i denotes a country, t is the year, $i \in \{1, 2, \ldots, 28\}$, $t \in \{1, 2, \ldots, 10\}$, $y_{i,t}$ is the value of the dependent variable of country i in year t, α is the constant equal for every country and every year, $x_{i,t,k}$ are values of the k-th independent variable for country i in year t, β_k is the value of the parameter k and $\varepsilon_{i,t}$ is the error term, assumed to be independently and identically distributed across all countries and time periods, with expected value of zero and homoscedastic variance, alongside being independent of all independent variables in the model. The use of panel models is a consequence of their advantages over time series or cross-sectional analysis. In panel models, we have access to more degrees of freedom, which makes the process of inferring about model parameters more accurate (Hsiao et al., 1995).

In addition, the article presents descriptive statistics and the Mann-Whitney test, with a detailed examination of possible differences in entrepreneurial activity between the old and new EU member states. This approach enables the identification of differences in the level of entrepreneurial activity that may be linked to various factors characteristic of these two groups of countries. Furthermore, the use of a heatmap visualizes the relative differences between countries within each variable and the influence of individual variables on a specific group within the grouping, thus providing a deeper understanding of the relationships between variables and revealing patterns that might not be immediately apparent from the regression analysis alone.

RESEARCH RESULTS

The main results are given in Table 2. Considering that the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity is not significant at the 5% level, that the Wooldridge test for autocorrelation in panel data is not significant at the 1% level, and the individual VIF values are not greater than 10 (with the mean VIF < 4.47), we have decided that the pooled panel model is appropriate. The Jarque-Bera normality test was conducted to assess the distribution of model residuals. The test results were chi(2) = 4.008, p = 0.1348, indicating that the residuals do not significantly deviate from normality at conventional significance levels.

The results show that several factors have a statistically significant impact on entrepreneurial activity in EU countries. These variables were divided into two groups: "Human Capital" and "Institutional conditions." In the "Level of development" category, none of the variables explained in the OLS model had a statistically significant impact on the level of entrepreneurial activity in the studied countries.

- Human capital: Emigration (var9), Young people neither in employment nor in education and training (NEET rates) 15-34 years (var11), Employment in high-technology sectors (var13), Human Development Index (var15), Employees by type of employment contract (Limited duration) (var16), Participation rate in job-related non-

formal education and training in age 35-54 (var17), Individuals who have above basic overall digital skills in 25-64 years (var18).

- Institutional conditions: Tax burden (var6), Business freedom (var7), Length of membership in the EU (var19), Euro currency and length of membership in the euro area (var20).

Table 2. Estimation results of the pooled OLS regression

Independent variables	Description	Model	VIF
var3	Duration of working life - annual data	0.027899 *(0.014935)*	4.28
var4	Monthly minimum wage as a proportion of average monthly earnings (%)	0.004678 *(0.005799)*	2.53
var5	Property rights (0-100 pts.)	0.000340 *(0.0024)*	6.18
var6	Tax burden (0-100 pts.)	0.021520*** *(0.002793)*	5.00
var7	Business freedom (0-100 pts.)	-0.008322* *(0.003446)*	3.20
var8	Final consumption expenditure of households by consumption purpose - total (% of GDP)	0.005934 *(0.004561)*	7.11
var9	Emigration (number)	-0.000002*** *(2.25e-07)*	2.73
var10	Curative care beds in hospitals (Per hundred thousand inhabitants)	0.000038 *(0.000245)*	2.59
var11	Young people neither in employment nor in education and training (NEET rates) 15-34 years (%) Not employed persons	-0.027634*** *(0.008308)*	5.97
var12	Long-term unemployment 20-64 years (% of unemployment)	- 0.000668 *(0.002539)*	2.69
var13	Employment in high-technology sectors (high-technology manufacturing and knowledge-intensive high-technology services) - % of total employment	-0.141147*** *(0.023641)*	3.67
var14	Human Resources in Science and Technology - Scientists and engineers as % of active population	0.001774 *(0.020919)*	5.54
var15	Human Development Index (0-100 pts.)	0.541454*** *(0.0058306)*	2.14
var16	Employees by type of employment contract (Limited duration) - % of employment in 15-64 years	2.984969*** *(0.395857)*	3.02
var17	Participation rate in job-related non-formal education and training in age 35-54 (%)	0.016235*** *(0.003308)*	5.52
var18	Individuals who have above basic overall digital skills in 25-64 years (% of individuals)	-0.029489*** *(0.004367)*	6.29
var19	Length of membership in the EU (number of years) - measured since the official establishment of the EU in 1993	0.019754* *(0.006832)*	6.73
var20	The membership in the Euro area (1=Yes, 0=No)	0.376434*** *(0.084821)*	5.22
const		-11.363520*** *(0.958892)*	
Adjusted R-squared		0.7020	
RMSE		0.24302	
F test		F(18, 191) = 28.35 Prob > F = 0.0000	
Ramsey RESET test		F(3, 188) = 0.44 Prob > F = 0.7229	
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity		chi2(1) = 0.54 Prob > chi2 = 0.4640	
Wooldridge test for autocorrelation		F(1, 20) = 4.908 Prob > F = 0.0385	
Mean VIF		4.47	
Jarque-Bera normality test for residuals		chi(2) = 4.008 Prob > chi2 =0.1348	

Note: *p < 0.05; **p < 0.01; ***p < 0.001. Standard errors are given in parentheses. All variables are time-dependent except for the variable var20, which is time-invariant.

Group 1 includes 15 EU countries (so-called "old EU Member States"). It consists of Belgium, France, Germany, Italy, Luxembourg, and the Netherlands (countries that founded the European Economic Community in 1957), supplemented by countries that joined the EU through four enlargements. In the first enlargement, in 1973, Denmark, Ireland, and the United Kingdom joined the EU. Then, in the second enlargement in 1981, Greece joined the European Community. Spain and Portugal joined the EU in 1986 (during the third enlargement), and the last countries of the old EU are Austria, Finland and Sweden. They joined in 1995, during the fourth enlargement.

Group 2 consists exclusively of new EU members, formed by three successive enlargements. In 2004, Cyprus, the Czech Republic, Estonia, Lithuania, Latvia, Malta, Poland, Slovakia, Slovenia, and Hungary joined the EU. During the next enlargement in 2007, the EU structures were expanded to include Bulgaria and Romania. The youngest EU member is Croatia, associated in 2013.

The Mann–Whitney test was conducted to assess differences between two distinct groups (Table 3).

Table 3. Results of comparative tests of two groups of countries - Old and New EU Member States

Two-Sample Wilcoxon Rank-Sum (Mann–Whitney) Test Results					
Group	**Observations (n)**	**Rank Sum**	**Expected Rank Sum**	**z-value**	**p-value**
Group 1 – Old EU Member States	15	171	217.5	-2.142	0.0322
Group 2 – New EU Member States	13	235	188.5		

Based on the descriptive statistics, the results of the Wilcoxon Rank-Sum (Mann–Whitney) test reveal a significant difference in the entrepreneurial activity between Old EU Member countries (M = 171) and New EU Member countries (M = 235), z = -2.142, $p < 0.05$. Notably, New EU Member countries exhibited higher scores compared to Old EU Member countries, suggesting that the rate of entrepreneurial activity is notably greater in New EU Member countries (Table 3 and Table 5 in Appendix).

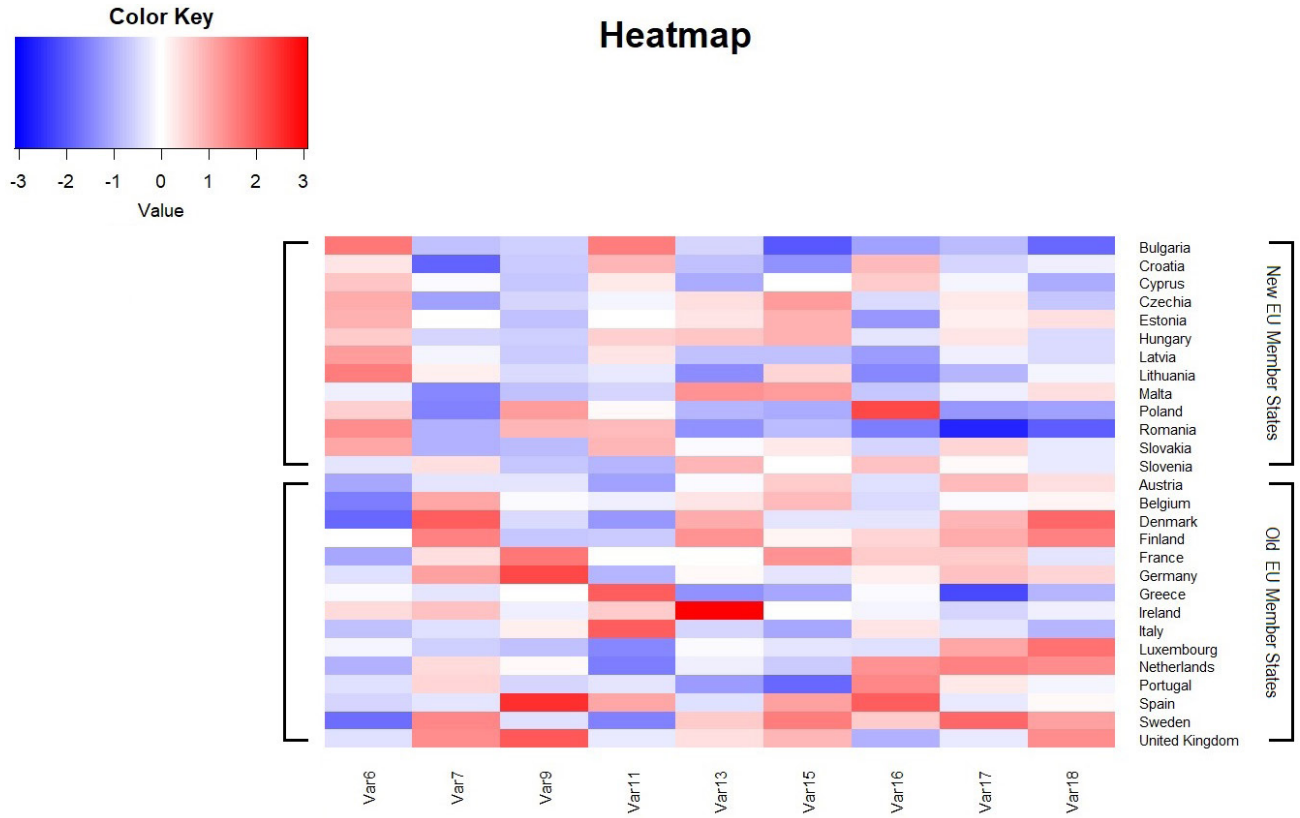

Figure 1. Heatmap of the analysed countries divided into country groups - Old and New EU Member States

Source: Own elaboration based on GeoNames, Microsoft, Open Places.

DISCUSSION

Factors affecting entrepreneurial activity in EU Member States

The research conducted using panel regression showed a statistically significant impact of 11 variables on new firm formation among EU Member States. In response to the first research question (RQ1), we briefly discuss the impact of each group on the entrepreneurial activity in the EU Member States.

A. Human capital factors

Entrepreneurial activity is explained by 7 variables from "Human capital" category. Human capital is considered as one of the factors influencing the decision to start and run one's own business (Block et al., 2011). Moreover, human capital and entrepreneurship are complementary factors that influence economic growth (Mankiw et al., 1992). Formal education, a component of human capital, is in turn positively correlated with entrepreneurship indicators (Dunn & Holtz-Eakin, 2000; Ahn & Winters, 2023). Education (especially higher education), increases the level of formal entrepreneurship (i.e., entry into business) by building greater self-confidence, lower risk perception, and increased human capital (Jiménez et al., 2015). This position is confirmed by Coduras et al. (2010). The authors argue that individuals tend to acquire knowledge through education, which equips entrepreneurs with the skills and abilities necessary for running a business. As a result, education deficits are accompanied by lower entrepreneurial activity. In the case of the NEET group (i.e., not in employment, education or training, var11) (Batini et al., 2017), stimulating entrepreneurship is equivalent to developing the skills needed to create their own workplaces (Gonçalves, 2020). Hence, a higher NEET rate corresponds to a lower rate of entry into business. The solution to this problem, among others, is entrepreneurship education (Rodriguez-Modroño, 2019; Cabasés Piqué et al., 2016).

The analysis of employment in high-tech sectors as a percentage of total employment (var13) shows that lower employment in the high-tech sector is accompanied by a greater number of company creations. The obtained result may also suggest the interchangeability between employment and owning a business as alternative career paths (Sorgner & Fritsch, 2018) in the high-tech sector (Harhoff, 1999). The demonstrated inverse relationship between the studied variables confirms the flow observed in the high-tech sector from full-time employment to one's own company (Thompson & Klepper, 2005), in which the rewards resulting from entrepreneurship depend entirely on the interaction of: ability, quality of business idea and experience in employment (Braguinsky et al., 2012). This formula is typical for spin-off companies involving advanced technologies, which are engaged in research on new fields and emerging sectors (Smith & Bagchi-Sen, 2012). For these companies, professional experience gained during employment in the industry may serve as a stimulant for starting their own business (Klepper & Sleeper, 2005).

The Human Development Index (var15) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable, and having a decent standard of living (UNDP, 2023). In line with the literature (Doan, 2021), the study confirmed that a higher HDI index is accompanied by higher entrepreneurship. Promoting social development, therefore, contributes to entrepreneurship. This is important because most research (e.g., Ballesta et al., 2020; Gries & Naudé, 2011) focuses on the impact of entrepreneurship on human development. Meanwhile, the presented results prove the opposite direction of the relationship. The research results include, among others, the narrative of Obschonka et al. (2011), which suggests that entrepreneurial development is related to factors during the teenage years and interactions with personality during the growth stages of human development. Moreover, low levels of human development at the country level may inhibit individuals from pursuing business opportunities (Gries & Naude, 2011). The study of the relationship between HDI and entrepreneurial activity also takes into account differences in the level of development of the countries studied. Amorós and Cristi (2010) showed that entrepreneurship is related to social development and income inequality of countries. Ács and Amorós (2008) confirmed this fact by pointing out that the percentage of the population engaged in economic activities is higher in developed countries than in less developed regions or countries. The results presented in this paper confirm this point of view.

There is a well-known fact in the literature that non-formal methods of entrepreneurship education have a stronger impact on the development of human capital (Debarliev et al., 2022), which in turn has a positive impact on the decision to enter business (Doan, 2021). This study confirmed this fact, proving that the higher the share of society participating in informal education (var17), the higher the rate of entrepreneurship in the studied country. These findings are also

confirmed by Umihanić et al. (2017). The results indicate the validity, or even necessity, of supplementing formal education (especially regarding entrepreneurship), with non-formal education and training. Debarliev et al. (2022) go a step further. They claim that at the level of universities, study programs should be created that include non-cognitive teaching methods that strengthen entrepreneurship potential. The authors point out that informal education should not be identified with a consequence of completed formal education, but should complement it. Moreover, the importance of the role of informal education in decisions about entering business varies depending on the level of development of the country and assumes the role of either complementing formal education or its substitute in underdeveloped countries (Asiyai, 2018). The validity of employees' participation in non-formal education, as well as the deepening of knowledge resulting from work and the process of continuing education, plays an important role, as pointed out by Piątkowski (2020). More than half of all workers who participate in non-formal work-related learning reside in eight EU countries, which, with the exception of Slovakia, belong to the group of Old EU members. Additionally, it should also be mentioned that it is necessary to strengthen entrepreneurship education in schools and colleges with non-economic profiles. Graduates of these schools have very extensive specialist knowledge and advanced technical skills, but they lack the skills to run a business in their profession on their own (Riviezzo et al., 2023). They are in some way forced to enter into business in the form of partnerships with their colleagues (graduates of economics and related fields) as a result of synergy and combination of knowledge and specialist competence in the production/provision of services with economic knowledge.

The outflow of people from a given country (var9) has a negative impact on the creation of new companies in this country (Anelli et al., 2019). This is the result of, among others, brain drain (Anelli et al., 2020), which causes the outflow to affect competent and resourceful individuals who can cope abroad. These are the people who have the potential to start their own business (Anelli et al., 2023). People leaving a given country will be willing to set up a business in the country they are going to. Migrants have a competitive advantage in the transnational space and are generally more entrepreneurial (Brinkerhoff 2016; Vandor & Franke 2016). A country's greater determination to create conditions for entrepreneurship attractive enough to stop the outflow of qualified people may translate into higher domestic entrepreneurial activity.

As expected, the greater the number of people employed periodically (var16), the higher the entrepreneurship rate. Entering a business is a solution not only to the problem of uncertainty of continued employment, but also to the unattractive working conditions (which are a derivative of the contract form). The narrative line adopted in the article fits into the concept of necessity entrepreneurship (O'Donnell et al., 2024). According to the authors, the relationship detected in the study may suggest that people looking for an alternative to unfavourable employment conditions (which are a derivative of the term contract formula) and wanting to improve their financial situation have no other alternative than starting a business.

Possessing above-basic digital skills (var18) negatively impacts entrepreneurial activity. The estimation results indicate that a higher percentage of people in society with above-basic digital competencies not only fails to drive greater overall entrepreneurial activity but actually has a braking effect. Research shows that even in the case of digital business, digital competences are not the most important (Handayani et al., 2020). For individuals planning to start a company, the lack of the aforementioned competencies is not an obstacle, as these tasks can be performed by specialized employees or outsourced (Heeks, 2017). The obtained result is also explained by the fact that the study does not take into account the division of companies into PKD (i.e. NACE) sections, and the number of all new firms serves as the explained variable. The authors do not limit themselves to innovative and technologically advanced entities for which an above-average level of digital competences is a factor determining entrepreneurial intentions (Fazil et al., 2022; Oggero et al., 2020). However, this relationship (as research shows) does not apply to the entire economy. The result of our estimation can be explained, and the result itself is consistent with the findings in the literature. Fossen and Sorgner (2021) suggest that while digitalization creates opportunities for highly skilled workers, it can have a detrimental effect on those with fewer skills, limiting their chances to enter entrepreneurship. They argue that for high-skilled individuals, digitalization may encourage them to start unincorporated businesses, but for low-skilled individuals, it tends to reduce their entrepreneurial potential. Furthermore, with the rapid growth of advanced digital technologies, the opportunity costs for less ambitious entrepreneurial ventures rise, creating additional barriers for entry-level entrepreneurs. As a result, while digital skills may benefit growth-oriented entrepreneurship, they may discourage those with fewer resources or less ambition from pursuing smaller-scale entrepreneurial ventures. Similarly, Abaddi (2024) finds a significant negative relationship between digital skills and entrepreneurial activity among final-year undergraduate students in Jordan. This study suggests that higher levels of digital skills may, in fact, discourage entrepreneurial intentions. The increasing complexity and demands of modern entrepreneurial ventures may seem overwhelming or inaccessible to those without the necessary resources to engage in more challenging entrepreneurial activities.

The results of this study are of particular importance in the context of starting a business in the digital economy. The prevailing belief is that having higher digital competences is one of the most important elements of building a company's competitive advantage, regardless of its business profile. This means that an idea based on an in-depth analysis of needs and market analysis, as well as our knowledge and broadly understood entrepreneurial competences, is still more important than the skills that we are able to buy, but which do not determine the creation of new firms. It should be noted, of course, that this does not apply to businesses based on information technologies, for which these skills and knowledge are crucial. This is also a key observation in the context of educating personnel based on exact/technical/engineering sciences, where the specificity of graduates of these fields is to have specialized production/manufacturing knowledge or a "profession in hand", rather than the skills possessed by graduates of social sciences, even those useful in the process of establishing and managing an enterprise based on competition on the free market. The study results allow the authors to conclude that interdisciplinarity will play an important role when starting a business. A key finding from the study is that the interaction between social sciences and engineering/technical sciences should be strengthened, as their cooperation will be crucial for a synergistic effect in the context of creating new enterprises.

B. *Institutional factors*

Research has proven that entrepreneurial activity is explained by 4 variables from Institutional category. The conditions for starting a business are favoured by transparent tax policy and an acceptable level of fiscal burdens (Skica & Rodzinka, 2021) (var6). The results of the conducted research confirm this relationship between the variables studied. A higher value of the tax burden indicator (corresponding to greater economic freedom in the fiscal sense and thus less fiscalism, which is associated with favourable conditions for business) is linked to higher entrepreneurial activity.

The estimations performed did not confirm the assumed positive relationship between the indicator describing economic freedom (var7) and new business entry. The obtained result, although negative, was statistically significant. In the described model, a higher value of the indicator does not translate into decisions about entering the business. The obtained result is consistent with the common criticism of indicator measures of entrepreneurship determinants (Michaels, 2009; Du Marais, 2009). The business environment assessed using indicator measures does not encompass all factors that determine the decision to start a business (Lesik, 2020). They do not include macroeconomic stability, the development of the financial system, the size of the market, the quality of the workforce (Besley, 2015), or systemic factors and oligarchizing of the economy (Doing Business Report, World Bank), as well as the occurrence of bribery and corruption (Index of Economic Freedom, Heritage Foundation). However, they reward the state's small share in the economy, which paradoxically boosts the rankings of countries (totalitarian and authoritarian) that are little involved in the economy (Economic Freedom of the World, Fraser Institute) and are capable of terminating the operations of any company in the country by means of a regulation.

The entrepreneurial activity varies also across countries (Grilo & Irigoyen, 2006). Country-specific effects are visible both from the perspective of entrepreneurial intentions and entrepreneurial activity (Grilo & Thurik, 2005). EU membership (var19) stimulates entrepreneurs to implement their business ideas (Pfaffermayr et al., 2004), and institutions have a decisive impact on the universality and nature of entrepreneurship (Bosma et al., 2018). These are stronger (also due to their persistence) in the old EU countries (Lane, 2010), which promotes the role of EU membership in entrepreneurship.

Finally, the estimation results show that the decision to enter a business is favored by having the Euro currency (var20). It eliminates the problem of exchange rate differences, increases access to the EU market, and dynamizes cooperation within the EU (Ferrando et al., 2018; Panico, 2015). Tavlas (2004) and Ramos et al. (2000) find that the Euro area contributes to entrepreneurship through more integrated financial markets. Moreover, it reduces transaction risk, stimulates cross-border trade and investment, and facilitates price comparisons. These features of the euro area make it an instrument that favours the business environment and has a positive impact on entrepreneurship policy.

Differences in factors determining entrepreneurial activity between old and new EU Member States

In response to the second research question (RQ2), we focus on the differences between the old and new EU Member States in terms of the factors responsible for higher or lower entrepreneurial activity.

Longer membership in the EU promotes better compliance of national legal systems with EU regulations, easier access to funds, and improved administrative and institutional support, which in turn affects new firm formation (Campos et al., 2014). Countries that joined the EU before 2004 have benefited significantly (albeit unevenly) from

integration. They are also characterised by a high degree of persistence of the effects of EU accession, suggesting a continuous deepening of the integration process (Campos et al., 2019). The old EU Member States have diversified and developed their internal markets, facilitating the establishment of companies across various sectors of the economy, including high-tech and services (Ilzkovitz et al., 2007). Southern European countries, in particular Portugal, Greece, and Italy have gained substantial political and financial support through structural funds (Varga et al., 2014). Moreover, participation in the EU has attracted significant investments in innovation and technology. Countries such as Finland, Sweden, Denmark, the Netherlands, and Germany exemplify this trend, as they lead in research and development investments, thereby fostering the emergence of technological startups (Simionescu et al., 2021). It is also important to note that nations with a long history in the EU tend to exhibit a well-developed culture of entrepreneurship. This culture is characterized by a willingness to take high risks and social support for entrepreneurial ventures, as observed particularly in Great Britain, Sweden, and Ireland (see Hofstede, 1983; Beugelsdijk, 2007).

On the one hand, the information presented demonstrates the significant effort invested by the new EU countries in shaping the conditions for entrepreneurial development. On the other hand, it is difficult to argue with the fact that the solutions creating the climate for entrepreneurs who are currently profiting in the old EU countries are a function of their duration in the national legal systems, institutional maturity and culture, and entrepreneurial traditions. These, however, cannot be acquired just through the fact of accession to the EU structures. Their formation requires time for them to grow into the institutional and organizational tissue and take root in the consciousness of societies, creating a culture of entrepreneurship.

The presented heat map (Figure 1) clearly shows the boundary dividing the EU Member States into two groups based on factors influencing entrepreneurial activity - new EU countries (upper part of the figure) and old EU countries (lower part of the figure).

It can also be observed that both groups of countries differ in each of the factors influencing entrepreneurial activity. This is most visible for variables classified in the "Institutional conditions" category, i.e. var6, var7 and for variables var17, var18 which belong to the group of "Human Capital" factors.

Among the old Member States, the percentage of NEETs (var11), i.e. young people aged 15-34 who are neither employed nor in school or training, is lower (14.18%) than the average for all EU countries (15.38%). The lowest NEET rate (below 10%) in Group 1 is found in the following countries: the Netherlands, Sweden, Luxembourg, Denmark, and Austria. The highest percentage of NEETs (above 20%) is in the southern European countries of Spain, Italy, and Greece, which are struggling with high unemployment among young people. The value of this factor among the countries belonging to Group 2 (new EU Member States) is higher than the EU average, 16.77%. The lowest values are observed in Slovenia and Malta (11.04% and 12.78%), while the highest are found in Romania, Croatia, Slovakia, and Bulgaria (ranging from almost 20% to more). It is interesting that the range between the min and max values among the new EU countries is lower (12.06%) than in the old EU countries (17.54%). It should be emphasized that this is a factor belonging to the group of destimulants in the context of influencing the level of entrepreneurial activity; therefore, it is desirable for the percentage of NEETs to decrease.

In the case of employment in high-technology sectors (var13), the average value of this factor for all EU countries is 4.08%. In 12 countries, it is higher than the EU average (in 7 old and 5 new EU Member States). In the group of old Member States (Group 1), the highest values are in Ireland, Finland, and Denmark (8.05-5.41%). In turn, the lowest values are in the southern countries, i.e.: Greece, Portugal, Italy, and Spain (2.39-3.6%). The level of employment in high-technology sectors in Ireland is the highest in the entire European Union. Among the new Member States (Group 2), employment above 5% in high-technology sectors is found in Malta, Slovenia, and Hungary, while the lowest rates, below 3%, are observed in countries such as Poland, Cyprus, Romania, and Lithuania.

According to our study and the results obtained, The Human Development Index (var15) is a stimulant and promotes greater entrepreneurial activity, which means that higher values for this indicator are expected. The method of measuring the HDI index determines values from the range 0-100, where results closer to 100 are the expected value. Among all EU Member States, the level of the HDI index was higher than 80, with an average value of 88. Above-average results are observed in 12 countries, in equal parts among the old Member States (Sweden, France, Spain, the United Kingdom, Belgium, and Austria) and the new Member States (Malta, Hungary, Czechia, Estonia, Lithuania, and Slovakia).

Among the stimulants that affect entrepreneurial activity and belong to the group of "Human capital" factors, which are important from the perspective of our study, the percentage of people aged 35-54 participating in job-related non-formal education and training (var17) should be distinguished. In Group 1, the dominant position is occupied by Sweden

and the Netherlands, where almost 60% of employees aged 35-54 participate in various informal forms of improvement and acquiring knowledge correlated with their professional activity. On the other side, in Group 1, there is Greece, where the situation described occurs at a level of only 10%. In Group 2, the worst situation is in Romania (5.2%), which is half of the previously described Greece. The next lowest value is in Poland, but it is a much better level, at 21.25%. In Group 2, the highest percentage of people at the level of 40-43% who participate in non-formal education and improve their professional qualifications is found in Slovakia, Hungary, the Czech Republic and Estonia. The differentiation between groups 1 and 2 is quite clear, as the difference between the average values is 9 percentage points (40.89% and 31.84%, respectively). This shows the important role played by various educational programs addressed to members of the EU community based on the idea of lifelong learning.

Emigration is another factor statistically identified in the model as significant in influencing the level of entrepreneurial activity. This factor is a destimulant, i.e. a negative impact. The volume of emigration of EU citizens is mainly determined by the labour market situation in the sending country (primarily the level of unemployment), while the level of immigration in the EU is mainly determined by the wage differential between the sending and receiving countries (Cabańska, 2015; Wahba, 2021). In the new Member States, the main push factor is high unemployment and the main pull factor is the level of wages (the differences in wages between the new and old Member States are so large that, despite rising wage levels in the new Member States, there is emigration to the old EU countries). In the old Member States, decisions to emigrate (i.e., the outflow of people from these countries) are driven by improved economic and social conditions in the home country, known as return migration (Coleman, 1994).

Another factor influencing the level of entrepreneurial activity is the number of employees on temporary contracts (Limited Duration) (the EU average is 12%, as a percentage of the employed group aged 15-64). The creation of new enterprises in this case is likely the result of forced action due to unfavourable employment conditions, such as the lack of permanent employment. In Group 1, the highest percentage of people with temporary employment is found in Spain, Portugal, and the Netherlands (25-21%), and the lowest is below 10% in Belgium, Austria, Luxembourg, and the United Kingdom. In Group 2, Poland stands out significantly (27%), and the lowest values are observed in Romania and Lithuania.

In the case of the variable of having above-basic digital skills among people aged 25-64 (var18), the average value for all EU countries is 31%. In Group 1 (old Member States), the average is 36% and is higher than in Group 2 (new Member States) - 24%. There is a visible disproportion in the possession of digital skills between citizens of EU countries belonging to these two groups. The clear leaders in Group 1, as in the entire EU, are Denmark, Luxembourg, Finland, the Netherlands, and the United Kingdom, where more than 46% of citizens aged 25-64 have above-basic digital skills. The worst results in having above-basic digital skills are achieved by citizens of Greece and Italy. In Group 2, none of the countries reach the average value for countries in Group 1. The best result is in Malta and Estonia (35%). In turn, the weakest digital skills are achieved by citizens of Romania (9%) and Bulgaria (11%).

The level of entrepreneurial activity is also influenced by 4 institutional factors (in addition to the above-mentioned factors belonging to the "Human capital" group). The first factor in this group is the level of fiscal burden and transparent tax policy (var6). This parameter takes values from 0 to 100 points. The highest values are expected, which should be interpreted as having a positive impact on the level of entrepreneurial activity in a given country. The average value of this factor in the entire EU is 66 points. Disproportions are visible between the two groups (the difference between the average value for the old and new EU Member States is as much as 23 points – in favor of the countries from Group 2). In Group 1, the tax burden is most favourable in Ireland (73 points) and only there does it exceed the EU average. The strongest tax restrictions occur in Denmark, Sweden, and Belgium (39-44 points). In Group 2, as many as 11 countries achieve an indicator higher than the EU average. The least stringent fiscal burdens occur in Bulgaria, Lithuania, and Romania (87-90 points). In turn, Malta and Slovenia are on the opposite side. Although Malta is considered a tax haven, companies can minimize the level of fiscal burdens through effective forms of taxation; however, the basic flat-rate corporate income tax rate is as high as 35%.

Turning to the business freedom index (var7), it ranges from 0 to 100 points. The average value for the EU is 79 points, and among the countries in Group 1, it is higher (84 points) than the value among the countries of Group 2, the new Member States (72 points). In the old EU Member States, Luxembourg, Italy, Austria, Spain, and Greece recorded below-average results (73-76 points), while Sweden, Finland, and Denmark achieved the highest results (92-97 points). Among the new Member States, the vast majority achieves a result below the EU average. Only in two countries (Lithuania and Slovenia) are the values of the business freedom index higher than the EU average (82 points).

Analysing the level of entrepreneurial activity among all EU countries based on the "y" variable in our model, we come to very interesting observations. Of the five countries with the highest level of entrepreneurial activity in the analyzed period, four countries belong to Group 2 (Lithuania, Slovakia, the Czech Republic, and Latvia), i.e., new Member States. In turn, among the five countries with the weakest indicator, 4 countries belong to the so-called old EU (Greece, Ireland, Austria, and Germany).

CONCLUSION

This study extends our understanding of the factors influencing the level of entrepreneurial activity among EU Member States, reinforcing and expanding the existing literature in this area. An important contribution to science is the results of our study aimed at discussing the differences between groups consisting of new and old EU Member States. This is a significant contribution that also has practical implications for the effective impact of new countries' accession to the European Union on entrepreneurial activity in these countries. The discussed factors influencing entrepreneurial activity in new Member States can be a determinant in creating appropriate sources of EU law aimed at entrepreneurial processes among Member States.

The results of the analyses allowed the authors to achieve the research goal and verify both research questions. The conducted research identified factors that affect entrepreneurial activity in EU countries. Moreover, statistically significant differences were identified in the level of entrepreneurial activity between the old and new EU Member States. The research was based on the analysis of panel data for EU countries from 2009 to 2018. Based on the analyses, a research model was developed, which identified two groups of factors: Human capital and Institutional conditions influencing the level of entrepreneurial activity.

It can be concluded that there is a visible differentiation in terms of conditions for new firm formation between the old and new EU Member States, with an advantage in favour of the latter. Membership in the EU and the investment outlays incurred in the New EU Member States, which were intended to strengthen the potential and competitiveness of these countries, brought a positive result in the area of entrepreneurship.

The conducted research allows for the formulation of the following conclusions. Human capital and entrepreneurship are complementary factors influencing economic growth. A higher NEET rate corresponds to a lower rate of entry into business. Lower employment in the high-tech sector is accompanied by a greater number of established companies. The inverse relationship between the variables studied was verified. This confirms the trend observed in the high-tech sector, where individuals transition from full-time employment to owning a company. Next, the study confirmed that a higher HDI is associated with higher entrepreneurship. Promoting social development, therefore, contributes to entrepreneurial activity. This study confirmed this fact, proving that the greater the share of society participating in non-formal education, the higher the entrepreneurship rate in the studied country. The outflow of population from a given country has a negative impact on the creation of new companies in that country. A greater determination by the country's governments to stop the outflow of qualified people may translate into higher domestic entrepreneurial activity. As expected, the greater the number of people employed temporarily, the higher the entrepreneurship rate. The narrative presented in the article aligns with the concept of entrepreneurship driven by necessity. Additionally, a higher percentage of people in society with above-basic digital competences does not necessarily lead to higher entrepreneurial activity and may have a negative impact on the decision to start a business. This is a key observation in the context of educating staff based on STEM sciences, where the specificity of graduates of these fields is having specialist knowledge or a "profession in hand", and not, as a rule, digital skills. The results of this study are of particular importance in the context of starting a business in the digital economy. The prevailing belief is that having higher digital competences is one of the most important elements of building a company's competitive advantage, regardless of its business profile. The results of the conducted research also confirm that the conditions for starting a business are favoured by a transparent tax policy and an acceptable level of fiscal burden. A higher value of the indicator, corresponding to greater economic freedom in the fiscal sense, is identical with favourable conditions for entrepreneurial activity.

Regarding the second research question, we confirm that both groups of countries differ statistically in terms of the factors that describe our model. These factors can be categorized into two groups: "Human capital" and "Institutional factors," which influence entrepreneurial activity, as confirmed by our research. Among the old Member States (Group 1), the percentage of NEETs, i.e., young people aged 15-34 who are neither in employment, education, nor training, is lower than the average for all EU countries. Among the countries belonging to Group 2 (new EU Member States), the percentage

of NEETs is higher than the EU average, which has a negative impact on the level of entrepreneurial activity. In the case of employment in high-tech sectors, the average value of this coefficient is higher among the 15 old EU countries than among the new Member States. There is a significant difference between groups 1 and 2 among people aged 35-54 participating in non-formal education and vocational training. Better values were observed in Group 2, with a dominant position of Sweden and the Netherlands, where almost 60% of employees participate in various non-formal forms of professional development. In Group 2, the average is only 32%, with a notably low value in Romania at 5%. In Greece, which belongs to Group 1, the situation is not significantly better, because only 10% of people participate in informal forms of improving professional skills. Additionally, a higher percentage of employees employed on temporary contracts is found in the old EU countries compared to the group of 13 new EU Member States. Another notable difference is visible in the percentage of people aged 25-64 who possess above-basic digital skills. A significant advantage can be observed among the Old EU Member States (36%), compared to the New EU members (24%). Additionally, according to our study, the Human Development Index as a stimulant for greater entrepreneurial activity occurs at an equal level in both groups (with a slight advantage of 1 point in the old EU countries). Considerable differences were also observed among institutional factors. Among the 13 new Member States, there is a more favourable situation in terms of fiscal burdens than in Group 1, which groups the old Member States. This variable has a stimulating nature, so the highest values are expected, which should be interpreted as indicating a positive impact on the level of entrepreneurial activity in a given country. A statistically significant difference also occurs between the groups for the parameter referred to as business freedom. The result obtained, although negative, was statistically significant. Higher values of the economic freedom index parameter occur in favour of the old Member States.

This study also had limitations, primarily related to the difficulty of obtaining complete data for the entire study period. Therefore, the study authors had to limit the analysis only to variables with repeated data in each year. The study was conducted at the country level until the UK's departure from the European Union, and it did not account for the market collapse caused by the COVID-19 pandemic or the war in Ukraine. In future studies, researchers can focus on the analysis of entrepreneurial activity with special consideration of external factors, including political factors such as wars, changes in the models of governing countries based on social support, migration processes or international relations and their impact on trade.

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Appendices

Table 4. Correlation matrix for the variables used in the model

Variables	y	var3	var4	var5	var6	var7	var8	var9	var10	var11	var12	var13	var14	var15	var16	var17	var18	var19	var20
y	1.000																		
var3	0.0640 (0.285)	1.000																	
var4	0.0801 (0.236)	-0.008 (0.905)	1.000																
var5	-0.1170 (0.050)	0.683 (0.000)	0.196 (0.004)	1.000															
var6	0.2634 (0.000)	-0.387 (0.000)	-0.323 (0.000)	-0.570 (0.000)	1.000														
var7	-0.1612 (0.006)	0.607 (0.000)	0.218 (0.001)	0.586 (0.000)	-0.522 (0.000)	1.000													
var8	-0.0014 (0.982)	-0.370 (0.000)	-0.093 (0.171)	-0.636 (0.000)	0.338 (0.000)	-0.351 (0.000)	1.000												
var9	-0.2445 (0.000)	0.102 (0.090)	-0.138 (0.041)	0.109 (0.070)	-0.218 (0.000)	0.127 (0.033)	0.052 (0.387)	1.000											
var10	-0.0068 (0.911)	-0.302 (0.000)	-0.074 (0.287)	-0.279 (0.000)	0.391 (0.000)	-0.203 (0.001)	0.133 (0.029)	0.056 (0.359)	1.000										
var11	-0.1302 (0.029)	-0.653 (0.000)	-0.382 (0.000)	-0.696 (0.000)	0.424 (0.000)	-0.376 (0.000)	0.579 (0.000)	0.101 (0.091)	0.027 (0.653)	1.000									
var12	0.1079 (0.071)	-0.547 (0.000)	-0.086 (0.204)	-0.571 (0.000)	0.293 (0.000)	-0.401 (0.000)	0.407 (0.000)	-0.045 (0.454)	0.101 (0.098)	0.641 (0.000)	1.000								
var13	-0.1209 (0.043)	0.287 (0.000)	0.135 (0.045)	0.543 (0.000)	-0.270 (0.000)	0.350 (0.000)	-0.614 (0.000)	-0.140 (0.019)	-0.338 (0.000)	-0.309 (0.000)	-0.138 (0.021)	1.000							
var14	-0.1533 (0.010)	0.637 (0.000)	0.334 (0.000)	0.658 (0.000)	-0.441 (0.000)	0.600 (0.000)	-0.585 (0.000)	0.107 (0.073)	-0.295 (0.000)	-0.575 (0.000)	-0.451 (0.000)	0.551 (0.000)	1.000						
var15	0.1131 (0.058)	0.300 (0.000)	-0.023 (0.740)	0.497 (0.000)	-0.236 (0.000)	0.165 (0.006)	-0.384 (0.000)	0.126 (0.035)	-0.148 (0.015)	-0.338 (0.000)	-0.254 (0.000)	0.457 (0.000)	0.290 (0.000)	1.000					
var16	-0.0025 (0.967)	0.139 (0.020)	0.101 (0.135)	0.126 (0.035)	-0.405 (0.000)	0.003 (0.957)	0.048 (0.427)	0.290 (0.000)	-0.397 (0.000)	-0.088 (0.142)	-0.057 (0.340)	-0.055 (0.357)	0.094 (0.115)	-0.121 (0.043)	1.000				
var17	0.1493 (0.012)	0.569 (0.000)	0.089 (0.188)	0.663 (0.000)	-0.515 (0.000)	0.422 (0.000)	-0.600 (0.000)	-0.164 (0.006)	-0.252 (0.000)	-0.655 (0.000)	-0.407 (0.000)	0.407 (0.000)	0.379 (0.000)	0.378 (0.000)	0.224 (0.000)	1.000			
var18	-0.0208 (0.728)	0.619 (0.000)	0.160 (0.018)	0.762 (0.000)	-0.586 (0.000)	0.554 (0.000)	-0.564 (0.000)	-0.015 (0.799)	-0.338 (0.000)	-0.693 (0.000)	-0.484 (0.000)	0.433 (0.000)	0.626 (0.000)	0.352 (0.000)	0.082 (0.174)	0.707 (0.000)	1.000		
var19	-0.1808 (0.002)	0.410 (0.000)	0.252 (0.000)	0.619 (0.000)	-0.724 (0.000)	0.633 (0.000)	-0.437 (0.000)	0.368 (0.000)	-0.328 (0.000)	-0.267 (0.000)	-0.235 (0.000)	0.245 (0.000)	0.497 (0.000)	0.146 (0.015)	0.266 (0.000)	0.381 (0.000)	0.534 (0.000)	1.000	
var20	0.0738 (0.218)	0.034 (0.572)	0.349 (0.000)	0.236 (0.000)	-0.128 (0.032)	0.143 (0.017)	-0.062 (0.304)	-0.070 (0.244)	-0.105 (0.085)	-0.053 (0.381)	0.194 (0.001)	0.026 (0.663)	-0.085 (0.155)	0.072 (0.233)	0.087 (0.145)	0.169 (0.005)	0.150 (0.012)	0.378 (0.000)	1.000

Note: the p-value is in parentheses.

Table 5. Descriptive statistics for the variables used in the model

Country	Group	y	var1	var2	var3	var4	var5	var6	var7	var8	var9	var10	var11	var12	var13	var14	var15	var16	var17	var18	var19	var20
Austria	1	.0046145	30 515.20	5 745 569.20	36.64	42.30	88.95	50.50	75.50	53.02	56 993.90	581.30	9.74	28.57	3.92	6.04	90	0.09	46.85	34.75	23	1
Belgium	1	.0060524	39 992.60	7 262 774.20	32.54	44.80	80.45	43.60	89.12	49.50	89 097.89	523.90	14.38	49.59	4.55	8.66	91	0.09	35.85	32.25	25	1
Denmark	1	.0064673	23 958.44	3 648 830.60	38.94	42.30	90.65	39.11	97.23	46.04	46 841.00	282.65	9.18	23.99	5.41	9.95	86	0.10	47.45	50.50	25	0
Finland	1	.0070245	24 164.80	3 504 621.20	37.50	42.30	90.46	65.84	93.18	50.94	15 044.10	311.75	12.04	25.28	5.82	10.12	88	0.16	49.15	47.50	23	1
France	1	.0104603	350 704.40	41 850 691.80	34.64	47.59	79.90	50.04	82.37	53.29	293 328.70	328.70	15.30	43.91	4.01	6.31	93	0.16	44.80	27.00	25	1
Germany	1	.0041181	222 012.78	53 541 424.20	37.73	41.05	88.39	60.51	89.29	51.41	358 491.30	615.73	10.88	45.37	4.19	7.45	86	0.14	46.15	36.75	25	1
Greece	1	.0052965	36 304.33	7 136 099.90	32.30	45.30	47.48	64.58	75.73	72.26	96 898.50	365.33	25.15	62.71	2.39	5.03	83	0.11	10.05	20.50	25	1
Ireland	1	.0049636	15 661.50	3 087 279.30	35.87	43.13	88.85	73.01	86.12	38.59	70 730.30	257.75	18.63	51.52	8.05	10.40	88	0.11	30.55	28.25	25	1
Italy	1	.0070526	277 130.20	38 887 931.70	30.61	42.30	55.58	55.25	74.60	61.12	122 619.80	277.55	25.14	55.32	3.38	4.09	83	0.14	32.90	21.00	25	1
Luxembourg	1	.0068239	2 857.00	375 981.50	32.73	46.91	88.85	64.33	73.38	35.47	11 411.10	401.33	8.12	30.75	3.94	8.72	86	0.09	49.30	49.25	25	1
Netherlands	1	.0110155	110 457.20	11 110 270.00	39.61	43.44	89.53	51.87	83.06	43.99	107 062.50	278.61	7.61	39.44	3.81	9.27	85	0.21	54.90	46.25	25	1
Portugal	1	.0217866	119 993.00	6 862 534.20	37.05	44.63	70.25	60.56	83.48	67.54	38 197.60	328.25	13.82	53.05	2.56	5.80	80	0.22	40.10	29.00	25	1
Spain	1	.0097029	264 727.90	31 210 278.50	34.82	35.09	70.43	58.28	75.54	60.33	392 145.70	248.16	20.83	44.29	3.60	5.69	92	0.25	33.35	31.50	25	1
Sweden	1	.0078224	51 535.50	6 155 472.20	40.87	42.30	90.62	40.66	92.30	44.60	48 728.00	231.13	7.82	21.05	4.92	10.64	94	0.16	58.80	43.50	23	0
U. Kingdom	1	.0082093	293 676.50	41 751 397.20	38.53	40.87	89.60	60.29	91.82	61.64	335 905.80	397.16	14.07	33.54	4.58	10.04	91	0.05	33.20	46.25	25	0
Bulgaria	2	.0087945	41 586.70	4 862 521.40	32.04	39.88	36.61	90.22	71.33	66.02	27 124.43	583.98	23.10	56.00	3.39	5.23	80	0.04	26.40	10.75	11	0
Croatia	2	.0057146	13 150.86	2 818 377.30	31.91	38.38	43.64	71.33	60.76	71.68	24 002.20	370.50	19.78	57.51	3.11	4.61	82	0.18	30.50	28.00	5	0

Country	Group	y	var1	var2	var3	var4	var5	var6	var7	var8	var9	var10	var11	var12	var13	var14	var15	var16	var17	var18	var19	var20
Cyprus	2	.0053592	3 144.38	587 653.50	36.53	42.30	74.66	77.05	77.92	71.61	14 387.50	346.68	16.77	33.58	2.79	5.73	87	0.16	35.15	19.50	14	1
Czechia	2	.0145349	94 503.90	7 154 576.70	34.86	34.17	70.33	81.68	67.85	49.64	39 783.50	437.51	14.62	40.54	4.56	5.42	92	0.09	40.00	23.00	14	0
Estonia	2	.0103043	8 712.56	872 812.40	36.95	37.03	84.80	80.60	78.45	52.00	8 349.30	366.64	15.56	41.36	4.48	6.06	91	0.04	39.50	35.25	14	1
Hungary	2	.0122299	57 684.70	6 726 573.90	31.42	43.76	61.27	76.36	73.98	52.45	30 985.30	432.91	18.31	45.81	5.00	5.16	92	0.10	40.90	25.25	14	0
Latvia	2	.0126775	15 723.00	1 344 229.80	35.21	44.09	55.09	83.87	77.42	59.92	24 914.20	353.84	16.99	44.23	3.12	4.67	85	0.04	34.00	25.25	14	1
Lithuania	2	.0220220	34 456.40	1 989 058.10	34.60	45.06	61.68	89.67	80.60	62.91	46 705.60	593.78	14.06	41.07	2.30	6.19	90	0.02	26.15	29.25	14	1
Malta	2	.0091443	2 925.75	296 114.70	32.82	45.65	74.08	63.53	65.26	62.39	5 752.60	287.37	12.78	55.89	5.80	5.53	92	0.07	34.25	35.25	14	1
Poland	2	.0103365	251 231.80	26 602 782.70	32.37	44.14	59.26	75.39	64.38	59.68	243 715.60	486.05	15.73	36.44	2.90	6.63	84	0.27	21.25	17.75	14	0
Romania	2	.0062866	74 124.20	13 501 662.60	32.56	38.70	43.49	87.10	69.83	61.34	202 112.40	503.06	19.46	42.94	2.38	5.85	84	0.01	5.20	9.00	14	0
Slovakia	2	.0168745	57 123.20	3 842 832.40	33.17	37.54	54.22	82.09	69.52	55.47	2 858.30	503.30	19.86	65.44	3.96	3.38	89	0.08	43.10	27.50	14	1
Slovenia	2	.0114455	14 532.80	1 396 965.10	34.38	49.50	63.16	61.55	82.22	57.31	15 041.40	425.65	11.04	47.35	5.24	6.99	88	0.17	37.55	27.75	14	1
Mean	-	.0095405	90 449.70	11 933 118.44	34.97	42.30	71.15	66.39	78.65	56.15	98 901.02	397.16	15.38	43.45	4.08	6.77	88	0.12	36.69	30.63	19.14	-
SD.	-	.0046815	105 168.26	15 254 133.99	2.73	3.64	17.08	14.76	9.43	9.59	117 567.60	114.17	4.96	11.55	1.29	2.10	4	0.07	12.00	11.04	6.25	-
Min	-	.0041181	2 857.00	296 114.70	30.61	34.17	36.61	39.11	60.76	35.47	2 858.30	231.13	7.61	21.05	2.30	3.38	80	0.01	5.20	9.00	5	-
Max	-	.0220220	350 704.40	53 541 424.20	40.87	49.50	90.65	90.22	97.23	72.26	392 145.70	615.73	25.15	65.44	8.05	10.64	94	0.27	58.80	50.50	25	-
LQ(Q1)	-	.0061695	15 707.63	2 611 047.50	32.56	40.62	58.34	57.52	72.87	50.62	21 762.68	305.66	11.79	35.73	3.12	5.37	84	0.08	32.31	24.69	14	-
UQ(Q3)	-	.0112305	112 841.15	11 708 118.15	36.98	44.67	88.85	77.94	84.14	61.83	110 951.83	490.30	18.84	51.90	4.67	8.68	91	0.16	45.14	35.63	25	-
Skew	-	1.33	0.67	1.4	0.37	-0.43	-0.4	-0.11	0.13	-0.19	1.4	0.45	0.26	-0.11	0.95	0.57	-0.28	0.44	-0.7	0.14	-0.42	-
Kurt	-	4.29	3.14	3.8	2.16	2.87	1.91	2.06	2.26	2.49	3.55	2.08	2.34	2.37	4.36	2.1	2.06	2.48	3.72	2.45	1.78	-
CV	-	0.49	1.16	1.28	0.08	0.09	0.24	0.22	0.12	0.17	1.19	0.29	0.32	0.27	0.32	0.31	0.05	0.58	0.33	0.36	0.33	-

Note: Group 1 = Old EU Member States, Group 2 = New EU Member States. Skew = Skewness, Kurt = Kurtosis, CV = Coefficient of Variation. The rows contain average values for the examined period. Var20 (Euro area) Yes=1, No=0.

Table 6. Descriptive statistics of variables in relation to country groups: new and old EU Member States

Variable	Description	Group	Mean	CI -95%	CI +95%	Median	Min	Max	LQ(Q1)	UQ(Q3)	SD	Skew	Kurt	CV
Var6	Tax burden (0-100 pts.)	1	55.90	50.45	61.33	58.28	39.11	73.01	50.04	64.33	9.83	-0.23	2.18	0.18
		2	78.50	73.06	83.93	80.60	61.55	90.22	75.39	83.87	9.00	-0.56	2.43	0.11
		EU-28	66.39	60.66	72.11	64.46	39.11	90.22	56.76	78.83	14.76	-0.11	2.06	0.22
Var7	Business freedom (0-100 pts.)	1	84.18	79.82	88.53	83.48	73.38	97.23	75.54	91.82	7.86	0.02	1.66	0.09
		2	72.27	68.20	76.35	71.33	60.76	82.22	67.85	77.92	6.74	-0.10	1.84	0.09
		EU-28	78.65	74.99	82.3	77.67	60.76	97.23	72.35	84.80	9.43	0.13	2.26	0.12
Var9	Emigration (number)	1	138 899.75	64 863.17	21 2936.30	89 097.89	11 411.10	392 145.69	46 841.00	293 328.69	133 692.75	0.95	2.24	0.96
		2	52 748.64	6 176.08	99 321.20	24 914.20	2 858.30	243 715.59	14 387.50	39 783.50	770 69.38	1.86	4.73	1.46
		EU-28	98 901.02	53 313.06	144 489.00	46 773.30	2 858.30	392 145.69	19 523.15	11 4841.15	117 567.60	1.40	3.55	1.19
Var11	Young people neither in employment nor in education and training aged 15-34 (%). Not employed persons	1	14.18	10.91	17.44	13.82	7.61	25.15	9.18	18.63	5.89	5.89	0.72	2.36
		2	16.77	14.77	18.78	16.77	11.04	23.10	14.62	19.46	3.31	3.31	0.11	2.44
		EU-28	15.38	13.46	17.3	14.96	7.61	25.15	11.54	19.04	4.96	4.96	0.26	2.34
Var13	Employment in high-technology sectors (% of total employment)	1	4.34	3.58	5.11	4.01	2.39	8.05	3.60	4.92	1.38	1.38	1.15	4.64
		2	3.77	3.08	4.46	3.39	2.30	5.80	2.90	4.56	1.15	1.15	0.35	1.82
		EU-28	4.08	3.57	4.58	3.95	2.30	8.05	3.11	4.75	1.29	1.29	0.95	4.36
Var15	Human Development Index (0-100 pts.)	1	88	85	90	88	80	94	85	91	4	0.04	-0.18	2.09
		2	87	85	90	88	80	92	84	91	4	0.04	-0.36	1.95
		EU-28	88	86	89	88	80	94	84	91	4	0.04	-0.28	2.06
Var16	Employees by type of employment contract (% of employment aged 15-64)	1	0.14	0.10	0.16	0.14	0.05	0.25	0.09	0.16	0.06	0.06	0.55	2.44
		2	0.10	0.05	0.14	0.08	0.01	0.27	0.04	0.16	0.08	0.08	0.89	2.87
		EU-28	0.12	0.09	0.14	0.10	0.01	0.27	0.08	0.16	0.07	0.07	0.44	2.48
Var17	Participation rate in job-related non-formal education and training in age 35-54 (%)	1	40.89	34.2	47.58	44.80	10.05	58.80	33.20	49.15	12.08	12.08	-0.91	3.90
		2	31.84	25.62	38.07	34.25	5.20	43.10	26.40	39.50	10.30	10.30	-1.35	4.41
		EU-28	36.69	32.03	41.34	36.70	5.20	58.80	31.73	45.48	12.00	12.00	-0.70	3.72
Var18	Individuals who have above basic overall digital skills aged 25-64 (% of individuals)	1	36.28	30.59	41.96	34.75	20.50	50.50	28.25	46.25	10.26	10.26	-0.04	1.65
		2	24.12	19.22	29.01	25.25	9.00	35.25	19.50	28.00	8.10	8.10	-0.52	2.48
		EU-28	30.63	26.35	34.91	28.63	9.00	50.50	24.13	36.00	11.04	11.04	0.14	2.45

Note: Group 1 = Old EU Member States, Group 2 = New EU Member States. CI = Confidence Interval for the Mean, LQ(Q1) = Lower Quartile, UQ(Q3) = Upper Quartile, SD = Standard Deviation, Skew = Skewness, Kurt = Kurtosis, CV = Coefficient of Variation.

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Authorship contribution statement

Tomasz Skica: Conceptualization, Data Curation, Writing Original Draft, Investigation, Writing - Review & Editing, Revisions. **Marcin J. Piątkowski:** Conceptualization, Data Curation, Writing Original Draft, Investigation, Writing - Review & Editing, Revisions, Project Administration. **Ademir Abdić:** Methodology, Formal Analysis, Validation, Writing - Review & Editing, Visualization, Revisions. **Lejla Lazović-Pita:** Writing Original Draft, Writing - Review & Editing, Revisions.

Conflicts of interest

The authors declare no conflict of interest.

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Entrepreneurial well-being research from 1979 to 2022: A comprehensive multimethod bibliometric analysis

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***Mario Alberto Salazar-Altamirano*[3*]**

Abstract

PURPOSE: *This study aims to provide a comprehensive bibliometric analysis of the entrepreneurial well-being (EW) field, addressing its evolution, intellectual structure, and emerging trends. It seeks to fill gaps in prior research, which often focuses narrowly on specific dimensions of well-being, by adopting a multidisciplinary and integrative perspective. The study highlights dominant narratives and offers actionable insights for future research and practice.* ***METHODOLOGY:*** *The analysis employs three bibliometric techniques: historiography, document co-citation, and bibliographic coupling. Using 668 primary and 37,951 secondary documents sourced from the Web of Science database, the study spans 1979–2022. Bibliometric tools such as Biblioshiny were applied to identify research clusters, visualise intellectual structures, and assess trends across the field.* ***FINDINGS:*** *The study identifies two dominant narratives: hedonic well-being, focusing on subjective satisfaction and positive emotions, and eudaimonic well-being, centred on psychological constructs like autonomy and purpose. Key contributions are concentrated in journals such as Journal of Business Venturing and Entrepreneurship Theory and Practice. The field exhibits fragmentation, with limited interdisciplinary collaboration, though recent years have seen growing diversity in authorship and geographical representation.* ***IMPLICATIONS:*** *The findings highlight the need for integrating multidisciplinary frameworks to deepen theoretical understanding and promote practical relevance. Stronger collaborations between researchers and practitioners can address challenges like work-life balance and sustainable development. These partnerships can translate academic insights into actionable strategies, benefiting entrepreneurs and society alike.* ***ORIGINALITY AND VALUE:*** *This study's use of three bibliometric techniques offers a unique, comprehensive view of EW research, bridging historical insights with emerging trends. By mapping the field's intellectual structure, it provides a valuable resource for advancing theoretical and practical contributions in entrepreneurial well-being.*

Keywords*: entrepreneurial well-being, bibliometric analysis, historiography, co-citation, bibliographic coupling, hedonic well-being, eudaimonic well-being, work-life balance, social entrepreneurship.*

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INTRODUCTION

Entrepreneurial well-being (EW) is a relatively new field of study that began gaining prominence in the research agendas of social and economic sciences around 2008 (González-Peña et al., 2023). It differs from general workplace well-being and organisational well-being, as it encompasses specific dimensions of the entrepreneurial experience, such as autonomy, risk perception, financial uncertainty, and work-life balance (Salazar-Altamirano et al., 2025; Stephan, 2018). Unlike organisational well-being, which focuses on employees within formal structures, entrepreneurial well-being is linked to the dynamics of self-employment and new business creation (Wiklund et al., 2019).

The conceptual trajectory of well-being has progressed through multiple phases and viewpoints. It began as a philosophical and introspective inquiry, subsequently turning to the intrinsic dimensions of human existence and the roots of happiness and ultimately gaining broad recognition as a notion linked to the experience of "feeling good" (Salazar-Altamirano et al., 2024). Previous research has shown that entrepreneurs who report higher levels of well-being exhibit greater resilience, higher levels of innovation, and an increased likelihood of sustaining their businesses in the long run (Mercader et al., 2025; Nikolaev et al., 2022). Moreover, entrepreneurial well-being not only influences individual performance but also impacts the economy and society by promoting sustainable businesses and generating employment.

In response to these developments, global leaders have implemented initiatives to position psychological well-being as a fundamental social goal, reflected in official statistics across various countries (Ravina-Ripoll et al., 2023). Simultaneously, entrepreneurship and management scholars have shown increasing interest in understanding the causes and consequences of well-being in the entrepreneurial context (Shepherd & Patzelt, 2017; Wiklund et al., 2017, 2019; Stephan, 2018; Shir et al., 2019). Considering the expanding academic literature on entrepreneurial well-being, examining the field's development through a bibliometric lens becomes a necessary endeavour.

The study of well-being has been addressed from multiple perspectives, including economic (Isham et al., 2021), psychological (Li & Hasson, 2020; Steiger et al., 2021), and sociological (Ostic et al., 2021). While this multidisciplinary approach has broadened the understanding of the phenomenon, it has also resulted in fragmented knowledge, with limited interdisciplinary exchange and a lack of a shared knowledge base (Stephan, 2018). This study employs three bibliometric techniques to map the development of EW, identify its main theoretical streams, and highlight gaps in the literature. By addressing key questions such as "How has knowledge on entrepreneurial well-being evolved?" and "What are the future directions for research in this area?", the analysis offers an integrated overview of the field's status and outlines possible trajectories for its future advancement.

The use of bibliometric techniques enables an objective assessment of the existing literature, avoiding subjective biases that may limit traditional narrative reviews. Moreover, by employing co-citation analysis, historiography, and bibliographic coupling, this study provides a detailed overview of the intellectual structure of entrepreneurial well-being, identifying key authors, dominant theories, and gaps in research.

The aim of this study is to conduct an impartial and integrative assessment of the entrepreneurial well-being (EW) domain by exploring its current landscape, historical progression, and anticipated directions. Although certain insights may resonate as familiar to experienced scholars in the field, this review delivers a broad and structured synthesis of EW's conceptual evolution. As such, it serves as a useful resource for researchers aiming to gain deeper insights and identify concrete pathways for future scholarly exploration.

Aligned with these aims, this study seeks to answer the following research questions (RQs):

RQ1: How has the knowledge domain of entrepreneurial well-being evolved over time?
RQ2: What is the underlying intellectual structure within the knowledge domain of entrepreneurial well-being?
RQ3: Considering the pathways, strengths, and gaps in the structure and evolution of research on entrepreneurial well-being, what are the theoretically and practically relevant future directions?

The remainder of this article is organised as follows. The next section presents a concise overview of the theoretical foundations and prior literature to contextualise the significance of entrepreneurial well-being. This is followed by a detailed explanation of the methodological framework, including the bibliometric techniques applied, the characteristics of the dataset, and the analytical procedures adopted. Subsequently, the results section displays the outcomes of the historiographic mapping, document co-citation, and bibliographic coupling analyses. The discussion then interprets these results, proposing conceptual and practical implications, while also identifying promising directions for future

research. Finally, the conclusion summarises the core contributions, acknowledges the study's limitations, and outlines recommendations for continued scholarly inquiry.

THEORETICAL BACKGROUND

Hedonic and eudaimonic well-being in entrepreneurial research

Entrepreneurial well-being (EW) has been widely examined through two dominant perspectives: hedonic well-being, which focuses on pleasure, satisfaction, and positive affect, and eudaimonic well-being, which emphasises meaning, self-realisation, and psychological growth (Ryan & Deci, 2001). These perspectives, originally from psychology, have been adapted to the entrepreneurial context to understand how individuals experience well-being in the uncertain and highly demanding nature of entrepreneurial activities.

Hedonic well-being in entrepreneurship is typically measured through subjective well-being indicators, such as life satisfaction, emotional balance, and work-related happiness (Stephan, 2018). Entrepreneurs, however, experience unique emotional fluctuations due to factors such as financial instability, workload variability, and personal investment in their ventures (Uy et al., 2013). Unlike employees in traditional work settings, entrepreneurs face extreme highs and lows, making hedonic well-being more volatile and context-dependent (Wiklund et al., 2019).

Eudaimonic well-being in entrepreneurship refers to the fulfilment derived from personal growth, resilience, and alignment between one's work and intrinsic values (Cardon et al., 2009). Entrepreneurs often derive purpose and satisfaction not just from financial success but also from overcoming challenges, achieving autonomy, and making meaningful contributions to society (Shir et al., 2019). This perspective suggests that entrepreneurial well-being extends beyond momentary happiness, encompassing a deeper sense of achievement and self-determination (Deci & Ryan, 2000).

Although theoretically significant, both hedonic and eudaimonic perspectives present measurement limitations within entrepreneurship research. Hedonic well-being often depends on affect-based self-assessments, which might not adequately reflect the enduring psychological consequences associated with entrepreneurial activity (Galvan-Vela et al., 2024). Conversely, eudaimonic well-being, often linked to entrepreneurial passion and identity, is difficult to quantify due to its subjective and evolving nature (Murnieks et al., 2020). Given this complexity, there is a pressing need to adopt more sophisticated methodological strategies, such as longitudinal designs and experience sampling techniques, that can more accurately capture the dynamic nature of entrepreneurial well-being across time.

Alternative conceptualizations of entrepreneurial well-being

While hedonic and eudaimonic well-being remain central to entrepreneurial well-being (EW) research, alternative perspectives highlight additional dimensions that shape well-being experiences. One such perspective is the relationship between well-being and entrepreneurial identity. Entrepreneurs often derive well-being from a sense of self-expression and alignment with their professional roles (Murnieks et al., 2020). However, identity tensions, such as role conflicts or business failure, can negatively impact well-being, suggesting that identity-based well-being requires further empirical investigation (Cardon et al., 2019). Similarly, well-being can be understood as a process of meaning-making, where entrepreneurs find fulfilment not only through financial success but also through the intrinsic value of their work and its contribution to broader societal goals (Shepherd, 2019). This perspective contests the idea of well-being as a fixed condition, proposing instead that it be understood as a fluid and evolving construct shaped by entrepreneurs' lived experiences throughout their journey.

In addition to personal determinants, the socio-material environment exerts a significant influence on the configuration of entrepreneurial well-being. Access to resources, market stability, and institutional support systems influence entrepreneurs' ability to maintain well-being in the face of uncertainty (Welter et al., 2017). This perspective shifts the focus from purely psychological determinants to external environmental factors that shape well-being outcomes. Such alternative perspectives indicate that research on entrepreneurial well-being would benefit from incorporating identity construction, the pursuit of meaning, and contextual socio-material dimensions, thereby fostering a more comprehensive understanding of the phenomenon. Future studies could explore these dimensions empirically to refine existing theories and broaden the field's scope.

Interdisciplinary perspectives on entrepreneurial well-being

Entrepreneurial well-being (EW) is an inherently interdisciplinary construct, drawing insights from psychology, sociology, and economics. However, these disciplines conceptualize and measure well-being in distinct ways, leading to epistemological tensions that must be considered when integrating them into a unified framework. From a psychological perspective, well-being is primarily examined through subjective measures, such as life satisfaction, positive affect, and mental health (Diener, 1984). Theories like self-determination theory (Deci & Ryan, 2000) highlight intrinsic motivations, autonomy, and competence as key determinants of well-being. However, psychological approaches often focus on individual agency, overlooking structural and contextual influences on well-being.

Sociology, in contrast, situates well-being within broader social structures, emphasizing the role of social networks, institutional environments, and cultural norms (Putnam, 2000). Sociological research on well-being considers how factors such as social capital, community engagement, and systemic inequalities shape entrepreneurial experiences. This collectivist approach challenges the psychological emphasis on individual perceptions, suggesting that well-being is co-constructed within social systems. Economic approaches to well-being focus on objective indicators, such as income levels, financial stability, and employment status (Frey & Stutzer, 2002). In entrepreneurship, economic research often examines how venture success, financial performance, and market conditions influence well-being outcomes. However, this approach has been criticized for overlooking non-monetary aspects of well-being, such as personal fulfilment and work-life balance.

These disciplinary differences create epistemological tensions in EW research. Psychology's reliance on self-reported well-being measures may contrast with economics' preference for objective financial indicators, while sociology's structural analysis may challenge the individualistic assumptions of psychological and economic models. Bridging these perspectives requires an interdisciplinary approach that integrates subjective and objective measures, individual and collective dimensions, and micro- and macro-level analyses.

METHODOLOGY

Bibliometric methods, while not novel, have garnered significant attention in recent years. This growing interest can be attributed to the increased availability of online citation databases and the development of advanced analysis software (Wu et al., 2021). As citation analysis forms the foundation of bibliometric methodologies, these methods complement traditional reviews and meta-analyses by offering one of the most objective means of visualising a specific field of knowledge without subjective constraints (Zupic & Čater, 2015).

Given the complexity and multidisciplinary nature of research fields, mapping a domain should comprise multiple maps derived from a series of studies employing diverse methodologies. While most scientific mapping studies utilise a single method, greater insights can be gained by triangulating different scientific maps. This approach involves integrating multiple methodologies, resulting in a more comprehensive understanding than any single method applied in isolation (Wen et al., 2016).

This study applies a triangulated methodological design that combines historiographic mapping, document co-citation analysis, and bibliographic coupling, complemented by a content-based examination of key texts. The use of these three bibliometric strategies allows for a comprehensive review of the entrepreneurial well-being literature, revealing underlying citation structures and thematic groupings. Additionally, the focused analysis of core documents offers deeper insight into the conceptual dialogue shaping the field. The subsequent sections describe the procedures used for document selection from the chosen database, outline the bibliometric techniques employed, and explain the coding process applied during content analysis.

Primary and secondary documents

Bibliometric techniques rely on different types of citation analysis that utilise secondary sources. The notion of „documents" is used broadly in this context, referring to a wide range of written materials, including journal articles, books, book chapters, and similar scholarly outputs. Primary documents are those identified through keyword searches that cite other documents, while secondary documents are those cited by primary documents but are not retrieved through the keyword search itself (Vogel et al., 2020).

The selection of primary documents was carried out through a search in the Web of Science (WoS), specifically within the Social Science Citation Index (SSCI), applying no time constraints and limiting the results solely to journal articles. WoS is one of the most recommended and widely used repositories in bibliometric research due to its rigorous selection of high-impact, peer-reviewed journals and its advanced citation indexing capabilities (Donthu et al., 2021). The search utilised keywords in the fields "title," "author keywords," and "abstract." Specifically, the search string "(well-being OR well-being) AND (entrepreneur OR self-employ)" was employed, allowing for the collection of an extensive set of primary documents spanning the entire temporal range.

Subsequently, the search was refined using all categories proposed by WoS, considering only articles written in English. This approach yielded 668 primary documents and 37,951 secondary documents that formed part of their references. This can be considered a more robust dataset than those used in previous reviews on entrepreneurial well-being. However, we acknowledge that the exclusive use of WoS may introduce a geographical bias, as it primarily indexes high-impact journals, many of which originate from North America and Europe. While this selection ensures methodological rigour and high-quality data, it may underrepresent research from non-Western contexts and alternative epistemologies.

Bibliometric methods

Table 1 summarises the characteristics of each bibliometric technique, outlining their analytical focus, treatment of time, distinctive features, methodological procedures, and the criteria used to assess the relevance of documents. Historiographic analysis, co-citation mapping, and bibliographic coupling serve as complementary approaches for examining the structure and evolution of the entrepreneurial well-being (EW) field.

Historiographic analysis explores the citation links among primary documents to trace the temporal progression and developmental milestones of the field. In contrast, co-citation analysis detects relationships between secondary sources that are frequently cited together, thereby shedding light on the domain's intellectual framework and key theoretical influences. Bibliographic coupling, in turn, assesses the degree of similarity among primary documents based on overlapping references, which helps to uncover emerging lines of inquiry and central research themes. The combined application of these complementary techniques allows for a thorough and multifaceted exploration of the entrepreneurial well-being (EW) domain, encompassing its historical roots, prevailing conceptual structures, and prospective directions for future investigation.

Table 1. Summary of bibliometric techniques

Method	Historiography	Document Co-Citation	Bibliographic Coupling
Focal Point	Primary documents (citing) and their chronological citations to other cited primary documents	Secondary documents (cited) that are cited together in primary documents	Primary documents (citing) that reference the same secondary documents
Temporal Focus	Past (development/evolution of the field)	Past/Present (intellectual structure; theoretical foundations)	Present/Future (research front, emerging topics)
Time Sensitivity	No	Yes	No
Unique Components	Reveals the evolution and dynamics of the EW field, as well as changes in perceptions over time.	Analyses the roots of the EW field and the „invisible colleges" of authors frequently cited together in clusters.	Detects current trends and future priorities in the EW field by examining recent works.
Key Methodological Mechanism	Frequency with which a primary document cites another primary document in its reference list. Knowledge flows from the cited work to the citing work, creating a link between them.	Frequency with which two documents in the EW field are cited together in another document. The more two documents are co-cited, the more likely their content is related.	Frequency with which two documents cite the same references. Overlapping bibliographies indicate greater similarity between documents.
Document Strength/Weight Indicator	„Core" documents = frequency of citations of a primary document by other primary documents.	Co-citation strength = frequency with which two secondary documents are co-cited by primary documents.	Coupling strength = frequency of co-occurrence of secondary documents in the reference lists of two primary documents.
Research Question	How has the knowledge domain of entrepreneurial well-being evolved over time?	What is the underlying intellectual structure within the knowledge domain of entrepreneurial well-being?	Considering the pathways, strengths, and gaps in the structure and evolution of research on entrepreneurial well-being, what are the theoretically and practically relevant future directions?

Source: Developed by the authors based on Vogel et al. (2020).

The combined use of these three bibliometric techniques offers significant advantages, as each operates within a distinct temporal framework. Historiography establishes a chronology, enabling the visualisation of themes, networks, and citations across the historical evolution of a field (van Eck & Waltman, 2014). Co-citation analysis investigates the degree of bibliographic intersection by assessing how often two primary sources are referenced together within subsequent literature. By analysing which secondary documents are co-cited and how frequently, co-citation sheds light on the relationships and interactions between researchers, unveiling the intellectual traditions and roots of a field (Vogel, 2012). Lastly, bibliographic coupling focuses on identifying primary sources that share common references to the same secondary literature. This method highlights emerging themes and potential future developments within the literature (van Raan, 2005). Collectively, these three bibliometric approaches offer mutually reinforcing insights into the organisation and positioning of knowledge within the entrepreneurial well-being (EW) domain.

To enrich the quantitative analysis provided by these methods, the content of the 50 most frequently cited documents was coded. These documents were selected based on their citation frequency, ensuring a focus on foundational works. The coding framework included fundamental attributes of each document (such as publication year and source), thematic elements (like the variables examined), methodological features (distinguishing between conceptual and empirical designs, analytical strategies, and units of analysis), and procedural components (such as stated objectives and reported outcomes). Incorporating content analysis in this way enriches the findings obtained through bibliometric methods, contributing to a more holistic comprehension of the entrepreneurial well-being (EW) domain.

Historiography

The analysis begins with historiography, a bibliometric approach designed to capture the evolution and dynamics of a field (Garfield, 2004; van Eck & Waltman, 2014). Historiography considers only the relationships among primary documents, which are identified in the database through keyword searches in WoS. For example, two primary documents, Document A and Document B, are connected if Document A cites Document B. For this connection to exist, Document A must be more recent than Document B, allowing historiography to track the development of specific topics over time (van Eck & Waltman, 2014).

The relevance of a primary source grows in proportion to the number of citations it receives, indicating the extent to which it influences subsequent scholarly work. Changes in the citation trajectories of influential documents illustrate how focal themes within the field evolve over time. Consequently, historiography provides insights into dominant paradigms and their transformations (Garfield et al., 2003). Using the Biblioshiny tool within Bibliometrix, 668 primary documents were analysed, focusing on the 50 most-cited documents (7.49% of the total) to visualise key paradigms and their evolution.

Co-citation

Co-citation indicates semantic similarity by tracking pairs of articles cited together in bibliographies. For instance, Documents A and B may both cite references r1, r2, and r3. In this context, r1 and r2 are considered co-cited because they appear in the bibliography of Document A, and similarly, r2 and r3 are co-cited because they appear in the bibliography of Document B (Spinak, 1996).

Co-citation analysis yields two principal outputs: the intensity of co-citation relationships and the graphical representation of clusters formed by frequently co-cited secondary sources. These clusters represent „invisible colleges" of scholars who communicate regarding shared research interests (Vogel, 2012). Additionally, the frequency and regularity with which a cited article appears in other works reduces the distance between nodes in the co-citation network (Ahmi, 2022). Graphically, co-citation relationships can be represented to illustrate the network of connections and groupings within a field (Figure 1).

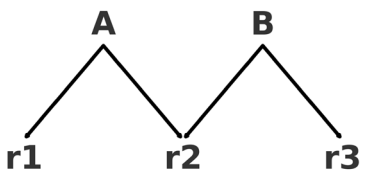


Figure 1. Document co-citation

The underlying assumption supporting this analysis is that when two secondary documents are co-cited, they share content similarities (Small, 1973). Nodes sharing the same colour tend to exhibit thematic commonalities, which are represented in a network graph. Document co-citation is a dynamic measure that evolves over time as older documents accumulate more citations (Batistic et al., 2017). Beyond measuring the intensity of shared citations, co-citation analysis also generates visual groupings that illustrate the interconnections among frequently cited documents.

The dimensions of interest in co-citation networks include: (1) the centrality and periphery of nodes, (2) their proximity and distance, (3) the strength of connections, (4) clusters, and (5) bridging contributions (Aria & Cuccurullo, 2017). Co-citation strength, regarded as a marker of scholarly relevance, denotes how often two secondary sources are jointly cited within primary literature. The greater the co-citation strength of a document, the more likely it is to be semantically related to other documents, and the more critical its role in the field becomes (Small, 1973). Additionally, betweenness centrality quantifies the frequency with which a node serves as an intermediary on the shortest paths linking other nodes, thereby reflecting its role as a key connector within the network structure.

The *Biblioshiny* software tool was employed to organise secondary documents within a two-dimensional similarity matrix. In this type of visualisation, nodes with stronger relationships are placed in proximity, whereas those with weaker connections appear more distant. The software subsequently groups documents into clusters, each comprising tightly linked nodes. To illustrate the co-citation network, *Biblioshiny* assigns distinct colours to indicate the cluster membership of each secondary source.

Bibliographic coupling

Bibliographic coupling contributes analytical value that complements and extends beyond what document co-citation reveals by presenting a more current perspective on the field. While co-citation analysis concentrates on secondary sources and draws on citation patterns that emerge over extended periods, thus reflecting the intellectual foundations of the past, bibliographic coupling redirects attention toward primary documents and the sources they reference, allowing for an analysis rooted in the contemporary structure of the literature. Since primary documents containing citations are more recent than the secondary documents they reference, bibliographic coupling analysis is particularly effective for detecting priority trends in the field (Vogel et al., 2020; Donthu et al., 2021).

The purpose of bibliographic coupling analysis is to examine the extent to which primary documents share common references, thereby identifying connections between sources based on overlapping bibliographies. This method examines whether two primary documents share at least one secondary reference (Kessler, 1963). More shared references between two primary documents indicate a stronger bibliographic coupling or greater document weight. For instance, if documents A and B both include sources C, D, and E in their bibliographies, their coupling strength would be three, representing the number of common references cited by both.

This study utilised the same dataset for bibliographic coupling as was used in the other two bibliometric techniques. From the 668 primary documents analysed, a minimum citation threshold of five was established, resulting in a subset of 50 documents. The data were visualised through *Biblioshiny*, applying the same procedures as in the co-citation analysis. The resulting clusters reflect groups of documents with strong thematic connections, each visually distinguished by a specific colour.

RESULTS

In response to the research questions, the findings are organised around three analytical dimensions: first, the temporal evolution of the entrepreneurial well-being knowledge domain; second, the underlying intellectual structure that supports this field; and third, future research paths of theoretical and practical relevance, identified through patterns and gaps observed in the analysis.

Historiography technique results

As a starting point for tracing the development of the entrepreneurial well-being (EW) field and the transmission of its knowledge over time, the analysis uncovers 12 clusters composed of thematically interconnected documents. However, as illustrated in Figure 2, a dominant cluster appears in turquoise (Cluster 1), representing the earliest documents in this

field of study. From this foundational cluster, three other clusters: purple, dark green, and light green (Clusters 7, 4, and 8, respectively) branch out and form part of the primary evolutionary trajectory of EW alongside Cluster 1. While these clusters eventually merge into the main discourse, it is worth noting that the dark green cluster, despite emerging later, has played an active role in recent years.

Based on this structure, the following analysis focuses on identifying the core themes represented in Cluster 1 and examining how these themes have developed over time. Among the identified clusters, the dark green group (Cluster 4) is the most extensive, encompassing 14 primary documents. The historical roots of Cluster 1 revolve around practical aspects of entrepreneurial well-being, including comparative studies between self-employment and conventional employment, as well as notable gender-based distinctions in various well-being dimensions.

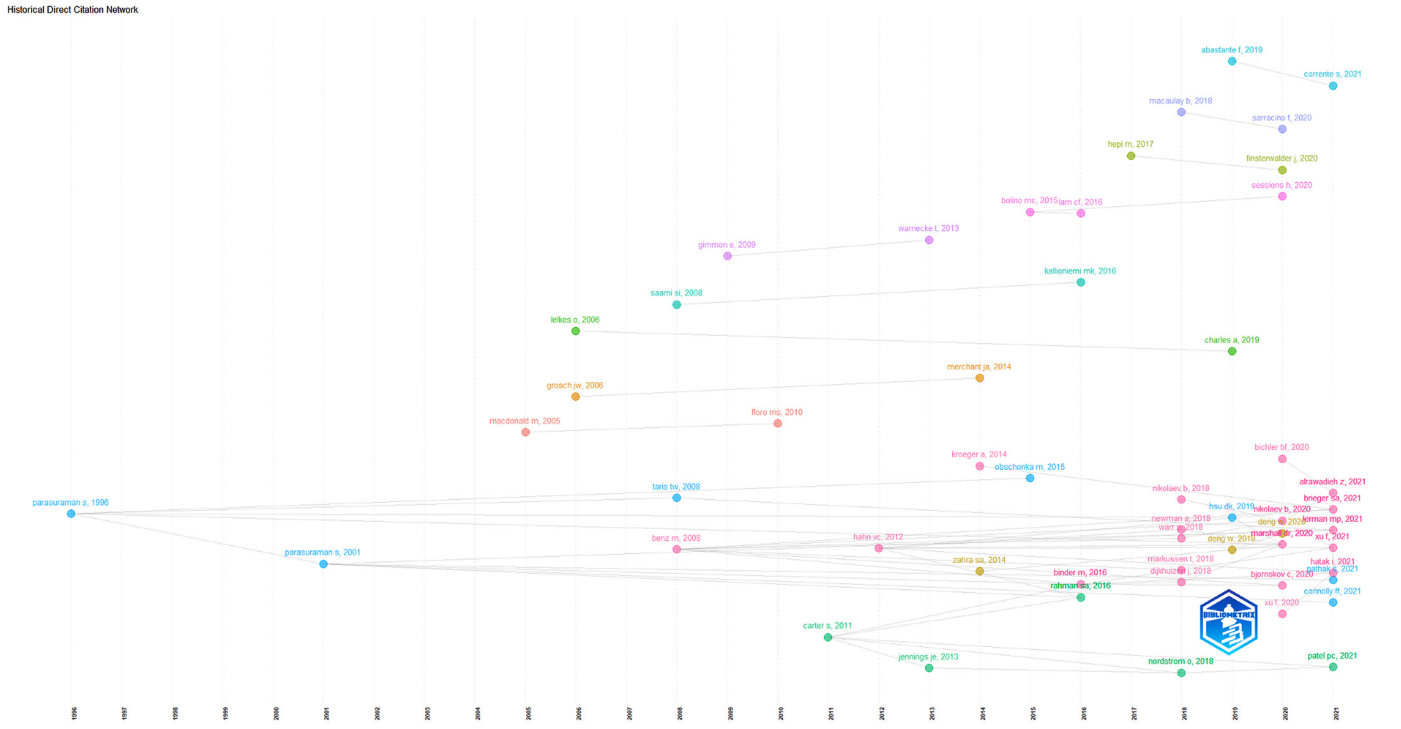


Figure 2. Historiography

The foundational work on entrepreneurial well-being (EW) begins with Parasuraman et al. (1996), who explore the influence of work and family variables on entrepreneurial success and psychological well-being. The findings underscore the influence of gender by revealing how professional achievement and stress among entrepreneurs are strongly shaped by the interaction between work and family responsibilities. Continuing in this vein, Parasuraman and Simmers (2001) investigate the effects of work and family role characteristics on work-family conflict and psychological well-being indicators across genders, comparing self-employed individuals and organisational employees. They suggest that while self-employment offers certain advantages, such as autonomy and flexibility, it is not a panacea for balancing work and family responsibilities. Self-employed individuals enjoy greater participation and job satisfaction, but they also report higher levels of work-family conflict and lower family satisfaction compared to employees.

Subsequent studies further illuminate these dynamics. Taris et al. (2008) examine the relationship between work addiction, manifested as excessive working hours and an inability to disconnect and perceived health outcomes, including exhaustion, physical discomfort, and professional efficacy. Their results indicate that the difficulty in detaching from work emerges as the factor most closely linked to adverse effects.

In 2008, a new perspective emerged, represented in the dark green cluster, with Benz and Frey (2008) taking self-employment as a significant case of independence. They demonstrate that self-employed individuals derive greater job satisfaction than employees, irrespective of income or working hours. Entrepreneurs value not only outcomes but also the processes leading to those outcomes, a concept referred to as „procedural utility." Binder and Coad (2016) revisit this

line of inquiry, building on the work of Hahn et al. (2012), who differentiate between hedonic and eudaimonic well-being. Using indicators such as life satisfaction and vigour, they affirm the self-regulation framework, showing that eudaimonic well-being is a critical dimension influencing proactive entrepreneurial behaviour.

In this context, Binder and Coad (2016) distinguish between voluntary and involuntary self-employment. Engaging in self-employment by choice has been linked to favourable outcomes, such as enhanced life satisfaction, improved health, and greater job satisfaction within the initial three years. In contrast, self-employment motivated by unemployment does not produce comparable benefits. Nonetheless, both voluntary and involuntary forms of self-employment are associated with a gradual decline in satisfaction with leisure time over extended periods.

The dark green cluster concludes with two significant contributions. The first is Pathak's (2021) work, which empirically tests a model combining individual-level psychological theories such as the broaden-and-build theory of positive emotions and human and social capital theories. Pathak explores the indirect influence of social well-being on entrepreneurship through national self-expression values. Drawing on secondary data from 44 countries provided by the Global Entrepreneurship Monitor and the World Values Survey, Pathak performs a multi-level, cross-cultural analysis. The study reveals that social well-being is positively linked to self-expression values, which in turn mediate the connection between collective and individual well-being and the propensity to engage in entrepreneurial activity.

The second notable contribution is by Connolly et al. (2021), who examine the relationship between business size and various dimensions of subjective well-being, including life satisfaction and emotional well-being, among small business owners. The analysis focuses on the potential benefits, such as financial satisfaction, as well as the disadvantages, including time pressure, associated with business size. The findings indicate that financial satisfaction shows a stronger relationship with overall life satisfaction, whereas time pressure exerts a greater influence on emotional well-being.

These investigations offer a historical perspective on research related to entrepreneurial well-being, with particular emphasis on its practical dimensions within entrepreneurial settings and on comparisons between the well-being of self-employed individuals and that of salaried workers. Notably, the dark green and blue clusters primarily consist of research conducted in European contexts. For instance, Benz and Frey (2008) empirically show that self-employed individuals derive greater satisfaction from their activities than employees, viewing self-employment as a significant step toward independence. Similarly, Kroeger and Weber (2014) develop a conceptual framework related to the satisfaction of social entrepreneurs within different socioeconomic and institutional contexts, published in the Academy of Management Review.

Broadly speaking, additional studies examine themes that encompass physiological well-being, psychological functioning, and overall life satisfaction, as well as entrepreneurial performance, thereby expanding the empirical scope to countries such as China, Turkey, Australia, and India. Comparative analyses at the European and international levels, often utilising meta-analytic methods, further enrich this area of research. In contrast, the other clusters (2, 3, 5, 6, 8, 9, 10, 11, and 12) deal with scattered and loosely connected subjects, lacking consistent development in subsequent scholarly contributions. Table 2 outlines the documents with the most local citations from the blue (1), dark green (1), and purple (7) clusters.

Table 2. Most important documents for each cluster in the historiography analysis

Cluster	Reference	Year	Local Citations	Global Citations	Title
1	Parasuraman S, 1996, J VOCAT BEHAV DOI 10.1006/JVBE.1996.0025	1996	13	425	Work and family variables, entrepreneurial success and psychological well-being
1	Parasuraman S, 2001, J ORGAN BEHAV DOI 10.1002/JOB.102	2001	13	235	Type of employment, work-family conflict and well-being: A comparative study
1	Taris TW, 2008, WORK STRESS DOI 10.1080/02678370701758407	2008	13	106	The effects of job demands associated with social and economic change on well-being among self-employed workers
1	Obschonka M, 2015, J PERS PSYCHOL DOI 10.1027/1866-5888/A000128	2015	13	40	"I wish I had a regular job": An exploratory study on entrepreneurial regret
1	Hsu DK, 2019, J BUS RES DOI 10.1016/J.JBUSRES.2018.11.006	2019	12	16	Entrepreneurial regret and its impacts on psychological well-being
4	Benz M, 2008, ECONOMICA DOI 10.1111/J.1468-0335.2007.00594.X	2008	13	105	Being independent is a great thing: Subjective evaluations of self-employment and hierarchy
4	Binder M, 2016, J HAPPINESS STUD DOI 10.1007/S10902-015-9698-2	2016	13	33	Are self-employed workers happier? Utility of procedure in their professional lives

Cluster	Reference	Year	Local Citations	Global Citations	Title
4	Hahn VC, 2012, ENTREPR THEORY PRACT DOI 10.1111/J.1540-6520.2011.00490.X	2012	13	38	Happy and proactive? The role of hedonic and eudaimonic well-being in entrepreneurial initiative
4	Nikolaev B, 2020, ENTREPR THEORY PRACT DOI 10.1177/1042258719830314	2020	11	45	Entrepreneurship and subjective well-being: The mediating role of psychological functioning
7	Djkhuizen J, 2018, J HAPPINESS STUD DOI 10.1007/S10902-017-9914-6	2018	13	35	Well-being, entrepreneurial success, and business performance: A longitudinal study
7	Carter S, 2011, ENTREPR THEORY PRACT DOI 10.1111/J.1540-6520.2010.00422.X	2011	13	37	Family-owned enterprises: Exploring income, wealth, and economic well-being of entrepreneurial households
7	Jennings JE, 2013, FAM RELAT DOI 10.1111/FARE.12013	2013	12	31	When families are entrepreneurs: Is family involvement good for entrepreneurial ventures?
7	Rahman SA, 2016, SOC INDIC RES DOI 10.1007/S11205-015-0951-4	2016	13	27	Entrepreneurship and well-being: The role of private organisations
7	Nordstrom O, 2018, ENTREPR THEORY PRACT DOI 10.1177/1042258717749236	2018	12	25	Entrepreneurial well-being: Insights into family businesses and their impact on family satisfaction
7	Patel PC, 2021, ENTREPR THEORY PRACT DOI 10.1177/1042258720936984	2021	11	15	Senior entrepreneurship and subjective well-being: Balancing self-employment, income, and leisure time

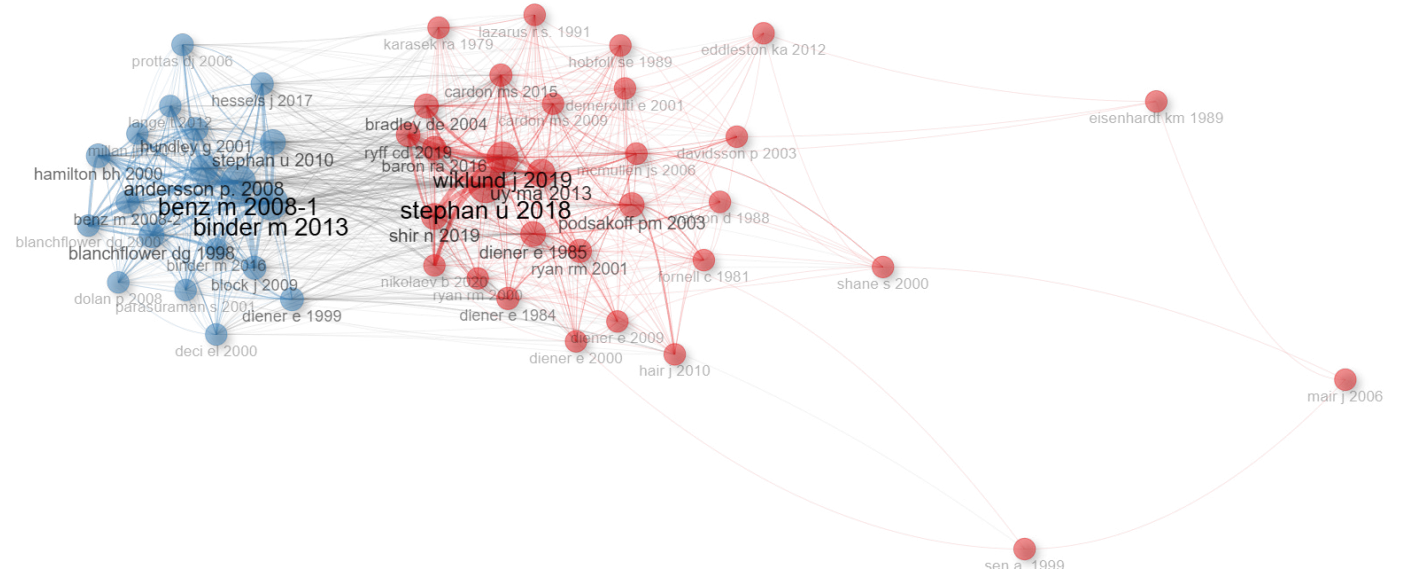
The application of historiography techniques reveals two principal observations. First, the most influential documents over time are organised into two main clusters: the blue cluster and the dark green cluster, with an emerging trajectory represented by the purple cluster. These two main clusters form the backbone of research in the field, while the other clusters contain isolated information that did not lead to significant subsequent lines of inquiry.

Second, the field of entrepreneurial well-being (EW) originated primarily from empirical investigations. Over time, the need to develop substantive theories to underpin this empirical evidence became evident (e.g., Carter, 2011; Zahra et al., 2014; Binder & Coad, 2016; Marshall et al., 2020; Patel et al., 2021; Pathak, 2021). However, relying solely on historiographic analysis would limit a comprehensive understanding of the intellectual structure of this field. To address this limitation, the results from the document co-citation analysis are presented below.

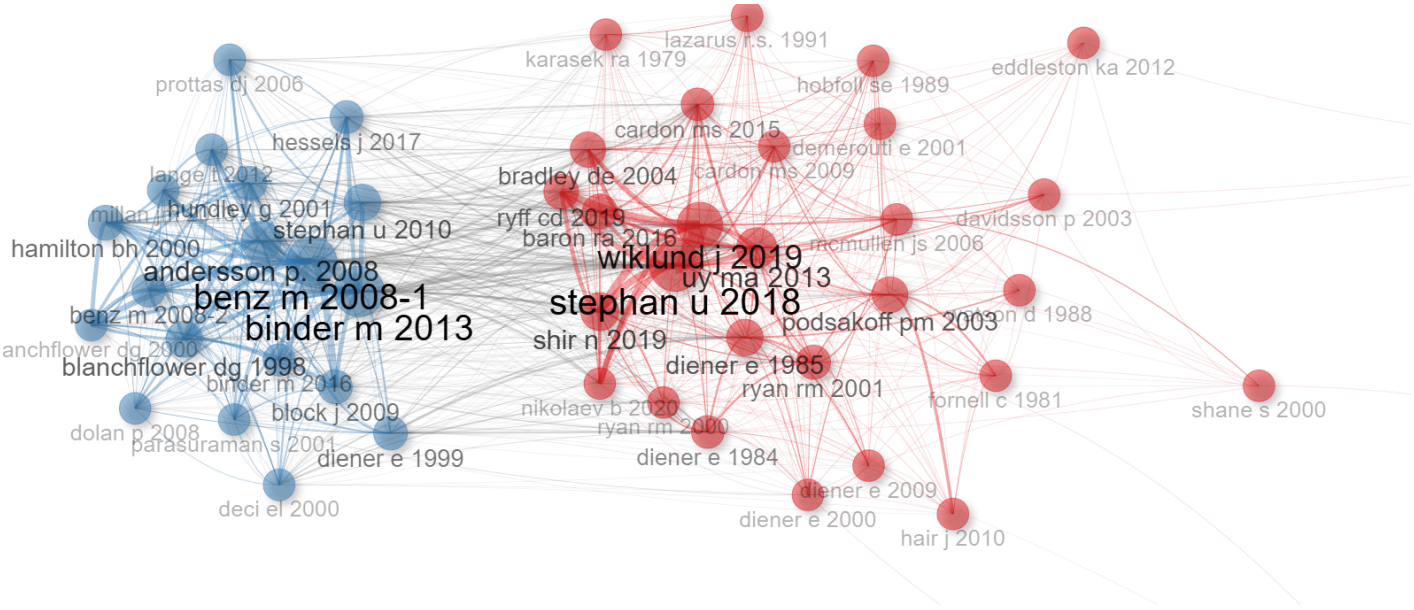
Results from the document co-citation technique

The information summarised in Table 3 and Figure 3 highlights the concentrated results of document co-citation analysis. From this analysis, it is evident that the year with the highest volume of publications on the topic was 2000, with six documents being co-cited. Furthermore, 78% of the documents were published between 2000 and 2020, reflecting a significant concentration of research activity during this period.

The dominant journals, as identified by the PageRank metric (which measures the direction and weight of connections), are the *Academy of Management Review* and the *Journal of Applied Psychology.* It is worth noting that co-citation analysis may present certain biases. A limited number of journals tend to concentrate most frequently co-cited documents, whereas the vast majority contribute only a few co-cited articles.



Complete graph



Graph detail

Figure 3. Co-citation analysis

The largest nodes correspond to the documents identified as the most frequently cited within the dataset, making them the most influential, with a high level of interrelation and thematic similarity. These include Stephan (2018), Wiklund et al. (2019), and Uy et al. (2013) in the red cluster, Binder and Coad (2013), Benz and Frey (2008), and Andersson (2008) in the blue cluster. Nodes with high betweenness centrality (values exceeding 100) are also identified, primarily within the blue cluster. These nodes serve as critical connectors between major groups within the network, making them accessible from multiple perspectives.

For instance, the study by Diener et al. (1999) (120.08) revisits the evidence from Wilson (1967) and discusses modern theories of subjective well-being, emphasising dispositional influences, adaptation, goals, and coping strategies. Similarly, Block and Koellinger (2009) (103.74) illustrates that entrepreneurs value not only outcomes but also the processes leading to them. Additionally, Benz and Frey (2008) (100.52) underscore the significance of procedural utility in understanding economic behaviour, demonstrating that the process leading to a decision impacts satisfaction with its outcome.

With lower betweenness centrality (values below 100), Stephan (2018) (70.30) in the red cluster outlines a framework for developing a dedicated theory of entrepreneurial work, where mental health and entrepreneurial well-being are dynamic, socialised, context-sensitive, and account for the variability and fluidity in entrepreneurs' life domains. This document's importance is attributed to two main factors: its originality in conceptualising entrepreneurial well-being and its practical relevance to the real-life experiences of entrepreneurs. Table 4 provides a detailed description of the various indicators analysed for the top five articles per cluster, ranked according to their PageRank results derived from co-citation analysis of the documents and their respective scores.

Table 4. Key articles based on document co-citation analysis

Cluster	Year	Node	Betweenness	Closeness	PageRank	Title
1	2018	Stephan U 2018	70.30270896	0.01123596	0.04062045	Entrepreneurs' mental health and well-being: A review and research agenda
1	2019	Wiklund J 2019	44.19281642	0.01123596	0.03665338	Entrepreneurship and well-being: Past, present, and future
1	2013	Uy MA 2013	30.69050506	0.01098901	0.03329534	Joint effects of prior start-up experience and coping strategies on entrepreneurs' psychological well-being
1	2019	Shir N 2019	43.23962329	0.01123596	0.02665366	Entrepreneurship and well-being: Past, present, and future
1	2001	Ryan RM 2001	13.86219877	0.01030928	0.02626487	On Happiness and Human Potentials: A Review of Research on Hedonic and Eudaimonic Well-Being
2	2008-1	Benz M 2008-1	100.5202787	0.01123596	0.03563125	Being independent is a great thing: Subjective evaluations of self-employment and hierarchy
2	2013	Binder M 2013	68.47907305	0.01052632	0.03354702	Life satisfaction and self-employment: A matching approach
2	2008	Andersson P 2008	16.74420992	0.00952381	0.02636518	Happiness and health: Well-being among the self-employed
2	1998	Blanchflower DG 1998	4.423548091	0.00900901	0.02565116	What makes an entrepreneur?
2	2008-2	Benz M 2008-2	5.310291207	0.00934579	0.02334446	The value of doing what you like: Evidence from the self-employed in 23 countries

The two most influential documents from each cluster are Stephan (2018) from the red cluster and Benz and Frey (2008) from the blue cluster. These references exhibit the highest values across the three analysed indicators: PageRank, betweenness centrality, and closeness centrality. They are the most co-cited references, and therefore, the most influential within their respective clusters. These works introduce key aspects that have shaped the trajectory of knowledge on entrepreneurial well-being (EW). Stephan (2018) emphasises the importance of mental health and well-being in entrepreneurs' lives and work, while Benz and Frey (2008) demonstrate how entrepreneurial decision-making autonomy impacts individual well-being, highlighting not only the outcomes but also the processes leading to these results (procedural utility).

In general, the red cluster encompasses 31 out of the 50 most impactful contributions within the entrepreneurial well-being literature. Most of these works focus on theoretical research on subjective and psychological well-being, happiness, entrepreneurial passion, entrepreneurship-related stress, and the development and validation of scales for measuring positive and negative affect (e.g., PANAS scales) and life satisfaction. Empirical studies in this cluster predominantly address the context of European countries, although American and Asian studies also appear.

The oldest document in this cluster is Karasek (1979), „Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign," published in *Administrative Science Quarterly*. This study formulates and empirically evaluates a stress management framework using data from Sweden and the United States. It proposes that psychological strain arises from the interplay between work demands and autonomy in decision-making. When individuals experience limited decision latitude alongside elevated job demands, the outcome is increased mental distress and reduced job satisfaction.

These concepts have influenced subsequent works, gaining prominence in recent years. For instance, Stephan (2018) reviews the literature and proposes new research directions on mental health and entrepreneurial well-being, while Shir et al. (2019) emphasise the importance of individual self-organisation in entrepreneurial work, which makes entrepreneurship more beneficial in terms of fulfilling basic psychological needs compared to other employment alternatives.

Of the 31 documents in the red cluster, only five were published in the *Journal of Business Venturing*, making it the journal with the highest number of co-cited documents in this cluster (16.13%). Three of these were published in 2019, coinciding with a surge in publications on entrepreneurial well-being. These documents primarily focus on the present state of entrepreneurship and well-being, its past developments, and future research directions, as well as specific aspects of well-being, including the eudaimonic well-being approach and its application to entrepreneurial science.

In this journal, Davidsson and Honig (2003) revisited the themes of social and human capital among nascent entrepreneurs. Similarly, *Uy et al.* (2013), drawing on coping and entrepreneurial theories, examine the combined effects of prior start-up experience and active and avoidance coping strategies on entrepreneurs' psychological well-being. The second journal with the most contributions was the *Academy of Management Review* (12.90%), followed by *Entrepreneurship Theory and Practice* and *American Psychologist* (9.68%).

Two subgroups emerged within the red cluster. The first comprises 28 references connected at various levels of betweenness and closeness centrality, as ranked by PageRank. In contrast, the second subgroup consists of three references located on the periphery, with zero betweenness centrality, far removed from the main group. This is logical, as these references pertain to highly specific research methodologies, such as Fornell and Larcker (1981) and Eisenhardt (1989). Meanwhile, Mair and Martí (2006) offer a distinct perspective on social entrepreneurship, viewing it as a process that catalyses social change and addresses significant societal needs. Unlike other forms of entrepreneurship, social entrepreneurship prioritises social value creation and development over direct financial benefits for entrepreneurs.

The blue cluster, in comparison, contains 19 documents, with the most prominent being Blanchflower and Oswald (1998) and Diener et al. (1999). Over half of these documents (10) were published between 2000 and 2010, with the year 2000 yielding the highest number of works (3). The year 2017 marks the final period of joint citations on entrepreneurial well-being for this cluster. This group encompasses a broader range of journals from both *Business & Management* and *Psychology* categories, with *Small Business Economics* having the highest number of co-cited documents (15.79%). Notably, there is little concentration of research within a single journal across both clusters.

Findings from the co-citation analysis indicate that foundational studies have played a central role in shaping the development of the entrepreneurial well-being field. on entrepreneurial well-being, distinguishing two main lines of inquiry: hedonic (subjective) well-being and eudaimonic (psychological) well-being. The red cluster emphasises literature reviews aimed at proposing integrative or holistic models of well-being. Conversely, the blue cluster focuses on comparative empirical studies between entrepreneurs and salaried workers, examining specific variables and domains such as health, performance, outcomes, happiness, life satisfaction, job satisfaction, stress, independence, work-family conflict, and individual or social well-being. An essential contribution in this cluster is the review of economic literature on subjective well-being and happiness, commonly referred to as the „economics of happiness," published in the *Journal of Economic Psychology* by Dolan et al. (2008). Although co-citation analysis provides a meaningful understanding of the structural foundations of the entrepreneurial well-being field, its retrospective nature makes it necessary to supplement it with bibliographic coupling. This complementary method emphasises the detection of emerging trends and prospective directions within the domain.

Results from the bibliographic coupling technique

In terms of overall structure, bibliographic coupling identified four clusters. The documents with the highest coupling strength are summarised in Table 4 and visualised in Figure 4. Among these, 26% were published in the *Journal of Business Venturing*, while 10% appeared in *Entrepreneurship Theory and Practice* and *Small Business Economics*, and 6% in the *Journal of Happiness Studies* and the *Journal of Business Research*. These journals collectively dominate the entrepreneurial well-being (EW) field, representing 58% of the publications. Notably, 72% of the documents were published between 2019 and 2022, with 24% and 26% corresponding to 2021 and 2022, respectively. However, 50% of the articles in the *Journal of Business Venturing* were published in 2019.

Of the four clusters, the red cluster exhibited the highest impact (4.14), followed by the green cluster (3.4), the blue cluster (2.28), and finally the purple cluster (1.88), which also displayed the lowest frequency. The oldest document, dating back to 2012, belongs to the green cluster (Hahn et al., 2012). Interestingly, 60% of the most-cited documents in

this cluster are relatively recent, published between 2020 and 2022. The blue cluster is the most contemporary, with 80% of its documents published in 2022.

The red cluster stands out due to two pivotal documents published in the *Journal of Happiness Studies* (2016 and 2021), with the former being the most cited (12.72). The articles within this cluster primarily focus on entrepreneurs' subjective well-being. In contrast, the blue cluster emphasises eudaimonic well-being, while the purple cluster, which has the least impact, centres on social entrepreneurs and their work-related well-being.

Table 4 provides detailed information on the five most influential documents in each cluster. The cited theories span organisational, individual, and social domains, contributing to the development of both management practices and psychological frameworks.

Figure 4. Research front of the EW field (based on bibliographic coupling)

Table 4. Most important documents for each cluster in the bibliographic coupling analysis

Cluster	Reference	Description	Frequency	Local Citations (Normalized)
1	Binder, M. (2016). *Journal of Happiness Studies*	Analyses the effects of self-employment on well-being, apart from monetary aspects, and highlights satisfaction with life, job satisfaction, and health.	13	12.72
	Xu, F. (2021). *Journal of Happiness Studies*	Proposes a multi-level theoretical framework explaining relationships between social and institutional factors and entrepreneurial well-being.	13	1.85
	Honjo, Y. (2022). *Applied Research in Quality of Life*	Investigates indirect positive effects of entrepreneurial experience on subjective well-being via risk and debt considerations.	13	1
	Rojas, M. (2022). *Applied Research in Quality of Life*	Examines life satisfaction and its relationship with entrepreneurs' emotional and sensory experiences.	13	1
	Abreu, M. (2019). *Journal of Business Venturing*	Studies entrepreneurial well-being differences between urban and rural settings.	13	0.94
2	Nikolaev, B. (2022). *Entrepreneurship Theory and Practice*	Explores how psychological functioning mediates the relationship between entrepreneurship and subjective well-being.	15	9.26
	Rahman, S. A. (2016). *Social Indicators Research*	Examines entrepreneurial success at the base of the pyramid, highlighting the role of organisational support and shared information.	15	1.73
	Nikolaev, B. N. (2022). *Entrepreneurship Theory and Practice*	Demonstrates that self-employed individuals are more likely to report higher levels of eudaimonic well-being (EWB), such as autonomy, competence, and purpose, compared to employees.	15	1
	Chatterjee, I. (2022). *Journal of Business Venturing*	Investigates women's well-being in entrepreneurial programmes, linking job and family support to realistic entrepreneurial goals.	15	1

Cluster	Reference	Description	Frequency	Local Citations (Normalized)
3	Hahn, V. C. (2012). *Entrepreneurship Theory and Practice*	Discusses the relationship between hedonic and eudaimonic well-being and entrepreneurs' proactive behaviours.	17	8.44
	Dijkhuizen, J. (2018). *Journal of Happiness Studies*	Analyses the links between entrepreneurial performance, subjective well-being, and personal resilience over time.	17	6.05
	Lerner, M. P. (2021). *Strategic Entrepreneurship Journal*	Expands entrepreneurial well-being research by exploring factors such as challenges and support systems.	17	4.62
	Marshall, D. R. (2020). *Journal of Business Research*	Highlights access to resources and resilience as predictors of entrepreneurial well-being.	17	1.68
	Kleine Stegemann, L. (2022). *Journal of Small Business Management*	Explores the importance of balancing entrepreneurial demands to improve work-life harmony and well-being.	17	1
4	Breiger, S. A. (2021). *Journal of Business Ethics*	Examines social value creation and its impact on entrepreneurs' well-being, focusing on work satisfaction and emotional health.	5	2.77
	Hatak, I. (2021). *Entrepreneurship Theory and Practice*	Studies entrepreneurial motives and the relationship between socio-economic and biological factors in well-being.	5	2.77
	Dong, J. (2022). *International Journal of Environmental Research and Public Health*	Examines the impact of social motivation on health and well-being, linking satisfaction with financial health and entrepreneurial success.	5	1
	Dong, J. (2022). *International Journal of Environmental Research and Public Health*	Analyses the relationship between prosocial intentions, health, and financial satisfaction in entrepreneurial exit strategies.	5	1
	Kibler, E. (2019). *Journal of Business Venturing*	Explores the interplay between prosocial motivation and subjective well-being in social entrepreneurship.	5	0.94

The red cluster (Coupling 1)

The red cluster addresses entrepreneurial well-being (EW) through the lens of hedonic well-being, focusing on life satisfaction, job satisfaction, health, and financial aspects. The most cited document in this cluster is Binder and Coad (2016), which establishes a framework for conceptualising entrepreneurs' work, centred on overall life satisfaction. In contrast, Xu et al. (2021) proposed a multilevel theoretical framework examining the relationships between social and institutional factors and entrepreneurial well-being. In 2022, Honjo et al. (2022) highlighted the influence of financial motives on entrepreneurial well-being, while Rojas et al. (2022) analysed the relationship between life satisfaction and the affective and sensory experiences of entrepreneurs. The oldest document in this cluster, Abreu et al. (2019), investigates variations in well-being between urban and rural areas.

The blue cluster (Coupling 2)

The blue cluster consists of 15 documents and integrates both conventional and alternative approaches to entrepreneurial well-being. The most influential work is *Nikolaev et al.* (2020), which presents a model where psychological functioning mediates the relationship between entrepreneurship and subjective well-being. This cluster also includes studies on the well-being of women entrepreneurs in India, emphasising the role of family support and prior experience (Chatterjee et al., 2022). Additional works explore the connection between business success and well-being at the base of the pyramid (Rahman et al., 2016), as well as Nikolaev et al. (2022). Key publications in this cluster originate from journals such as *Entrepreneurship Theory and Practice* and the *Journal of Business Venturing*.

The green cluster (Coupling 3)

The green cluster contains 17 documents and focuses on eudaimonic well-being and proactive behaviour among entrepreneurs. The oldest and most frequently cited work is Hahn et al. (2012), which links affective well-being with personal initiative. Most publications in this cluster are empirical, framed within socio-cognitive theories and job demands frameworks. High-impact journals such as *Entrepreneurship Theory and Practice*, *Journal of Happiness Studies*, and the *Strategic Entrepreneurship Journal* dominate this group.

The purple cluster (Coupling 4)

The purple cluster comprises five articles that emphasise the well-being of social entrepreneurs and prosocial motivation. Kibler et al. (2019) argue that prosocial motivation can negatively impact the subjective well-being of social entrepreneurs. Dong et al. (2022) explore how health and financial satisfaction influence social entrepreneurs' exit intentions. Key publications in this cluster are found in journals such as the *International Journal of Environmental Research and Public Health* and the *Journal of Business Ethics*.

The bibliographic coupling results reveal current trends in the EW field. The four clusters highlight distinct approaches: subjective well-being, psychological well-being among entrepreneurs, eudaimonic well-being, and the well-being of social entrepreneurs. Additionally, the *Journal of Business Venturing* emerges as a key journal across all clusters. These findings reflect both established and emerging perspectives in entrepreneurial well-being, offering a comprehensive view of the field's development.

Results of the content analysis technique

This study explored both the historical progression and emerging directions of the entrepreneurial well-being (EW) field by analysing the most influential publications. It contrasted prominent contributions identified through co-citation analysis (the 50 most frequently cited works) with those highlighted via bibliographic coupling (the 50 most recent documents). Drawing on the framework developed by Rajagopalan and Huff (1999), gaining insight into "the conversation" that unfolds within an academic domain is vital for understanding its development. Beyond the main research questions, the content analysis employed here aims to examine this scholarly dialogue by addressing the following specific questions within the EW literature:

Q1: Where is the conversation in EW taking place?

To understand the dominant venues for the EW conversation, the type of publication was coded (restricted to English-language articles). While earlier documents included a greater proportion of books (excluded from this analysis), more recent works predominantly appear in academic journals. The most prominent publication, across both the co-citation and bibliographic coupling analyses, is the *Journal of Business Venturing*. Historically, key journals included the *Academy of Management Review* and *American Psychologist*, whereas in the present, leading journals include *Entrepreneurship Theory and Practice*, *Small Business Economics*, and *Journal of Happiness Studies*. This evolution reflects a shift in the platforms that dominate the EW discourse over time.

Q2: Who are the key experts in the field of EW?

To determine the dominant voices in EW, the frequency of first authors across the 50 most significant documents was analysed. In the bibliographic coupling analysis, the most relevant authors included Dong, Nikolaev, Patel, Pathak, and Uy, each contributing two documents. Their works are concentrated within specific clusters: Patel, Pathak, and Uy in the green cluster, Nikolaev in the blue cluster, and Dong in the purple cluster. Conversely, in the co-citation analysis, the most influential author was Diener, with five cited works spanning 1984 to 2009. Benz, Binder, Blanchflower, Cardon, Ryan, and Stephan followed with two cited documents each. Benz, Binder, and Blanchflower were associated with the blue cluster, while Cardon, Ryan, and Stephan belonged to the red cluster.
Additionally, the analysis reveals that in more recent documents, the diversity of authors has increased, reflecting a broader array of contributors to the EW conversation. Nonetheless, most of the leading contributors remain based in the United States, indicating a geographical concentration of expertise in this field.

Q3: What is the content of the conversation among dominant documents in EW?

To uncover prevailing themes and theories, the documents were grouped according to their thematic focus. In the co-citation analysis, two principal groups emerged, each reflecting distinct approaches to EW. Conversely, the bibliographic coupling analysis, which emphasises more contemporary contributions, reveals a notable change in the thematic orientation of the scholarly discourse. Key themes include: 1) Subjective or Hedonic Well-being: Centred on life

satisfaction and positive and negative emotions, this theme explores the affective dimensions of entrepreneurial well-being. 2) Eudaimonic or Psychological Well-being: Offering a more philosophical perspective, this theme conceptualises EW as a deeper, purpose-driven form of fulfilment. 3) Work-Life Balance and Performance: This theme examines the intersection of work, life, and performance as indicators of entrepreneurial well-being. 4) Social Entrepreneurship and Prosocial Motivation: This focus addresses the well-being of social entrepreneurs, particularly their motivation to generate social impact beyond financial gain.

DISCUSSION

This section offers a reflective analysis of the results in relation to the three central research questions addressed in this study: first, the temporal evolution of the entrepreneurial well-being knowledge domain; second, the intellectual foundations that support it; and third, the prospective theoretical and practical directions emerging from the identified trends and research gaps. The entrepreneurial well-being (EW) field remains conceptually fragmented, highlighting the need for a more integrated framework to support its continued advancement. This bibliometric study addresses several limitations found in prior systematic reviews and meta-analyses, which often focus narrowly on specific aspects of well-being, use inconsistent definitions, and restrict their scope to a limited number of journals or time periods. While such restrictions are defensible in terms of parsimony and scientific progress (Glynn & Raffaelli, 2010), they hinder a comprehensive understanding of the field's theoretical evolution and constrain the ability to guide future research. To overcome these limitations, we employed three bibliometric approaches—historiography, document co-citation, and bibliographic coupling (Zupic & Čater, 2015)—to assess the evolution, current state, and future directions of EW.

This analysis incorporated two key features: (1) broad temporal coverage, spanning from 1979 to 2022, to enable an exhaustive examination of the field's evolution, and (2) diverse inclusion of sources, incorporating a wide range of influential documents, including those not commonly reviewed in existing literature or written in languages different from English.

The present analysis advances the literature on entrepreneurial well-being (EW) in three key dimensions. First, it offers a thorough and objective account of how the field has progressed over time. Second, it delivers an inclusive and balanced overview of the current landscape, focusing on its intellectual foundations and patterns of scholarly communication. By examining both the historical development and present configuration of the field, the study identifies prevailing trends and existing research gaps. Third, it proposes well-founded and actionable suggestions to inform future investigations. These suggestions involve reinforcing established areas of inquiry, delving into topics that remain insufficiently explored, and reconsidering the methodological and theoretical approaches used to examine EW. In the following section, the findings are discussed in relation to these contributions and the guiding research questions concerning the field's current status, its historical trajectory, and its potential future directions.

One of the principal contributions of this review lies in its broad and impartial analysis of the evolution of entrepreneurial well-being (EW). The findings allow for several key insights: first, the dissemination of knowledge within the field has primarily been shaped by two dominant narratives; second, the field initially emerged from practical concerns; and third, foundational well-being theories serve as the conceptual basis of the EW discourse.

The historiographic analysis highlights a dominant group of studies that initiated and shaped the EW knowledge trajectory over time. The transmitted knowledge in EW has primarily evolved around a paradigm that seeks holistic well-being for entrepreneurs in their professional and family lives, examining its societal influence and the impact of institutional frameworks. This prevailing line of thought features influential scholars like Diener, whose theoretical contributions are central to the field, along with the significant impact exerted by *the Journal of Business Venturing.*

While this integration and alignment have advanced the field, the concentration of research in a narrow range of journals and authors may have limited the inclusion of alternative perspectives. The EW discourse generally focuses on entrepreneurship and organisational behaviour, but there is significant scope to incorporate multidisciplinary frameworks. In particular, while EW research has benefited from contributions in psychology and economics, its integration with fields such as sociology, public policy, and cultural studies remains limited. Expanding the scientific dialogue to include a broader range of contributors could generate innovative perspectives, novel theories, and practical insights.

Historiographic analysis traces the origins of EW research, revealing that co-citation studies have predominantly focused on longitudinal field experiments exploring well-being development within and beyond entrepreneurial organisations. In this regard, future research should adopt alternative approaches, such as constructivism, critical

theory, and pragmatism, which require deeper interactions with organisations and institutions to foster both individual entrepreneurial well-being and broader social well-being.

Aligned with these trends, the future of EW lies in fostering strong partnerships between research and practice, such as co-creation labs or collaborative communities. These partnerships aim to bridge tensions between academic and practical stakeholders, promoting collaboration that leverages diverse perspectives. Such a model can generate research that addresses the challenges and opportunities of entrepreneurial organisations while maintaining a scientific, innovative, and experiential focus, thus supporting both EW research and practice.

The results also indicate that promoting greater interdisciplinary integration is essential to deepen both the conceptual and applied comprehension of entrepreneurial well-being. Psychology, sociology, and economics each contribute distinct conceptualizations of well-being, yet their integration remains challenging due to epistemological tensions. Psychological research predominantly frames well-being in subjective terms, focusing on emotional states, cognitive evaluations, and self-determination (Diener, 1984; Deci & Ryan, 2000). In contrast, sociological perspectives emphasize structural and relational factors, such as institutional support, social capital, and collective resilience (Putnam, 2000). Meanwhile, economic approaches focus on objective measures, including financial performance, employment stability, and income levels (Frey & Stutzer, 2002). These disciplinary differences create methodological and conceptual tensions, particularly regarding how well-being is operationalized in entrepreneurial contexts.

This analysis indicates that psychological perspectives on well-being have gained prominence in EW research in recent years. However, this shift may reflect broader socioeconomic transformations, evolving entrepreneurial practices, or policy-driven initiatives promoting mental health and well-being in business settings. Future research could benefit from mixed method approaches that integrate bibliometric techniques with qualitative analyses, such as expert interviews and policy document reviews, to further explore these connections.

Such collaborative efforts also create opportunities to investigate complex and transformative issues within the entrepreneurial well-being (EW) domain. These include questions such as how EW theory and practice can foster a sense of purpose, whether innovative EW strategies can address global challenges like climate change or sustainable consumption, and to what extent EW can directly support the achievement of the United Nations' Sustainable Development Goals. This influence may extend beyond entrepreneurial organisations, empowering individuals to apply their leadership abilities in family and community settings. Additionally, attention should be given to how the physical environment and infrastructure shape EW processes and their associated outcomes.

These represent just a few of the pivotal questions that hold value for both the academic and professional communities. Collaborations between researchers and practitioners enable the development of relevant organisational studies that reflect the goals of the entrepreneurial well-being (EW) field. Such initiatives can apply experimental designs, quasi-experimental strategies, and comprehensive qualitative approaches to investigate the drivers and consequences of EW across multiple analytical levels.

In addition, our findings contribute to the literature by identifying how the structure and intellectual evolution of EW research align with, diverge from, or expand upon prior studies. Unlike previous systematic reviews that focus on specific aspects of EW (e.g., Sánchez-García et al., 2018; Usai et al., 2020), our study offers a broader, more integrative perspective through bibliometric techniques. This allows us to validate existing frameworks while uncovering overlooked connections between research clusters, thereby contributing to the theoretical advancement of the field.

An additional key insight from this study is the acknowledgment of the importance of fostering deeper interdisciplinary integration within entrepreneurial well-being (EW) research. While prior literature (e.g., Nikolaev et al., 2020) has acknowledged the role of psychology and economics in shaping EW, our findings suggest that sociology, public policy, and organisational studies must also be incorporated to develop a more holistic framework. Bridging these disciplines will not only enrich the theoretical landscape of EW but also enhance its practical applications by considering broader social, economic, and institutional influences on entrepreneurial well-being.

Furthermore, our results suggest that despite the increasing diversification of authorship and research methodologies in recent years, EW remains concentrated in a few influential journals and regions. This finding extends discussions by Pathak (2021) and highlights the necessity of greater geographical and thematic diversity in future research.

Finally, this analysis identifies distinct research clusters that contribute to different intellectual traditions and theoretical frameworks shaping entrepreneurial well-being (EW). These clusters provide crucial insights into the field's conceptual development and highlight emerging theoretical perspectives. Specifically, the findings suggest three key implications for advancing theory in EW research.

To begin with, foundational theoretical frameworks have been instrumental in guiding the development of research on entrepreneurial well-being. The widespread use of psychological constructs such as self-determination theory, positive psychology, and the job demands resources model reflects the strong influence of individual and cognitive perspectives within the field. While these theories provide a strong foundation for understanding entrepreneurial well-being at the personal level, they may not fully account for the social and institutional factors that shape well-being in entrepreneurial contexts. This highlights the need for a broader theoretical lens that incorporates external influences beyond the entrepreneur's psychological state.

Second, the integration of sociological and economic perspectives is gaining traction in EW research. Certain research clusters reflect a growing interest in institutional influences, social capital, and economic stability as key determinants of EW. This shift suggests an ongoing transition toward multi-level models that account for both individual and systemic determinants of well-being. Such an approach aligns with broader interdisciplinary discussions advocating for a more holistic understanding of entrepreneurship, recognizing that well-being is influenced not only by personal resilience and psychological traits but also by market conditions, regulatory environments, and social support systems.

Third, epistemological tensions between research traditions highlight the need for hybrid theoretical models. The fragmentation of research clusters underscores a persistent divide in EW studies. Research that focuses on subjective well-being (psychological lens) often operates separately from studies examining financial well-being (economic lens). This theoretical divide limits the development of integrative models that consider both individual experiences and structural conditions. Future research should prioritize hybrid theoretical frameworks that incorporate insights from psychology, sociology, and economics, facilitating a more comprehensive understanding of how entrepreneurial well-being is shaped across multiple levels of analysis.

By identifying these key theoretical trends, this study not only maps the existing knowledge structure of EW but also provides a foundation for advancing interdisciplinary research that bridges conceptual gaps. Moving forward, greater integration of these perspectives will be essential for developing more inclusive, robust, and practically relevant models of entrepreneurial well-being.

CONCLUSION

This study aimed to deliver a thorough, unbiased, and integrative examination of the scholarly work on entrepreneurial well-being (EW). Through the application of three bibliometric techniques, it explored how the field has developed over time, its present intellectual dynamics, structural foundations, and evolving areas of interest. Furthermore, an analysis of the content within the most impactful publications was conducted to gain deeper insight into the ongoing academic discourse on EW.

The findings reveal a distinct set of future research directions, which can be categorised into three main areas: (1) research themes within the existing framework that explore hybrid models, (2) research themes that revisit proposed yet underrepresented or disconnected contributions, and (3) research themes that systematically analyse how to implement findings into practice using existing models.

It is expected that future investigations guided by these proposed research directions will meaningfully contribute to the continued expansion and distinctiveness of the entrepreneurial well-being literature. In addition, these contributions are intended to promote the refinement of best practices in the field, supporting both theoretical progress and real-world implementation.

As is common in academic inquiry, this research presents some inherent constraints.

First, while the selected keywords are believed to have face validity, the specific choice of keywords to describe the entrepreneurial well-being (EW) field may have influenced the results (Batistic & van der Laken, 2019). However, the strength of the bibliometric methodology lies in its use of citation patterns to determine whether these topics are indeed dominant within the field.

Second, the selection of a citation threshold ensures feasibility but may introduce bias, particularly affecting smaller clusters (B. Vogel et al., 2020). To mitigate this, we followed Batistič and van der Laken's (2019) guidelines by comparing different thresholds, finding no substantial differences. Despite this limitation, our review remains extensive and objective, incorporating a broad range of key documents identified through citation counts.

Third, bibliometric techniques rely on citation data, which, while valuable for mapping intellectual structures, do not necessarily reflect the intrinsic quality or real impact of research contributions. Citation behaviours can be influenced

by self-citation, strategic citation, and preferential citation of mainstream journals, shaping the perceived evolution of the field. Self-citation can inflate the prominence of certain authors, strategic citation may align research with journal expectations, and preferential citation of high-impact journals might reinforce dominant narratives while marginalizing alternative perspectives.

Additionally, bibliometric approaches do not account for the motivations behind citation behaviours, such as self-legitimisation, micropolitics, or critiques of specific works (Zupic & Čater, 2015). While some argue that self-citation is an organic part of the process (Glänzel, 2004; Glänzel et al., 2006), future research should explore how these behaviours shape the field of EW through qualitative assessments, such as expert evaluations or content analysis.

Fourth, the exclusive use of Web of Science (WoS) introduces a potential Western-centric bias. While WoS is a widely recognized database, its coverage is primarily focused on high-impact journals, many of which originate from North America and Europe. As a result, research from non-Western regions and indigenous epistemologies may be underrepresented, shaping theoretical frameworks and research priorities predominantly through a Western lens. Entrepreneurial well-being is a multidimensional concept that may vary significantly across cultures, with some contexts emphasizing communal well-being over individual autonomy. The omission of these perspectives could constrain the generalizability of EW theories across diverse entrepreneurial environments. To address this, future studies should incorporate multiple databases (e.g., Scopus, Google Scholar, regional repositories) to improve representation. Additionally, qualitative meta-analyses of non-Western research could provide deeper insights into alternative conceptualizations and cultural dimensions of entrepreneurial well-being.

This research enhances the theoretical understanding of entrepreneurial well-being (EW) by presenting a bibliometric overview of its intellectual progression. In contrast to conventional systematic reviews, which tend to concentrate on subdomains, this study delivers a broad and impartial evaluation of the entire scholarly landscape. The findings reveal a convergence of perspectives from psychology, economics, and organisational studies within EW research, while also uncovering theoretical gaps that warrant further exploration. Moreover, the results emphasise the importance of adopting interdisciplinary frameworks that incorporate contributions from management, behavioural science, and public policy in order to construct more integrative conceptual models.

Entrepreneurs and business leaders can leverage the insights from this study to understand the factors influencing their well-being and make informed decisions that foster a healthier entrepreneurial ecosystem. By recognising the evolving trends in EW research, organisations can implement strategies that enhance resilience, work-life balance, and long-term business sustainability. Additionally, the study offers meaningful implications for investors and entrepreneurial support systems, enabling them to design more focused strategies to enhance entrepreneurs' well-being.

The results of this study carry important implications for policymakers aiming to promote entrepreneurial well-being. The identification of prominent research patterns points to the relevance of public policies that support mental health, financial stability, and balanced work conditions as key contributors to enhancing well-being among entrepreneurs. Moreover, the study underscores the necessity of adapting policy measures to the demands of each industry, given that different sectors face distinct sources of stress and well-being influences. Looking ahead, policy development should incorporate evidence-based approaches designed to assist entrepreneurs throughout various phases of their business journey, thereby fostering a more resilient and inclusive entrepreneurial ecosystem.

We acknowledge that entrepreneurial well-being (EW) can vary significantly across different industries and national contexts. However, given that our study is designed as a bibliometric analysis of the field, incorporating a sectoral or cross-national comparison falls outside the scope and methodological design of our research.

Nevertheless, future research should further explore how EW manifests in various sectors, such as high-tech, healthcare, financial services, and social work. These industries present unique challenges and opportunities for entrepreneurs, particularly in how they navigate work-life balance, innovation pressures, and regulatory landscapes. Comparative studies across these sectors could help identify industry-specific determinants of EW and inform tailored policy interventions.

Additionally, longitudinal and comparative studies could provide deeper insights into the factors shaping EW across different geographical regions and cultural contexts. The role of institutional frameworks, labor market regulations, and cultural attitudes toward entrepreneurship should be considered when analyzing differences in EW. Future investigations could also assess the impact of external shocks, such as economic crises, geopolitical conflicts, or technological disruptions, on entrepreneurial well-being. Given the increasing prevalence of automation, AI-driven decision-making, and digital work environments, understanding how technological change affects entrepreneurs' psychological and economic stability is a critical avenue for future research.

Moreover, a growing research agenda should address the tensions between entrepreneurial practices, sustainable development goals (SDGs), and institutional barriers. While entrepreneurship is often associated with economic growth and innovation, many traditional businesses models conflict with sustainability objectives, particularly regarding environmental impact and social equity. Institutional constraints, such as inconsistent regulatory frameworks, limited access to impact-driven investment, and insufficient policy incentives, often hinder the adoption of sustainable entrepreneurial practices. Future research should explore how hybrid business models (e.g., social entrepreneurship, circular economy ventures) can reconcile economic viability with sustainability commitments, as well as how governments and financial institutions can facilitate the transition to responsible entrepreneurship.

Finally, future research should adopt interdisciplinary methodological frameworks to investigate entrepreneurial well-being from diverse perspectives. While quantitative methods continue to be essential, qualitative approaches such as ethnographic inquiry, expert interviews and participatory action research can offer deeper insights into the lived realities of entrepreneurs. Moreover, the incorporation of big data analytics and machine learning into EW studies may facilitate the identification of patterns and predictive variables, generating new knowledge about the evolution of entrepreneurial ecosystems over time.

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Authorship contributions statement

Cristina Sierra Casanova: Conceptualisation, Methodology, Formal Analysis, Data Curation, Writing – Original Draft, Writing – Review & Editing. **Esthela Galván-Vela:** Conceptualisation, Writing – Original Draft, Writing – Review & Editing. **Mario Alberto Salazar-Altamirano:** Editing for Style and Academic Tone, Translation, Adaptation to Journal Guidelines, Writing – Review & Editing.

Conflicts of interest

The authors declare no conflict of interest.

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The role of the leader's digital innovativeness on family firm digital innovation activities

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Abstract

***PURPOSE**: The paper investigates whether the leader's digital innovativeness is directly and indirectly associated with a family firm's digital innovation activities. **METHODOLOGY**: The study was conducted on a sample of Polish family firms. In total, 501 self-declared family businesses that represent the SME sector were completed. Structural Equation Modeling (SEM) was employed to capture underlying relationships between latent constructs and to verify hypotheses. **FINDINGS**: The findings indicate that the leader's digital innovativeness has a significant impact on the digital innovation activities of family firms. However, the achievement of these outcomes depends on the existence of complementary organizational factors, including IT capabilities, employee digital competencies, and a strong digital culture. These results emphasize the interconnected relationship between the leader's innovativeness and organizational resources in facilitating digital transformation within family businesses. **IMPLICATIONS**: This research highlights the necessity for family-owned businesses to invest in leadership development programs that foster digital innovativeness, enabling leaders to effectively navigate digital transformation and enhance the company's overall resilience. Additionally, cultivating a supportive digital culture—through collaboration, advanced digital tools, and an innovation-driven mindset—ensures that the entire organisation aligns with digital transformation goals, ultimately driving long-term competitiveness. **ORIGINALITY AND VALUE**: This paper contributes to the literature on family firms by presenting the association between leader's digital innovativeness and digital innovation activities in family firms. We offer new evidence for the upper echelons theory by demonstrating the impact of the leader's digital innovativeness on digital innovation activities.*

***Keywords:** digital innovativeness, family firms, digital innovation activities, leadership, digital transformation, upper echelons theory, small and medium-sized enterprises (SMEs), IT capabilities, organizational digital capabilities, employee digital competencies, digital culture, family business, Structural equation modeling (SEM).*

INTRODUCTION

Addressing the preparedness of family businesses for digital transformation involves mixed perspectives (Tirdasari et al., 2022). Some scholars have observed a negative association between family businesses and their willingness to adopt digital technologies (Chung & Lee, 2024). On the flip side, a body of research (Tirdasari et al., 2024; Begnini et al., 2023) suggests a favourable link between family businesses and adopting digital technologies. Unlike non-family firms, which base their decisions primarily on economic considerations, family firms tend to prioritise a behavioural approach to decision-making, where non-financial goals are more important than purely financial ones (Chrisman et al., 2015b). Some researchers have proven that a higher level of family shares in the ownership structure is negatively associated with

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the R&D expenses incurred by these firms (Chrisman & Patel, 2012) and technology adoption (Souder et al., 2017). This phenomenon can be explained using the concept of socio-emotional wealth (SEW), emphasising the impact of socio-emotional factors on strategic and financial decisions in family firms (Arzubiaga, 2020). Family businesses often perceive digital changes as threats to their SEW and as a risk to keeping the firm in the hands of the family (Gomez-Mejia et al., 2024; Lasio et al., 2024). Digital transformation could be an even more complex decision from the standpoint of family business leaders, as it is important to harmonise traditional family values with progressive growth. As family businesses increasingly acknowledge the necessity and advantages of technological progress, they equip themselves to tackle modern challenges and seize opportunities, ensuring their cherished brand stays relevant and thrives.

Still, some studies show that family firms are more innovative than non-family firms (Muñoz-Bullón & Sanchez-Bueno, 2011), attach great importance to innovation (Craig & Moores, 2006), and due to their business models that have embraced digital technology, are more resilient during times of crisis (Bürgel et al., 2022). Family firms demonstrate the so-called' ability and willingness paradox' (Chrisman et al., 2015a; Dieleman, 2019). It refers to their lower propensity to engage in innovative activities than non-family firms despite significantly greater innovation capability. This capability results from the ability of family firms to identify opportunities and gather knowledge beyond their boundaries, driven by their non-economic goals (Zapata-Cantu, San-Guino, Barroso et al., 2023). The reduced willingness to introduce innovations, on the other hand, results from, among other things, an above-average attachment to tradition and increased concern for the reputation of the business and the family that represents it (Hauck & Prügl, 2015). However, the literature lacks empirical studies that would indicate which characteristics of a leader in a family enterprise should overcome barriers associated with aversion to innovation and skillfully use their specific attributes to implement digital solutions effectively.

According to the Upper Echelons Theory (UET) as formulated by Hambrick and Mason (1984) and Hambrick (2007), the strategic decisions and overall managerial orientation of an organization are significantly influenced by the demographic and psychological attributes of its top executives. Hambrick and Mason (1984) suggested measuring unobservable or difficult-to-measure psychological and social characteristics of senior managers through observable proxies, such as education, professional experience, or social background. This methodological framework has been further operationalized in the conceptual model of UET presented by Hiebl (2014). Building on this foundation, and in light of contemporary empirical findings, we propose an extension of the UET framework to incorporate managerial attributes related to digital innovativeness. In this paper, a business leader's individual digital innovativeness is defined as a leader's inherent predisposition and ability to understand, embrace, and champion digital technologies, reflecting their openness to experimenting with and implementing novel digital solutions to drive business growth and transformation (Waal et al., 2016). It is justified due to growing empirical evidence that digital literacy and technological adaptability are critical determinants of strategic and operational decision-making. As an example, (Asrarudin, 2023; Willis et al., 2021) asserted that the personal characteristics of innovative leaders could enhance an organisation's competitive advantage by fostering innovative attitudes and behaviours among subordinates. Others (Alekhina et al., 2020; Korableva et al., 2024) clarified that an enterprise's innovative activity necessitates a leader who possesses a specific set of innovative and motivational characteristics. These characteristics empower leaders to spearhead digital transformation and cultivate a culture of innovation, thereby significantly improving organisational performance in the digital era (Schulster et al., 2023).

This paper aims to investigate whether leader's digital innovativeness is directly and indirectly associated with a family firm's digital innovation activity – meaning the creation of products, services, processes, or business models driven by digital technology (Bornhausen & Wulf, 2023) or the trials that can lead to such a creation. The research was carried out using a sample of Polish family firms, comprising 501 self-identified family businesses from the SME sector. Polish family firms were chosen due to access to the dataset that was collected within the framework of the broader research project. To test the hypotheses and address the primary objectives of the study, Structural Equation Modeling (SEM) served as the primary analytical method.

This paper makes several contributions. First, it contributes to the literature on family firms by presenting the association between the digital innovativeness of a family firm's leader and digital performance. Second, we provide new evidence to UEP, extracting the impact of the digital innovativeness of the family business leaders on digital innovation activities. Additionally, we verify whether there is a mediation impact of digital culture, digital capabilities of employees, and IT capability on the relationship between the digital innovativeness of family business leaders and digital innovation activities.

To achieve this, we propose a model that incorporates mediators outlined by Proksch et al. (2024) in their research on the impact of digital strategy on digital innovation activities in new ventures. Our model adapts this framework to the context of family businesses. Rather than focusing on digital strategy as a predictor, we introduce the personal

innovativeness of the family business leader as the antecedent variable. This modification reflects the founders' pivotal roles in shaping strategic management practices and influencing organisational behaviour within family businesses (Kelly et al., 2000; Soluk et al., 2021).

The paper is structured as follows. The first section reviews the relevant literature on the leader's digital innovativeness, digital capabilities of employees, IT capabilities, digital culture, and their impact on digital innovation activities. The following section details the study's methodological aspects, and the subsequent sections present the main results and discussion about the suggested model. The last section concludes by outlining research implications, limitations, and future research perspectives.

LITERATURE REVIEW

Leader's digital innovativeness

In recent years, digitalisation and digital transformation have emerged as key performance drivers (Pouri, 2021; Vojvodic et al., 2022). It is stressed that successful digital transformation requires leaders with appropriate digital features (Schwarzmüller et al., 2018), ready to lead digital change (Ohain, 2019). The new leadership paradigm, among others, is referred to as digital leadership (Schuster & Lehmann, 2023; Schuster et al., 2023). Leaders are perceived as critical to „laying the foundation for and facilitating digital transformation" (Hunt, 2015). Leaders' digital literacy requires knowledge and understanding of relevant digital concepts, tools, systems, and social technology features and platforms (Hunt, 2015; Santhanam, 2024). According to Ohain (2019), explicitly, executives must proactively acquire these skills. In this context, upper echelons theory (Hambrick & Mason, 1984; Hambrick, 2007) provides a vital theoretical foundation for understanding how top executives' characteristics, specifically their cognitive base and held values (Cristofaro et al., 2022), are likely to predict their strategic choices (Hambrick, 2007). In more detail, theoretical foundation of the UEP assumes that characteristics of senior managers, such as: age, functional background, career path, work experience in the company, education, professional experience, social background, or financial situation are translated into unobservable or difficult to measure psychological and social features as: motivation, risk aversion, way of perception, etc. (Hambrick, 2007). Finally, top management's impact on enterprise outcomes (Hiebl, 2014) is connected with experimentation, technological dynamism, innovation, and R&D spending (Hoskisson et al., 2017). Therefore, the catalogue of characteristics preliminary included to UEP cannot be closed. It is especially obvious in the digital age with the growing role of Chief Digital Officer (CDO) (Singh & Hess, 2020). Therefore, there is currently a need to upgrade the upper echelons theory and bridge the gap in reference to the newly emerging digital characteristics of top executives. This upgrade should also explore how these characteristics impact new strategic choices brought about by the digital age (Moker, 2020). CDOs channel managerial attention to strategic issues in implementing digital technologies and utilise their capabilities to address them (Wei et al., 2024). The presence of a CDO amplifies the positive influence of the top management team's digital knowledge on digital innovation (Firk et al., 2022). Agarwal and Prasad (1998) argue that individuals characterised by a higher degree of personal innovativeness are more likely to form favourable perceptions of an innovation. In reality, it is not necessary for leaders to be technical experts; they need to understand the implications of the changes while using digital technology (Berman, 2012). Family business research also reveals that the personal traits of the CEO are connected with the innovation outcomes (Rovelli et al., 2023; Kraiczy et al., 2015). Therefore, we formulate the following hypothesis:

H1: The leader's digital innovativeness positively affects the degree of digital innovation activity in the context of Polish family SMEs.

Digital capabilities

In scientific production, digital capabilities are aligned with online activity, delivery, and remote work (Zhou & Wu, 2010), acquiring and developing hardware, software, and organisational capabilities (Davies et al., 2023; Khin & Ho, 2020; Zhen et al., 2021), visualisation (Bärenfänger & Otto, 2015), digital ecosystem (Karimi & Walter, 2015), processes digitalisation (Da Silva Freitas et al., 2017), artificial intelligence, cloud computing, robotics, smart device and big data analytics (Marnoto et al., 2024) or usage technologies to create relationships with customers, known as digital marketing capabilities (Wang, 2020). Therefore, digital capabilities would be perceived as technological and technical processes professionalising the enterprise,

including family firms (Duréndez et al., 2016; Gao et al., 2022). Among digital capabilities, we assumed for our model we utilize those suggested by Proksch et al. (2023): IT capabilities, digital capabilities of employees, and digital culture.

IT Capabilities

Information Technology (IT) capabilities encompass a broad range of common information and communication tools and related services that firms mobilise to achieve their business objectives (Chen et. al., 2015; Parida & Örtqvist, 2015). Each company requires a tailored IT infrastructure upon which digital solutions are developed (Khin & Ho, 2019). In addition to soft capabilities such as talent, skills, and organisational climate, the technical infrastructure—comprising hardware, software, communication networks, collaboration platforms, and databases—plays a crucial role in supporting business decision-making processes (Gulzar et. al., 2024). IT capabilities are critical tools for organisations, enhancing information dissemination, strengthening business-customer relationships, overcoming geographic constraints, and improving overall communication efficiency (Spiezia, 2011). Chen et al. (2015) conceptualise IT capabilities as a multidimensional construct, including IT infrastructure flexibility, IT integration, IT business alignment, and IT management. IT infrastructure flexibility is particularly crucial for enabling competitive performance and organisational agility (Lim, 2014; Mikalef et al., 2016). IT integration facilitates the seamless merging of data and processes within an organisation, thereby reducing coordination costs and errors while providing a stable platform for business operations (Mao et al., 2024). For organisations to fully leverage IT infrastructure, it must be aligned with business objectives and effectively managed, necessitating coordination between IT and non-IT domains (Luftman et al., 2015).

Building an adequate IT infrastructure requires significant investment in ICT resources, which poses a dilemma for family business owners, as these investments are risky but essential for long-term success (Kathuria et al., 2023). Family firms generally opt for investments in assets that involve lower levels of uncertainty, such as buildings and production types of machinery (Anderson et al., 2012). This reluctance is primarily due to the family's desire for stability and the preservation of socioemotional wealth (SEW), which encompasses non-financial aspects such as family control, legacy, and identity (Basly & Hammouda, 2020). Research also indicates that family businesses often adopt information technologies more slowly than larger corporations, particularly regarding implementing integrated systems that support business processes and inform management decisions with long-term impacts on revenue and profit margins. Furthermore, many small business owners and managers, including those in family businesses, tend to lack strong planning skills and often rely on more user-friendly systems (Zapata-Cantu et al., 2023).

Additionally, financial constraints and a lack of understanding of how to leverage technology to enhance competitive advantage often limit family businesses' technological advancements (Begnini et al., 2023; Rozmi et al., 2020; Soluk & Kammerlander, 2021). Despite family businesses investing less than their non-family counterparts, they should not be labelled as „less innovative" (Duran et al., 2019). They possess a strong capability for technological innovation but often exhibit a lower inclination to pursue it (willingness-ability paradox) (Chrisman et al., 2015). In family businesses, firm leaders play a critical role not only in making resource-allocation decisions but also in overseeing and directing how those resources are utilised (Bennedsen, 2010). They foster, select, and nurture innovation activities within the company (Duran et al., 2019), including guiding and supporting IT investments. Family business leaders help shape the firm's strategic direction and ability to adapt to technological advancements and market changes by actively encouraging this kind of investment. Therefore, we stated as follows:

H2: Leader's digital innovativeness positively influences IT capabilities in Polish family SMEs.

The technological infrastructure within an organisation plays a pivotal role in adopting technological innovations (Bhatia & Kumar, 2023; De Souza et al., 2017). IT capabilities, particularly in terms of systems architecture design, significantly influence an organisation's capacity for digital transformation and its ability to integrate new technologies (Brunner et al., 2021). These capabilities facilitate the deployment and utilisation of innovative IT tools and systems, thereby directly improving the efficiency and outcomes of digital projects (Wiesböck et al., 2020). Single studies that discuss the efficiency of ICT investments in family businesses show that family involvement positively moderates the relationship between ICT investments and performance (Gargallo Castel & Górriz, 2017). However, the positive relationship between IT alignment and family firm performance is weakened by prioritising family goals (Issah & Calabro, 2024). In terms of digital performance, enhancing IT capabilities, including technical infrastructure, and developing dynamic capabilities

play a critical role in product and service digitalisation in family-owned businesses (Soluk & Kammerlander, 2021). So, we stated as follows:

H3: The level of IT Capabilities positively affects the degree of digital innovation activity in Polish family SMEs.

Digital capabilities of employees

Digital capabilities of the business go beyond pure IT technologies (Da Silva Freitas et al., 2017) and are defined as the ability of the organisation to use digital technologies to gain a competitive advantage in the digital environment (Sousa-Zomer et al., 2020).

It is stressed that leaders play a crucial role in digital transformation processes (Bouwman et al., 2018; Diéguez-Soto et al., 2016), especially when leaders trust digital advancements (Costa et al., 2023). Family firm leaders can drive relevant capabilities and quickly form a consensus within the company to achieve high pragmatism and formulate appropriate digital strategies (Ano & Bent, 2022), and allocate resources to relevant areas. Consequently, leaders' vision, attitude, and behaviour significantly influence employees' perceptions of the benefits of IT innovation and hence its adoption outcomes (Li et al., 2016). In particular, onboarding the younger generation into the firm's leadership position, utilising their technological expertise (Young & Cater III, 2019), can catalyse changes in this field (Calabrò et al., 2019). Ohain (2019) investigated various attributes of digital leaders, such as empathy, innovativeness, openness, and agility. He presented the point that trust in digital leaders can be a springboard to overcoming follower resistance and transmitting positive emotions. It can be stated that for leaders, inspiring followers seems to become a more crucial skill in the digital age (Schwarzmüller et al., 2018). Moreover, conversely, if employees need to be agile and creative and constantly change and develop themselves, leaders might likewise have to more actively promote and allow for such changes (McCann et al., 2009). Positive feelings towards applying digitalisation can reduce resistance to change because it makes employees eager to deal with novelty (Bastari et al., 2020). In this context, leaders have a pivotal role in fostering a positive outlook towards digitalisation on the employee side (Schuster & Lehmann, 2023).

However, family firms strongly differ from non-family ones (Astrachan, 2010; Hasenzagl et al., 2018; Martin & Gomez-Mejia, 2016; Sharma & Sharma, 2011; Chrisman et al., 2012; Madison et al., 2016). These differences also refer to the attitude of family and non-family employees towards the business. Identifying family members with the business is more substantial than non-family ones (Deephouse & Jaskiewicz, 2013) and is connected with social and emotional involvement in running the business (Cleary et al., 2019; Sharma & Sharma, 2011). Hence, family firms constitute a particular working environment for non-family employees (Beehr, 1997; Habbershon et al., 2003; Lansberg, 1983). Non-family employees are facing nepotism (Padgett & Morris, 2005), authoritarian leadership style (Tagiuri & Davis, 1992), human resource practices biased against non-family members (Barnett & Kellermanns, 2006; Lubatkin et al., 2007; Schulze et al., 2001) ingroup–outgroup perceptions of non-family employees (Barnett & Kellermanns, 2006), founder-centric cultures (Schein, 1983), and lack of delegation (Kelly et al., 2000). It leads to a lower level of psychological ownership represented by non-family employees (Melanie et al., 2014). Owners and top managers of family firms are aware that strong formal and informal interrelationships and family life are deeply intertwined with the firm (Hasenzagl et al., 2018) and result in social and emotional involvement in running the business (Cleary et al., 2019; Sharma & Sharma, 2011). Therefore, family managers struggle to create care-oriented employment relationships with employees (Issah & Calabro, 2024). For example, Atalay and Özler (2013) confirmed a positive relationship in correlation analysis between organisational justice and psychological ownership of non-family employees. (Köhn et al., 2023) provided evidence that family values, family involvement, care towards employees, direct communication, strong personal relationships, and business mechanisms support the motivation of non-family employees. Generally, the professionalisation of family firms (Dekker et al., 2013) supports organisational culture and helps family firms overcome their weaknesses and optimise their strengths (Polat, 2021). Digitalisation could foster family business professionalisation (Batt et al., 2020). To achieve this, a family business owner needs to encourage their employee to be innovative, open-minded, and curious about emerging technology (Schulze & Bövers, 2022) because a workforce capable of developing novel products or services using digital technologies could contribute to business value creation (Mancha & Shankaranarayanan, 2021). Therefore, we stated as follows:

H4: Leader's digital innovativeness positively affects digital capabilities of employees in Polish family SMEs.

Digital transformation requires employees to be skilled, motivated, empowered and autonomous (Basly & Hammouda, 2020). Adequate human capital is a critical determinant toward a digital-oriented transformation of a business since sophisticated technologies require significant organisational changes (Ano & Bent, 2022). We share the point that a motivated workforce is prepared to achieve organisational goals (Idowu, 2022; Rae et al., 2015), encompassing digitalisation (Prokesch, 2017). Information technology requires employees to adapt to the technology, which will have different effects on employees. Some employees will perceive them as opportunities and are more likely to use them as active working tools to improve performance and job satisfaction (Bala & Venkatesh, 2016). Other people need more time to adapt to new technologies (Eduar et al., 2020). Besides leadership capabilities and adequate firm structure, digital capabilities of employees are key for digital entrepreneurship (Gurbaxani & Dunkle, 2019). Digital transformation of the business requires not only leaders to drive the transformation continuously but also employees with the appropriate digital skills (Sousa-Zomer et al., 2020). It is emphasised that to perform with digital transformation, a digital-savvy workforce, including digital natives, is necessary (Warner & Wäger, 2019). Consequently, digital capabilities lead to better digital business performance (Da Silva Freitas et al., 2017; Heredia et al., 2022). So, we stated as follows:

H5: The level of digital capabilities of employees in family businesses positively affects the degree of digital innovation activity in Polish family SMEs.

Digital culture

A majority of the scholars agreed that the shift to digital transformation is imperative for companies nowadays (Kostyrko et al., 2023; Chattaraj, 2021; Ogrean & Herciu, 2021). This transformation is not just a fleeting moment or a limited-time project anymore. It has become a continuous and prevailing phenomenon (Firican, 2023). The relationship between cultural change towards a digital culture and digital transformation is quite intertwined. According to Mergel et al. (2019), cultural transformation is commonly acknowledged as one of the four primary pillars of digital transformation, in addition to domain, business model, and process transformation. A cultural change towards digital culture is increasingly seen as essential for organisational digital transformation (Firican, 2023). On the other hand, digital transformation initiatives can also drive cultural change (Forsythe & Rafoth, 2022). Abhari et al. (2021) stated that digital transformation efforts can drive cultural change, harmonising organisational goals, values, and culture with employees. There are different approaches to defining the concept of digital culture, drawing attention to its many facets and complexity. Uzelac (2010), emphasising the role of technology in shaping behaviours and practices, defined digital culture as the extent to which digital tools and technologies are embedded in an organisation's daily operations and strategic initiatives. Another prevalent approach to define digital culture from the prospective of organisational behaviour according to Bachtiar and Susanty (2020) is collective behaviours, values, and practices of the company that support the use of digital technologies, focusing on the aspect how staff members engage with digital technologies and one another, encouraging a culture of ongoing learning and adaptation. Another intriguing way to define digital culture, as presented by Vasilopoulou, Theodorakopoulos, and Giannoukou (2023), is through a customer-focused strategy. This definition focuses on utilising digital technologies to gain insights into customer behaviour and preferences, enhancing service delivery, creating value, and boosting customer satisfaction. Finally, another way to define digital culture is through the lens of leadership and strategic vision. Ossiannilsson (2018) specified that leaders who prioritise digital transformation and create a vision for digital strategies are the driving force behind digital culture. Indeed, the role of leaders is vital in promoting digital transformation and fostering a digital culture in organisations (Philip, 2021). Whether digital change is forced or planned, the transformative behaviours of leaders are essential to its success (Cortellazzo et al., 2019). Although extensive research has been conducted on digital transformation, a gap exists in understanding how leader's digital innovativeness and capabilities influence the digital culture in family firms (Soluk & Kammerlander, 2021). Building on these perspectives, we hypothesise that the digital innovativeness of family business leaders serves as a critical driver of the firm's digital culture, shaping the environment necessary for effective digital transformation. Thus, we propose:

H6: The leader's digital innovativeness positively affects digital culture in Polish family SMEs.

According to Sivulca et al. (2024), digital transformation and digital culture synergistically contribute to organisational success, particularly in an increasingly volatile and digitally complex environment. Cultivating a digital organisational culture not only accelerates the digitisation of business processes but also significantly enhances overall firm performance.

By fostering an environment that embraces digital tools and technologies, organisations can streamline operations, improve efficiency, and drive innovation, ultimately leading to a competitive advantage in the digital age (Martinez-Caro et al., 2020). The following studies (Kreslins et al., 2020; Isensee et al., 2020; Petrova & Spatenka, 2022) collectively underscore the pivotal importance of digital culture in enabling successful digital transformation and enhancing organisational performance. By fostering a digital culture, organisations can create an environment that supports innovation, agility, and continuous improvement.

Although there has been some research (Batt et al., 2020; Amato et al., 2024; Daskalopoulos & Machek, 2023) examining the correlation between a company's digital culture and its digital outcomes or activities, the moderating role of family business essence in this relationship remains unclear. Further investigation is needed to understand how the unique characteristics of family businesses influence the impact of digital culture on digital performance. This gap in literature highlights the importance of considering the distinct attributes of family-owned enterprises when analysing the dynamics between digital culture and digitalization activities. Referring to this, we stated as follows:

H7: The level of digital culture positively affects the degree of digital innovation activity in Polish family SMEs.

METHODOLOGY

Data collection and sample

The online questionnaire was distributed to 8,000 Polish enterprises initially identified as family businesses. The list of potential family businesses was compiled through web searches, exploration of enterprise registers and databases (Madison et al., 2018), and contacts provided by the survey company. It is important to note that, in the case of family businesses in Poland, no comprehensive sampling frame exists that captures enterprises fulfilling various definitional criteria of a family business. This precludes the use of probability sampling techniques and introduces the risk of incomplete population coverage. In such contexts, non-probability sampling—while not without limitations—remains a widely accepted approach in family business research, provided that the potential for sampling bias is acknowledged and discussed (Szreder, 2010).

In total, we received 550 responses from self-declared family businesses. This perspective draws on the widely recognized Thomas theorem, which states: „If men define situations as real, they are real in their consequences" (Bornmann and Marx, 2020, p. 554). Accordingly, when an owner or manager identifies their enterprise as a family firm, it can be inferred that this designation shapes tangible outcomes, such as the development and utilization of distinctive resources. This criterion has been employed in prior research (Gallo et al., 2004; Zellweger et al., 2012; Żukowska et al., 2021).

To refine the sample, we excluded all entities that employed more than 250 employees in the previous year or whose owner was self-employed, which was in line with the SME definition. Additionally, we retained only responses provided by business owners, co-owners, CEOs, or members of management boards (they can indicate more than 1 role in the enterprise). This process resulted in a final sample of 501 observations, and therefore, the final response rate totalled 6.26%.

The analysed sample comprised family businesses with an average age of 20.4 years, most of which (86.42%) were led by a family CEO. The mean number of employees across the businesses was 27.52, with 17.16% employing 50 or more people. Regarding ownership, 57.88% of the businesses were owned by the first generation, 38.92% by the second generation, 13.97% by the third generation, and 3.20% by the fourth generation or later. A similar generational pattern was observed in management, with the first generation comprising 57.49%, the second generation 41.12%, the third generation 13.37%, and the fourth generation or later 2.40%. The businesses operated across various sectors, with 31.94% in retail, 52.10% in services, and 34.33% in production (Table 1).

The composition of the study sample, encompassing variables such as age, industry sectors, and generational involvement, exhibits a strong alignment with the profiles observed in prior research on family enterprises in Poland (Pernsteiner & Węcławski, 2016; Żukowska et al., 2021). This consistency might suggest that the sample is not significantly affected by selection bias. However, it does not eliminate the risk of inherent selection bias. Replicating similar sample structures across studies may reproduce unmeasured biases, rather than guarantee actual representativeness, especially regarding latent characteristics such as attitudes, capabilities, motivation, professionalization level, or organizational culture, which remain outside the scope of the measured variables. The obtained results should be interpreted within the context of these sampling-related constraints.

The comparability of findings across studies is also constrained by a persistent methodological challenge: the lack of a universally recognised definition of a family business within Poland and in the broader international context.

Table 1. Sample description

Respondents[a]	Business owner	31.94%
	Co-owner	32.14%
	CEO	22.55%
	Member of the management board	22.75%
Owner generation[a]	First	57.88%
	Second	38.92%
	Third	13.97%
	Fourth or later	3.20%
Generations in management[a]	First	57.49%
	Second	41.12%
	Third	13.37%
	Fourth or later	2.40%
Age		20.4
Employees		27.52
Sector[a]	Retail	31.94%
	Service	52.1%
	Production	34.33%

Note: [a]More than one answer could be given.

The test for non-response bias compared the means for each item response obtained from the first 5% answers against the same means for the last 5% answers (Armstrong & Overton, 1977), using a t-test for the equality of means. In our study, we found that for most items (33 out of 35), the mean values used in the research do not differ between the examined groups. This finding suggests that response timing was not systematically associated with substantive differences in the measured variables, providing evidence against the presence of meaningful late-response bias.

In order to mitigate the problem of common method bias, we implemented several procedural remedies during the survey. We ensured respondent anonymity, used a mix of positively and negatively worded items, and separated items used as dependent and independent variables (Polas, 2025). Additionally, we performed Harman's single-factor test on the final sample. The total variance extracted by a single factor was 40.94%, which is below the commonly accepted threshold of 50% (Riley et al., 2018).

Variables

Our constructs were developed based on items identified in the existing literature, with modifications made to accommodate the application of certain constructs in the family business context for the first time. The survey statements were translated from English to Polish with the assistance of language experts. Table 2 presents a comprehensive list of these items, their original sources, and the corresponding survey questions. A 5-point Likert scale was utilised for all items.

Table 2. List of items

Item		M	SD	Skew	Kurtosis
Leader's digital innovativeness (LDI) - Agarwal and Prasad (1998), Mancha & Shankaranarayanan (2021).					
L1	If the family business leader heard about a new digital technology, he/she would look for ways to experiment with it	3.57	1.16	-0.56	-0.54
L2	If the family business leader heard about a new digital technology, he/she would be the first among the team members to try it out.	3.48	1.17	-0.48	-0.51
L3	In general, if the family business leader encountered a new digital technology, he/she would be hesitant to try it out. (REV)	3.10	1.35	-0.15	-1.16
L4	Family business leader likes to experiment with digital technologies.	3.48	1.19	-0.44	-0.67
L5	When interacting with digital technologies, the family business leader would be spontaneous.	3.47	1.14	-0.37	-0.60
L6	When interacting with digital technologies, the family business leader would demonstrate a lack of imagination. (REV)	3.06	1.28	-0.07	-1.07

Item		M	SD	Skew	Kurtosis
L7	When interacting with digital technologies, the family business leader would be playful.	3.60	1.16	-0.51	-0.54
L8	When interacting with digital technologies, the family business leader would be flexible.	3.62	1.12	-0.56	-0.38
L9	When interacting with digital technologies, the family business leader would not be inventive. (REV)	3.32	1.21	-0.24	-0.86
L10	When interacting with digital technologies, the family business leader would be creative.	3.53	1.19	-0.56	-0.54
L11	When interacting with digital technologies, the family business leader would not demonstrate originality. (REV)	3.50	1.18	-0.45	-0.62
IT Capabilities (ITDC) - Proksch et al. (2024)					
IT1	We adapt our digital offerings whenever changing business needs arise.	3.77	1.06	-0.65	-0.17
IT2	We implement new digital products and services on a regular basis.	3.70	1.07	-0.51	-0.48
IT3	Our IT integrates the most current digital offerings by third parties like digital payments, customer relationship management systems, and others.	3.66	1.04	-0.47	-0.46
IT4	Our company provides access to a variety of digital devices.	3.85	1.05	-0.66	-0.30
IT5	We use the most current IT infrastructure.	3.71	1.06	-0.52	-0.31
IT6	We store all data digitally.	3.56	1.11	-0.40	-0.71
IT7	We have Internet access with gigabit speed.	3.97	1.03	-0.75	-0.23
IT8	We are planning to enhance our IT capabilities	3.81	0.99	-0.53	-0.34
Digital capabilities of employees (EDC) - Proksch et al. (2024)					
EM1	We offer different trainings (courses, literature, coaching) to improve the digital expertise of our non-family/family team members.	3.49	1.11	-0.37	-0.72
EM2	Digital skills are an important selection criterion in recruiting new non-family/family team members.	3.67	1.09	-0.56	-0.62
EM3	Our non-family/family team members use all digital services and products we offer.	3.92	0.92	-0.79	0.50
EM4	Our non-family/family team has the necessary skills to further digitalize our company.	3.75	0.95	-0.57	-0.13
EM5	We actively discuss our digital projects within our company including failures and best practices.	3.83	1.06	-0.74	-0.01
Digital culture (DC) - Proksch et al. (2024)					
C1	We openly discuss failures with all team members.	3.84	0.98	-0.55	-0.43
C2	Decisions are based on the opinion of the whole team, not on a single person only.	3.88	0.97	-0.78	0.26
C3	We work in cross-functional teams (combining people from IT, marketing, finance, etc.).	3.65	1.05	-0.51	-0.34
C4	In our company, we avoid strong hierarchies in project work.	3.78	0.95	-0.56	0.13
C5	Every team member brings in ideas and suggestions for digital products and services.	3.77	0.98	-0.55	-0.25
Digital innovation activities (DA) - Bornhausen and Wulf (2023)					
DA1	Our firm has introduced many new digital products or services over the past three years.	3.53	1.19	-0.52	-0.55
DOA	Our firm has made many dramatic digital changes in the mix of its products and services over the past three years.	3.52	1.16	-0.37	-0.74
DA3	Our firm has emphasized making major digital innovations in its products and services over the past three years.	3.50	1.15	-0.38	-0.71
DA4	Over the past three years, our firm has shown a strong proclivity for high-risk, digital projects (with chances of very high returns).	3.28	1.22	-0.15	-0.92
DA5	Our firm has emphasized taking bold, wide-ranging action to position itself and its products or services as digital over the past three years.	3.41	1.15	-0.25	-0.78
DA6	Our firm has shown a strong commitment to research and development, technological leadership, and innovation towards digitalization.	3.41	1.19	-0.36	-0.76
DA7	Our firm has followed strategies for digitalization that allow it to exploit opportunities in its external environment.	3.56	1.12	-0.43	-0.62

To measure the individual digital innovativeness of a business leader, we adopted the scale developed by Mancha and Shankaranarayanan (2021), which conceptualizes digital innovativeness as an individual's tendency to experiment with, adapt to, and creatively engage with information technologies. This scale builds upon the conceptual foundation of personal innovativeness introduced by Agarwal and Prasad (1998), but it is specifically adapted to the context of digital technologies. While the original authors excluded several items due to low factor loadings or cross-loadings, we initially included all 11 items in our measurement model. After conducting exploratory and confirmatory factor analyses, we found that all items demonstrated acceptable psychometric properties in our sample and therefore were retained for further analysis.

To operationalise the mediators—digital IT capabilities, digital employee capabilities, and digital culture—we utilised measurement tools previously employed by Proksch et al. (2024). The items addressing digital employee capabilities were modified to distinguish between family and non-family employees. Subsequently, the average scores for each item within this mediator were calculated.

The digital innovation activity i.e. the creation of products and services, processes, or business models on the basis of digital technology or the trials of such creation, was assessed using a scale adapted and modified by Bornhausen and Wulf (2023). This scale, which has been validated for both small and large enterprises, was previously employed to measure the innovativeness of family firms (Chirico et al., 2011; Kellermanns et al., 2012).

Method

The final sample size was sufficient for employing the SEM method to test the proposed hypotheses (Priyanath et al., 2020). To assess potential issues with normality, we conducted Mardia's tests for multivariate normality. The results indicated significant Mardia's coefficients, suggesting a possible deviation from a normal distribution. However, it is crucial to emphasise that this significance test alone is not a comprehensive measure of normality. Mardia's tests are susceptible to sample size, with larger samples more likely to produce significant results indicating non-normality.

To provide a more robust assessment, descriptive statistics should complement significance tests, especially kurtosis values, as kurtosis can significantly affect tests of variances and covariances—key components in SEM (Byrne, 2009; DeCarlo, 1997). According to Westfall and Henning (2013), kurtosis values exceeding 3.00 may indicate that a variable does not follow a normal distribution. Our analysis examined the kurtosis for individual items and found that none exceeded the threshold of 3.

All data preparation and SEM computations were performed in RStudio, with the lavaan package (Rosseel, 2012) serving as the primary tool for model estimation.

Measurement model

The validity of the constructs was assessed by systematically eliminating items with insufficient factor loadings. Following established guidelines, factor loadings exceeding 0.70 are preferred, as they indicate that the construct explains a substantial proportion of the variance in its indicators. However, their removal was considered appropriate for items with loadings in the range of 0.40 to 0.70 to enhance construct validity, minimise measurement error, and improve overall model fit (Hair et al., 2016). Ultimately, only items with loadings above 0.65 were retained for further analysis (Table 3).

The variance inflation factors (VIFs) for the individual observed variables in our model ranged from 1.70 to 2.94, indicating low to moderate multicollinearity (i.e., below the commonly accepted threshold of 5; Sarstedt et al., 2017). In contrast, the VIFs calculated for the latent variables (after additional analytical steps, i.e., exporting factor scores from the measurement model) ranged from 5.5 to 9.8. However, according to the SEM literature, multicollinearity becomes problematic when the VIF for latent variables exceeds 10 (Kock & Lynn, 2012).

Table 3. Measurement model diagnostics

Standardised parameter estimates for the measurement model					
	LDI	ITDC	EDC	DC	DA
L1	0.7998				
L2	0.7513				
L4	0.7709				
L5	0.7302				
L7	0.8015				
L8	0.7762				
L9	0.6866				
L10	0.7939				
L11	0.7457				
IT1		0.7234			
IT2		0.7301			
IT3		0.6717			
IT4		0.6924			
IT5		0.6755			

Standardised parameter estimates for the measurement model					
IT8		0.7264			
EM30			0.7339		
EM31			0.7865		
EM33			0.7895		
C1				0.6456	
C2				0.6876	
C3				0.6570	
C4				0.6397	
C5				0.6787	
D1					0.7534
D2					0.7821
D3					0.7826
D4					0.7666
D5					0.7706
D6					0.7660
D7					0.7738
Reliability criteria for the constructs					
alpha	0.9254	0.8542	0.8111	0.8047	0.9108
CR	0.926	0.854	0.810	0.796	0.911
AVE	0.5812	0.5007	0.5896	0.4381	0.5937

The remaining items were subjected to a five-factor confirmatory factor analysis (CFA) to evaluate the psychometric properties of the scales corresponding to each construct. While the chi-square statistic for the model was significant (χ^2 = 835.113, df = 395, $p < 0.01$), additional fit indices demonstrated strong model performance: Tucker–Lewis index (TLI) = 0.942, comparative fit index (CFI) = 0.947, root mean square error of approximation (RMSEA) = 0.049, and standardised root mean square residual (SRMR) = 0.038.

Construct reliability was assessed using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE) (Cheung et al., 2024). For each construct, the values of Cronbach's α and CR are more than the floor level of 0.70 and are acceptable for basic research (Ritika & Kishor, 2022). Also, the criterion that CR must be greater than AVE is also satisfied in all 5 constructs. Thus, all the conditions to be satisfied for ensuring convergent validity were met by all the constructs (Ritika & Kishor, 2022). While the AVE for the Digital Culture (DC) construct was slightly below the conventional threshold (0.44), it was retained based on the guidance of Fornell and Larcker (1981), who suggested that convergent validity may still be acceptable if composite reliability exceeds 0.60, even when AVE is below 0.50. However, it is important to note that the prevailing standard remains an AVE of at least 0.50 (Hair et al., 2019). Therefore, the lower AVE for DC should be acknowledged as a limitation, and results involving this construct should be interpreted with appropriate caution.

Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio (HTMT). The HTMT values (Table 4) for all constructs were below the threshold of 0.90 (or 0.85 for a more conservative criterion), indicating satisfactory discriminant validity (Henseler et al., 2015).

Table 4. Heterotrait-Monotrait Ratio

	LDI	**DA**	**DC**	**EDC**	**ITDC**
LDI	1.0000	0.7963	0.5320	0.8675	0.7761
DA	0.7963	1.0000	0.7298	0.8754	0.8314
DC	0.5320	0.7298	1.0000	0.7049	0.7598
EDC	0.8675	0.8754	0.7049	1.0000	0.8478
ITDC	0.7761	0.8314	0.7598	0.8478	1.0000

RESULTS

Structural model

The proposed model predicts that digital IT capabilities, digital capabilities of employees and digital culture partially mediate the effect of leader's digital innovativeness on digital innovation activities. The findings indicate a satisfactory fit for the model (χ^2 = 835.113, p < 0.05, df = 395, CFI = 0.947; TLI = 0.942; RMSEA = 0.049, SRMR=0.038). Analysis of the structural path coefficients (Figure 1) reveals that only one of the seven proposed paths examined did not reach statistical significance (specifically, H1: LDI → DA). Therefore, all hypotheses except H1 receive empirical support (Table 5).

Table 5. Hypotheses support

H	term	Estimate	statistic	p.value
H1	LDI→ DA	0.1587	1.8347	ns
H2	LDI → ITDC	0.6434	13.6896	p<0.001
H3	ITDC→DA	0.2154	2.0689	p<0.05
H4	LDI → EDC	0.7661	15.0755	p<0.001
H5	EDC → DA	0.4706	3.4188	p<0.001
H6	LDI → DC	0.3601	9.0181	p<0.001
H7	DC → DA	0.2709	2.7020	p<0.01

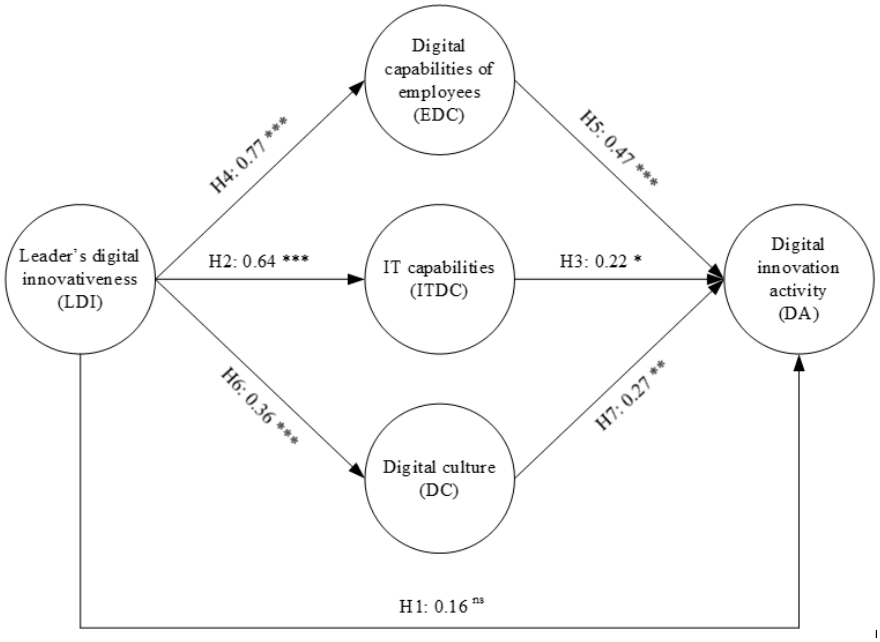

Figure 1. Graphical representation of path coefficients

Analysis of mediation

We propose that digital innovation activities are partially mediated by three key factors: IT capabilities, digital capabilities of employees, and digital culture. To test these mediation effects, following the approach outlined by James et al. (2006) and adopted in the family business research (Afonso et al., 2021), we estimated three additional models (Table 6). Model 1 - that presents a full mediation scenario. Model 2 examines only the direct effect of leader's digital innovativeness on digital innovation activities. Model 3 incorporates the direct effects of leader's digital innovativeness on IT capabilities, digital capabilities of employees, and digital culture, as well as on digital innovation activities, but excludes the mediating effects of these factors on digital innovation activities. Lastly, Model 4 represents the proposed model, assuming a partial mediation scenario where a direct effect on digital innovation activities is also included.

Table 6. Mediation analysis results – path coefficents

Path	Model 1 Full mediation	Model 2 IV affects DV	Model 3 No mediation	Model 4 Partial mediation
LDI→ DA		0.76***	0.76***	0.16
LDI → ITDC	0.64***		0.64***	0.64***
LDI → EDC	0.77***		0.77***	0.77***
LDI → DC	0.36***		0.36***	0.36***
ITDC→DA	0.24*			0.22*
EDC → DA	0.68***			0.47***
DC → DA	0.17*			0.27**

Note: Two-tailed significance testing; *Significant $p < 0.05$; ** Significant $p < 0.01$; *** Significant $p < 0.001$.

Before evaluating the mediator effect, it is crucial to examine four conditions that validate the presence of mediation. The initial step involves identifying whether the independent variables (leader's digital innovativeness) directly influence the mediators (IT capabilities, digital capabilities of employees, and digital culture) and whether the mediators, in turn, directly affect the dependent variable (digital innovation activities), based on the estimation of Model 1. The analysis then explores whether the leader's digital innovativeness directly impacts the digital innovation activities when the mediators are excluded, as outlined in Model 2. Lastly, the test evaluates whether the influence of the leader's digital innovativeness on digital innovation activities diminishes or becomes statistically insignificant upon including the mediators in the model, thereby indicating either partial or full mediation. The findings point to full mediation, as the effect becomes insignificant. All calculated models obtained a satisfactory fit (Table 7).

Models 3 and 4 demonstrated identical fit indices and the same number of degrees of freedom, indicating that they are statistically equivalent and cannot be distinguished based on model fit criteria alone. Therefore, the selection of Model 4 was guided by theoretical considerations and its closer alignment with the study's conceptual framework and research objectives. This approach is consistent with best practices in structural equation modeling, where theoretical justification is used to guide model selection when statistical criteria are inconclusive (Guo et al., 2009).

Table 7. Mediation analysis results – model fits

Model	AGFI	CFI	chi2	df	RMSEA	SRMR	TLI
Model 1	0.86	0.95	837.95	435	0.05	0.04	0.94
Model 2	0.93	0.98	210.55	103	0.05	0.03	0.98
Model 3	0.86	0.95	835.11	395	0.05	0.04	0.94
Model 4	0.86	0.95	835.11	395	0.05	0.04	0.94

DISCUSSION

Although H1 posited a direct positive effect of the family business leader's digital innovativeness on digital innovation activity, this path was not statistically significant. This finding suggests that digital innovativeness at the leadership level, while important, may not be sufficient on its own to drive digital innovation activity in Polish family SMEs. Recent research increasingly emphasizes that the influence of digital leadership is often indirect and operates through organizational mediators—such as digital culture or specific human resource management practices —rather than as a direct effect (i.e., Cetinkaya & Surucu, 2025; Wang et al., 2024). In the context of family SMEs, qualitative research indicates that even when top managers are open to or fascinated by digitalization, it does not mean that it translates into concrete innovation activity (Bouncken & Schmitt, 2022).

The findings for hypotheses H2, H4, and H6 emphasise the pivotal influence of leader's digital innovativeness on establishing a robust organisational framework for digital transformation. Specifically, the results demonstrate that leader-driven digital innovativeness has a direct, positive impact on three essential facilitators of digital innovation activities: IT capabilities (H2), employee digital competencies (H4), and organisational digital culture (H6). This observation upgrades the preliminary assumptions of the Upper Echelons Theory, which asserts that the unique traits of leaders—including their personalities—significantly shape their interpretations of various situations, thereby affecting their strategic

decisions (Hambrick & Mason, 1984; Hambrick, 2007). Consequently, these characteristics enable leaders to determine the extent and quality of IT and employee digital capabilities while simultaneously influencing the organisational culture and strategic priorities. The results for H3, H5, and H7 emphasise the critical roles of IT capabilities, digital capabilities of employees, and digital culture as direct drivers of digital innovation activity in family businesses. Specifically, the positive and significant relationships between these mediators and digital innovation activity highlight their individual contributions to the digital transformation process. These findings align with the dynamic capabilities framework, underscoring the importance of cultivating organisational competencies that adapt and respond to technological changes in family businesses (Putritamara et al., 2023; Soluk & Kammerlander, 2021).

Our findings resonate with those of Gunawan et al. (2023), who similarly underscored the vital role of organisational digital culture in facilitating digitalisation within family enterprises. In parallel, Porfírio et al. (2024) identified critical factors such as organisational culture, change management, knowledge, human capital, IT systems, and digital transformation strategies as essential components driving the advancement of digital transformation initiatives.

In the literature, it is relatively often stated that successful digital transformation requires leaders with appropriate digital skills (Hunt, 2015; Schwarzmüller et al., 2018) and a certain mindset ready to lead digital change (von Ohain, 2019). In the context of family businesses, the innovativeness of the leader plays a pivotal role in driving digital transformation. Santiago's (2021) research highlights that the adaptability of family firms to digital technologies is significantly influenced by the level of control exerted by the leader in the decision-making process. Leaders with a more controlling nature, particularly those who lack exposure to new knowledge, often resist digital advancements—a phenomenon described as „family inertia." However, as our research shows, those personal traits of leaders influence digital innovation activities indirectly - through supporting their employees in their digital capabilities growth, deciding on developing IT capabilities, and facilitating digital culture.

Our findings align with the research of Proksch et al. (2024), revealing that digital innovation activities are not solely propelled by leader's digital innovativeness or digital strategy; instead, these outcomes are fully mediated by IT capabilities, employee digital competencies, and organisational digital culture. While Proksch et al. focus on new ventures and highlight the partial mediation effects of IT capabilities and digital culture within their digital strategy framework, our study extends this perspective by emphasising the comprehensive role of these mediators, specifically in the context of family businesses. This contrast may stem from contextual differences between new ventures and family businesses. In our study, the deeply embedded traditions, governance structures, and long-term orientations typical of family firms may amplify the mediating role of internal capabilities and culture, rendering leadership innovativeness insufficient as a direct driver of digital innovation activities. This distinction is crucial, as family firms often face unique challenges and opportunities that differ from those encountered by new ventures.

CONCLUSION

The subject of digital transformation within family firms remains significantly under-researched, primarily due to the intricate nature of the digital transformation phenomenon and the inherent diversity among family businesses (Daskalopoulos & Machek, 2023; Tirdasari et al., 2022). Future research should focus on the role of family influence, antecedents, enablers, barriers, and performance outcomes of digital transformation in family businesses (Daskalopoulos & Machek, 2023).

The practical implications of this research are multifaceted. Firstly, the findings underscore that organisations, particularly family-owned businesses, need to invest in leadership development programs that emphasise digital innovativeness. By fostering these qualities in their leaders, businesses can more effectively navigate the complexities associated with digital transformation. This strategic investment not only equips leaders with the necessary skills to drive technological advancements but also enhances the overall digital resilience of the company. Furthermore, such programs can foster a culture of continuous learning and innovation, ensuring that the organisation remains competitive in an increasingly digitalised market. Therefore, businesses need to recognise the value of nurturing digitally innovative leaders as a critical component of their long-term success and sustainability.

The research highlights the importance of cultivating a supportive digital culture within the organisation. Practical measures to achieve this include promoting collaboration and knowledge sharing among employees, investing in advanced digital tools and technologies, and encouraging a mindset that embraces change and innovation. Businesses can significantly enhance their overall performance and achieve superior digital innovation activities by creating an

environment where digital capabilities are highly valued and nurtured. This approach ensures that the entire organisation, not just its leaders, is aligned with the overarching goals of digital transformation. Consequently, fostering a robust digital culture is pivotal for organisations aiming to thrive in the digital age.

Ultimately, our findings emphasize the imperative to integrate key characteristics of family firm executives—particularly those pertaining to their digital competencies—into the framework of Upper Echelon Theory. This divergence suggests that dominant models of digital transformation—often derived from startup or corporate contexts—may not fully capture the dynamics at play in family firms. By integrating insights from Upper Echelon Theory with the distinctive features of family business governance, our findings call for more nuanced models of digital innovation. The digital orientation, attitudes, and behaviours of these top-level leaders may significantly influence both the development of digital capabilities of employees and the cultivation of a digitally oriented organizational culture. Furthermore, we critically assessed the methodology employed for measuring the leader's digital innovativeness proposed by Mancha and Shankaranarayanan (2021).

Several limitations constrain the generalizability of our study's findings. The sampling approach employed inherently limits external validity, as it does not provide equal selection probability for all family businesses in the population of all family businesses, potentially introducing systematic bias. Geographic limitation to Polish enterprises constrains applicability to family businesses operating in different institutional and cultural contexts. The cross-sectional design captures family business dynamics at a single point in time, limiting insights into developmental processes. While these constraints limit population-level inferences, the findings remain valuable for understanding family business dynamics within the specified contextual boundaries (Polish SME's) when interpreted with appropriate caution. Another limitation of this study is its reliance on a single respondent to assess the leader's digital innovativeness, which may introduce bias and limit perspective diversity. Future research should incorporate multi-source ratings (e.g., from subordinates or peers) to enhance validity and capture the potential impact of differing viewpoints on the observed relationships. The leader's digital innovativeness was assessed from the perspectives of managers and family business owners. These perspectives may differ due to their distinct roles and priorities, which require further investigation.

While this study advances understanding of digital innovation within family firms, several avenues remain open for further exploration. Future research could benefit from expanding the sample to include family businesses from diverse geographical regions, enabling a more comprehensive understanding of the phenomenon in question and enhancing the external validity of the findings. Another intriguing avenue for future research lies in exploring how the personal traits of managers within managerial teams influence digital innovation activities and how their interactions shape these processes (Dasí & Kok, 2023). Future research should explore these differing viewpoints in more depth to better understand the leadership dynamics driving digital innovation within family businesses. Longitudinal research could illuminate how digital leadership and organizational capabilities evolve over time, particularly across generational transitions within family businesses. Comparative studies contrasting family and non-family firms or examining differences between first-generation and multi-generational family businesses may yield insights into how ownership structure and legacy shape digital transformation pathways. Expanding research across diverse institutional and cultural contexts would enrich understanding of how environmental factors influence the success of digital strategies in family firms. Cross-national comparisons, in particular, may reveal context-specific enablers or barriers not evident in single-country studies. Besides, future studies could investigate digital leadership as a team-level phenomenon, exploring how intra-family dynamics and collective managerial decision-making impact the development of digital capabilities, especially in firms where multiple family members are involved in top management teams. Digital governance and risk management practices in family firms present an under-explored area. Understanding how these firms balance innovation with risk aversion could provide practical insights for digital implementation strategies. Lastly, future research may explore intergenerational dynamics, examining how digital fluency and attitudes toward transformation differ across age cohorts within family firms. Investigating the influence of successors versus incumbents may shed light on how generational tensions or synergies shape digital innovation activity. As digital transformation continues to reshape business landscapes, understanding how family firms respond at structural, strategic, and cultural levels remains a rich area for scholarly inquiry.

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Robert Zajkowski is an Associate Professor and Head of the Department of Banking and Financial Markets, Faculty of Economics at Maria Curie-Skłodowska University in Lublin. His main research interests are family businesses, corporate finance and governance, VBM, business creation processes, optimisation of company managerial decisions, and implementation of qualitative and quantitative research methods. Prof. Robert Zajkowski holds the positions of Expert of the Polish National Agency for Academic Exchange, the Regional Court, the Polish Academy of Sciences Foundation, and the Finance Expert of the Marshal Office of the Lubelskie Voivodeship in Lublin. Prof. Robert Zajkowski is additionally a co-originator and member of the Family Business Research Network (FaBeRNET), an association of family business researchers in Poland.

Valerija Kozlova is a lecturer and researcher at the Transport and Telecommunication Institute (Latvia) and a Research Associate at the Stockholm School of Economics in Riga. She is the co-founder and board member of the Baltic Family Firm Institute, as well as a scientific committee member for the BFFI-ECGI Family Business Conference and the STEP Project Global Consortium Global Summit. Additionally, she serves as a reviewer for the EURAM SIG 4 Conference**.**

Author contributions statement

Beata Żukowska: Conceptualization; Data Curation; Formal Analysis; Investigation; Methodology; Project Administration; Validation; Writing – Original Draft Preparation; Writing – Review & Editing. **Robert Zajkowski**: Conceptualization; Supervision; Writing – Original Draft Preparation; Writing – Review & Editing. **Valerija Kozlova**: Conceptualization; Writing – Original Draft Preparation; Writing – Review & Editing.

Conflicts of interest

The authors declare no conflict of interest.

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