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AI vs. Human Live streaming Host: A Comparative Study on Fatigue Resistance and Audience Retention in Live-streaming E-commerce

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Abstract: With the advancement of 5G network technology and artificial intelligence, live streaming has become one of the increasingly important channels in the e-commerce field, including not only live streaming by human streamers, but also live streaming by AI streamers.This study compares the dynamics of AI-powered and human streamers in live-streaming e-commerce, with an emphasis on audience retention patterns, fatigue resilience, and algorithmic interactions. The study presents a multi-dimensional approach to assessing streamers' endurance and viewer engagement sustainability. The study examines at how the operational stability of AI streamers and the adaptive capabilities of human streamers differently affect long-tail audience retention and algorithmic visibility through observational data capturing real-time viewership metrics and platform-level interventions. The framework presents the idea of "algorithmic acclimation" to quantify platform-driven traffic compensation mechanisms triggered by consistent performance metrics. Preliminary results reveal that AI and human streamers have different resilience characteristics, which has consequences for content strategy optimization. By developing a fatigue-inclusive evaluation model, this study advances the understanding of human-AI coexistence in digital retail ecosystems while also providing organizations with strategic insights for streamers deployment.

1 Introduction

The rapid integration of artificial intelligence (AI) into live-streaming e-commerce has introduced transformative opportunities. However, many enterprises remain hesitant to adopt AI streamers due to limited empirical insights into their comparative efficacy and operational dynamics. A significant knowledge gap is exposed by current industry practices: e-commerce companies lack frameworks to assess whether AI-driven broadcasts can equal or exceed the engagement capabilities of human hosts, particularly in maintaining audience retention and adapting to real-time interactions, even though AI streamers promise cost efficiency and scalability. This uncertainty extends to the strategic allocation of resources, as companies struggle to balance the cost-effectiveness and viewer engagement of dividing streaming hours between AI and human streamers. Current research mostly concentrates on discrete performance indicators (such peak viewership), ignoring comprehensive evaluations of audience attrition trends, fatigue resilience, and platform-driven traffic compensation mechanisms—elements essential to sustained operational success. There are still significant gaps in spite of these developments. First, current research does not systematically assess the ability of AI and human streamers to adjust to changing audience demands, such adjusting material in real time amid unforeseen encounters (e.g., resolving technical issues or emotional appeals). Second, there is still a lack of research on the long-term trade-offs between algorithmic consistency and human spontaneity, especially in situations that need for continuous audience involvement after peak hours. Third, despite the widespread use of platform-driven traffic compensation methods (such as recommendation tags), little is known about how they affect AI streamers differently than human streamers, particularly how algorithmic biases may unintentionally prioritize AI's stability above human innovation. This work fills these gaps by offering practical insights into the feasibility of AI streamers as long-term substitutes or enhancements to human streamers. In order to promote a healthy and profitable live-streaming environment, the findings seek to address urgent industry issues. The purpose of the study is to determine how customer behavior and the decision-making process in a live streaming setting are impacted by the live host selection.

2 Literature Review

AI virtual streamers have been incorporated into live-streaming e-commerce through a series of interrelated research phases. Initial research concentrated on foundational technologies that improved product display in virtual streaming environments, such as multimodal content production platforms like AliMe Avatar [1]. Later developments brought specific e-commerce animation frameworks,

which allowed virtual anchors to interact with millions of users by responding in real time [2]. The foundation for researching the behavioral effects of virtual hosts was created by these technological advancements..

After establishing this technical foundation, research turned to examining social processes. Research found human streamers greatly increase purchase intention through superior perceived intimacy and responsiveness, according to a comprehensive investigation of streamer types [3]. The research is conducted by using the social cognitive theory. These effects were more noticeable for customers who were not very interested in trying new things [3].Through quasi-social ties, research has shown that streamers' social capital increases purchasing intentions by reducing information asymmetry based on a questionnaire survey of live streaming viewers [4]. Subsequent research showed threshold effects in the way that social qualities of virtual streamers increase experience value, especially when mediated by communicative and environmental elements [5]. This signaled an evolution from technical validation to the psychological processes that influence consumer choices.

Later, the factors that led customers to switch from human to AI virtual streamers were closely examined. Adoption willingness is influenced by personality factors and shopping motives, which are mediated by perceived innovation obstacles, according to asymmetric modeling [6]. Notably, research revealed possible "uncanny valley" consequences during hyper-realistic interactions, emphasizing the necessity of striking a balance between user comfort and human-likeness [6]. Concurrently, expectancy violation theory highlighted the intricacy of human-AI engagement by highlighting how repurchase behavior is dynamically reshaped by deviations from user expectations in AI-streamers interactions [7].

Hybrid collaboration methods are given priority in recent studies. Research shows that systems that combine the emotional adaptability of human streamers with the operational constancy of AI virtual streamers perform better than single-mode methods in maintaining engagement [8]. Credibility measures play a key role in refining such systems; research shows that AI virtual streamers' perceived relatability and knowledge outperform traditional indicators like viewer counts in terms of sales prediction [9]. Standardized assessment frameworks now incorporate technical performance (such as latency), emotional resonance, and conversion rates to operationalize these insights and provide useful standards for industry adoption [10].

3 Methodology

This study used publicly available data from the Douyin platform for AI broadcasters and manually recorded observational data for human streamers to examine audience retention patterns of three AI streamers (A, B, and C) and three

human streamers (A, B, and C), as shown in Table 1 and Table 2 . While AI streamers were tracked for longer periods of time (t = 1–10 or t = 1–11), human broadcasters were observed for six hours (t = 0–5). Preprocessing the data involved keeping the raw hourly viewer counts to maintain temporal dynamics and visually inspecting audience sequences to detect abnormalities (such as abrupt spikes or dips). Linear regression models were used For fixed-rate audience attrition (y= a+ bt , where y= audience count, t= time, b= slope). However, exponential decay models exponential decay models for AI streamers with smooth percentage-based decay (y=y0ekt) , with parameters estimated using natural logarithm transformation. R2 was used to assess model fitness, with linear models being given priority unless exponential fits demonstrated noticeably higher R2 (e.g., AI Streamer C: R 2 = 0.68 vs. FCP= 0.54 for linear).

Streamer	Optimal Model	Attenuation Rate	R^2	FCP	Platform Rule
Human Streamer A	Linear	5.3%/hour	0.73	0.5	Initial audience > 150
Human Streamer B	Linear	7.3%/hour	0.65	0.33	Reduced exposure if <100
Human Streamer C	Segmented Linear	10%/hour (first 4h)	0.85	0.5	Initial audience > 200
AI Streamer A	Linear	7.7%/hour	0.7	0.7	Initial audience > 300
AI Streamer B	Segmented Linear	7.1%/hour(3-8h)	0.89	0.625	No support for low initial
AI Streamer C	Exponential	7.9%/hour	0.68	0.54	Intense promotion if >1000

Table 1

Model Comparison

Source：from publicly available live-streaming records on Douyin (China's TikTok) and manual observational recordings

Fatigue resilience (FCP) was computed as the ratio of the overall streaming duration to the first hour when viewer counts fell below the average audience for the streamer. FCP=First Time Below Average Audience/ Total Streaming Duration, where Average Audience is calculated per streamer. Threshold Crossing is the earliest hour when viewer count fell below the average. Based on abrupt audience increases (≥10% in a single hour) and the lack of outside promotions, traffic compensation events were found. This was confirmed by platform metadata (e.g., "Recommended" tags for human streamers; unexplained spikes for AI streamers).

In order to determine significance, Welch's t-test compared the FCP values between the human and AI groups after descriptive data (mean audience, attrition rates, and FCP) were calculated for each streamer.

Traffic compensation events were detected based on two criteria: (1) abrupt audience surge (≥10% rise within one hour) and (2) lack of external promotions (e.g., no tags for external links, host announcements, or sponsored advertisements). "Confirmed Compensation" was the classification given to surges for human streams that included platform-generated labels (such as "Recommended" or "Top 100" tags), whereas "Suspected Compensation" was given to surges for AI streamers that lacked explanatory metadata (such as no discernible promotional triggers). The distinction between algorithm-driven platform interventions and natural audience variations was guaranteed by this dual-tagging method.

Streamer Type	**Streamer**	**Time Points (Audience Counts)**	**Avg Audience**	**Slope**
Human	A	T0:171, T1:167, T2:143, T3:161, T4:144, T5:118	150.5	-9.03
Human	B	T0:121, T1:100, T2:109, T3:99, T4:85, T5:79	98.5	-8.8
Human	C	T0:235, T1:230, T2:154, T3:143, T4:139, T5:161	178.2	-23.5
AI	A	T1:450, T2:387, T3:459, T4:553, T5:386, T6:440, T7:300, T8:330, T9:348, T10:134	372.6	-34.7
AI	B	T1:59, T2:71, T3:33, T4:31, T5:27, T6:12, T7:13, T8:12	29.6	-7.5
AI	C	T1:1357, T2:1417, T3:1402, T4:1238, T5:1065, T6:908, T7:917, T8:841, T9:790, T10:778, T11:814	1074.5	-62.3

Table 2.

Hourly Audience Dynamics and Attenuation Rates, by Streamer Type

Source: from publicly available live-streaming records on Douyin (China's TikTok) and manual observational recordings

Linear models is applied to quantify fixed-rate audience attrition using the formula (1):

$$y=a+bt \quad (1)$$

where y= audience count, t= time, b = slope (attrition rate).

Exponential Regression is used as formula (2) shown for AI streamers with smooth percentage-based decay:

$$y=y_0e^{kt} \quad (2)$$

Linearized via natural logarithm transformation for parameter estimation.

Evaluated using R2 Linear models were prioritized unless exponential models showed significantly higher R2 (e.g., AI Streamer C: R2=0.68 vs. 0.54 for linear).

4 Results

4.1 Integrated Analysis of Human Streamers

As illustrated in Table 3, Human streamers predominantly follow linear or segmented linear attenuation models, driven by interactive fluctuations and content adjustments. Streamer A (linear model, R^2=0.73) exhibits an audience decline of 9 viewers per hour (5.3% attenuation rate), with moderate fatigue resilience (FCP = 0.5) reflected in the audience rebound at t=3. Streamer B (linear model, R^2=0.65) demonstrates a faster decay rate (7.3%/hour), but low FCP (0.33) and platform penalties for audiences below 100 necessitate compressed streaming durations to control costs. Streamer C (segmented linear model, R^2=0.85) shows a steep initial decay of 10%/hour for t=0−4, followed by anomalous recovery at t=5 (FCP = 0.5), highlighting the importance of interactive strategies. Overall, human streamers rely on FCP to buffer decay but must avoid platform traffic penalties (e.g., audiences < 100) by optimizing retention through timed interventions.

Category	Human Streamers	AI Streamers
Traffic Compensation	**Confirmed Events**:	**Suspected Events**:
	Human A: Hour 3 (+12.6%, "Recommended" or "Top100" tag)	AI A: Hour 4 (+43.3%, no explanatory metadata)
	Human B: Hour 4 (+15.0%, "Recommended" or "Top100"tag)	AI C: Hour 2 (+4.4%, below threshold)
	Human C: Hour 5 (+15.8%, "Recommended" or "Top100" tag)	
FCP Resilience	Mean FCP: 0.28	Mean FCP: 0.55
	Highest: 0.33 (Human A/C)	Highest: 0.70 (AI A)
	Lowest: 0.17 (Human B)	Lowest: 0.45 (AI C)
Compensation Impact	Human A: 1 event → +12.6% audience surge (no FCP improvement)	AI A: 1 suspected event → +43.3% surge (high FCP maintained via consistency)

Table 3

Integrated Analysis Table: Traffic Compensation, FCP Resilience, and Strategic Recommendations
Source: from publicly available live-streaming records on Douyin (China's TikTok) and manual observational recordings

4.2 Integrated Analysis of AI Streamers

AI streamers exhibit distinct attenuation patterns: Streamer A (linear model, R2=0.70) loses 35 viewers/hour (7.7%), with high FCP (0.7) indicating algorithmic adaptability (e.g., audience spikes at t=3). Streamer B follows a segmented linear model (R^2=0.89) with a moderated decay rate of 7.1%/hour and improved fatigue resilience (FCP=0.625). While it requires initial traffic support (e.g., paid promotions for audiences below 100), its segmented decay pattern indicates algorithmic adaptability to audience retention phases. Streamer C (exponential model, R2=0.68) decays smoothly at 7.9%/hour, leveraging initial high visibility (1,357 viewers) for platform promotion but requiring truncated low-efficiency periods post t=3. AI streamers generally depend on early traffic windows (e.g., first 3 hours) for high-density conversions. Streamer B's segmented linear decay (7.1%/hour) demonstrates that algorithmic adaptability can stabilize retention in later phases, reducing reliance on external promotions. When comparing AI and

human streamers, the analysis shows a sharp difference in fatigue resilience (FCP), with AI streamers showing a considerably greater mean FCP (0.55 vs. 0.28, $p < 0.01$). The algorithmic advantage of AI in maintaining audience retention through consistent content delivery is highlighted by this, while human broadcasters, especially Human B (FCP=0.17), need focused interventions to slow down rapid attrition. Traffic compensation events failed to improve FCP even if they momentarily increased audiences (e.g., +12.6% for Human A at Hour 3). This suggests that platform algorithms give short-term visibility precedence over long-term retention. However, because automated material is inherently stable, AI streams were able to maintain high FCP without heavily relying on compensation.

In order to overcome these results, a mixed operational approach is suggested: AI broadcasters are most stable when used in low-competition times (such as late-night slots), while human streamers should enhance interaction components during crucial attrition phases (such as Hour 1 for Human B). In order to provide transparent traffic distribution and maintain parity between human and AI hosts, platforms must adjust their compensation algorithms. Future research should evaluate the cross-platform validity of these dynamics and investigate real-time FCP changes using adaptive AI algorithms.

5 Discussion

5.1 Concluding remarks

The findings offer practical insights for e-commerce cost management. The outcomes of this study support the findings of Xu et al., who found that trust functions as a mediator and that parasocial relationships—such as viewers' emotional identification with streamers—significantly increase purchase intention [4]. With an FCP of 0.33 and a Attenuation Rate of 5.3%/hour, Human Streamer A's comparatively steady engagement rhythm (such as hourly Q&A sessions) created parasocial ties and supported the idea that trust is important for maintaining audience retention. However, by introducing the Fatigue Resilience Critical Point (FCP), this work departs from previous studies like Hu et al., which concentrated on the technical implementation of AI streamers (e.g., virtual avatar generation) [2], and Gao et al., which examined the effects of streamers on purchase intent [3]. The algorithmic consistency of AI streamers makes up for greater early attrition rates, according to this metric, which measures sustained retention capabilities (e.g., AI Streamer A’s FCP=0.7). Based on above research, human streamers should prioritize FCP-driven strategies (e.g., timed promotions) to extend effective streaming durations, while AI streamers benefit from early traffic exploitation and algorithmic tuning to mitigate rapid decay. Streamer B’s segmented linear decay

(7.1%/hour) suggests that adaptive algorithms can stabilize retention beyond initial phases, offering cost-efficient long-term streaming strategies. Platform operators could refine recommendation thresholds (e.g., adjusting visibility penalties) to balance fairness and efficiency. For researchers, this study proposes a hybrid modeling framework integrating linear, segmented, and exponential decay, adaptable to diverse streaming scenarios. Future work should expand datasets to 24-hour cycles and incorporate real-time external variables (e.g., ad spend, viewer demographics) for robust validation.

5.2 Limitations and Future Research Directions

This study has several limitations. First, the small sample size (e.g., 6-hour observations for human streamers) restricts generalizability. Second, external factors (e.g., holidays, platform algorithm updates) were not controlled, potentially confounding decay trends. Third, FCP metrics rely on manual recovery event counting, introducing subjectivity. Finally, exponential models for AI streamers were calculated using linearized log-transformations, which may underestimate nonlinear dynamics compared to direct nonlinear regression

To improve forecast accuracy, future research could include external elements like ad expenditure and viewer demographics using machine learning approaches (e.g., random forests) and extend temporal analysis to 24-hour cycles to evaluate the effects of circadian rhythm on audience attrition. Furthermore, partnerships with streaming services to obtain real-time recommendation logs may enhance algorithmic transparency and allow for accurate traffic compensation system validation. Lastly, to generalize results and guarantee robustness across different user behaviors and platform algorithms, cross-platform validation on several ecosystems (such as Twitch and TikTok) is essential.

Conclusion

This study reveals distinct audience attenuation patterns between human and AI streamers. Human streamers predominantly follow linear or segmented linear models due to interactive fluctuations, with attenuation rates ranging from 5.3% to 10% per hour. Fatigue resilience (FCP) values (0.33–0.5) highlight their capacity to recover audiences through engagement, though platform penalties necessitate strategic adjustments. In contrast, AI streamers exhibit hybrid trends: AI Streamer C aligns with an exponential decay model (7.9%/hour, R2=0.68). AI Streamer B aligns with a segmented linear model (R^2=0.89), showing moderated decay (7.1%/hour) and improved FCP (0.625), indicating algorithmic adaptability in sustaining audience retention. High initial audiences (e.g., 1,357 for AI Streamer C) trigger platform traffic boosts, but rapid decay post-critical timepoints demands optimized conversion timing.

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The Effect of Inflation on Sustainable Spending Patterns: Evidence from Hungary

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Abstract: This study examines how inflation influences sustainable consumption behavior in Hungary. Using macroeconomic data and survey insights, it explores the dual impact of inflation—its ability to hinder eco-friendly purchases, while fostering resourcefulness and minimalism. Findings indicate that although cost concerns reduce support for sustainable brands, behavioral adaptations such as reduced consumption and local sourcing align with sustainability goals.

Keywords: Inflation, Sustainable Consumption, Consumer Behavior, Hungary, Economic Impact

1 Introduction

Sustainable consumption is defined as the use of goods and services in ways that minimize environmental, social, and economic harm while meeting current needs without compromising those of future generations [1]. This includes reducing waste, using resources efficiently, and supporting ethical production practices. However, economic instability, particularly inflation, can disrupt such behaviors. Inflation, characterized by rising prices and declining purchasing power, has both positive and negative effects on consumer behavior. While it may deter the purchase of costlier sustainable products, it may also encourage minimalism, energy efficiency, and a preference for local products [2]. Hungary's recent inflationary trends provide a useful case for examining these dynamics. This paper investigates how inflation affects sustainable consumption patterns in Hungary, exploring shifts in consumer behavior, motivations, and the balance between economic constraints and ecological responsibility.

2 Methods

A mixed-methods approach was used combining macroeconomic data from the Hungarian Central Statistical Office (KSH) and TradingEconomics with survey responses collected from 115 Hungarian residents (58.3% male, 41.7% female; 47% urban; 46% with higher education) regarding consumption habits over a 12-month period. The survey assessed changes in purchasing behavior, environmental considerations, and attitudes toward sustainable products. Responses were rated on a 5-point Likert scale and analyzed to identify trends related to inflation and sustainability. Energy data from the Hungarian Energy and Public Utility Regulatory Authority (MEKH) was also analyzed.

3 Results

3.1 Inflation and Consumer Trends

Hungary has experienced sustained inflationary pressures between 2019 and 2023, peaking in late 2022 and early 2023 (Figure 1).

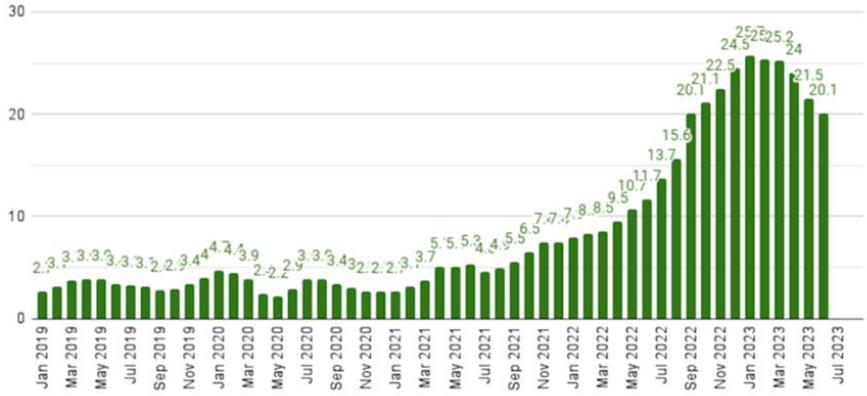

Figure 1

Hungary Inflation % y/y between 2019 and 2023 Source: Hungarian Central Bank

As prices sky-rocketed, retail sales declined, especially in the non-essential and luxury segments [3] (Figure 2). Consumers prioritized affordability over brand value or environmental considerations, reflecting a drop in demand for high-cost sustainable goods. While affordability concerns led to decreased support for ethical

brands, consumers displayed increased price sensitivity and engaged in minimalist practices.

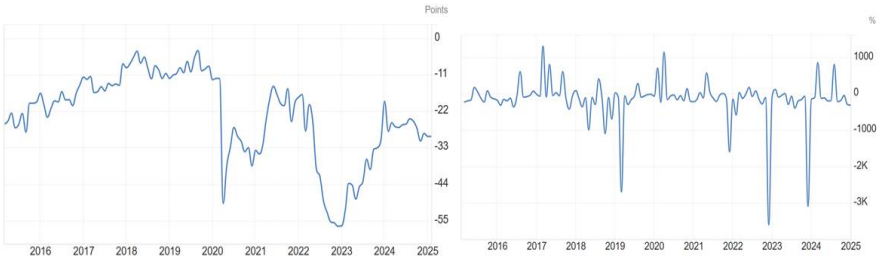

Figure 2

Consumer Confidence and Retail Sales MoM in Hungary between 2016 and 2025 Source: tradingeconomics

New energy use regulation was introduced in August 2022. These regulatory changes have also led to a 27% increase in renewable energy usage and a 5.6% decline in fossil-based consumption [4] (Figure 3).

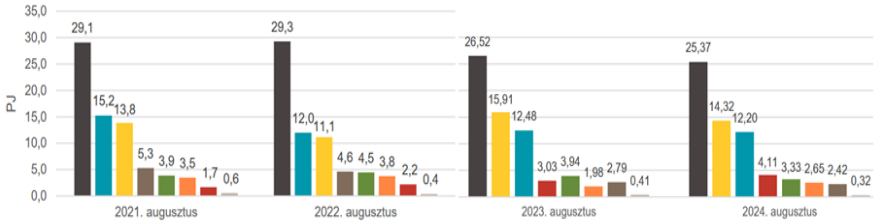

Figure 3

Primary Energy Consumption Change (PJ) between August of 2021 and 2024 Source: MEKH Color code: Black- Petroleum, Blue- Natural gas, Yellow- Nuclear, Green- Renewable, Red-Solar, Orange-Electricity, Brown- Coal

3.2 Dual Impact of Inflation on Sustainability

Negative Outcomes:

Eco-friendly goods, often priced higher, saw a decrease in demand. Consumers changed to lower-cost alternatives, thus undermining ethical brands and sustainability-focused initiatives.

Positive Outcomes:

Consumers adopted minimalist behaviors by buying fewer items and and an increased interest in product repairs. Due to the new energy-use regulations consumtion decreased and many have shifted to renewable energy sources [4].

Local product consumption increased, partially due to price sensitivity and to supply-chain disruptions favoring nearby sourcing. Food waste has also declined [5] (Figure 4).

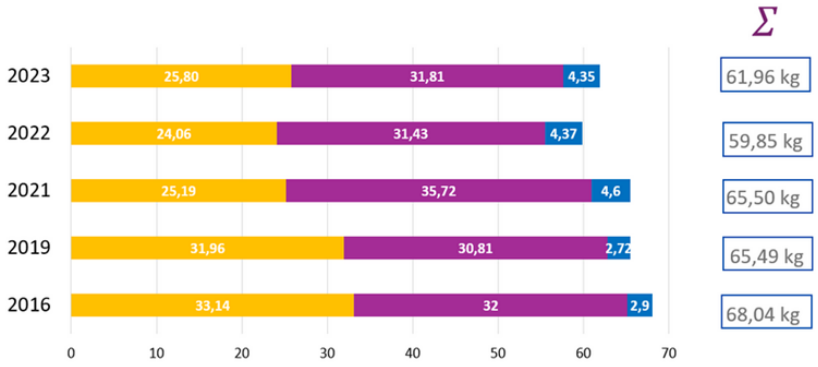

Figure 4

Food Waste in Hungarian Housholds (Kg) between August of 2016 and 2023 Source: maradeknelkul

Color code: Yellow-Avoidable, Purple-Unavoidalble, Blue-Possibly Avoidable

3.3 Consumer Behavior Insights from Survey Data

Survey responses suggest a marked shift toward a more price-conscious behavior. Most respondents reported regularly checking prices and avoiding unnecessary purchases. Interest in non-essential and environmentally friendly products has decreased compared with previous year (Figures 5 and 6).

Figure 5

How true the following statements were for you in the previous year compared to this year?

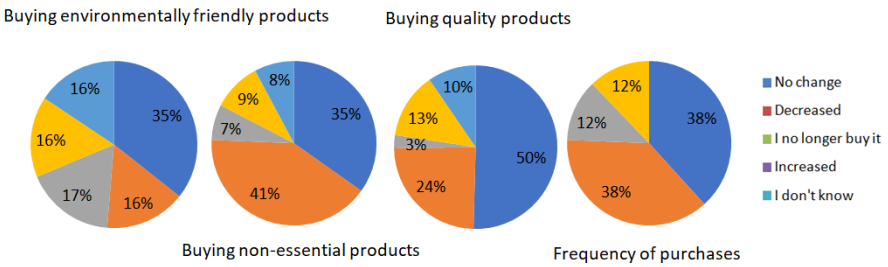

Figure 6

Compared to last year, how much have the following habits changed for you?

Although 80% of respondents experienced income increases, inflation eroded real purchasing power, altering consumption habits. This finding is in line with similar surveys conducted during the same time period [5]. There is a clear distinction between consumer awareness of sustainability and their capacity to act on it. This is a known representation of the affordability-action gap [6]. The survey responses confirmed heightened awareness (Figure 6), but reduced purchasing power as a key limitation.

Average	SD
How important is it for you that a product is recyclable?	
2.79	1.0962
How important is it to you that the food you buy comes from sustainable sources?	
3.12	1.2150
How important is it to you that the packaging of a product is recyclable?	
3.05	1.2899

*on a scale of 1 to 5

Figure 7

Importance of buying sustainable products

Conclusion and Recommendations

Inflation presents a complex challenge for sustainable consumption. In Hungary, inflation has led many consumers to abandon eco-friendly products and services in favor of affordability. At the same time, it also encouraged behaviors that are in line with sustainability, such as reduced consumption, energy efficiency, and support for local goods. These adaptive behaviors suggest that even in times of economic stress, sustainable values can endure albeit in altered forms, and higher prices can in fact reinforce certain sustainable practices. Understanding these dual dynamics is critical for creating resilient sustainability strategies that can withstand economic fluctuations. Such strategies could include:

- subsidies or tax reductions for sustainable goods,
- encouraging local supply chains and cooperatives through microfinancing,
- popularizing community-based initiatives and second-hand markets,
- promoting repair and reuse programs.

Limitations and Further Research

This study is limited by the relatively small sample size of survey respondents and its focus on urban populations. Further research could include longitudinal studies across different income groups and regions, and explore how policy tools can mitigate the trade-offs between inflation and sustainable behavior.

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Increasing Financial Literacy Among University Students in Terms of Teaching Bitcoin and Cryptocurrencies

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Abstract. Increasing financial literacy among university students is crucial, as in many cases, this debt burden and inappropriate spending impose a serious burden on households. A new approach to this could be cryptocurrency-based education. The research aims to shed light on the need to examine several factors before investing. When investing in cryptocurrency, choosing the right cryptocurrency can be crucial, as a bad investment exposes the invested capital to serious risk, and even then, the constantly changing market conditions have not been considered. For this reason, the research will develop what approach would be appropriate to teach the subject in certain majors, taking into account student interest. These can be: IT, economics, mathematics, or legal approaches. This would allow students to decide on the most optimal investments based on their individual preferences, while also becoming familiar with the given blockchain and its inherent possibilities.

Keywords: Blockchain technology, Education, Data security, Financial literacy

1 Introduction

Investing in human capital and lifelong learning are the defining educational issues of the 21st century. It is well known that universities have a huge role to play in this, if only because they have to convey up-to-date knowledge to students. Bitcoin education is not a widespread phenomenon in higher education institutions, however, taking into account the rapid changes in the labor market, cryptocurrency education has become a current issue that requires decisive answers. Education and technology are closely linked, with the former being shaped by education systems and methods for centuries [1]. The appreciation and expansion of innovation is forcing universities to make structural changes, standardize procedures, and solve methodological problems. In this environment, teaching Bitcoin as a possible subject has become a timely issue, because in our current digital era, the existence of digital money, in addition to traditional paper money, offers numerous payment,

transfer and transaction options. The aim of the research is to examine the potential of blockchain education and its thematic aspects.

In the competition for students, universities must take into account the demand and supply of the labor market. They must have a professionally compiled complex "curriculum package" that future graduates can use in the labor market in a short time. In this curriculum system, it is necessary to examine the possibilities of possible teaching of Bitcoin and other cryptocurrencies. This would be important because it can be assumed that this would reduce the interval during which the costs of education would be repaid, as students would thus acquire up-to-date knowledge that even the labor market would be familiar with. Higher education institutions need to monitor current needs and trends to provide their students with the most up-to-date knowledge possible. In universities where Bitcoin as a subject would be included in the curriculum, it would definitely be possible to establish that these higher education institutions are open to new ideas, even if they contain some risks, since there are currently many questions that need to be answered around Bitcoin. It is definitely advisable to think about such an option, since investment in human capital has increased significantly in the 21st century.

The research questions that guided this study were as follows:

Research Question 1:

What approach would be appropriate to use to teach blockchain technology at universities?

Research Question 2:

Can financial literacy be increased through blockchain technology?

The research is structured according to the following structure:

- Blockchain technology and its educational possibilities,
- Important aspects of cryptocurrency and blockchain technology education.

2 Blockchain Technology and its Educational Possibilities

Science, technology and innovation play a significant role in the economies of industrialized countries and can therefore be considered one of the driving forces of international competition.

The role of entrepreneurs in promoting the economic growth of small businesses has received significant attention over the past three decades. Supporting businesses and creating new businesses is a crucial element of government industrial and

innovation policy. An official government publication on Entrepreneurship, Skills and Innovation sets out the form in which support programmes are delivered to individuals, communities and businesses.

Three sources of demand for entrepreneurial education can be identified:

- Government: this source is primarily economic in nature, and significant emphasis is placed on job creation.
- Students: Students may seek entrepreneurship education for two reasons. The first reason is to start their own business, while the second is to acquire knowledge that can later help students successfully advance in a larger company.
- Educational: There is a demand for non-linear entrepreneurial knowledge that can be applied in real life. It is a known fact that recent graduates lack real business knowledge [2].

Pittaway says a recent study with focus groups of entrepreneurship educators reveals the complexity and diversity of the practical tasks of entrepreneurship education, and the need to consider entrepreneurial learning outcomes and their connections for effective course design. Despite the increased pedagogical emphasis, innovations of an innovative nature in the development of practical tasks cannot be considered satisfactory. The research names business ideas as the intended learning outcome and also suggests that student motivation and student group behavior have an impact on the learning outcome. The extent of the impact of motivation on learning outcomes is also a function of student group behavior. The emergence of online training in the era of information society has been facilitated by the spread of lifelong learning, which means that learning becomes a way of life [3].

One of the main aims of educational institutions is to prepare children for further education and successful integration into the workforce [4]. In the competition for students, universities must definitely take into account labor market demand and supply. They must have a professionally compiled complex "learning package" that future graduates could use in the labor market for a short time. In this curriculum system, it is necessary to examine the possibilities of possible teaching of Bitcoin and other cryptocurrencies. This would be important because it can be assumed that this would reduce the interval during which the costs of education would be repaid, as students would thus acquire up-to-date knowledge that even the labor market would be familiar with. Higher education institutions need to monitor current needs and trends to provide their students with the most up-to-date knowledge possible. In universities where Bitcoin as a subject is included in the curriculum, it would definitely be possible to establish that these higher education institutions are open to new ideas, even if they involve some risk, as there are currently many questions that need to be answered around Bitcoin. It is definitely advisable to consider such

an option, as investment in human capital has increased significantly in the 21st century.

Economic thinking on education as an economic investment is currently dominated by human capital theories, which explain the return on educational expenditure through the increase in the productivity of the individual receiving it. Consequently, they conclude that the costs of training are repaid at both the individual and societal levels. In the former case, in individual living wages, and at the macro level, in the productivity growth of the economy as a whole [5].

3 Important Aspects of Cryptocurrency and Blockchain Technology Education

The importance of entrepreneurship education lies in three factors:

- The need for students to learn about entrepreneurship;
- Preparing students to create jobs rather than training them to fill existing jobs and
- The need for economic growth through the creation of new jobs [6].

However, approaching entrepreneurship from the Bitcoin perspective opens up many new opportunities for job creation, as numerous BTC-based start-ups have been launched so far, launched by recently graduated students. However, in order for this to be successfully achieved, universities face one of the most difficult tasks: to equip their students with skills that they can successfully apply in business life.

Universities can contribute to entrepreneurship in two ways: indirectly, by educating students, and directly, through research and by serving as a hotbed for new businesses and initiatives. In order to exploit the potential of candidates and future innovators, universities can be considered responsible for preparing candidates within their own fields. However, according to McMullan and Melnyk, research at universities also includes many new ideas and innovations that have commercial potential, but these remain untapped in most institutions [7].

Universities have an innovative role due to their position in the economy, as students are introduced to and come into direct contact with new technological solutions through higher education institutions. Bitcoin start-ups are developing at a tremendous pace, with new ideas and solutions in the field of digital money appearing almost monthly. However, in order for students to have the appropriate competence in the field of digital money, it is essential to have a well-trained teacher in the field of digital money. Unfortunately, in recent years, due to the lack of

financial literacy, people have been making increasingly poor decisions in their financial affairs, which have an impact on the entire country's economy and GDP.

According to Tomasz Tunguz, a venture capital analyst at Redpoint, Bitcoin has been the fastest-growing startup investment area since mid-2012. Despite this, Bitcoin startups still receive a very small share of total funding – last year they accounted for just 0.18% of total funding.

The following possible guidelines can be formulated for teaching Bitcoin using the project method in IT departments:

- Development of Bitcoin applications,
- Security and privacy protection in cryptocurrency,
- Further development of the digital wallet,
- Further development of Bitcoin as an open source project.

From an economic perspective:

- the possibility and examination of Bitcoin's integration into everyday life and cash flow,
- Bitcoin in the banking system,
- Payment methods with cryptocurrency in everyday life,
- Bitcoin's regulatory possibilities.
- Examination of Bitcoin as a medium- and long-term investment opportunity.

From a mathematical perspective:

- Further development of Bitcoin-related algorithms in terms of reducing energy requirements,
- Further development of the Bitcoin code using algorithms,
- Continuous security review of changes to the Bitcoin code, and testing of the code.

From a legal perspective:

- Promoting and developing legal regulation of Bitcoin,
- Questions of categorizing Bitcoin within the framework of legal regulation,
- Examining the tax liability of Bitcoin.

These formulated Bitcoin guidelines are definitely innovation-based for higher education institutions, as it is known that one of the fundamental conditions for social innovation is increasing the level of education of human resources and acquiring knowledge. The way to this is through learning. In line with the major changes experienced in the economy and society today, the learning environment has also completely changed in order to meet the needs of the new knowledge and innovation-based economy and society [8].

However, it can be observed that innovation-based needs in education are not local needs, they cannot be broken down into individual localities or smaller regions, but

rather we can formulate student needs that span national borders. This is why it is necessary to examine the needs of Bitcoin education in a broad context in order to obtain relevant data. For higher education institutions to operate successfully, it is not enough for instructors to have expertise and competence in the field of digital money; in addition, universities must also have advanced technology, thus strengthening the learning culture. However, we should not ignore everyday experiences, which show that success in the education system also depends on the presence of certain personality traits and abilities (for example, the importance of diligence and quick comprehension) [9].

The human capital economics literature treats it as a fact that the perception of capital accumulation as a physical process has now been replaced by the productive capacity of human beings. The obvious traditional conclusion, which also applies to education, is that learning can help people become more productive over time, thereby contributing to economic growth. In this approach, the fullest possible fulfillment of human abilities is a fundamental task of education, not only in a pedagogical but also in an economic sense [10].

Conclusions

Cryptocurrency-based education is a new way to communicate today's modern educational curriculum. Teaching cryptocurrency is not only possible at IT universities and departments, as blockchain technology covers such a wide range that it can even be taught at economics, mathematics, or law universities.

In order to achieve this, it is necessary to take into account aspects of blockchain technology, as well as the interests of students and instructors in this topic. It is very important to find the right balance between theoretical and practical education.

The first step is to assess the needs of students and instructors in this topic, and then develop them according to needs and interests. In today's modern curriculum, teaching blockchain technology is an easily conceivable and achievable task. Looking back on the past 5 years, this was still an unimaginable goal, but today, the demand and willingness to teach blockchain meet, so this idea can be realized without any obstacles.

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Soft Skill Management In Academic Environment in the Service of Enhancing Well-being

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Abstract: Having gained experience in technical higher education and institutional research – also as professional consultants – and recognizing the need for student and researcher satisfaction and skill development, the focus of the research area became crucial for examining the existing engineering-research competence and enhancing the related basic abilities, soft skills. The main goal is to contribute and make suggestions for the retention and improvement of the well-being of students and young researchers in higher education

and research institute with the active participation of the management, which strengthens their commitment, enhances their mental and spiritual health, and their research performance with regard to the social acceptance of the research. As an empirical approach, relevant research-engineering soft skill sessions are organized and conducted in line with the external and internal expectations of engineering education and research mainly along the following topics: increasing the cohesion of student and research group, insights into the specifics of human relationships experienced in everyday work activities with self-knowledge perceptions in private life as well, special attention to the prominent role of time, the importance and management of stress, identification of goals and motivation

Keywords: well-being, engineering, research, soft skill, labour market

1 Introduction

Important question can be why we are dealing with well-being. Because it is a chain reaction. If you are well, you are satisfied, then you stay, where you are, it means that your commitment is strengthened, you can be more creative, constructive and healthy in a holistic way. Main essential non-material factors of being well consist of community with quality offline social relations and mental health incuding the supporting physical health. In general, the goal is prevention and promotion at the same time. Prevention on the way to burnout and promotion of skills using them even better. [5]

As an empirical approach, relevant research-engineering soft skill sessions are organized and conducted in line with the external and internal expectations of engineering education and research parallel to the labour market mainly along the following topics: increasing the cohesion of student and research group, insights into the specifics of human relationships experienced in everyday work activities with self-knowledge perceptions in private life as well, special attention to the prominent role of time, the importance and management of stress, identification of goals and motivation.

2 Method

The engineering curriculum at Obuda University Bánki Donát Faculty of Mechanical and Safety Engineering (OE BGK) makes it possible that during the first three semesters students take part in engineering skill improvement. These programs are integrated into dedicated mandatory subjects like Learning Methodology and Creative Thinking, Student Tutoring Preparation, Student Tutoring.

The prephase of the semester is the Welcome Festival at the Faculty at the beginning of September during the registration week. The event is organized specifically for first-year students arriving at the university, and its goal is to create an opportunity for new students to establish initial social connections and establish their commitment to the university.

More trainings of the Learning Methodology course take place in the first half of the fall semester. Students of security technology, cyber, mechatronics and mechanical, energetical engineering participated in the half-day training in the afternoon. Around four hundred students participated in the programs. The goal is to become familiar with the basics of time management, various learning techniques, and to explore the background of procrastination. During the trainings, each student receive a handout package that can help the students develop regular study habits and plan their time before the test period, as well as provide support in overcoming procrastination, in time and stress management.

This program and basically the three-semester engineering skill development curriculum is hosted by the Well-being Center at the Faculty. Motivated and fascinating university lecturers, professionals, mental hygienic experts are committed to this determining field. there's a strong newly formed cooperation within the university about to share experience, be coherent outlook for the future in order to keep and provide this opportunity for every newcomer student independently from changing management or any other circumstances.

We are keen on compose some basic principles which are inevitable to keep the results and also to expand to those who choose other forms of being university student e.g. correspondence training.

Many of us have different and precious experience in human resource area. So it is guaranteed that we have a common denominator which makes cooperation more efficient.

The main question is who we are mainly dealing with? They were mainly born between 2005 and six. It's a relatively new generation, but what is even more important that they are still secondary school students they know that role better. It's not a second that they become university student so we provide the interface in building a bridge between high school life and university life.

Although there's a big flexibility for students in deciding what and where and when to study it is still a big responsibility for them in terms of time what they spend this precious resource for.

Beside at training sessions, where teams are built upon friendly relations, there is a rule which means almost nothing is compulsory, however, one thing cannot be saved: deep internal work of the student that can be enhanced by personal life coaching - it is an optional individual opportunity for the student.

From more directions students can be supported in increasing their resiliency and improving coping strategies which can be even harder for foreign students come to Hungary, moreover, if they get into a brand new culture far away from their home and beloved family. If they have common interests, that's the main focus then they can relate to each other and this can fundamentally establish their well-being - being catalyzed by us.

3 Results

After a survey among the newcoming students the following first insight was generated shown in Fig. 1.:

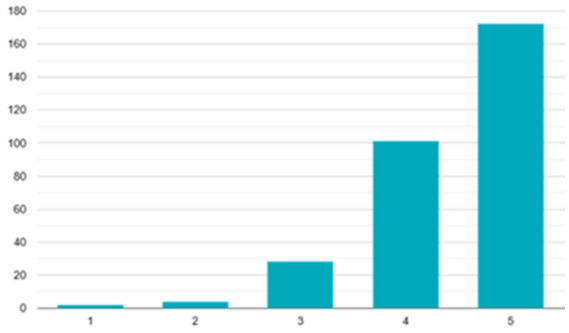

Figure 1
Usefulness of the Welcome Festival – 89% satisfaction (4 and 5)

Parallel to university student skill management at HUN-REN SZTAKI Institute for Computer Science and Control a lab with young researchers take part in similar skill development sessions mainly studying in technical higher education as well like MSc and PhD courses. There are different challenges at the same time since the research institute is a workplace for them. Regarding also the specific generation traits the claim for being well is getting higher and higher composed by many elements. As an example Fig. 2. shows a ratio of expected taking advantage life coaching opportunity at the research institute life coaching opportunity at this lab of the research institute among those who took part in these sessions focusing on skill development.

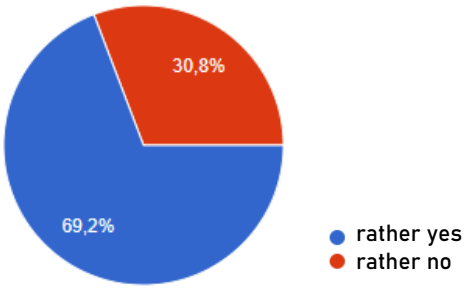

Figure 2
If individual life coach supported by your workplace were available, would you take advantage of the opportunity?

These occasions make the participant recognize and cope with difficulties enhancing their resiliency which is supported by more events and opportunies available on the spot where they spend around one third of their lifetime.

Some evidence based statements based on international studies: According to WHO, a company health program reduces absenteeism by 27% in three years. A 20% decrease in psychological well-being measures leads to a 10% decrease in performance. 62% of managers believe that productivity is influenced by the well-being and health of employees. Where there is no wellness program, they are four times more likely to lose their best employees in the next twelve months.

Those employees who realize that their employer takes care about their health and well-being will be more committed by 38% than those who do not realize this, and by a 28% more probability they recommend the company for friends and relatives, moreover, taking extra work load with plus 18% probability. [4]

Conclusions

Taken also the expectations of the labour market into account the values of professional knowledge, active participation in teamwork and self-awareness or the closely related emotional intelligence (EQ) show that companies consider both soft and hard skills to be important factors in terms of employability. [1, 2, 3]

According to labour experience relation between motivation and knowledge show that however, you got the knowledge, but you’re not motivated that much the overall holistic performance will be lower as motivation gives an added value to the work. You are satisfied after doing it. In another aspect when you don’t have the knowledge as a whole, but you’ve got a big motivation. That’s when you get wings and also the universities and labor market seek for those people.

When employees are satisfied fluctuation and absenteeism decrease, while productivity increases. The efficient (even informal) social net helps to catalyze information flow, which is a key factor in not feeling like an outsider.

Well, being well makes you satisfied. Check yourself: how satisfied are you at this moment? And in general?

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We are highly supported in this essential activity since also according to the Obuda University management well-being is a flagship topic recently. It is strongly supported by them immaterial and material way as well via events, publications, projects and different sessions. Based on research institute experience there is a big role of lab management that it is strongly adviced for all lab student and employees.

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Responsible recruitment practices enhancing social responsibility in SMEs

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Keywords: CSR, responsible recruitment, SMEs, DEI

1 Introduction

Developing recruitment practices is crucial to tackle the shortage of manpower in certain sectors in Finland. The employment market for skilled workers has become increasingly competitive and for successful recruitment, it is important to be able to attract the right candidates to fulfill the positions and to achieve sustained competitive advantage [1]. Recent research also shows that HRM personnel consider CSR important in every aspect of job recruitment [15], [21] and that CSR involvement is likely to positively affect company performance [8].

In the context of SMEs, it is important to recognize that the individual responsible for recruitment is often the general manager or an administrator, and that HR processes may be either absent or lack formal definition. To successfully acquire suitable talent, the hiring manager must balance maintaining the company's operational efficiency with focusing on recruitment. Therefore, additional emphasis should be placed on ensuring that recruitment processes are both suitable and efficient and meet the SME´s own needs. [6]

The importance of social and economic responsibility for SMEs' strategic business has increased since the EU CSRD (Corporate Sustainability Reporting Directive) entered into force in 2023 [12]. In addition, the new EU-level legislative initiatives, such as Pay Transparency Directive [11] are also affecting SME recruitment

practises causing a growing pressure for more sustainable recruitment practices also in SMEs.

This study is based on the VALIOT project of Laurea University of Applied Sciences and LAB University of Applied Sciences in Finland. In the project, we developed CSR competencies of Finnish SME personnel by collaboratively developing practical CSR courses tailored for SME needs. In this study, we focus solely on responsible recruitment. We aim to identify the most important and relevant elements of responsible recruitment for SME participants and to understand the recruitment needs and challenges currently faced by companies in Finland.

2 Responsible recruitment

2.1 Connections between corporate social responsibility, responsible recruitment, and human resource management

Corporate Social responsibility (CSR) is defined by the UN Global Compact as *aligning strategies with principles of human rights, labor, environment and anti-corruption to advance societal goals* [30]. Ethical values are an important part of CSR [1] CSR also involves diversity, equity and inclusion in recruitment [3]. Recruitment, a critical HRM activity, involves searching for candidates and encouraging applications [10]. Studies show a significant connection between HRM and CSR, highlighting mutual influences. [31] [1]

2.2 Responsible recruitment as an integral component of the company's overall strategy and HR practices

Recruitment should not be understood solely as a means of meeting a company's resource needs. Instead, recruitment has substantially broader and far-reaching effects and it plays an integral role in a company's overall strategy and company image building [26]. Responsible recruitment should align with the company's values, mission, and long-term strategy. In practice, this means attracting candidates who not only have the required skills, but who also fit the company culture, share and convey the message about its values. The recruitment process, which reflects the company's values, has a positive effect on brand image. Responsible recruitment has been shown to enhance both employer attractiveness and employee retention in sectors with a shortage of skilled personnel.[5] [4] Additionally, recruitment is company communication: promotion of equality, transparency and inclusiveness both in messages and in concrete actions contributes to the brand image of company stakeholders.

As HR activities are highly intertwined with each other and CSR, improving responsibility in recruitment cannot occur in isolation from other HR practices and processes. Clear connections can be identified in areas such as workforce planning, compensation and benefits policies, career development, and induction to mention a few. A responsible employer integrates recruitment with strategic workforce planning, ensuring a thorough understanding of the company's current and future resource and competency needs. They align recruitment efforts accordingly and balance new recruitments and career and competence development of existing personnel. Internal job descriptions and a well-articulated compensation and benefits policy help maintain fairness in salary negotiations and an effective induction process ensures that the new employees are well-prepared, engaged, and aligned with the organization's values. [31] [1] [26]

Research on CSR and HRM [15] shows that CSR has a positive effect on job satisfaction and employee loyalty [2], employee´s trust in the organization [28], employee´s commitment [16] and staff retention [18]. The extensive systematic review by Omidi & Zotto (2022) indicates that socially responsible HRM has several societal, individual, and company level outcomes, such as increased societal wellbeing, company performance and employee commitment.

2.3 Transparency and openness as guiding principles in the responsible recruitment

Transparency and openness in recruitment are crucial for building trust and ensuring a fair hiring process. Providing accurate information about the open position including information about current or expected challenges, help candidates make more informed decisions. This avoids misunderstandings which can lead to dissatisfaction, reduced performance or even rapid resignation. Open communication about the progress of the recruitment process and the evaluation criteria is important. It is important to give honest and constructive feedback also to candidates who were not selected. This builds a positive candidate experience which has a positive influence on further recruitment processes. [26]

The challenges arise in the execution of fair candidate evaluation and selection, which is affected by the same cognitive biases as any other human decision-making processes. Even though humans are assumed to make decisions rationally, in fact research shows that the decisions are often influenced by environment and context and the outcomes deviate from the so called rational decisions. [29] [27] [17]. This happens also in recruitment candidate evaluation. What makes avoiding biases increasingly difficult is the fact that we fail to see biases in our own behavior, even though we can clearly see bias in other people. That is why it is not sufficient to consciously try to avoid being biased. 24] [23]

Cognitive biases and heuristics (e.g. affinity bias, confirmation bias, representativeness heuristic, and halo effect) can significantly influence recruitment processes, often leading to unintentional discrimination and poor decision-making. [22] [4] Recognizing the existence of biases is necessary to address them effectively. Workforce diversity serves as a clear indicator of the outcomes of past recruitment efforts and can highlight potential biases in decision-making. Implementing clear, predefined evaluation criteria, involving multiple independent evaluators, and utilizing external parties for candidate testing and evaluation can further enhance objectivity. To avoid potential bias, recruitment processes should never be rushed or conducted under pressure. [22] [7]

In recent years, anonymous recruitment, also known as blind hiring, has become an increasingly common method to enhance the equal treatment of all applicants. This approach conceals personal details such as name, gender, age, and other identifying information from the recruiter. [14] [19].The study by Krause, Rinne, and Zimmermann (2012) suggests that the use of anonymous applications ensures that all applicant groups have an equal chance of receiving interview invitations in nearly all recruitment processes and that this approach can reduce discrimination in scenarios where it previously existed. [19]

2.4 Regulations guiding responsible recruitment practises in Finland

Creating equal employment opportunities (EEO) is one of the most important DEI forms in responsible recruitment [3] as it protects against the discrimination of vulnerable communities within the workplace [9]. HRM discrimination research focuses on characteristics such as gender, race and ethnicity, and differences in employment patterns and earnings. These are characteristics that cannot be attributed to other (observable) characteristics. [19]

National and EU level regulations aim to enhance EEO and DEI principles in recruitment. In Finland, diversity law and the equality law between men and women guide the recruitment practices and policies also at SME level. Diversity law was established to decrease discrimination among the marginalized groups in Finland and according to the law, people cannot be discriminated against based on the applicants´age, sex, ethnic background, citizenship, religions background, status of health or sexual orientation. In Finland, companies employing a minimum of 30 employees are required to conduct an equality plan to enhance the equality between men and women. [13]. Importantly, the European Parliament approved the "EU Pay Transparency Directive" in 2023, which aims to implement concrete measures to close the gender pay gap. [11]. EU member states are expected to implement the Directive by June, 2026.

3 Context, Data and Methods

Developing sustainable business competencies for the personnel in SMEs and startups (VALIOT) project is funded by the European Union (ESR+ funding). In the Responsible Recruitment training, the participants acquired the skills necessary to enhance their company's recruitment process by integrating responsible practices. The training enabled them to leverage responsibility as a key factor in improving their employer image, thereby strengthening their competitive position in attracting skilled and motivated employees. The competence development in VALIOT is based on learning-by-developing pedagogy (LbD), work-life orientation, and co-creation.

Our study is based on the observations and discussions with the SMEs, including all together 40 participants and 12 online meetings during the time April 2024-May 2025.. We investigated: 1) what themes of responsible recruitment are the most important and relevant for the SME participants and 2) what kind of recruitment needs and challenges the companies were facing. Additionally, we utilized the secondary survey data, which included following questions: On a scale from 0-5, how important and current are following themes for your company in the recruitment (selection processes and the personnel processes related to the selection)

1. Company image and staff availability
2. DEI principles and implementation of equality and diversity in the personnel processes
3. Anonymous recruitment
4. EU or national level legal issues related to recruitment (e.g. open salary policy, EU directive)
5. Induction

The survey also sought to determine which elements of the course were found particularly beneficial and whether the acquired knowledge would be applied to the company development.

4 Results

Our discussions with the SME participants and additional survey data showed that creating and maintaining a good company image and the availability of good personnel are currently the most important recruitment needs in Finland. Obtaining the “best and skilled workers” in the recruitment was a challenge for some companies and also the most important recruitment need. Even though Finland is facing an increasing unemployment rate, some sectors are suffering from the lack of skilled personnel. Therefore, improving and maintaining a good and attractive company image in the recruitment process was considered highly important. For

example, it was stated that it is important to inform also those applicants who did not get selected, in order to create and maintain a good company image. In addition, communication about the company values and sustainability related goals in the recruitment advertisements were emphasized.

In larger companies, responsible recruitment practices were well integrated into the overall company strategy. Some participants emphasized their intention to make these practices even more visible to personnel following the project. Openness and transparency were deemed crucial in both the recruitment and selection processes. While diversity, equality, and inclusiveness were considered important, some participants noted that the requirement for native-speaking personnel stems from customer needs, particularly in sectors such as social and health care. Consequently, despite a company's willingness to hire immigrants who may not speak fluent Finnish, certain sectors necessitate fluency or perfect proficiency in Finnish to meet customer expectations.

Promoting gender equality, enhancing work-life balance, and ensuring equal promotion opportunities for both men and women were highlighted as crucial factors in attracting and retaining new employees. Many participants emphasized their intention to develop equality plans based on insights gained from the project. It is mandatory for Finnish SMEs with at least 30 employees to create an equality plan [13] aimed at promoting gender equality. Non-discrimination policies were also considered important in both recruitment and company personnel policies. Some participants even considered implementing 'positive discrimination' in their recruitment strategies. However, our observations and the additional survey indicated that anonymous recruitment policies were not currently viewed as a top priority.

Some companies expressed interest in redeveloping their recruitment processes based on insights gained from the project. Many participants recognized also the importance of addressing cognitive biases in future recruitment efforts. Most of the participants were already well familiar with the GDPR principles in the recruitment policies. Companies stressed the importance of obtaining permission to retain applicants' data post-recruitment. However, some participants observed that not all companies comply with GDPR principles, such as asking for consent to save data for future use and specifying the retention period.

Larger SME´s were also familiar with the EU-level directives guiding the recruitment including open salary policy and the possibility of anonymous recruitment. Despite this familiarity, these directives were not yet fully implemented in practice. Also, the need to incorporate AI into recruitment processes was highlighted by professional HR participants and in the additional survey

Discussion and conclusions

SME participants exhibited considerable heterogeneity, ranging from solo entrepreneurs to larger SME companies, and spanning sectors from social and health care to manufacturing and forest industries. The needs and challenges associated with responsible recruitment varied across different business fields. Additionally, while some SMEs were already proficient in recruitment, others had no prior experience. Nonetheless, participants found the recruitment issues addressed in the project to be relevant for all personnel, not solely for recruitment staff. Some participants also highlighted that they had not previously considered recruitment as an integral part of implementing social responsibility initiatives.

Our study revealed that maintaining a strong employer brand and implementing DEI principles in recruitment were the most significant priorities for companies. Fairness and transparency are crucial in the Finnish SME context. However, participants did not consider anonymous recruitment practices highly relevant at this time. Emphasizing the understanding of cognitive biases in recruitment was seen as vital for enhancing DEI principles. Recognizing and addressing one's own cognitive biases is an essential aspect of responsible recruitment, as it encourages questioning our thought processes and decision-making.

There are several avenues for future research. Firstly, Artificial intelligence (AI) is rapidly transforming business processes, including recruitment. Although it may significantly enhance recruitment efficiency and present opportunities for more objective decision making, it also introduces potential algorithmic biases that can perpetuate existing prejudices and affect the fairness of hiring decisions. [25] [20] AI could be used as a means to make the processes more efficient in the recruitment, especially among smaller firms. However, ethical issues should be well evaluated when AI is used as a support tool in the recruitment, especially when using the free AI tools.

There are some limitations of this study. Firstly, not all course participants participated in the meetings or replied to the survey. Additionally, some SMEs were more active in the discussions than others. This study was conducted in Finland, and the needs, challenges and practices of responsible recruitment are likely to vary across different countries and cultures, which should be acknowledged in the future research. It is important to assess how DEI policies in recruitment are applied in various cultural contexts. In January 2025, DEI programs were banned in US government and public offices, and it remains to be seen whether this shift in US policy will influence the implementation of DEI policies in recruitment within European countries and Finland.

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Board Gender Diversity and ESG disclosure in V4 countries

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Abstract: The study examines the relationship between board gender diversity and ESG disclosure in publicly listed companies in Visegrád Group (V4) countries. It aims to investigate whether a higher representation of women on corporate boards drives companies to disclose more environmental, social, and governance (ESG) practices. Using 642 firm-year observations from 2012 to 2021, the regression analysis reveals a statistically significant and positive association between gender diversity on corporate boards and ESG disclosure in V4 countries. A higher representation of women on boards is correlated with increased transparency and disclosure regarding ESG issues. This finding suggests that

gender diversity is crucial in shaping companies' decisions to disclose their sustainability practices in V4 countries, potentially reflecting a broader commitment to social responsibility and transparency.

Keywords: Board Gender Diversity, ESG Disclosure, V4 Countries

1 Introduction

With climate change and environmental issues getting severe, environmental, social, and governance (ESG) has received great attention in recent years; it effectively assesses a company's capacity to operate sustainably and socially. As stakeholders increasingly demand transparency and accountability, companies must disclose their ESG practices to demonstrate commitment to sustainable and socially responsible operations. Among the factors influencing ESG disclosure, board gender diversity has emerged as a significant area of interest. A diverse board, particularly with higher female representation, is often associated with broader perspectives, enhanced ethical oversight, and improved stakeholder engagement.

The Visegrád Group (V4) countries—comprising the Czech Republic, Hungary, Poland, and Slovakia—present a unique context for studying this relationship. These Central European economies have experienced dynamic transitions in their corporate governance frameworks, aligning with European Union directives and global sustainability standards. Prior studies concerning issues related with ESG reporting have mostly focused on countries of America and Western Europe [1]. It might not be possible to generalize the findings of these studies for Central and Eastern European countries, especially for V4 countries. As these countries have experienced legal or institutional reform, the methods that are suitable for old EU member states may not be suitable for them. Moreover, these countries have undergone market reforms, as well as social and political transformations that could have caused stakeholders (i.e., civil organizations, media, consumers) from V4 countries to be less influential than those from the old EU Member States. Gender diversity on corporate boards in V4 countries remains a significant issue, with slow progress in achieving gender parity despite growing awareness and EU-driven initiatives. Thus, the purpose of this study is to illustrate the status of ESG reporting in V4 countries, to assess the degree of these practices' quality, as well as examine the relationship between board gender diversity and ESG disclosure.

Through a regression analysis of 642 firm-year observations from 2012 to 2021, this research reveals that there is a significant positive relationship between board gender diversity and ESG disclosure. By examining this link, the study contributes to the broader discourse on corporate governance and sustainability, offering insights that could inform policymakers, corporate leaders, and stakeholders in fostering diversity and enhancing ESG transparency. Ultimately, this research

underscores the potential of board gender diversity not only as a governance best practice but also as a catalyst for promoting sustainable business practices and reinforcing companies' commitments to social responsibility and transparency.

2 Literature Review and Hypothesis Development

A company's ESG practices and disclosures benefit from effective corporate governance. [2]. ESG factors are regarded as a key corporate governance issue, with the board of directors playing a crucial role in determining the success or failure of a company [3]. Besides, the board of directors also acts as a management oversight body, providing direct and indirect information to all stakeholders, and monitors management choices pertaining to the sustainable development of internal management and society [4], [5]. The reform of the board governance is effective on ESG performance, which can have significant effects on various listed firms in worldwide [5], [6].

Historically, corporate boards in the V4 region have been characterized by lower gender diversity, with male-dominated leadership and limited female representation. While the EU has promoted gender diversity initiatives, including voluntary targets and proposed quotas, progress in the V4 countries has been slower compared to Western Europe. Board structures in the V4 region typically follow a two-tier system, separating supervisory and management boards, which is common in Central and Eastern Europe. The supervisory boards are often composed of representatives with financial, legal, and industry expertise, but diversity in terms of gender, age, and international experience remains limited. Recent regulatory changes and growing investor pressure gradually encourage V4 companies to adopt more transparent governance practices, including enhancing board independence, implementing diversity policies, and improving ESG disclosure.

Boards with female directors can enhance monitoring processes and strengthen reporting discipline. Specifically, female directors may be more effective in overseeing ESG reporting practices by increasing focus on social and environmental issues. Additionally, they tend to be well-prepared for meetings, often gathering and analyzing information related to ESG disclosure more thoroughly [7]. Moreover, a board with female directors is more likely to uphold ethical standards and show a greater commitment to considering the interests of a broader range of stakeholders and society [8], this suggests that including female directors could lead to enhanced ESG disclosure. Thus, we propose the following hypothesis:

H1: There is a significant positive relationship between board gender diversity and ESG disclosure in V4 countries

3 Methodology

3.1 Sample and Data

This study investigated the relationship between board composition and ESG disclosure, also known as environmental, social, and governance (ESG) factors, by companies operating in the V4 countries. To achieve this objective, Bloomberg's database collected ESG disclosure scores for publicly listed companies in the V4 countries, providing a preliminary sample of 8,290 firm-year observations. The reason for utilizing Bloomberg's database as the principal data source in this study was predicated on its robust coverage of sustainability and financial data for publicly traded firms in the V4 countries. Adopting a standardized approach to computing ESG scores facilitated comparing sustainability performance among different companies and industries. Bloomberg's database is widely recognized and respected as a trustworthy source of ESG data, lending credibility and dependability to the findings of this investigation. Moreover, the database's archival of historical data provided a means to discern trends and patterns in the sustainability reporting practices of companies over a protracted duration. However, missing data in some of the observations resulted in a reduction of the sample size to 642 usable observations spanning the years 2012-2021.

3.2 Measurement

This study utilized the percentage of women on the board to measure the board's gender diversity; these variables were adopted as explanatory variables, while ESG disclosure served as the dependent variable. In addition, it is expected that firms with larger assets and stronger financial performance would allocate more resources towards social and environmental projects, firm size, ROA, leverage, GDP growth, and corporate governance-related characteristics, including board size, the percentage of non-executive directors on the board, and CEO duality were employed as control variables in the analysis. The selection of these proxies was informed by previous studies conducted [9], [10], [11], [12]. Table 1 provides a detailed account of the measurement of these variables.

3.3 Model of study

The objective of our study was to explore the potential relationships between board composition variables, including gender diversity, board size, non-executive directors on the board, CEO duality, and ESG disclosure. To test our formulated hypotheses, we employed a two-way random effects regression model, shown as follows:

$$\text{ESG Disclosure Score}_{i,t} = \beta_0 + \beta_1\ \text{PctWomenOnBoard}_{i,t} + \beta_2 \text{BoardSize}_{i,t} + \beta_3\ \text{PctOfNonExecDirectorOnBoard}_{i,t} + \beta_4\ \text{CEODuarity}_{i,t} + \beta_5\ \text{FirmSize}_{i,t} + \beta_6\ \text{ROA}_{i,t} + \beta_7\ \text{Leverage}_{i,t} + \beta_8\ \text{GDPGrowth}_{i,t} + \varepsilon_{i,t}$$

Where: i represents an individual firm, t represents year, $\varepsilon_{i,t}$ is the error term.

Using a random effects model allows us to control unobserved heterogeneity across the units (e.g., individuals, firms, countries) in our panel data. This is important because if we do not account for this heterogeneity, it can bias our estimates and lead to incorrect conclusions. In statistical analysis, the conventional approach involves examining the means of individual levels of the fixed factors. However, an alternative approach is to focus on the variance of means across the levels of a random factor. In cases where there are a limited number of firms being estimated, and the variation across firms with respect to the independent variables, such as board composition and control variables, is anticipated to be low due to their similar average behavior, the implementation of a random-effects model is likely to provide more reliable estimates of the regression coefficients [13]. In order to determine the most appropriate panel regression model for our sample, we conducted an analysis of both fixed and random effects models. Despite the use of fixed effects, the adjusted R-squared was found to be negative (-0.30666), indicating a very low level of explanation towards the response variable. As a result, the use of a random effects model is recommended to better capture the variability within the data and provide a more accurate and reliable model for our analysis. To test the robustness of the results, the Newey-West standard errors [14] are also computed, which allow for the presence of both autocorrelated errors over a specified lag length and heteroskedasticity, providing more accurate estimates of standard errors and improving the precision of statistical inferences.Furthermore, this study incorporated environmental, social, and governance disclosures as dependent variables in a sensitivity analysis. The objective was to investigate whether board composition potentially influenced each dimension of ESG disclosure. Consequently, three additional regression equations were formulated and presented as follows:

$$\text{Environmental Disclosure Score}_{i,t} = \beta_0 + \beta_1\ \text{PctWomenOnBoard}_{i,t} + \beta_2 \text{BoardSize}_{i,t} + \beta_3\ \text{PctOfNonExecDirectorOnBoard}_{i,t} + \beta_4\ \text{CEODuarity}_{i,t} + \beta_5\ \text{FirmSize}_{i,t} + \beta_6\ \text{ROA}_{i,t} + \beta_7\ \text{Leverage}_{i,t} + \beta_8\ \text{GDPGrowth}_{i,t} + \varepsilon_{i,t}$$

$$\text{Social Disclosure Score}_{i,t} = \beta_0 + \beta_1\ \text{PctWomenOnBoard}_{i,t} + \beta_2 \text{BoardSize}_{i,t} + \beta_3\ \text{PctOfNonExecDirectorOnBoard}_{i,t} + \beta_4\ \text{CEODuarity}_{i,t} + \beta_5\ \text{FirmSize}_{i,t} + \beta_6\ \text{ROA}_{i,t} + \beta_7\ \text{Leverage}_{i,t} + \beta_8\ \text{GDPGrowth}_{i,t} + \varepsilon_{i,t}$$

$$\text{Governance Disclosure Score}_{i,t} = \beta_0 + \beta_1\ \text{PctWomenOnBoard}_{i,t} + \beta_2 \text{BoardSize}_{i,t} + \beta_3\ \text{PctOfNonExecDirectorOnBoard}_{i,t} + \beta_4\ \text{CEODuarity}_{i,t} + \beta_5\ \text{FirmSize}_{i,t} + \beta_6\ \text{ROA}_{i,t} + \beta_7\ \text{Leverage}_{i,t} + \beta_8\ \text{GDPGrowth}_{i,t} + \varepsilon_{i,t}$$

Variable	Definition	Measurement
Dependent variables		
ESG Disclosure Score	ESG disclosure score	The Bloomberg ESG disclosure score is a numerical indicator used to evaluate the transparency and quality of a company's environmental, social, and governance disclosures, ranges from 0 to 100, with higher scores indicating greater transparency and quality in a company's ESG disclosures
Environmental Disclosure Score	Environmental disclosure score	Bloomberg environmental disclosure score, ranging from 0 to 100
Social Disclosure Score	Social disclosure score	Bloomberg social disclosure score, ranging from 0 to 100
Governance Disclosure Score	Governance disclosure score	Bloomberg governance disclosure score, ranging from 0 to 100
Explanatory variables		
PctWomenOn Board	Percentage of women on board	The percentage of women serving on the company's board of directors
Control variables		
BoardSize	Board size	The total number of board members at the end of the year
PctOfNonExec DirectorOnBoa rd	Percentage of non-Executive directors on board	The percentage of non-executive directors serving on the company's board of directors
CEODuality	CEO duality	The CEO duality is a binary indicator, taking a value of 1 when the CEO holds both the positions of CEO and chair of the board of directors and 0 otherwise.
FirmSize	Firm size	The natural logarithm of total assets
ROA	Return on assets	Net income divided by total assets
Leverage	Financial leverage	Total liability divided by total assets
GDPGrowth	GDP growth	The annual growth rate of the country's GDP in which the firm operates.

Table 1

Variables measurement

4 Analysis and Results

4.1 Descriptive Analysis

The ESG disclosure score for each country shows an overall increasing trend from 2012 to 2021 (See **Table 2**). In the Czech Republic, the score starts at 6.86 in 2012 and increases to 34.41 in 2021. In Hungary, the score starts at 39.53 in 2012, peaks at 45.07 in 2017, and then decreases to 32.51 in 2021. In Poland, the score starts at 18.92 in 2012, increases to 35.45 in 2017, and then decreases to 26.72 in 2021. In Slovakia, the score fluctuates over the years but shows a general upward trend from 2015 to 2020, with a slight decrease in 2021. The trend suggests an increasing emphasis on ESG factors by companies in these countries over the years. Overall, Hungary has consistently had the highest ESG levels compared to the other three countries.

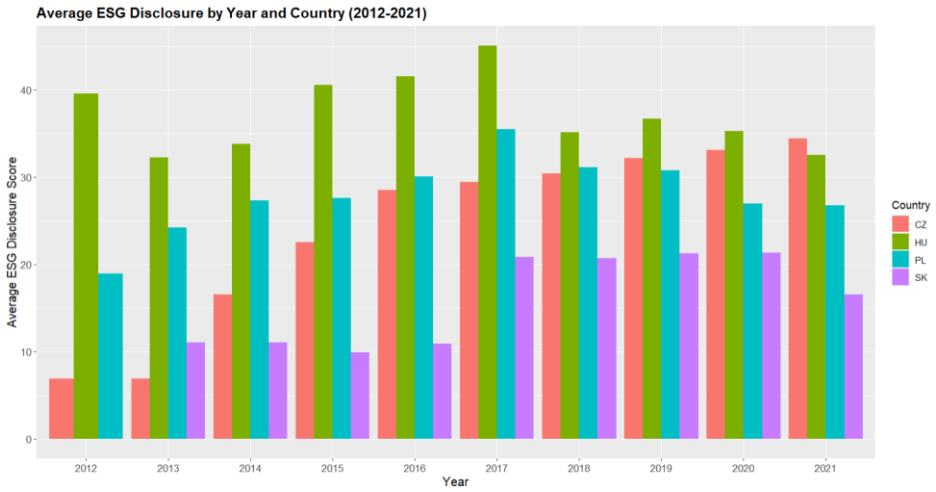

Table 2

Average ESG disclosure by countries for 2012-2021

Table 3 provides summary statistics for nine variables, including the number of observations, mean, standard deviation, median, minimum, and maximum. The ESG Disclosure Score has a mean of 28.86, with a standard deviation of 13.96 and a median of 26.07. The minimum and maximum values for ESG Disclosure Score are 4.05 and 69.59, respectively. Similarly, the other variables have been summarized with their respective statistics. PctWomenOnBoard has a mean of 14.41 and a maximum value of 71.43, indicating some variability in the data. BoardSize has a mean of 7.33 with a relatively low standard deviation of 2.44. PctOfNonExecDirectorOnBoard has a high mean value of 96.85 with a large

negative skewness indicating an asymmetrical distribution. CEODuality has a mean of 0.01 with a high kurtosis of 123.01. FirmSize has a mean of 9.27 and a maximum value of 17.13. ROA has a mean of 4.39 but has a large standard deviation of 10.24, indicating some variability in the data. Leverage has a mean of 0.61 with a relatively low standard deviation of 0.22. GDPGrowth has a mean of 2.96 with a negative skewness indicating a slightly left-skewed distribution.

	Number of observations	Mean	SD	Median	Min	Max
ESG Disclosure Score	642	28.86	13.96	26.07	4.05	69.59
PctWomenOnBoard	642	14.41	14.88	12.92	0	71.43
BoardSize	642	7.33	2.44	7	3	15
PctOfNonExecDirectorOnBoard	642	96.85	11.92	100	4	100
CEODuality	642	0.01	0.09	0	0	1
FirmSize	642	9.27	2.68	8.93	2.99	17.13
ROA	642	4.39	10.24	3.28	-90.82	111
Leverage	642	0.61	0.22	0.57	0.05	1.97
GDPGrowth	642	2.96	3.26	4.03	-5.5	6.85

Table 3
Summary descriptive statistics

4.2 Results of Regression Analysis

	Two-way random effects
Independent Variables	ESG Disclosure Score
PctWomenOnBoard	0.258***
	(0.037)
BoardSize	1.407***
	(0.241)
PctOfNonExecDirectorOnBoard	0.01
	(0.034)
CEODuality	-1.958
	(3.232)
FirmSize	3.281***
	(0.198)
ROA	-0.063
	(0.039)
Leverage	1.63
	(2.447)
GDPGrowth	0.163
	(0.145)
Constant	-16.692***
	(3.966)
Country Random Effect	Yes
Year Random Effect	Yes
Firm Random Effect	Yes
Sample Size	642
Adjusted R2	0.35

Table 4
The relationship between board gender diversity and ESG disclosure

Note: *p<0.1; **p<0.05; ***p<0.01, Newey-West standard error estimates in parentheses.

The regression analysis in **Table 4** demonstrates a statistically significant and positive association between board gender diversity and ESG disclosure, with a coefficient estimate of 0.258 and a p-value of less than 0.01. The results suggest that the presence of gender diversity on corporate boards can catalyze greater transparency and disclosure regarding ESG issues. This is due to the fact that companies with a greater representation of women on their boards may view ESG disclosure as a critical component of their broader sustainability strategy and may be more willing to report on their ESG practices publicly.

Furthermore, the analysis reveals a significant and positive relationship between board size and ESG disclosure, with a coefficient estimate of 1.407 and a p-value of less than 0.01. The findings suggest that companies with larger board sizes are more likely to prioritize ESG disclosure as a fundamental aspect of their sustainability strategy. This highlights the importance of board composition and size in promoting ESG transparency and accountability among companies operating in V4 countries. However, the analysis did not find a significant relationship between the percentage of non-executive directors on board and CEO duality with ESG disclosure. This implies that these variables do not play a significant role in shaping companies' decisions to disclose their ESG practices. These results have important implications for policymakers and other stakeholders seeking to enhance corporate sustainability and promote greater ESG disclosure among companies operating in V4 countries.

4.3 Sensitivity analysis

Independent Variables	Dependent variable:		
	Environmental disclosure score	Social disclosure score	Governance disclosure score
PctWomenOnBoard	0.297***	0.243***	0.141**
	(0.048)	(0.037)	(0.043)
BoardSize	1.730***	1.534***	0.885**
	(0.313)	(0.274)	(0.273)
PctOfNonExecDirectorOnBoard	0.023	0.018	-0.009
	(0.05)	(0.033)	(0.051)
CEODuarity	-4.133	-2.845	1.125
	(6.448)	(4.964)	(5.61)
FirmSize	3.737***	2.679***	2.950***
	(0.257)	(0.224)	(0.236)
ROA	-0.039	-0.012	-0.147*
	(0.048)	(0.041)	(0.063)
Leverage	-0.532	4.716	-5.101
	(3.209)	(2.579)	(2.75)
GDPGrowth	0.269	0.24	0.082
	(0.209)	(0.148)	(0.201)
Constant	-33.385***	-24.098***	13.954*
	(5.528)	(3.885)	(5.649)
Country Random Effect	Yes	Yes	Yes
Year Random Effect	Yes	Yes	Yes
Firm Random Effect	Yes	Yes	Yes
Sample Size	642	642	642
Adjusted R2	0.251	0.265	0.234

Note: *p<0.1; **p<0.05; ***p<0.01, Newey-West standard error estimates are in parentheses.

Table 5

The relationship between board gender diversity and E, S and G disclosure

In sensitivity analysis, we test the robustness of our model by introducing small changes to the model specifications and observing how the coefficients and statistical significance of the independent variables are affected. The results of the sensitivity analysis are presented in Table 5.

The results show that the coefficients and statistical significance of the independent variables are generally robust to changes in the model specifications. The coefficients for the variable PctWomenOnBoard remain statistically significant across all three dependent variables, indicating that they have a strong association with ESG disclosure. The coefficient estimates for these variables are also relatively stable across the three dependent variables.

Conclusion

The empirical results verify that gender diversity has a positive and significant relationship with ESG disclosure in V4 countries. It suggests that the presence of gender diversity on corporate boards can serve as a catalyst for greater transparency and disclosure regarding ESG issues. This result is aligned with [15]. A company with a larger board can include directors who are more likely to advocate voluntary disclosure, thereby strengthening management oversight and enhancing corporate legitimacy. From the perspective of corporate governance, focusing on gender diversity helps enhance corporate sustainability and align global ESG standards.

However, ESG disclosure has far-reaching implications for corporate governance and is crucial in shaping how businesses operate and thrive. For the V4 countries, the challenge is not just about 'catching up' with their Western counterparts but about fully embracing and integrating ESG into their business models and corporate governance practices.

Moreover, it's essential to acknowledge the study's limitations, such as potential data constraints and the need for further research to explore additional factors influencing ESG disclosure. Additionally, while gender diversity on boards emerges as a significant factor in promoting ESG disclosure, other variables related to board composition may also warrant investigation in future studies to provide a comprehensive understanding of governance practices and their impact on sustainability reporting. In conclusion, the study underscores the importance of gender diversity in corporate governance and its implications for ESG disclosure in the V4 countries. It highlights the potential policy implications of promoting gender diversity on corporate boards to enhance transparency, accountability, and sustainability practices within the region's listed companies.

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Exploring the relationship between fintech by Google search and bank stability: Evidence from Vietnam

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Abstract: Due to the ongoing global debate regarding the relationship between fintech and banks, including developing countries, this study aims to investigate this relationship in the case of Vietnam, an emerging nation. Using a sample of 27 Vietnamese commercial banks from 2012 to 2023, we construct a fintech index tailored to the Vietnamese banking industry based on data from Google Trends. This index reveals substantial growth in fintech adoption within the Vietnamese banking sector over the study period. Our empirical analysis demonstrates a significant inverted U-shaped relationship between fintech development and bank stability. At moderate levels, fintech adoption positively contributes to bank stability; however, when fintech adoption becomes extensive, it introduces risks that may offset these stability benefits. This study provides important insights for bank managers, investors, and policymakers seeking to optimize fintech integration for sustainable banking stability.

Keywords: Bank stability, Fintech, Vietnam

1 Introduction

In the digital era, technology drives Vietnam's socioeconomic transformation, with information technology playing a key role. Since transitioning to a market-based economy in the late 1980s and early 1990s, Vietnam has followed a cautious liberalization path, maintaining state-owned banks as dominant players with government-backed advantages. This mirrors gradual banking reforms in China and Russia [1], [2]. Fintech, the application of technology to financial services, is reshaping the industry, impacting banks by introducing both opportunities and challenges [3]. While fintech enhances financial intermediation, it also introduces risks that banks must navigate to maintain stability. In Vietnam's bank-based economy, fintech innovations—such as mobile payments and peer-to-peer lending—are rapidly expanding, positioning the country as a key fintech hub in Asia-Pacific.

This study examines the impact of fintech on the stability of 27 Vietnamese commercial banks from 2012 to 2023. The literature presents mixed findings, with some studies highlighting fintech's stabilizing effects through risk diversification and efficiency, while others warn of increased competition and potential instability. Some suggest an inverted U-shaped relationship, where moderate fintech adoption enhances stability, but excessive adoption may undermine it.

The study makes three key contributions: (i) extending research on fintech's impact on bank stability in Vietnam, (ii) introducing a novel Fintech Index using Google Trends data, and (iii) analyzing the role of bank size in this relationship.

2 Literature review and hypothesis development

2.1 Background of banking in Vietnam

Compared to well-established banking systems in the US, Europe, and other emerging markets, Vietnam's banking sector exhibits distinct characteristics. A small number of large state-owned banks dominate the market, leaving private banks with significantly smaller shares. This dynamic suggests that government-funded projects often depend on state-owned banks rather than private financial institutions [4].

As the backbone of Vietnam's economy, the banking sector operates under strict regulation by the State Bank of Vietnam (SBV). Before 1990, Vietnam had a one-tier banking system, where the SBV handled both regulatory and commercial functions. To enhance financial sector diversification and eliminate the State Bank's monopoly, Vietnam transitioned to a two-tier banking system, separating regulatory

oversight from commercial banking operations. This reform aimed to promote competition and expand banking services.

Following the 2007–2009 financial crisis, Vietnam faced economic challenges, including high inflation and slowed growth. In response, the SBV implemented various monetary policies to stabilize the economy and support recovery. Between 2007 and 2021, Vietnam's economy grew at an average annual rate of 5.8%, with commercial banks supplying 60%–80% of the economy's capital needs [5]. The rising demand for business and production capital fueled significant credit expansion within the banking system.

The global economic crisis of 2022, triggered by post-pandemic disruptions in supply chains, pushed many businesses toward bankruptcy. In response, the SBV introduced monetary policies to regulate inflation, real estate, securities, bonds, and credit supply—significantly impacting commercial bank lending. Additionally, the rapid advancement of technology, alongside the effects of COVID-19, accelerated digital transformation within the banking sector. As a result, banks increasingly integrated technology to enhance efficiency and profitability, making digitalization a key priority for both investors and researchers in the post-pandemic recovery phase.

2.2 Fintech in Vietnam

Fintech activity in Vietnam has grown exponentially and has been playing an important role in transforming the financial services sector. However, there is still potential for further growth. Access to technology along with a young population structure with increasing per capita income has laid the foundation for the rapid growth of Fintech. The development of the Fintech market in Vietnam is most evident through the number of startups in this field that is always growing year by year. Along with the rise in the number of Fintech companies, the Fintech industry in Vietnam is also a potential market that has received the amount of funding value reaching a significant number year by year. The prolonged pandemic in 2021 has resulted in record investment volume in Fintech in Vietnam, along with increasing adoption of Fintech solutions such as e-wallets, cryptocurrencies and online investment platforms.

It can be seen that FinTech is rapidly developing in Vietnam with a wide range of functions, offering diverse services related to payments, lending, blockchain/crypto, digital banking, wealth management, insurtech, and more. With functions similar to those of banks, FinTech activities have a strong impact on the operations of traditional banks, thereby affecting the financial stability of banks in Vietnam.

Due to its rapid and prominent development, FinTech has become a popular topic for researchers. There have been numbers of papers worldwide, in the context of the industrial revolution 4.0 taking place strongly and creating a trend of digital transformation in the banking system, choose Fintech-related indicators to analyze

banks' performance. However, existing studies in Vietnam mostly measure FinTech's impact on bank performance, such as the studies by Pham et al. [6], Vu et al. [7], and L. Nguyen et al. [8], or focus on user acceptance of FinTech, as in the research by Huong et al. [9]. Studies examining FinTech's impact on the stability or risk-taking levels of Vietnamese banks are still quite new. Utilizing this research gap, this paper will explore the relationship between FinTech development and the stability of commercial banks in Vietnam.

2.3 Relationship between bank stability and fintech development

Recent studies have explored the diverse effects of fintech development on the banking sector, showing that its impact varies widely. For example, Bilgin et al. [10] found that economic uncertainty increases default risk for conventional banks but not for Islamic banks, indicating differences in how banks respond to financial and technological pressures. Li et al. [11] showed that fintech's links to traditional financial institutions become stronger during downturns, which can raise systemic risk. In the European context, Pacelli et al. [12] found that during market declines, risk spillovers from traditional banks to fintech firms are more pronounced. Chaudhry et al. [13] observed that while technology firms face higher risk levels, they are less likely than banks to experience distress after market shocks.

In terms of stability, some scholars argue that fintech can make banks more vulnerable. Thakor [14] suggested that financial innovations may increase banks' susceptibility to crises. Buchak et al. [15] studied the shadow banking market in U.S. residential mortgages and concluded that fintech firms contribute to shadow banking, raising issues of moral hazard and potentially destabilizing the financial system. Based on the above discussion, we propose the following hypotheses:

H1a: Fintech development has a negative relationship with the stability of Vietnamese banks.

However, other research suggests that fintech can positively affect financial intermediation. Philippon [16] emphasized how fintech can reduce intermediation costs, while Fuster [17] found that fintech platforms streamline lending, particularly for mortgages, allowing quicker responses to demand fluctuations. Similarly, Tang [18] reported that peer-to-peer lending platforms offered effective alternatives to traditional banking. Thus, we propose the following hypothesis:

H1b: Fintech development has a positive relationship with the stability of Vietnamese banks.

Several studies have highlighted fintech's mixed impacts on bank performance. Lv et al. [19] discovered a U-shaped relationship between fintech and bank profitability: fintech initially lowers profitability but eventually boosts it. Zhao et al. [20] noted that fintech lowers profitability and asset quality for large state-owned

banks, but it can improve their capital adequacy and efficiency. Nguyen et al. [8] observed that while fintech competes with banks, it also enhances stability by improving risk performance. Yudaruddin [21] found that fintech startups negatively impact bank lending and performance. Wang et al. [22] observed that while fintech adoption initially reduces bank risk-taking, high levels of adoption can increase risks. Nguyen et al. [8] also noted the destabilizing potential of fintech under certain conditions. International studies echo this complexity, for example, Daud et al. [23] found that fintech promotes financial stability in a sample of 63 countries. Fung et al. [24] reported that fintech innovation, represented by regulatory sandboxes, supports stability in emerging markets but poses risks in developed economies. Liem et al. [25] used global fintech credit data to show fintech's positive role in financial stability across 73 countries. So, we proposed the second hypothesis:

H2: From a dynamic evolution standpoint, fintech development has a U-shaped impact on the stability of Vietnamese commercial banks.

The literature presents diverse perspectives on the impact of fintech on banks. The relationship can be positive, negative, or follow an inverted U-shape, depending on factors like technology level, regulatory environment, and bank characteristics.

FinTech development impacts banks of different sizes in varied ways. Large banks tend to be more risk-averse due to their substantial liquidity buffers and capital reserves. These resources shield them from acute liquidity shortages, allowing large banks to invest heavily in FinTech without significantly affecting their overall risk profile. With ample capital, these banks can leverage FinTech innovations to enhance efficiency and reduce operational and financing costs, enabling them to adopt lower-risk strategies while maintaining a competitive edge in the FinTech space [26]. Their strong capital positions lessen the need to pursue high-risk activities for returns, allowing a focus on steady, long-term gains.

On the other hand, smaller banks often face tighter liquidity constraints and have less capital available for FinTech investments. This can compel them to take on riskier practices to stay competitive with larger banks and other financial service providers. Limited capital resources may drive smaller banks to seek higher-yield, higher-risk opportunities, such as extending credit to riskier borrowers or adopting FinTech solutions that promise high returns but carry greater risk exposure [27]. For smaller banks, FinTech adoption may thus require a careful balance between using technology to spur growth and managing the associated risks. Based on these discussions, we propose a third hypothesis:

H3: FinTech development has heterogeneous impacts on different size of banks.

3 Methodology

3.1 Sample collection and data source

In this research the author uses yearly bank-level panel dataset, collected from audited financial statements as well as notes to the financial statements of 27 out of 27 joint-stock listed banks, spanning from 2012 to 2023 on three Vietnam Stock Exchanges, which are the Hanoi Stock Exchange (HNX), the Ho Chi Minh City Stock Exchange (HSX) and the Unlisted Public Company Market (UPCOM). Based on this secondary data set we calculate the dependent variables of bank stability and control variables of banks' characteristics. For the macroeconomic variables, we collect data from the World Bank database. With 27 selected banks in 12 years, we collected 324 samples.

For the glossary of fintech development, we mainly based on previous literature. To ensure the list of keyword is applicable in Vietnam, we refer to Vietnam Financial Times - a newspaper house which is under the management of Vietnamese Ministry of Finance (thoibaotaichinhvietnam.vn), Banking Magazine – a financial press under the State Bank of Vietnam (tapchinganhang.gov.vn), and a fintech dictionary in English [28], as well as from the reports and articles published by the investigated banks themselves. For the calculation of Fintech development index, we collect data from Google trend and then construct this index.

3.2 Variables construction

3.2.1 Measuring bank stability

Research literature shows that the indicators used in financial risk assessments vary, including capital-asset ratios, expected default rates, capital adequacy ratios, stock volatility, non-performing loan ratios, and Z-values [29]. This study uses the ZEQTA variable, which represents the Hannan & Hanweck [30] accounting model of bank risk index. This index has been used in various studies to measure bank risk-taking, such as Lepetit & Strobel [31], Yusgiantoro et al. [32], Maria et al. [33], Yudaruddin et al. [34], and Ahmad et al. [35]. The risk index ZEQTA is calculated as follows:

$$ZEQTA_{i,t} = \frac{ROA_{i,t} + EQTA_{i,t}}{SD(ROA)}$$

where ROA is the return on average assets, EQTA is the equity capital-to-asset ratio, and SD(ROA) is the standard deviation of ROA. ROA is calculated as net income divided by total assets. We calculate SD(ROA) for each bank using a five-year time series approach and derive the ZEQTA value.

ROA provides an overview of the bank's performance, while its standard deviation describes the volatility of bank earnings, therefore, the equity capital-to-total assets ratio shows the amount of equity capital available to absorb unexpected losses [35]. The index captures three essential aspects of bank risk, assessing how much earnings can decrease before the bank's book value becomes negative, potentially resulting in insolvency [36]. A low ZEQTA score indicates a riskier bank, while a higher ZEQTA score implies a safer bank. The ZEQTA value has its unique characteristics, showing a tail after the peak, so the logarithm of this value must be taken during regression [11]. When we did the calculation, considering the fact that the Z value may be zero, we used log (1+ ZEQTA) instead of log (ZEQTA).

3.2.2 Measuring fintech index

In this study, we use Google Trends to collect data on the level of interest in search activity related to FinTech. In today's era of rapidly advancing information technology, things that develop more tend to attract greater public attention and information searches. Therefore, we believe that the public's interest in FinTech can serve as a proxy for the level of FinTech development in Vietnam.

Internet search data, particularly from Google, is strongly linked to socioeconomic indicators [37]. Google, as a leading search engine, provides cost-effective, readily available, and continually updated data (hourly, daily, weekly, monthly, and yearly), which can be segmented by time and region, offering advantages over traditional survey data. When specific keywords are queried on Google Trends, the search volume time series appears as the Google Search Volume Index (GSVI), ranging from 0 to 100, representing the frequency of keyword searches from lowest to highest.

By following literature, the author formed a bank fintech development index using a three-step model approach: (i) Forming a bank fintech glossary, (ii) calculate Average Google Searching Value (AGSV) Index, (iii) calculate the fintech index.

Step 1: Forming a bank fintech glossary

First, the author constructed a list of functional keywords from the four dimensions of fintech, based on fintech applications in the commercial banking business, as shown in Table 1.

Dimensions	Keywords
Information transfer	financial technology (fintech), openAPI, digital banking, e-banking, digitalization
Clearing and payment	cashless payment, e-wallet, mobile banking, e-payment, internet banking
Resource allocation	online lending, crowdfunding, online disbursement, online investment, peer-to-peer lending (P2P)
Technical base	blockchain, big data, cloud computing, eKYC, artificial intelligence (AI)

Table 4
Glossary of Fintech keywords
Source: compiled by author.

The keyword set was compiled based on the lists of keywords used in studies by Guo & Shen [38], Li et al. [1], and B. Chen et al. [29]. To ensure the keywords are relevant and applicable in the Vietnamese context, we consulted the Vietnam Financial Times - a publication under the Vietnamese Ministry of Finance (thoibaotaichinhvietnam.vn) and the Banking Magazine, which is managed by the State Bank of Vietnam (tapchinganhang.gov.vn). Additionally, we referenced an English-language FinTech dictionary [28], as well as reports and articles published by the banks included in the study.

Step 2: Calculating Average Google Searching Value (AGSV) Index

Next step, we used Google Trends, a big data source, to construct an index for FinTech development in Vietnam. Following Bijl et al. [39], Kim et al. [40], Huynh [41], and Pham, Pavelkova, et al. [6], we apply the $AGSV_t^k$ equation of the GSVI at week t of keyword k with $SD_{GSVI_t^k}$ of the standard deviation of GSVI for the past 52 weeks to measure the components of fintech variables.

$$AGSV_t^k = \frac{GSVI_t^k - \frac{1}{52}\sum_1^{52} GSVI_{t-1}^k}{SD_{GSVI_t^k}}$$

Step 3: Calculate the fintech index

After computing the AGSV index weekly for each keyword, we derive the annual score of each keyword by taking its arithmetic average. The next step is to calculate the score for each dimension based on the average annual score of the keywords. Finally, the overall FinTech index is created from the average of these four dimension scores.

3.2.3 Control variables

To better analyze changes in the dependent variables and reduce multicollinearity more effectively, the author incorporated several control variables at both the macro and micro levels.

In line with the existing literature on bank stability and according to the theory of economies of scale and scope, expanding bank scale can reduce credit risk. Therefore, bank asset size is included as a control variable, with the asset size transformed by taking its logarithm.

According to the theory of economy of scale and scope, the expansion of scale can reduce the credit risk faced by banks. We have taken the bank's asset size as one of the control variables and taken the logarithm of the asset size.

Well-capitalized banks have more resources and expertise to effectively manage and mitigate the risks associated with FinTech adoption [42]. Their substantial capital reserves also provide a cushion against potential losses or disruptions caused by new technologies. Therefore, we included capital structure (equity-to-total assets) as a control variable.

In addition, liquidity plays a crucial role in bank stability [43], [44], [45], [46]. A lack of liquidity can lead to insolvency, erode market confidence, and even trigger bank runs [42]. This can cause reluctance in the interbank market to lend, force asset sales at distressed prices, prompt regulatory intervention, and exacerbate the maturity mismatch between assets and liabilities. Thus, the loan-to-deposit ratio, an important indicator of a bank's liquidity level, is included in this thesis as a control variable.

The higher the GDP growth rate, the better the economic development, which affects the business and operations of commercial banks. Generally, there is an inverse relationship between the GDP growth rate and the risk-taking of commercial banks.

There are three possibilities for the impact of inflation (INF) on bank risk. First, inflation will increase bank costs, which is adverse for banks. Second, the central bank's currency is over issued, and inflation is beneficial for the bank, which is the debtors. Third, when the economy is prosperous, inflation will make the country use tight monetary policy to curb inflation, which is adverse for the banking system.

In summary, our variables are illustrated in the Table 5 below:

	Symbol	Description	Existing literature
Dependent variables			
Bank risk	ZEQTA	The natural logarithm of: $ZEQTA_{i,t} = \frac{ROA_{i,t} + EQTA_{i,t}}{SD(ROA)}$	Ozili (2018), Yudaruddin et al. (2023)
Loan loss coverage ratio	LLC	Loan loss provisions to non-performing loans	
Independent variable			
Fintech index	FTI	The author calculated this index based on the data collected from Google Trend	Pham, Pavelkova, et al. (2024)
Control variables			
Operating Scale	SIZE	The natural logarithm of total assets	Li et al. (2022), Khan et al. (2023)
Liquidity	LDR	Loan-to-deposit ratio = total loans / total deposits	Li et al. (2022), B. Chen et al. (2022)
Capital Structure	CAP	Bank capital shows a bank's sufficient capital status and safety and health. CAP = equity capital / total assets	Li et al. (2022), Khan et al. (2023)
Economic Development	GDP	Growth rate of Gross Domestic Product of Vietnam	Li et al. (2022), Guo & Shen (2016), Ozili (2018), B. Chen et al. (2022), Khan et al. (2023)
Inflation	INF	Consumer Price Index of Vietnam	Li et al. (2022), Khan et al. (2023)

Table 5
Main variable description
Source: compiled by author.

3.3 Econometric models

Our econometric model is specified as follows:

$$\mathbf{ZEQTA_{it} = \alpha + \beta FTI_{it} + \gamma Controls_{it} + Firm\ FE + Year\ FE + \varepsilon_{it}}$$

where the dependent variable $ZEQTA_{it}$ is the indicator of banks stability. FTI_{it} represents the index measuring the development of fintech in Vietnam. $Controls_{it}$ denotes the vectors of bank characteristics and macroeconomic variables. Year FE and Firm FE are year fixed effect and the time-invariance bank-specific effect respectively, and ε_{it} is the error term. α, β, and γ are the coefficients to be estimated.

To examine how FinTech development changes over time, the squared independent variable for FinTech is included in the baseline regression to capture this nonlinear effect:

$$\mathbf{ZEQTA_{it} = \alpha + \beta_1 FTI_{it} + \beta_2 FTI^2_{it} + \gamma Controls_{it} + Firm\ FE + Year\ FE + \varepsilon_{it}}$$

Furthermore, we include bank fixed-effects and year fixed-effects to control for time-invariant unobserved heterogeneity and biases related to potentially omitted explanatory variables as well as time fixed-effects to account for time-specific unobservable factors which may systematically influence the level of bank stability. Throughout the regressions, we use Newey–West standard errors to control for potential serial correlation matters and heteroskedasticity which may lead to biased standard error estimate.

4 Empirical Results

4.1 Descriptive statistics

	Mean	Median	St.dev.	Min	Max	Obs
ZEQTA	3.52	3.46	0.73	1.18	7.08	324
FTI	26.41	23.74	13.96	10.85	49.18	324
SIZE	32.59	32.56	1.17	30.28	35.37	324
CAP	8.97	8.18	3.46	4.06	23.84	324
LDR	88.26	88.43	16.59	36.33	142.82	324
GDP	5.95	6.53	1.69	2.65	8.24	324
INF	3.72	3.25	2.15	0.63	9.27	324

Table 3
Descriptive statistics for main variables
Source: compiled by author.

Table 3 reports the descriptive statistics of the main variables in this study, including those associated with bank stability, fintech development, and other bank-specific characteristics. The stability measure, ZEQTA, has a mean of 3.52, with a median of 3.46, indicating slight positive skewness, and ranges from 1.18 to 7.08. Regarding fintech development, the Fintech Index (FTI) shows an average of 26.41 with considerable variability (standard deviation of 13.96), reflecting diverse levels of fintech adoption across institutions. Overall, the statistics in Table 3 illustrate a comprehensive view of the banking environment, highlighting diverse fintech adoption levels, capital and liquidity positions, and macroeconomic conditions that may influence bank stability.

	ZEQTA	FTI	SIZE	CAP	LDR	GDP	INF
ZEQTA	1.0000						
FTI	0.2785	1.0000					
SIZE	0.1094	0.4135	1.0000				
CAP	-0.1036	-0.1119	-0.4173	1.0000			
LDR	0.0971	0.4505	0.3124	0.1441	1.0000		
GDP	-0.0135	-0.2332	-0.0797	-0.0259	-0.0508	1.0000	
INF	-0.1769	-0.3921	-0.2443	0.2434	-0.1801	-0.0533	1.0000

Table 4
Correlation matrix
Source: compiled by author.

Table 4 presents the correlation matrix, illustrating the relationships between bank stability (ZEQTA), fintech development (FTI), bank-specific characteristics (SIZE, CAP, LDR), and macroeconomic indicators (GDP, INF). The results reveal a positive correlation between bank stability (ZEQTA) and fintech development (FTI) with correlation equal 0.2785, suggesting that greater fintech adoption is modestly associated with enhanced bank stability. This finding aligns with the notion that fintech innovations may support stability through improved operational efficiencies and customer engagement.

4.2 Fintech development in in Vietnam

Based on the Fintech Index for Vietnam that we calculated, it reveals a steady upward trend from 2012 to 2023, highlighting the country's increasing adoption and development of financial technologies (see Figure 1).

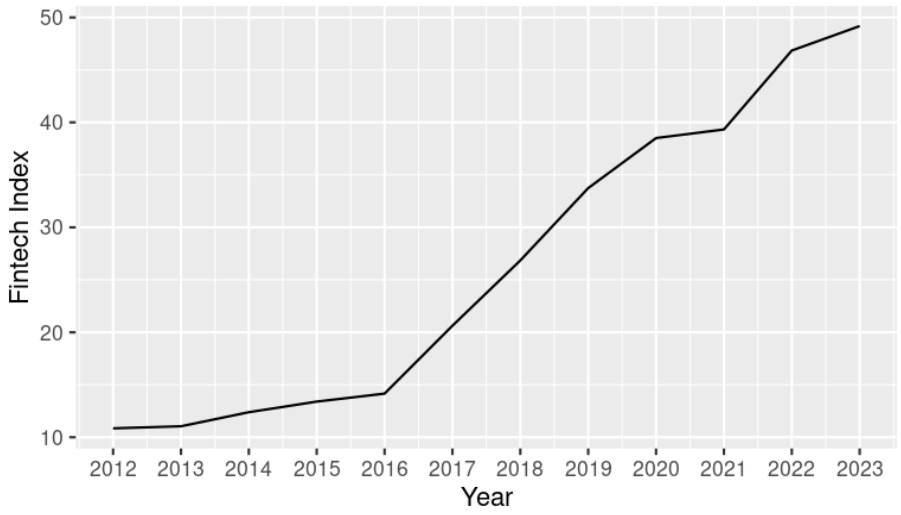

Figure 1
Time series of FinTech Index
Source: compiled by author.

Between 2012 and 2016, Vietnam's Fintech Index remained low and stable (around 10), reflecting limited development due to regulatory barriers, low adoption, and weak digital infrastructure. Fintech's potential was not yet widely recognized in the financial sector. A major shift occurred in 2017, with rapid growth through 2021, driven by supportive regulations, technological advances, and changing consumer behavior. Government policies boosted digital payments, while smartphone adoption and venture capital fueled fintech expansion. A young, tech-savvy population further accelerated adoption. From 2021 to 2023, growth slowed, signaling market consolidation and steady expansion. The COVID-19 pandemic reinforced digital trends, while fintech diversified into insurtech, wealth management, and blockchain.

4.3 Results of baseline model

	ZEQTA	
	(1)	(2)
FTI	0.015***	0.015**
	(0.003)	(0.006)
SIZE		-0.079
		(0.178)
CAP		-0.01
		(0.019)
LDR		0.002
		(0.004)
GDP		0.017
		(0.019)
INF		-0.025
		(0.02)
Bank fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	324	324
Adjusted R2	0.0262	0.0227

Table 5

The impacts of fintech development on bank stability – linear relationship

Source: compiled by author. Note: ***, ** and * represent 1%, 5% and 10% significance levels, respectively. To address the potential issue of heteroskedasticity and autocorrelation, Newey-West standard error is estimated [49].

The regression results in Table 5 examine the linear impact of fintech development on the stability of Vietnamese banks, as measured by ZEQTA. Specifically, column (1) reports the results of the two-way fixed effect regression model without any control variables and in columns (2), we include bank characteristic variables and macroeconomic variables as control variables. The result of column (2) shows that when FTI increases by 1 standard deviation, ZEQTA will increase by 0.015 * 13.69/3.52= 5.83% points (0.015 is coefficients on FTI, 13.69 is the standard deviations of FTI, and 3.52 is the mean of ZEQTA). Based on the result of baseline model, we accept the hypothesis H1b which posits a positive association between fintech adoption and stability and reject hypothesis H1a. This finding implies that as Vietnamese banks increase their fintech adoption, they experience improvements in stability, likely driven by efficiencies gained through technological innovation, enhanced service delivery, or risk diversification. This result aligns with the finding of Cizel et al. [50], Fuster et al. [17], Tang [18], Daud et al. [23], and Liem et al. [25].

	ZEQTA	
	(1)	(2)
FTI	0.075***	0.081***
	(0.016)	(0.019)
FIT^2	-0.001***	-0.001***
	(0.0003)	(0.0003)
SIZE		-0.063
		(0.179)
CAP		0.007
		(0.019)
LDR		-0.0002
		(0.003)
GDP		0.024
		(0.019)
INF		-0.003
		(0.021)
Bank fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	324	324
Adjusted R2	0.077	0.067

Table 6

The impacts of fintech development on bank stability – non-linear relationship

Source: compiled by author. Note: ***, ** and * represent 1%, 5% and 10% significance levels, respectively. To address the potential issue of heteroskedasticity and autocorrelation, Newey-West standard error is estimated [49].

The regression results in Table 6 examine the non-linear impact of fintech development on the stability of Vietnamese banks. The inclusion of both the Fintech Index (FTI) and its squared term (FTI^2) allows for the exploration of a potential U-shaped relationship. In both models, the coefficient for FTI is positive and statistically significant at the 1% level. That mean, at the lower levels of fintech development, when FTI increases by 1 standard deviation, stability of bank will increase by 29,16% (0.075* 13.69/3.52) points. This positive coefficient suggests that at lower levels of fintech adoption, an increase in fintech development is associated with improved bank stability, likely due to efficiency gains, enhanced risk management, and increased financial accessibility enabled by technological innovations. Conversely, the coefficient for FTI^2 is negative and also highly significant at the 1% level in both models (-0.001), indicating that, with high level of fintech development, when FTI increases by 1 standard deviation, stability of bank will decrease by 0.39% (-0.001* 13.69/3.52) points. In other words, it indicates a diminishing and eventually negative effect of high levels of fintech development on bank stability.

This finding supports Hypothesis H2, which posits a inverted U-shaped impact of fintech on bank stability. Specifically, while moderate levels of fintech adoption appear to enhance stability, excessive fintech development could introduce destabilizing effects, possibly due to increased operational complexity, heightened competition, or emerging technological risks that may undermine traditional risk management practices. The findings align with research of Lv et al. [19], Wang et al. [22], and Nguyen et al. [8]. In the early stages of FinTech development, FinTech companies have yet to establish a strong position in the financial market, allowing banks to benefit from reduced operational costs and improved service quality through the adoption of digital services. As the FinTech sector grows and takes on more intermediary services traditionally reserved for commercial banks, these banks may start losing customers to the competition and may need to increase their risk-taking to maintain their revenue.

4.4 Heterogeneity analysis

According to previous studies, the application of financial technologies by banks may have different effects on liquidity creation for banks with various characteristics. To further investigate this heterogeneity, we create a dummy variable based on bank asset size (S_dummy) and conduct a comprehensive heterogeneity analysis.

$$\mathbf{LC_{it} = \alpha + \beta_1 FTI_{it} + \beta_2 FTI_{it} * S\_dummy_{it} + S\_dummy_{it} + \gamma Controls_t + FirmFE + Year\ FE + \varepsilon_{it}}$$

The size dummy variable is set to one for banks whose total asset is greater than or equal to the mean, and zero for the rest. As shown in the equation below, these three sets of dummy variables were introduced into the model as interaction terms with bank fintech. The corresponding regression results are displayed in Table 7.

	ZEQTA
FTI	0.112***
	(0.026)
FTI^2	-0.002***
	(0.000)
S_dummy	0.819**
	(0.396)
FTI*S_dummy	-0.080**
	(0.033)
FTI^2 *S_dummy	0.001**
	(0.001)
Control variables	YES
Bank fixed effect	YES
Year fixed effect	YES
Observations	324
Adjusted R2	0.078

Table 7

Heterogeneity analysis

Source: compiled by author. Note: ***, ** and * represent 1%, 5% and 10% significance levels, respectively. To address the potential issue of heteroskedasticity and autocorrelation, Newey-West standard error is estimated [49].

The heterogeneity analysis in Table 7 investigates how the impact of fintech development on bank stability varies with bank size. The results show a significant positive coefficient for FTI (0.112), indicating that fintech development generally has a positive effect on bank stability. However, the squared term for FTI (FTI^2) has a negative coefficient (-0.002), which is also significant. This finding align with the results of baseline model, suggests a nonlinear, inverted U-shaped relationship.

The interaction term FTI*S_dummy is negative (-0.080) and significant, suggesting that as fintech adoption increases, the positive impact on stability becomes less pronounced for larger banks. This could mean that while larger banks benefit from fintech at moderate levels, they might face diminishing returns at higher levels of adoption. Additionally, the interaction between the squared fintech term and the size dummy (FTI^2*S_dummy) is positive (0.001) and significant. This result show that for larger banks, excessive fintech adoption may initially reduce stability but eventually leads to a stabilizing effect. This pattern may reflect larger banks' ability to manage and adapt to high levels of fintech adoption more effectively than smaller banks.

Overall, these findings highlight the complexity of fintech's impact on bank stability. Moderate fintech adoption generally supports stability, particularly for larger banks, but extensive fintech adoption can introduce new challenges that require careful management, especially for banks with greater resources and market presence.

5 Robustness test

In this part, we employ GMM model to address endogeneity concerns and use the alternative measure of bank stability and to conduct robustness tests. Additional models will be implemented in this stage to enhance the validity and reliability of the baseline regression results by undertaking robustness tests from several different perspectives.

5.1 Addressing endogeneity concerns

To reduce potential endogeneity problems, a system GMM approach is used in the thesis (see Table 8). Considering that bank risk has dynamic continuation effects, the current risk-taking level maybe influenced by the risk level from the previous period. Therefore, one-period lagged explanatory variables, $ZEQTA_{t-1}$, are introduced in the paper to construct a dynamic panel model, and the GMM estimation method is used to test the baseline results.

	ZEQTA	
	(1)	(2)
$ZEQTA_{t-1}$	0.388***	0.492***
	(0.100)	(0.066)
FTI	0.006*	0.045**
	(0.004)	(0.022)
FTI^2		-0.001*
		(0.0004)
SIZE	0.069***	0.045***
	(0.012)	(0.010)
Control variables	YES	YES
Bank fixed effect	YES	YES
Year fixed effect	YES	YES
Observations	324	324
Sargan test	0.831	0.989
AR(2)	0.031	0.057

Table 8

Addressing endogeneity concerns - GMM estimator

Source: compiled by author. Note: ***, ** and * represent 1%, 5% and 10% significance levels, respectively. Column (1) is the GMM model result for the linear relationship and column (2) is the GMM model result for the non-linear relationship.

The results in Table 8 show that the GMM analysis reinforces the idea that fintech development has a complex relationship with bank stability. While moderate fintech adoption improves stability, excessive reliance on fintech may introduce risks. The findings also suggest that larger banks are generally more stable, benefiting more

from moderate fintech adoption. These insights are essential for bank managers and policymakers, highlighting the need for a balanced approach to fintech integration in the banking sector.

5.2 Alternative measure of bank stability

In this section, an alternative measure of bank stability is also employed in this study. The loan loss coverage ratio (LLC) is calculated as the ratio of loan loss provisions to non-performing loans [47]. A higher LLC provides greater protection against loan losses, contributing to improved banking stability, whereas a lower LLC may indicate insufficient protection [47].

$$LLC = \frac{Loan\ loss\ provisions}{Non - performning\ loans}$$

In **Table 9**, the results align with the results obtained from the baseline regression. FTI shows a positive and significant effect across all models (the result of two-way fixed effect models are in columns (1) and (2), and column is GMM model's result). This suggests that increased fintech adoption generally enhances stability in Vietnamese banks. However, the squared term, FTI^2, is negative and significant in all models, indicating an inverted U-shaped relationship.

	LLC		
	(1)	(2)	(3)
LLC_{t-1}			0.888***
			(0.028)
FTI	0.030***	0.022**	0.017**
	(0.008)	(0.009)	(0.008)
FTI^2	-0.0003**	-0.0003**	-0.0004**
	(0.0001)	(0.0001)	(0.0001)
Control variables	YES	YES	YES
Bank fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
Observations	324	324	324
Adjusted R^2	0.095	0.126	
Sargan test			0.910
AR(2)			0.585

Table 9

Robustness tests – Alternative measures of bank stability

Source: compiled by author. Note: ***, ** and * represent 1%, 5% and 10% significance levels, respectively. To address the potential issue of heteroskedasticity and autocorrelation, Newey-West standard error is estimated [49].

6 Discussion

The findings of this study reveal that fintech development has a generally positive impact on the stability of commercial banks in Vietnam. However, the results also highlight a nonlinear, inverted U-shaped relationship between fintech development and bank stability.

The positive impact of fintech on bank stability aligns with previous studies that suggest fintech can enhance operational efficiency and risk management. Fintech can help banks expand their customer base by providing convenient and accessible online financial applications and services. From the perspective of lending activities – the primary source of revenue for Vietnamese banks, the application of fintech in their operations has helped commercial banks expand customers and increase credit [51]. Morover, the growth of digital payments, online lending and mobile internet have improved financial inclusion in the community by enabling firms to provide highly accessible services to their customers [52], [53]. This helps banks attract more customers, including small and medium-sized businesses that were previously overlooked due to lack of cash flow and collateral. [17] found that fintech platforms improve the efficiency of lending processes, allowing banks to process loans faster and adapt more flexibly to shifts in demand.

However, the inverted U-shaped relationship, where fintech's positive impact on stability decreases at high levels of adoption, aligns with findings from Lv et al. [19] and Wang et al. [22]. These studies show that while moderate fintech adoption can strengthen stability, too much reliance on fintech can bring added complexities and risks. In the early stages of fintech development, fintech firms do not yet dominate the financial market, allowing banks to enjoy lower costs and better service quality through digital solutions. However, as fintech companies grow and start providing services traditionally handled by banks, banks may lose customers to this new competition and feel pressured to take on more risks to maintain their income. In other words, in Vietnam, as fintech use expands, banks are exposed to new challenges like operational and cybersecurity risks, as well as increased competition from fintech companies offering similar services at lower prices.

The study's heterogeneity analysis indicates that the impact of fintech on stability is not uniform across banks of different sizes. This finding is supported by Nguyen et al. [8], who argue that competitive pressures from fintech firms push banks to adopt new technologies and strategies to maintain market share. In Vietnam, larger banks have the infrastructure and capital to adopt fintech innovations effectively, which likely contributes to their stability. Conversely, smaller banks may find it challenging to manage the risks associated with high levels of fintech integration, leading to a more volatile impact on their stability.

Conclusion

In the past decade, the rise of the FinTech industry and increasing use of its applications in the banking sector have played a prominent role in financial markets and drawn academic attention to this area. Nevertheless, the recent literature has focused on the external impact of the FinTech industry on the banking sector or the relationship between banks' FinTech development and their performance (credit risk and failure risk) and, specifically, on banks in Vietnam. Thus, the effect of FinTech development on stability of the Vietnamese banking sector are unexplored in the existing empirical literature. To address this gap in the literature, we use data on a sample of the 27 commercial banks in Vietnam using a yearly frequency period from 2012 to 2023. Further, we ultitze the data from Google Trends to construct a new fintech index specifically tailored for the Vietnamese banking industry. Our index indicates a notable increase in fintech development within the Vietnamese banking sector during the sample period.

Our empirical findings consistently support our hypotheses, providing convincing evidence that there is a significant U-shaped relationship between fintech development and bank stability within the Vietnamese banking sector. At moderate levels, fintech adoption appears to support bank stability, but excessive fintech expansion may introduce risks that counteract these benefits.

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The evolution of Hungarian exports and imports in the 21st century

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Abstract: The aim of the study was to review Hungarian competitiveness over the past 25 years. The aim was to identify the competitive products and to see if there is a trend in competitiveness over time. The export values in the WITS database were calculated using the Balassa index, which shows the evolution of competitiveness. For most products we cannot speak of positive competitiveness, i.e. most products are not competitive. So we have to import them instead of exporting them, or if we do export them, it is not advantageously. Among the m ost competitive products, live animals have maintained their competitiveness, but as they are basic products, i.e. not processed, their value added is not high. Even if it is competitive, the trader cannot realise a high margin on it in general. We can see similar situation in the case of vegetable planting materials. But the competitiveness of processed products, however, declined during the period under review and they lost importance. There are some product areas that we export in larger quantities, but their competitiveness has increased recently. These include rubber, railways, vehicles, plastics and pharmaceutical products. The latter has a high added value, but this is also the case for vehicles. - Its most competitive products are mainly of agricultural origin. - There are emerging product areas such as vehicles or pharmaceutical products.- Their competitiveness has declined over the last 25 years.- Both imports and exports are very similar. Electronics, vehicles, rubber, etc.- These are competitive but to a slightly or at most medium extent.- In general, the competitiveness of the Hungarian economy as measured by the Balassa index is moderate.

Keywords: export, Balassa index, competitiveness, Hungary

1 Introduction

The analysis of foreign trade is a key issue in the life of a country. In our country we have products that we can export and products that we import (Gáspár et al., 2023). The Hungarian economy was long considered a leader in terms of international investments, the appearance of foreign capital, privatization, the presence of a skilled workforce and several other economic and social indicators,

but this initial advantage seems to be disappearing today. Two of our neighbors have already adopted the euro (Slovenia in 2007, Slovakia in 2009), and macroeconomic indicators have also not developed very favorably in recent years. Based on GDP per capita, our country is in the middle of the world. The contribution of agriculture to the total GDP is only 3.4%, industry 22.8%, and the increasingly strong service sector 73.8%. See Figure 1. Accordingly, 4.5% of the workforce is employed in the primary sector, 32.1% in the secondary sector, and 63.3% in the tertiary sector. In 2023, Hungary's gross domestic product (GDP) at current prices was HUF 75 086.6 billion, down by 0.9% at constant prices compared to the previous year. The gross domestic product per capita was HUF 7.8 million, or €28,770 at purchasing power parity (KSH, 2023).

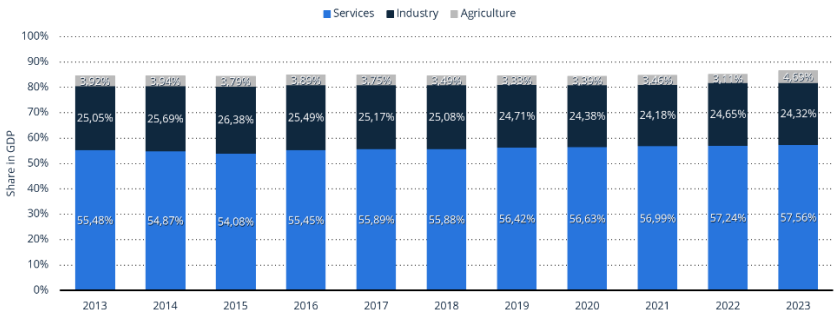

Figure 1

Share of economic sectors in gross domestic product (GDP) from 2013 to 2023 Source: Statista 2025b

1.1 Agriculture

The natural conditions of our country make it excellently suited for agricultural production, which is complemented by a fundamentally well-trained workforce. Approximately 83% of the country's territory is arable land, 48% is arable land, 19% is forested land and 11% is grassland. Of the remaining values, 1% is garden, orchard, vineyard and reedbed, and the proportion of areas taken out of cultivation is 17%.

The leading varieties of arable crop production are corn and wheat, but rye, barley, oats, sugar beet, sunflower, alfalfa and potato production are also important. We should also highlight the production of prime commodities, vegetables and fruits. The historical roots of grape and wine production can be traced back to Roman times, and some of our country's 22 wine regions produce world-famous wines.

The leading branches of animal husbandry are cattle breeding, pig breeding and poultry farming, while sheep breeding and horse breeding no longer reach the previous quality and quantity standards.

Regarding agricultural products, it is worth highlighting our products with protected origin, which further enhance our country's reputation on the international stage. Our country also has excellent qualities in the field of game and fish farming.

The average size of land holdings is only 7.5 ha, so the holding structure is fragmented, despite the fact that large-scale farms are the dominant ones in terms of production (KSH, 2025a).

1.2 Industry

The spatial concentration of industry in Hungary changed significantly after the change of regime. The production structure and spatial weight of industry is nowadays concentrated outside the Central Region, mainly on the Budapest-Székesfehérvár-Nagykanizsa and Budapest-Tatabánya-Győr-Mosonmagyaróvár axes, i.e. mainly in the Central Region, Western Hungary and Central Transdanubia. This area accounts for about 70% of industrial production and 75% of industrial co-operatives (KSH, 2025b).

The domestic energy sector is mainly based on the processing of imported hydrocarbons and the production of the Paks nuclear power plant, so Hungary is highly dependent on imports. This import dependency is not only predominant in the food industry, but also in the raw materials, semi-finished products and components sectors.

In the structure of industry in Hungary, the mechanical engineering industry is the leading sector, followed by the chemical industry (plastics and pharmaceuticals), but the electronics industry should also be highlighted. The most visible sector of the mechanical engineering industry is car manufacturing (Esztergom, Győr, Szentgotthárd and, more recently, Kecskemét), while the country's main electronics companies have chosen Székesfehérvár, Gödöllő, Pécs and Zalaegerszeg as their locations. The formerly important mining, metallurgy and textile industries have lost considerable importance. The most important industrial cities in Hungary are now Budapest, Székesfehérvár, Győr, Debrecen, Miskolc and Szeged. The country's main export-import partners are Germany, Austria, Romania, Slovakia, Taiwan, Italy, France, the United Kingdom and Slovakia, and outside the EU Russia and China.

1.3 Services

From a transport-geography point of view, Hungary is clearly a transit country, with important transport corridors both east-west and north-south. Our transport

infrastructure is of a medium level of development and quality, but the construction of motorways in recent years has certainly improved the accessibility of certain areas and thus their competitiveness. Rail transport is declining and the share of passenger transport is decreasing year by year. In addition to road transport, air transport is also important in our country, although it is highly concentrated in certain areas. The most important waterway is of course the Danube, an international waterway.

In Hungary, as in the other countries that changed their regime, the financial sector underwent significant changes after the change of regime, including the dominance of foreign banks in the country.

Hungary has been an important player and player in world tourism for decades, but its positional advantage and attractiveness has changed significantly in recent years. Hungary's tourism is characterised by a strong territorial and temporal concentration, with the vast majority of tourists visiting the country coming to Budapest and Lake Balaton, and most of them in the high season (July-August). The problem of seasonality can be significantly improved by the world-famous health tourism, cultural tourism, rural tourism and gastronomy, including wine tourism (Tóth, 2010).

1.4 Hungarian GDP and trade

Hungarian production has grown steadily but unevenly in USD terms since 1989, except for the 2008 and 2020 crises. This is shown in the first graph. This is partly because the Hungarian economy is embedded in international trade, i.e. it is an integral part of it. The Hungarian economy is involved in world trade through both its export and import activities.

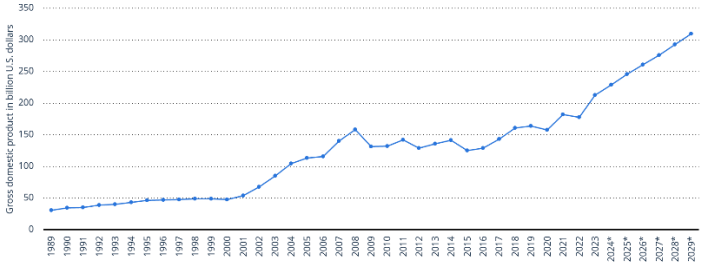

Figure 2
Gross domestic product (GDP) in current prices from 1989 to 2029 (in billion U.S. dollars) Source: Statista 2025a

Hungarian foreign trade has been typically export-oriented over the past decade. Exceptions were the years after 2020, such as 2021 and 2022. The magnitude of

exports and imports shows that it was caused by the increased value of imports. It could have been driven by the drive towards self-sufficiency that emerged in the 2020 crisis, but this is contradicted by the increase in imports. What is behind this? The year 2022 was mainly about the difficulties caused by the war between Russia and Ukraine and the deepening energy crisis, with the effects of these developments reflected in both the performance of national economies and international trade. The ratio of domestic external trade to GDP reached 185%. The volume of trade in goods again outperformed previous years, reaching 155% of GDP in 2022, but its balance held back GDP volume growth by 0.5 percentage points. However, foreign trade in services again supported the expansion of the national economy. The share of services in total external trade continues to grow, reaching nearly 16.1% in 2022 as a whole. See the balances in Figure 3.

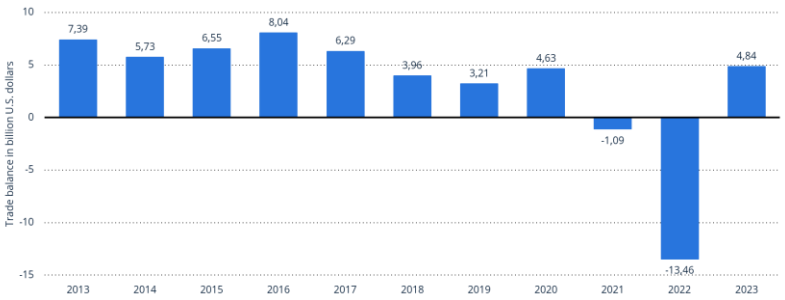

Figure 3

Trade balance of goods from 2013 to 2023 (in billion U.S. dollars) Source Statista 2025a

Its main export partners are Germany, Italy, Romania, Slovakia and Poland, while its main import partners are Germany, China, Austria, Poland and South Korea (KSH 2025a).

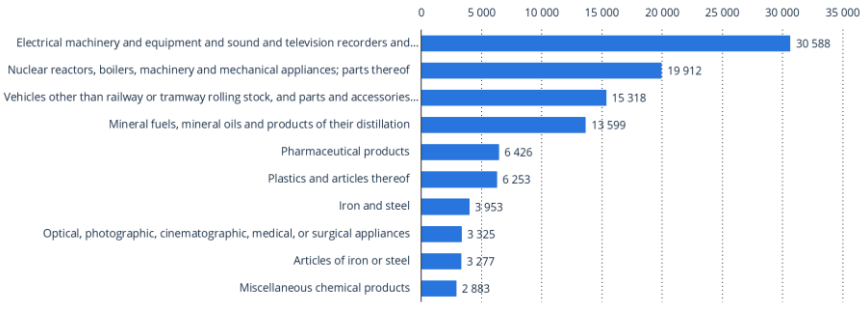

Figure 4

Main products imported to Hungary in 2023, by value (in million euros). Source: Statista 2025a

The main products imported were. Electrical machineries, nuclear reactors, vehicles, mineral fuels, pharmaceutical products, plastics, iron, steel. Interestingly, these products were the main exports, but with other countries as we can see on Figure 4 and 5.

Figure 5

Main products exported from Hungary in 2023, by value (in 1,000 euros). Source: Statista 2025a.

2 Data and methodology

For the research I used the WITS Login - World Integrated Trade Solution (WITS) database data. The selected period was 1999-2023. Export data in thousands of dollars, 97 main divisions were retrieved. The selected country was Hungary with all products. The data is used to calculate the Balassa index, which measures the competitiveness of each product. Trend function is calculated and compared with 2023 data. There are non-returning and returning competitive products and countries. Some examples of products.

01 -- Live animals

02 -- Meat and edible meat offal

03 -- Fish & crustacean, mollusc & other aquatic inv

04 -- Dairy prod; birds' eggs; natural honey; edible

05 -- Products of animal origin, nes or included.

06 -- Live tree & other plant; bulb, root; cut flowe

07 -- Edible vegetables and certain roots and tubers

08 -- Edible fruit and nuts; peel of citrus fruit or

09 -- Coffee, tea, matï and spices.

10 -- Cereals

11 -- Prod.mill.indust; malt; starches; inulin; whea

12 -- Oil seed, oleagi fruits; miscell grain, seed,

13 -- Lac; gums, resins & other vegetable saps & ext

The methodological basis of the study is the index of manifest comparative advantage defined by Balassa (1964). The index is based on the theory of trade based on Ricardo's theory of comparative advantage. The original index is calculated using the following formula:

$$B_{ij} = RCA_{ij} = \left(\frac{X_{ij}}{X_{it}} \right) \Big/ \left(\frac{X_{nj}}{X_{nt}} \right),$$

where X is the export, i is the country, j is the product, t is the group of products, and n is the reference country.

3 Results

Both in general and for the most competitive products, we see that since the 1990s the calculated Balassa index, i.e. the competitiveness of product groups, has been steadily decreasing. For most products we cannot speak of positive competitiveness, i.e. most products are not competitive. So we have to import them instead of exporting them, or if we do export them, it is not advantageously. Among the most competitive products, live animals have maintained their competitiveness, but as they are basic products, i.e. not processed, their value added is not high. Even if it is competitive, the trader cannot realise a high margin on it in general. We can see similar situation in the case of vegetable planting materials. But the competitiveness of processed products, however, declined during the period under review and they lost importance. See the figure 6.

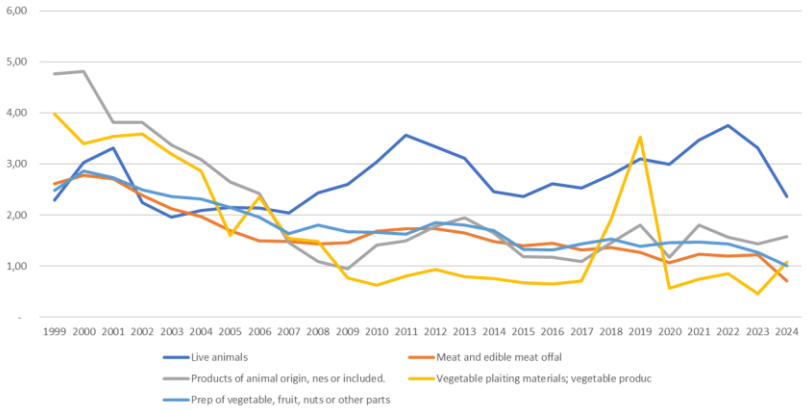

Figure 6

The most competitive products in Hungary. Source: own calculation.

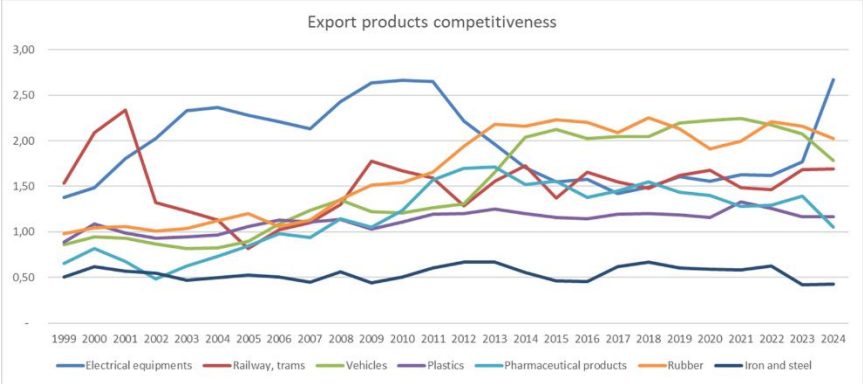

Figure 7

Export product competitiveness. Source: own calculation.

The good news is that there are some product areas that we export in larger quantities, but their competitiveness has increased recently. These include rubber, railways, vehicles, plastics and pharmaceutical products. The latter has a high added value, but this is also the case for vehicles. This is shown in Figure 7.

Unfortunately, in general, with one or two exceptions, Hungarian products are not competitive.

Conclusions

The following conclusions can be drawn from the analysis.

- Its most competitive products are mainly of agricultural origin.
- There are emerging product areas such as vehicles or pharmaceutical products.
- Their competitiveness has declined over the last 25 years.
- Both imports and exports are very similar. Electronics, vehicles, rubber, etc.
- These are competitive but to a slightly or at most medium extent.
- In general, the competitiveness of the Hungarian economy as measured by the Balassa index is moderate.

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Informatics and Its Impact on Financial Inclusion

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Abstract Financial inclusion, the process of ensuring that individuals and businesses have access to useful and affordable financial products and services, has been significantly influenced by advancements in informatics. This paper explores the role of informatics in enhancing financial inclusion, focusing on digital banking, big data, blockchain technology, artificial intelligence (AI), cloud computing, and cybersecurity. It also examines the challenges associated with technological advancements and suggests potential strategies to further leverage informatics for inclusive financial growth.

1 Introduction

Financial inclusion is a key driver of economic growth and poverty reduction. However, traditional financial institutions often fail to reach marginalized populations due to geographical, economic, and infrastructural barriers. Informatics, which encompasses the use of information systems, computing, and data analytics, is revolutionizing financial access by providing innovative solutions that overcome these barriers. The significance of financial inclusion extends beyond individual financial stability; it has broader economic implications. Countries with higher levels of financial inclusion experience greater economic development, reduced income inequality, and enhanced financial resilience among underserved populations. However, achieving financial inclusion on a global scale requires the integration of technology-driven solutions, as traditional banking models alone cannot meet the diverse needs of unbanked and underbanked communities. A key factor in financial exclusion is the lack of formal banking infrastructure in rural and low-income areas. Traditional banks often hesitate to operate in these areas due to high costs and low profit margins. This is where informatics plays a transformative role—by enabling digital financial services that eliminate the need for physical bank branches, reducing operational costs, and increasing accessibility. Moreover, informatics empowers financial service providers to create personalized banking solutions using data analytics and artificial intelligence. These technologies enable banks, fintech companies, and microfinance institutions to assess creditworthiness

without relying on traditional credit histories, allowing individuals and small businesses to access loans and financial services they were previously excluded from. Additionally, blockchain-based financial systems provide secure, transparent, and decentralized alternatives to traditional banking, fostering trust and financial independence. This paper explores the various dimensions of informatics that drive financial inclusion, analyzing their impact, challenges, and future potential. By examining key technologies such as mobile banking, big data analytics, blockchain, artificial intelligence, and cloud computing, we aim to understand how informatics can bridge the financial gap and create a more inclusive global economy.

2 Methodology

This study employs a qualitative research approach, incorporating a comprehensive review of existing literature, case studies, and technological assessments to evaluate the role of informatics in financial inclusion. The methodology consists of the following steps:

- **Literature Review:** A thorough examination of academic articles, reports from financial institutions, and policy papers related to financial inclusion and informatics. Sources include publications from the World Bank, IMF, fintech research institutions, and peer-reviewed journals.

- **Case Studies:** Analysis of successful implementations of informatics-driven financial inclusion initiatives, such as mobile banking platforms, AI-based credit scoring systems, and blockchain-enabled financial services.

- **Comparative Analysis:** A comparison of financial inclusion levels across different regions, assessing the impact of various technological interventions.

- **Challenges and Limitations Assessment:** Identifying barriers to digital financial services, including regulatory challenges, cybersecurity risks, and digital literacy gaps.

- **Recommendations Development:** Formulating strategies to maximize the impact of informatics on financial inclusion based on empirical findings and expert opinions.

This methodology ensures a comprehensive understanding of how informatics contributes to financial inclusion and provides insights into future technological advancements and policy frameworks needed to enhance accessibility to financial services.

3 Role of Informatics in Financial Inclusion

3.1 Digital Banking and Mobile Payments

The rise of digital banking and mobile payment platforms has facilitated financial access for millions worldwide. Mobile banking apps and digital wallets, such as M-Pesa, PayPal, and Alipay, allow users to perform transactions without requiring physical bank branches. This development is particularly impactful in remote and rural areas where banking infrastructure is limited.

3.2 Big Data and Alternative Credit Scoring

Traditional credit scoring methods often exclude individuals without formal banking histories. Informatics enables alternative credit assessment through big data analytics, which considers digital footprints such as mobile phone usage, online transactions, and utility bill payments. This approach helps extend credit to underserved populations, thereby promoting financial inclusion.

3.3 Blockchain and Cryptocurrencies

Blockchain technology enhances financial inclusion by providing a secure and transparent method for conducting transactions. Decentralized financial systems, including cryptocurrencies, enable individuals without access to traditional banking to participate in the global financial ecosystem. Smart contracts further streamline financial services by automating transactions with minimal intermediaries.

3.4 Artificial Intelligence and Chatbots

AI-powered solutions, such as chatbots and robo-advisors, enhance financial literacy and customer support. These tools help individuals make informed financial decisions, access tailored financial products, and detect fraud. AI-driven risk assessment also improves the efficiency of microfinance and loan disbursement processes.

3.5 Cloud Computing and Fintech Platforms

Cloud-based financial services reduce operational costs, enabling banks and fintech companies to offer affordable banking solutions. Fintech platforms provide micro-lending and peer-to-peer (P2P) lending services, which are essential for small businesses and individuals lacking traditional financial support.

3.6 Cybersecurity and Digital Identity

The integration of biometric authentication, encryption, and blockchain-based identity verification enhances security and trust in digital financial services. Secure digital identities enable individuals to access banking services safely, reducing the risk of fraud and identity theft.

4 Challenges and Limitations

Despite the significant benefits, several challenges hinder the full potential of informatics in financial inclusion:

- **Digital Literacy Gaps:** Many underserved populations lack the necessary skills to use digital financial services effectively.
- **Cybersecurity Risks:** Increasing digital transactions expose users to cyber threats such as phishing, hacking, and fraud.
- **Regulatory Barriers:** The evolving nature of financial technology requires adaptive regulatory frameworks to ensure consumer protection and system stability.
- **Infrastructure Constraints:** In many developing regions, limited internet connectivity and power supply hinder access to digital financial services.

5 Future Prospects and Recommendations

To maximize the impact of informatics on financial inclusion, the following strategies should be considered:

- **Enhanced Digital Education:** Governments and financial institutions should invest in digital literacy programs to empower users.
- **Robust Cybersecurity Measures:** Strengthening cybersecurity frameworks will enhance trust in digital financial services.
- **Regulatory Innovations:** Policymakers should create flexible and adaptive regulations to support fintech innovation while ensuring consumer protection.
- **Infrastructure Development:** Expanding internet access and mobile networks in remote areas will facilitate broader financial inclusion.

Conclusion

Informatics has revolutionized financial inclusion by leveraging technology to provide accessible, affordable, and secure financial services. While challenges persist, continued advancements in digital banking, AI, blockchain, and cloud computing hold great promise for bridging the financial gap. By addressing the existing limitations through education, regulation, and infrastructure development, informatics can play a crucial role in achieving global financial inclusion.

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Security awareness of Generation Z among university students

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Abstract The research focuses on the cybersecurity awareness of Generation Z. This generation was born into the digital age, and the use of smart devices has been an integral part of their everyday lives since they were infants. How capable are they of making conscious decisions to properly protect their digital data? Are they aware of basic cybersecurity methods? Do they apply them? What is their level of digital security awareness? I did quantitative re-search for this. The research focuses on the following 2 hypotheses:H1: Generation Z mem-bers are not sufficiently cautious in terms of cybersecurity H2: Generation Z members do not receive adequate and relevant education on the topic of cybersecurity. Based on the re-sponses of the students involved in the research, we consider both hypotheses to be accepted. We recommend that Generation Z be educated on cybersecurity within an institutionalized framework, integrated into the curriculum, so that they pay more attention to protecting their data and live their online lives more responsibly

Keywords: Generation Z, cybersecurity, cyber protection

1 Introduction

The research examined the cybersecurity awareness of university stu-dents. The focus was on members of Generation Z, as a significant proportion of university students belong to this generation, and this is the first generation that has grown up in the digital age, and not only encountered the phenomenon of the online space that permeates their entire lives at a later stage in their lives.

The primary hypothesis of the research is that members of Generation Z are not sufficiently cautious in terms of cybersecurity. To support this assumption, I conducted a quantitative survey among university students. Participation in the research was voluntary and anonymous, using a snowball sampling method. The second hypothesis is that members of Generation Z do not receive adequate and relevant educa-tion on the topic of cybersecurity.

In the first part of the study, I clarify the emerging concepts through a critical analysis of relevant literature sources, followed by a presenta-tion of my primary research.

2 Generation Z

Different researchers categorize the members of each generation based on different years. It is not possible to draw a specific line in the years to sharply separate the main characteristics that are more charac-teristic of different generations. In my research, I consider the defini-tion of one of the most significant Hungarian generation researchers, clinical psychologist Annamária Tari, as a basis for comparison, i.e. those born between 1995 and 2009. They are preceded by Generation Y and followed by Generation Alpha. [1]

In the 21st century, the technological revolution permeates our every-day lives. The use of digital devices has become indispensable, and this is true not only for members of Generation Z, but for the vast ma-jority of people. Modern technology is present in education, the labor market, recreation, and all areas of our lives, and it even permeates our daily activities to an extent and depth never seen before. The ex-plosive development of information and communication technologies is a revolutionary change that we have not yet reached the end of. [2]

Today, we include fast, efficient, flexible and complex problem solv-ing, as well as excellent communication skills, effective information management and the ability to work in groups as basic expectations. [3]

Today's young people have a much broader range of interests than previous generations. This is thanks to the widespread, easily accessi-ble online world. The number of stimuli they encounter on a daily basis is increasing exponentially compared to previous generations. Such a turbulent pace of technological development has also had a significant impact on communication relationships [19].

“While in the lives of previous generations there was a clearly distin-guishable real and online identity, for today’s young people there is only one identity, meaning that for them offline and online existence are completely intertwined. For the young generation, these two are inseparable, and technology is only a means of expressing identity. [4]

The members of Generation Z were born into this world. They are the first global generation who listen to the same music, watch the same movies, have the same fast-food selection, and follow the same fash-ion regardless of their geographical birth. The use of digital devices is self-evident to them, and the phone is not only an accessory to their lives, but an integral part of them. They also experience their free time, social life, studies, and work on the airwaves. [1]

The attitudes and expectations of Generation Z are also completely different from those of previous generations. Their approach and rela-tionship to learning and work are completely different. They need to be motivated and valued differently than members of previous genera-tions. [5]

When Generation Z members face a problem or have a question, they expect an immediate answer. Patience and waiting for a complete, authentic answer are not their virtues. They take out their smart devic-es and search for the solution. Previous generations considered their teachers to be the main source of their knowledge. [6]

2.1 What platforms do Generation Z prefer?

Facebook was used and known specifically by young people, and then its use spread more and more widely among the older genera-tions. During a transitional period, young people slowly "erased out" from the camp of Facebook users or only left their profiles as an alter-native option (perhaps to reassure their parents), but they slowly moved their daily activities to Twitter, which is now called X, to In-stagram and later to TikTok, YouTube, and Snapchat. Using Face-book is no longer fashionable among young people. However, all the other platforms mentioned above are readily used every day.

3 Cybersecurity

Cybersecurity means the continuous and planned application of “po-litical, legal, economic, educational, awareness-raising and technical tools that can be used to manage risks arising in cyberspace.” This was discussed by, among others, Brigadier General Dr. László Ko-vács, a university professor at the Faculty of Military Science and Defence Officer Training and a cyber defense observer at the Hungar-ian Defence Forces Command, at a lecture at the Ludovika Free Uni-versity on Tuesday evening, 09.03.2022. [7]

The concept of cybersecurity does not only concern the private and corporate sectors. A country can also be exposed to a serious threat in cyberspace, i.e. the online world. In the 21st century, we no longer view aggression between countries in a purely physical sense.

Hungary considers cyber capabilities that threaten physical security or are capable of causing significant material damage as weapons, and their use as armed aggression, to which a response in the physical space is also possible (New National Security Strategy, 2020).

In United Dreams, a cyber general was appointed as early as 2008. They also declared that they might respond to a serious cyberattack with conventional missiles. [8]

An excellent example is the series of regular and very massive cyber-attacks that hit Estonia, in April and May 2007. This incident drew attention to the importance of global cooperation from a cyber defense perspective. NATO declared cyberspace an operational area in 2016, and the European Union also defined a number of tasks in this area for joint action between member states, effective information ex-change, and the protection of critical infrastructures. [9]

During the coronavirus pandemic, the digitalization of the economy and society has increased drastically all over the world. Many activi-ties could only be carried out digitally due to the quarantines that have appeared everywhere globally. Digitalization is changing our world. The effects of the rapid technological development of the fourth in-dustrial revolution pose enormous challenges to society and political decision-makers. [10] This transformation was particularly visible in higher education, where institutions and students had to rapidly adapt to online platforms and remote digital tools [17].

Remote IT solutions have become a collective and mass phenomenon in our world. From one day to the next, ordinary people have been forced to study online, work online, and shop online. The crisis has highlighted the seriousness of the (potential) dangers posed by cyberattacks.

The perpetrators of the attacks no longer posed an increased threat only to large companies, but mass threats affecting citizens have also become increasingly widespread. Jean-Baptiste Demaison, Chair of the Management Board of the European Union Agency for Cyberse-curity (ENISA), drew attention to the seriousness of the escalating situation and urged member states to identify new challenges and ad-dress them as soon as possible. [11]

More sophisticated and dangerous forms of attack appear every day, and their target may not only be large companies. Small and medium-sized companies, state institutions, critical infrastructure operators, or ordinary citizens may also fall victim.

Successful cyberattacks can result in the disclosure of business se-crets, personal and valuable information, or irreplaceable data about operations, and in addition to significant financial damage, significant loss of prestige can also be expected. Therefore, it is now very im-portant, one might say essential, to pay due attention to comprehen-sive and regular cybersecurity. [12]

Taking all these factors into account, it is necessary to create an open and secure online existence. This requires strong and up-to-date cy-bersecurity measures to ensure that citizens' security and trust in digi-tal devices and services remain intact. In Hungary, the Regulated Ac-tivities Supervisory Authority performs its official duties of certifying the cybersecurity of digital products based on EU Regulation

2019/881. The purpose of the certification activity is to guarantee compliance with the constantly evolving requirements of cybersecuri-ty in the case of info communication devices and services that can be purchased and used by citizens and businesses.

"The National Cybersecurity Strategy has defined as an important task that Hungary, through its specialized institutions, cooperation with civil, economic and scientific actors, supports activities aimed at and raising awareness of the safe use of cyberspace, as well as initia-tives promoting practical cybersecurity knowledge, paying special attention to raising awareness among individual users and small and medium-sized enterprises. Taking all this into account, one of the key goals of the SZTFH is for Hungarian citizens to use digital services safely, to know and consciously apply the procedures that will enable them to avoid or reduce the harmful effects of cyber threats" – empha-sized Dr. Balázs Bencsik, Director of Cybersecurity Certification at SZTFH. [13]

To promote cybersecurity awareness among ordinary citizens, the SZTFH has launched a podcast series called “Minden Kiberül”. Here, the latest cybersecurity trends and threats are shared with the audience in plain language. The podcast aims to raise public awareness of the importance of cybersecurity and provide useful advice. [14]

3.1 Why is cybersecurity so important for ordinary citizens?

It is important to clarify from what perspective a cyberattack can af-fect the target group of Generation Z. An incident in cyberspace can cause any size problem, from a minor annoyance to the realization of a serious financial loss. As I explained earlier, this generation lives its social life primarily in the digital space. An attack on a social platform that shares personal data can have serious social consequences: em-barrassment, exclusion, depression, and in the most severe cases even suicide [18].

Even an attack on our reputation can cause very serious damage. The next level is where our data is abused. With ransomware, attackers achieve that we cannot access our personal data stored on our com-puter. Perhaps the most complex form of attack is when severe reputa-tion loss is combined with financial loss. After logging into a banking application on a public computer or using an improper password, we can also suffer serious financial losses.

The range of crimes is wide, but prevention and protection largely depend on the users. Properly managed and applied password protec-tion, two-factor authentication, keeping updates up to date, and keep-ing our passwords secret all contribute to not becoming the next vic-tim of a cyberattack. There are young people who have invested thou-sands of hours of their lives in an online game. If we consider the smallest incident to be hacking the game and not being able to log

in to their own user profile, it can cause enough pain and annoyance. If untrue and malicious images of a young person are uploaded to vari-ous social platforms, they can suffer very serious, even lifelong, psy-chological abuse and even lose their friends.

4 Risk analysis on digital platforms used by Generation Z

I conducted my quantitative research using a questionnaire survey. A total of 171 responses were evaluable. I used a snowball sampling technique online. My sample is not representative.

First, I assessed which platforms are the most popular among Genera-tion Z today. Respondents could select multiple options, according to their habits.

As expected, the most popular online platforms are the following: Instagram is the most popular, which is used regularly by 88%, fol-lowed by YouTube 86%, and then in 3rd place on the podium is Tik-Tok, which represents 82% of respondents. TikTok (as expected) is more popular than Facebook.

My next study was about cybersecurity awareness. I was looking for an answer to the question of how often respondents change their passwords in general.

It is sad to see that 25% of the respondents have never changed their password, while 45% last changed it more than 6 months ago. In total, 4% change their password every month and the same number of re-spondents change their password approximately every 2 months. This generation was born into online life. They use their smart devices al-most every hour, their smartphones are constantly logged in on all password-protected platforms, perhaps with the exception of online banking, yet their user awareness falls short of the desired level. This question also clearly illustrates that more needs to be taught about cyberattacks and cybersecurity and greater emphasis needs to be placed on it during everyday life.

Finally, I closed the questionnaire with an open question, where re-spondents had the opportunity to share their personal experiences and opinions. Completing the question was not mandatory.

The vast majority of the responses (approximately 80%) were that cybersecurity is a very important and under-emphasized topic these days. More education and information should be shared on this topic and young people should be made more aware of this topic. A particu-larly interesting segment of the responses is that so many people are aware that they have shortcomings in the field of cybersecurity, but they no longer devote their free time to looking into it or getting in-formation on the issue themselves. This is also a typical characteristic of this generation. They

like to get answers ready (instantly). They don't spend time on what they don't shove under their noses, even if they know that they have shortcomings in such an important and even life-defining thing.

There was also a surprising answer to this question, which I would like to quote verbatim. The answer was: “The generation before us is quite negligent in handling the data entrusted to them.” This answer could be evaluated from many aspects, which are not closely related to the topic of our research, so I will not go into it, but I found it worth mentioning.

3.1 Tips for higher cybersecurity protection based on my secondary research

- It is important to perform regular backups.
- Managing our passwords is of paramount importance. We should have separate passwords for each important platform. The password can be of mixed composition, but it is more important that it is long enough, if it needs to be quantified, in today's world it should be at least 12 characters long, but in important places it is better to have more. [15]
- Where we have the opportunity, we should use the option of two-step identification.
- We should avoid opening suspicious emails or using links in emails. If we receive an email from a friend with an unusual wording that also contains a link, we should not click on the link until we have in-formed the sender of the suspicious message. A typical example is the case of fake utility bills.
- We should use antivirus and anti-malware on our devices. The use of these programs should be essential.
- When using external data carriers, e.g. We connect a pen drive to our device, let's check it with our machine to see if it is safe to use.
- If you are not using Bluetooth, turn it off to prevent data leakage via Bluetooth devices.
- Keep your cybersecurity knowledge up to date. Take the time to inquire and get informed regularly to protect your data. Don't skimp on your resources and even seek professional help.
- Avoid using public and free Wi-Fi networks if possible. Communi-cation or file sharing may not be secure.
- If you are a victim of a cyberattack, it is important to inform as many potential victims and service providers as possible about the incident as possible. [16]

Summary

In my research, I sought to answer the question of how much mem-bers of Generation Z make conscious decisions regarding their cyber-security protection. My secondary research was followed by primary research, where I applied a quantitative method using a questionnaire and a snowball sampling procedure, focusing on the responses of Generation Z. After data cleaning, I found a total of 171 completed responses that could be evaluated. As a result of my research, it can be said that from the perspective of risk analysis, Generation Z, based on their user habits, can participate in various digital platforms with a high-risk factor. They do not make conscious decisions in order to protect their data, they do not come across preparatory materials on cybersecurity, and they do not deal with cybersecurity to a satisfactory level. Based on this, I consider the two hypotheses set out in the re-search, namely: members of Generation Z are not sufficiently cautious in terms of cybersecurity, and members of Generation Z do not re-ceive adequate and relevant education on the topic of cybersecurity, to be confirmed and accepted.

My suggestion is that ordinary users should meet on many more communication platforms regarding cybersecurity and protection. The importance of the security of our digital data should be better promot-ed by more educational videos, advertisements, podcasts or influenc-ers, and it should also be integrated into the National Core Curricu-lum. This research focused on Generation Z, who are currently the most active online generation, and I believe that even among them I discovered major shortcomings in this regard. Previous generations, who were not born into the digital age but had to learn about and ap-ply the excitement of being online as adults, could probably discover even greater shortcomings. This could be the subject of another re-search, but in any case, the stakes and potential sources of danger cannot be ignored.

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Tourism actors' perceptions of responsible tourism practices: Analysis based on literature review

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Abstract: Sustainable tourism (ST) is increasingly recognized as vital for the long-term development of destinations, with shared responsibility among all tourism actors. Responsible tourism practices (RTP) are the practical expressions of this vision, enabling the implementation of ST principles. While the importance of RTP is well acknowledged, there remains a notable gap in the academic literature regarding how different tourism actors perceive these practices.

This study aims to provide a comprehensive and focused literature review of empirical studies published between 2020 and 2024, examining the perceptions of various tourism actors toward RTP. The primary objectives are to assess tourism actors attitudes, identify gaps in the current research, and derivate a future research agenda. The Scopus database was utilized to extract relevant empirical studies, with clearly defined inclusion criteria and a rigorous evaluation process ensuring the relevance and quality of the selected literature.

Findings reveal that tourists view RTP as enhancing travel authenticity, ethical engagement, and enjoyment, contributing to repeat visitation and responsible behavior. Tourism businesses, particularly smaller firms, demonstrate uneven awareness of RTP; however, many recognize the benefits of RTP for competitiveness, employee well-being, and community relations. Communities increasingly appreciate RTP, associating them with improved quality of life and sustainability, with perceptions shaped by the inclusiveness and authenticity of implementation. Notably, there is a lack of empirical research on government perspectives regarding RTP.

This review contributes to bridging knowledge gaps in RT research. It supports future academic inquiries and informs policymakers and tourism practitioners in designing more effective, inclusive, and strategic approaches to promoting responsible tourism and achieving sustainable development goals.

Keywords: sustainable tourism, responsible tourism, responsible tourism practices, tourism actors, literature review.

1 Introduction

Tourism, as one of the fastest growing industry globally, presents high potential to contribute to the sustainable development of tourism destinations, but also faces many challenges because of its complex and dynamic nature [1]. In this context, the development of sustainable tourism (STD) has become a necessity of the time to manage and balance the social-economic and environmental impacts of tourism. Working for ST requires taking responsibility to promote tourism development for the better [2]. The practice that improves ST development constitutes responsible tourism (RT), while ST constitutes the aspirational strategy around which responsible tourism practices (RTP) are built [2]–[6]. RT is a modern approach that aims to promote the development of ST. For this reason, RT is accepted as the cornerstone of ensuring that tourism develops sustainably by minimizing potential negative impacts and maximizing its economic, socio-cultural and environmental benefits in a place that appeals to tourism.

Research broadly recognizes that all tourism actors should take responsibility for implementing ST [2], [4], [5], [8], [9]. Tourism actors, individually and collectively, are responsible for the way tourism operates in a country, for its positive and negative impacts. Specifically, RT shows how tourism actors need to take responsibility and take action to make tourism more sustainable. This is a very important challenge for tourism actors who organize and sell tourism experiences, as well as for those who consume them, given the vital role they play in in ensuring that tourism activities contribute to the development of successful tourism today and in the future.

In recent years, the necessity of RT has increased greatly, especially due to the escalation of global challenges such as overpopulation, geopolitical conflicts, climate change, and global health crises.These developments have exposed the structural weaknesses of the tourism sector and have prompted the need for more comprehensive and responsible approaches to destination management [8], [10]. In a world with such global challenges and where travel and exploration of the tourist place are becoming increasingly accessible, the responsibility to preserve and carefully manage environmental and cultural resources becomes even more important. By the way, RT plays an important role in providing an operational framework that translates strategic policies into actions for sustainable resource management [11]. Now, ST as an aspirational strategy and RT as a practical tool for its successful implementation represent two major challenges for scientific researchers and tourism actors regarding policies, actions, and outcomes for STD. The Cape Town Declaration emphasizes the need for tourism stakeholders to take responsibility in making destinations “better for people to live in and better places for people to visit” [2] (p. 3). This call to action highlights the importance of

improving local livelihoods and safeguarding the environments where tourism takes place, while benefiting tourism businesses . In doing so, RT contributes to positioning tourism as a vital force for both communities and the environment, and as a key force in achieving the United Nations Sustainable Development Goals for 2030 [12], [13]. The growing recognition of tourism's potential role in sustainable development has spurred increased academic interest in RTP as a means to ensure tourism remains a driver of positive change [7].

RT is an approach still in development. In parallel with the academic discussion on sustainability and its RT mechanism, the tourism industry has used Corporate Social Responsibility (CSR) to address responsibility at the business level, while in recent years Destination Social Responsibility (DSR) has been introduced as another complementary mechanism to RT, transferring the rationale of CSR to the tourist destination level [10]. The support and implementation of CSR at both the individual and business and destination levels depends on the attitude of tourism actors towards them, as it is tourism actors who can make changes to make tourism better. But, the different interests and impacts that tourism actors have influence their perceptions and attitudes towards RT engagement. This requires the orientation of the tourism actors on the impacts of RT, so that RT practices can make sustainable tourism development strategies more effective. For this, it is essential to understand the perceptions and attitudes of tourism actors, as they play a critical role in transforming policies into concrete actions and in orienting the industry towards sustainability [9], [12]. The responsibility of tourism actors can significantly influence the success of RT initiatives and how they are translated into practice [12].

Although the importance of RT and the importance of stakeholders is widely acknowledged, the scientific literature still has gaps in systematic reviews analyzing the perceptions and attitudes of these stakeholders towards RTP in recent years [10], [7].

Therefore, this study aims to provide a literature review of empirical studies focused on the perceptions of different tourism actors towards RTP, which have been published between 2020 and 2024. The primary objectives are to assess tourism actors attitudes, identify gaps in the current research, and derivate a future research agenda.

2 RT and the importance of understanding tourism actors' perceptions

RT is a multidimensional concept, the meaning of which varies depending on the perceptions of the tourism actors involved. From the perspective of tourists, RT embodies a lifestyle and set of values that promote cultural and biological diversity, encourage responsible behavior within host communities, and support environmental preservation [13]. This sense of responsibility is reflected not only

in the decision-making process prior to travel but also in the actions and choices made during the journey and stay at the destination. From the perspective of tourism stakeholders, RT entails the provision of enhanced and meaningful experiences for tourist visitors, increased commercial opportunities for tourism businesses, and the generation of socio-economic benefits for local communities. At the same time, it involves the implementation of strategies that ensure more effective and sustainable management of environmental resources [14]. These complementary perspectives highlight the interdependence between demand and supply-side responsibilities in achieving the broader goals of sustainable tourism development. As complementary mechanisms for the overall RT aims through ethical influences and value creation, Corporate Social Responsibility (CSR) and Destination Social Responsibility (DSR) are used. Corporate Social Responsibility (CSR) in tourism refers to the voluntary commitment of tourism businesses to act in a way that contributes to social, environmental and economic well-being while bringing benefits to the business itself [15]. DSR extends the principles of CSR to the destination level, participating in the coordination of stakeholders to promote sustainable and community-focused tourism [16]. CSR and DSR support RTP by fostering trust, enhancing the destination image and fostering the creation of environmental and social. Their effectiveness depends largely on perceived authenticity and compatibility with the values of the local community.

Understanding the perceptions of tourism actors is critical for the effective implementation of RT, as tourism systems are shaped by the values, beliefs and interpretations of the stakeholders involved [17]. According to stakeholder theory, each tourism actor has unique interests and power, and sustainable tourism outcomes depend on how well these perspectives are understood and integrated [18]. When perceptions are ignored, stakeholder misalignment can lead to conflict, disengagement or token participation, undermining the legitimacy and sustainability of RT initiatives [19].

From a social exchange theory perspective, perceptions influence how tourism actors assess the compromise between the costs and benefits of participating in RT. If tourism actors perceive RTP as unfair or ineffective, their support for these practices decreases, regardless of the objective benefits [16]. This highlights that perception - not just actual outcomes - determines behavioral commitment. Similarly, the theory of planned behavior posits that attitudes, subjective norms, and perceived behavioral control predict actions [20]. Therefore, positive perceptions of RTP increase the likelihood of sustainable behavior across all stakeholder groups.

Furthermore, institutional theory posits that public organizations and institutions are not only driven by efficiency or profitability, but also by the need to gain legitimacy within their institutional environment [17]. This environment includes formal regulations, cultural values, social norms, and expectations from stakeholders. According to this theory, tourism actors, such as businesses and government agencies, are more likely to adopt RTP not only because they are effective, but because they are perceived as the “right” or “acceptable” thing to do within a given social context [18].

When RTPs bring into the line with what tourism actors perceive as institutional legitimacy – it means, in line with legal standards, prevailing norms, or cultural narratives - they become more broadly accepted and widespread throughout the tourism system. For example, if environmental protection is widely valued in a society, businesses that adopt green practices are more likely to be perceived as truthful, socially responsible, and reliable. On the other hand, if tourism stakeholders perceive RTP as inappropriate to local norms, too costly, or lacking public or government support, they are less likely to engage in such practices – even if the sustainability benefits are clear.

3 Research methodology

This literature review is designed to analyze the perceptions of tourists and stakeholders regarding RTP, based on research published from 2020 to 2024. This literature review aims to provide a comprehensive and concise overview of current studies on tourism actors' perceptions of RTP to identify tourism actors' attitudes towards RTP, and by identification of the research gaps to provide an agenda for future research.

3.1 Search and Selection of Articles

For this literature review, relevant empirical studies on the topic of tourism actors' perceptions of RTP were taken exclusively from the Scopus database. Reliance on this database is justified for numerous scientific and methodological reasons. First, Scopus is one of the largest and most recognized international sources for scientific publications, providing access to peer-reviewed, high-impact indexed journals, which guarantees the scientific quality and thematic relevance of the selected articles [21], [22]. Second, due to its interdisciplinary nature, Scopus covers a wide range of fields directly related to RT [23]. Third, the exclusive use of this base helps to standardize the methodological review, ensuring verified sources and avoiding non-scientific or unapproved literature by the international academic community [24]. The selection of articles was guided by clear criteria such as the inclusion of only articles that directly address the topic of tourists' and stakeholders' perceptions of RTP, including only peer-reviewed publications to ensure the reliability and scientific validity of the data [25]. Only articles published in English were selected to ensure clarity and accessibility at an international level, as well as articles published in the period 2020–2024, with the aim of reflecting the latest developments in this field, at a time when tourism is facing new global challenges such as the COVID-19 pandemic, climate change and economic pressures. The newly published articles rely on more recent and reliable data, helping to understand the new attitudes and expectations of tourists and stakeholders. Furthermore, this

review provides a valuable basis for policymakers and professionals to develop more effective and up-to-date strategies in promoting sustainable tourism.

3.2 Keywords and Search Strategy

To identify the most relevant articles for this review, a detailed search strategy was developed in the Scopus database, relying on a set of keywords directly related to the topic of tourism actors' perceptions of RTP. The keywords used included the terms "responsible tourism", to find studies that focus on responsible tourism practices and their impacts, "tourist perception", to identify articles that explore how tourists perceive responsible tourism, "stakeholder perception", to analyze how stakeholders engage with and understand the development of responsible tourism, and "responsible tourism practices", to include studies that address the ways in which these practices influence the perceptions and attitudes of tourists and stakeholders. During the search process, Boolean operators "AND" and "OR" were used to combine terms strategically, expanding or limiting the results depending on thematic relevance and research objectives.

3.3 Article Quality Assessment

Once candidate articles were identified through searches of the Scopus database, a rigorous evaluation process was implemented to ensure that each article met the established criteria for inclusion in the systematic review. First, the abstracts and conclusions of the articles were carefully read to determine thematic relevance and to identify key findings relevant to tourism actors' perceptions of RTP, as recommended by [26]. Next, a detailed assessment of the methodology of each study was conducted, analyzing the research design, instruments used, and data reliability, in accordance with the methodological guidelines of Booth, Sutton, and Papaioannou [27] , to ensure the quality and scientific rigor of the analysis. The evaluation also included an examination of the thematic relevance and scientific contribution of each article in relation to the object of the study, in accordance with the approach proposed by Tranfield, Denyer and Smart [28] for systematic reviews in social and management research. This evaluation process ensured the selection of the most valuable and reliable literature for the analysis of the perceptions of different tourism actors regarding RT.

3.4 Analysis and Synthesis of Findings

The articles included in this review were analyzed with the aim of extracting the main findings and identifying common themes and patterns that run through the literature on the perceptions of tourists and stakeholders regarding RTP. The analytical process was carried out through thematic coding, where the data extracted

from each study were categorized into relevant themes to facilitate the organization and interpretation of the information, according to the methodological guidelines of Braun and Clarke [29]. In addition, a narrative synthesis was applied to describe the findings across studies in a structured manner, focusing on conceptual connections between them, existing gaps in the literature, and identifying areas requiring further research [30]. This combined methodological approach provides an in-depth and reliable analysis, helping to build a clear and comprehensive picture of current knowledge in the field of RT.

4 Analysis and research findings

The base of articles that met the established criteria for inclusion in the systematic review consisted of 38 empirical studies related to the study of tourism actors' perceptions of RTP. Of these, 15 articles conducted the study from the perspective of tourists, 11 articles from the perspective of the local community and 12 articles from the perspective of tourism businesses, while from the perspective of government bodies related to tourism, no scientific paper resulted that studied their perceptions of RT.

4.1 Tourists' Perceptions on Responsible Tourism Practices

Tourists' awareness and perceptions on RTP have grown in recent years yet remain uneven with a predominant focus on environmental aspects while social and economic dimensions are less understood [31] , [32]. For example fewer than half of tourists familiar with RTP could identify practices beyond environmental conservation [31] and demographic factors such as age influence awareness with younger generations showing higher interest but still lacking detailed knowledge [33],

Generally tourists hold positive attitudes toward RTP especially when practices are perceived as authentic and aligned with personal values contributing to enhanced travel satisfaction and authenticity [34], [35]. Destinations genuinely embracing RTP tend to receive higher evaluations and repeat visits [35]. Emotional responses such as awe and social learning from local role models further encourage pro-environmental behavior among tourists [36], [37].

Authenticity is critical as superficial or marketing-driven RTP initiatives lead to skepticism reducing trust and behavioral intentions [38]. Similarly tourists favor DSR initiatives perceived as altruistic which increase trust, commitment, revisit intentions, and pro-environmental behaviors especially when combined with high service quality [38] - [40].

CSR by tourism businesses also positively shapes tourist satisfaction, trust, loyalty, and green consumer behavior when seen as sincere and community-oriented [41] - [43]. During crises like COVID-19 CSR helped reduce tourist uncertainty and foster revisit intentions [44] but perceived inauthentic CSR diminishes credibility and its effects [45].

Overall tourists perceive RTP as enhancing travel satisfaction, authenticity, and ethical fulfillment, promoting repeat visitation, responsible behavior, trust, and positive destination image [34] [35], [41], [42]. These impacts depend strongly on the perceived authenticity, consistency, and ethical motivation behind RTP initiatives which shape tourists' emotional and social engagement with sustainability values [41], [43].

4.2 Tourism businesses' Perceptions on Responsible Tourism Practices

Tourism businesses play a central role in applying RTP to achieve sustainability. Research shows that CSR is the primary framework through which businesses integrate RT into their operations by addressing economic, social, and environmental concerns [46] . However, awareness and understanding of CSR and RTP vary significantly, particularly among small and medium-sized enterprises (SMEs). For example, small hotel owner-managers in London often perceive CSR as optional and costly, largely due to limited knowledge and insufficient government support, which contributes to viewing sustainability and operational efficiency as unrelated [47]. Similarly, marine tourism businesses in Tenerife recognize CSR as a means to improve competitiveness, strengthen community ties, and protect local ecosystems, reflecting positive attitudes toward CSR's broader environmental and social impacts [48].

Employee-focused CSR practices are seen as essential in the hospitality sector, where staff are vital assets and turnover rates are high. Studies demonstrate that CSR initiatives improve employees' quality of life by enhancing workplace environments, increasing engagement, reducing turnover intentions, and boosting job satisfaction, with stronger effects in hotels with more developed CSR programs [49]. Moreover, responsible human resource management practices foster organizational commitment and intrinsic motivation, leading employees to support sustainability efforts and adopt pro-environmental behaviors [50], [51].

Perceptions of responsible marketing also highlight the importance of authentic and ethical communication in promoting destinations. For instance, responsible visual representation of Sri Lanka's tourist sites helps manage visitor expectations, encourages responsible behavior, preserves heritage, and delivers economic benefits, emphasizing tourism businesses' role in ethical destination marketing [52].

In developing economies, responsible tourism is positively perceived by local entrepreneurs as a tool for economic empowerment and social recognition when aligned with community values, such as in Kerala, India [53].

Recent research highlights the critical role of CSR and Responsible Leadership (RL) during crises like the COVID-19 pandemic. RL, emphasizing ethics, stakeholder engagement, and environmental orientation, is linked to better financial and innovative performance, particularly in SMEs such as restaurants [54] - [56]. Firms with strong CSR engagement before the pandemic showed greater financial resilience, while CSR initiatives helped build stakeholder trust, which in turn generated marketing, financial, and reputational advantages during the crisis [57] - [59]. Such trust fosters customer loyalty, investor confidence, government support, and enhances employee morale, reinforcing the perception that CSR and RTP provide long-term organizational benefits beyond crisis management.

In summary, tourism businesses' knowledge and awareness of RTP and CSR remain uneven, especially among smaller firms, but their perceptions of the positive impacts of these practices on competitiveness, community relations, employee well-being, and crisis resilience are generally favorable. These findings underscore CSR and RTP as strategic approaches that deliver economic, social, and environmental value, integral to sustainable tourism business management today.

4.3 Community Perceptions on Responsible Tourism Practices

Local communities are increasingly recognized as key stakeholders in sustainable tourism, and research indicates that their awareness of RTP and their perceived impacts has grown significantly. Communities generally acknowledge the social, economic, and environmental benefits of RTP, often viewing it as a tool for improving both destination sustainability and quality of life (QoL). In Malaysia's Cameron Highlands, Rasdi et al. [60] - [63] found that local residents perceive a strong link between RTP and destination sustainability, particularly in environmental dimensions. Community members expressed high environmental awareness and a collective sense of responsibility for cultural and natural heritage preservation. However, their 2023 study also revealed that perceived benefits of RTP do not always translate into direct QoL improvements, suggesting the influence of broader contextual factors such as socio-economic conditions.

Positive perceptions are echoed in other contexts. In Kumarakom, India, residents reported that RTP contributed to community empowerment, infrastructure development, and increased employment, while also fostering pride in cultural and ecological conservation [63]. Similarly, Saraswat and Arya [64] found that in two Indian destinations, RT initiatives enhanced both economic sustainability and sustainable resource use, supporting residents' well-being.

Further studies affirm that RTP positively influences multiple dimensions of community QoL. Dávila [65] showed that economic, social, cultural, and environmental aspects of RTP all contribute to community empowerment, cohesion, and preservation. Active participation in tourism planning emerged as a key factor in aligning development with community needs. Sangkhaduang et al. [66] also identified strong positive links between RT, destination sustainability, and QoL, reinforcing the importance of integrating RTP into local development plans.

Mathew and Nimmi [67] provided a more nuanced view, showing that each RTP dimension is associated with specific aspects of community well-being: economic responsibility enhances material well-being, social responsibility improves community relations, cultural responsibility fosters emotional well-being, and environmental responsibility contributes to health and safety. These findings emphasize the need for a comprehensive, multi-dimensional approach to RTP.

Emotional and psychological dimensions are increasingly addressed in recent literature. Su et al. [68] found that DSR initiatives foster emotional solidarity and community satisfaction, which in turn strengthen local support for sustainable tourism. Transparent communication and authentic community engagement were identified as key drivers of these emotional bonds. Similarly, Aytekin et al. [69] revealed that community perceptions of RT's environmental, economic, and social benefits enhance residents' place attachment, which significantly predicts their support for sustainable tourism development. Higher environmental awareness among residents was associated with greater attachment and engagement, suggesting that environmental education and awareness campaigns can strengthen community commitment. Peng et al. [70] emphasized the importance of perceived legitimacy in DSR initiatives. Their study found that when RT and DSR efforts align with community values and are seen as legitimate, they are more likely to foster environmentally responsible behaviors among residents.

In summary, communities are increasingly aware of RTP, DSR, and CSR, and generally view them as beneficial for sustainability and QoL. Perceptions are shaped by the authenticity, inclusiveness, and effectiveness of these practices. The evidence underscores the importance of transparent communication, community participation, and environmental education in fostering local support for sustainable tourism development that reflects community priorities and enhances long-term resilience.

5 Recommendations for future research

Exploring the last five years of research on RT allows the identification of several promising research avenues for the future. The future research on actors' perceptions of RTP should adopt broader, more inclusive, and methodologically diverse approaches to advance theoretical and practical understanding.

First, studies should expand geographically and culturally by incorporating cross-national and multi-site research to capture diverse stakeholder perspectives, particularly across different developmental and tourism contexts [31], [63] Comparative analyses among tourist segments - such as generational groups or domestic versus international travelers - can offer insights into differential RTP attitudes [33]; [32].

Second, despite the centrality of government agencies in tourism policy-making, their perceptions and attitudes toward RTP remain markedly under-researched. Future studies should prioritize this gap by examining how public sector actors conceptualize and operationalize RTP principles in governance and regulatory frameworks. Understanding government commitment, policy coherence, and institutional challenges can clarify their role as enablers or barriers in the implementation of responsible tourism [52], [68].

Third, longitudinal and mixed-methods research is recommended to assess how stakeholder perceptions - including those of communities, tourists, and businesses - evolve over time in response to policy changes, environmental shifts, and destination development [37] , [67]. Such approaches can enhance depth and contextual sensitivity, especially when examining psychosocial mediators like cultural values, altruism, fear, or environmental commitment [36], [69]

Fourth, further investigation is needed into the perceptions of SMEs, particularly in underrepresented urban and coastal settings. As SMEs constitute a large portion of the tourism supply chain but often lack CSR infrastructure, exploring their attitudes and constraints related to RTP is crucial [54] ,[47].

Fifth, researches should explore how employees within tourism organizations perceive CSR and RTP, focusing on internal outcomes such as job satisfaction, motivation, and commitment to sustainable practices [51], [50]. Moreover, the ethical framing of destination marketing - particularly its impact on trust, authenticity, and destination loyalty - requires deeper ethical and empirical inquiry [52].

Finally, future studies should adopt an inclusive lens, especially in exploring how women and marginalized groups experience RTP initiatives. Research in developing regions should examine both barriers to and enablers of empowerment through responsible tourism entrepreneurship [53], [64].

6 Theoretical and practical implications

Theoretical implications: As a literature review, this paper provides theoretical implications by synthesizing and critically evaluating existing research on the perceptions of tourism actors - namely businesses, tourists and local communities - regarding the impacts of RTP. Through this synthesis, the paper contributes to the theoretical understanding of RTP, identifying tourism actors' perceptions and presenting RTP as a multidimensional and stakeholder-dependent construct, which help in designing research frameworks for responsible tourism research. It further clarifies the conceptual interaction between RTP, CSR and DSR, situating them within a broader theoretical context of sustainable tourism management and shared responsibility. Furthermore, the identification of gaps in knowledge provides an agenda for future empirical researches.

Practical implications: The findings of this literature review provide valuable practical implications for a wide range of tourism actors, including destination managers, host tourism businesses, tour operators and policymakers. In all the studies reviewed, RTPs are shown to play a central role in shaping tourists' satisfaction, loyalty and green consumer behavior. This suggests that implementing sustainable and authentic CSR and DSR initiatives can improve the image of tourism destinations and encourage repeat visits [34], [43]. In particular, understanding tourists' perceptions of RTPs helps stakeholders align their offerings with sustainability values, fostering trust and reputational credibility [44]. For local communities, the literature highlights the importance of participatory planning and inclusive development models that ensure equitable distribution of tourism benefits. Studies show that RTP contributes to socio-economic empowerment, community cohesion and stronger connection to place, reinforcing support for sustainable tourism strategies [34], [63], [64] . Transparent and culturally sensitive communication strategies are highlighted as effective tools in increasing residents' trust and emotional engagement with tourism initiatives [68]. Furthermore, targeted environmental awareness campaigns and the promotion of responsible entrepreneurship - especially among under-represented groups such as women - are identified as important for inclusive development and sustainabile development of the destination [69], [53]. In the business domain, the review supports the development of CSR strategies that are tailored to the specific resource capacities of the firm and the expectations of stakeholders, thereby enhancing sustainability performance and competitiveness [47], [58]. Domestically, green human resource practices, such as environmental knowledge sharing and environmentally friendly human resource policies, and responsible leadership have been found to increase employee motivation, ecological outcomes, and organizational well-being [49], [51]. In terms of marketing, promoting ethical and authentic representations of destinations is necessary to maintain visitor trust and avoid reputational damage from perceived lack of authenticity [52]. Furthermore, integrating CSR into crisis preparedness strategies provides tourism organizations with a proactive approach to navigate uncertainty and enhance strategic resilience [57]. [59]. Overall, the literature reviewed highlights that stakeholder perceptions of CSR provide essential guidance for developing practical tools and strategies that promote resilience, community engagement, and business adaptability. This knowledge supports the design of holistic and inclusive tourism development frameworks that integrate environmental, social, and economic objectives to enhance the long-term sustainability and quality of tourism destinations.

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Dog ownership as a way of life: urban service needs and owner motivations

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Abstract: The research focuses not only on animal love, but also on how dog ownership has become an increasingly complex lifestyle and social phenomenon, creating demand for many new types of services. The combined effects of urban lifestyles, busy work schedules, and emotional attachment to animals have led to a dramatic increase in demand for dog-related services such as dog grooming, daycare, boarding, pet transportation, dog fitness and online dog training. The primary objective of the research is to identify what services dog owners would use, how often and how much they would be willing to pay for them. In addition, the study aims to understand the preferences and motivations behind the choice of service provider and to identify promotional tools that could encourage owners to try a new service. The quantitative questionnaire survey targeted dog owners only, with particular attention paid to ensuring that only relevant respondents, i.e. those who actually own dogs, were included in the sample. The analysis of the data received not only provides useful information for service providers in terms of pricing and service development, but can also contribute to making society more sensitive to issues of responsible pet ownership and animal welfare. The research therefore serves both market and social objectives: it helps to better understand the needs and habits of pet owners, while also strengthening a culture of conscious and caring dog ownership.

Keywords: Dog-related services, consumer behaviour, payment willingness, urbanised lifestyle

1 Theoretical background

Many people who have dogs and are very attached to them may have wondered whether this special relationship has a mutually positive effect on both parties. This topic is addressed by Beetz, A. and colleagues in their 2012 study. They analysed 69 scientific publications to provide a comprehensive picture of the physiological and psychological effects of human-animal interactions. I consider it important to mention the significant social impact that animals have on humans. Several studies have confirmed that the presence of animals has a 'social catalyst effect' (McNicholas & Collis, 2000; Wood, Giles-Corti, & Bulsara, 2005; Walsh, 2009). For example, dogs facilitate conversation, increase trust and make people smile. In the case of children with autism, it has been observed that the presence of animals improves language skills. In addition, there is limited but convincing evidence that animals can help reduce aggression and develop empathy. Dogs also have an effect on mood and depression, as evidenced by the fact that individual dog programmes have been more effective in reducing loneliness than group interactions. In addition, animal-assisted therapies are effective in reducing depression, especially in the elderly and psychiatric patients. These results can be achieved through personal contact with animals, for example through physical touch. Human-animal interactions significantly reduce stress hormone levels; for example, cortisol levels decreased in several studies after petting animals, and some studies also support that epinephrine and norepinephrine levels are also reduced (Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012; Handlin et al., 2011; Odendaal & Meintjes, 2003). Moving on from stress hormone levels, it is important to mention the anxiety-reducing effect, which is most evident in stressful situations. These positive effects are not only emotional but also physical, such as pain relief. There is little research on pain relief, but existing studies show positive results. There are also few studies on the effect of animals on learning, but existing studies show that the presence of animals increases concentration and motivation, which can facilitate learning. In terms of health, several large-scale surveys show that pet owners take less medication, visit the doctor less often and lead more mentally balanced lives.

Companion animals also have a positive effect on the prevention and treatment of cardiovascular problems. The reduction in heart rate and blood pressure has been proven many times, especially in the presence of one's own animal, and pet ownership is positively associated with heart attack survival rates. The key to these many positive effects is oxytocin, a hormone that reduces stress and promotes social bonding, which is released during petting, eye contact and other loving interactions, but is not solely responsible for them. Human-animal interaction and oxytocin overlap almost completely, as both improve social interactions and health and reduce stress and anxiety. Several studies have shown that even a few minutes of interaction between a dog and a human increases oxytocin levels in both the human and the animal, especially when it comes to one's own dog. The biological, psychological and social effects form a complex system in which human-animal interaction can be an effective tool for physical and mental well-being. (Beetz, Uvnäs-Moberg, Julius, & Kotrschal, 2012.)

Dogs exhibit social behaviours similar to those of humans, such as attachment, as dogs bond with their owners in a similar way to humans bonding with their parents. Ádám Miklósi and József Topál wrote about this in 2013, noting that dogs can interpret human communication, whether it be gestures or eye contact. (Miklósi & Topál, 2013.) From what has been described, we know that dogs have a lot of positive effects on us, so it is not surprising that there are many dog owners in the world and in Hungary

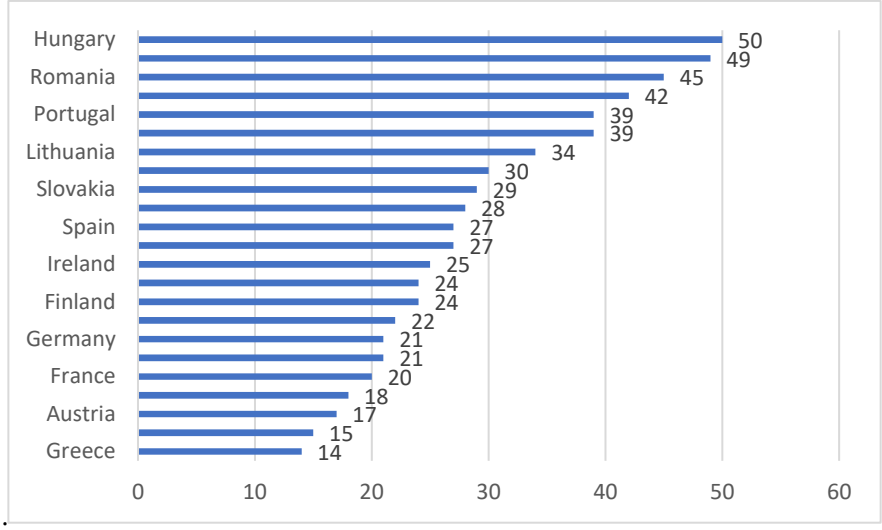

Figure 1

Percentage of households with dogs in Hungary (%) (2023) (Statista, 2023.)

The bar chart on Statista's official website shows the percentage of households with at least one dog in the European Union in 2023. Hungary ranks high on this list. (Statista, 2023.)

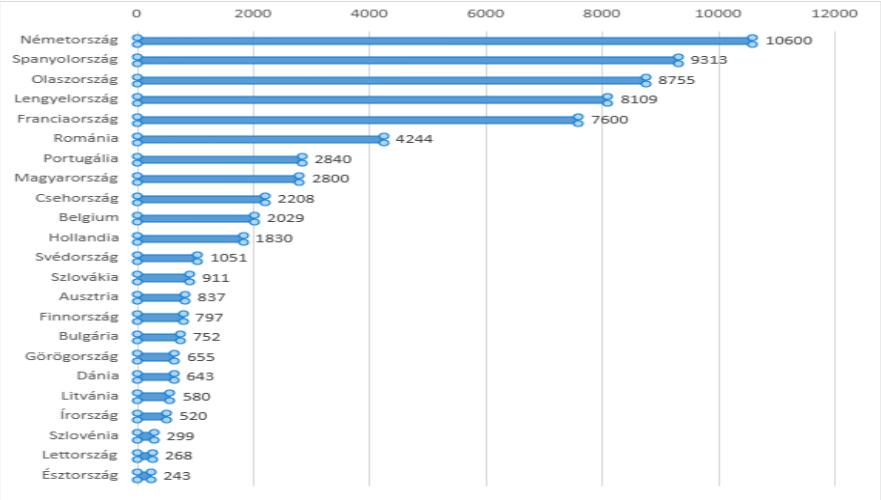

Figure 2

Number of dogs in the EU (thousands) (2023) (Statista, 2023.)

The other bar chart shows how many dogs there are in the countries of the European Union. In 2023, there were 2.8 million dogs registered in Hungary. We can see that in terms of the number of dogs, the country is in the upper middle of the European

Union, but in terms of households, it ranks first, followed closely by Poland, which is only 1% behind. From these statistics, we can conclude that there are proportionally many dog owners in Hungary and therefore many people may be affected by the topic of dog services. (Statista, 2023.) Examining the role of dog grooming is particularly important from the point of view of maintaining animal health, as many basic hygiene procedures are related to this service area. These include, for example, regular claw trimming, which is especially important for dogs that don't wear down their claws properly, as well as ear cleaning and sanitary clipping, which involves the hair around the eyes, paw pads, genitals and anus. (McDonald, Silver, Nienstadt, & Dombrowski, 2022.) These treatments not only increase the animal's comfort, but can also prevent inflammatory diseases, infections and skin irritations caused by matted fur. Regular grooming, including brushing and bathing, is especially important for breeds that are prone to matting. However, dog grooming services serve not only a health function but also an aesthetic one, as they allow for the creation of different styles and special procedures such as undercoat removal or trimming, which are essential for breeds with wiry or wire-haired coats. (Szinák, Bauman, Dömötör, & Bíró, 2023.)

2 Practical research

2.1 Presentation of the sample

After cleaning the sample, 568 respondents remained. The questionnaire was primarily completed by respondents from Pest County, Komárom-Esztergom County and Budapest, but there were also respondents from other regions of Hungary. The main target group was dog owners. I considered it important to design the questionnaire in such a way that respondents only answered questions to which they could give relevant answers. For example, respondents with dogs weighing 20+ kilograms were not asked questions about how much they would pay for a full grooming service for a small dog. I consider this kind of differentiation important because, in general, dog groomers determine their prices based on various factors that customers are not necessarily aware of. This means that the price for grooming a 5-kilogram Bichon Bolognese starts at 9,000 forints in many places, but someone who has a 30-kilogram German Shepherd is unlikely to pay six times 9,000 forints.

2.2 Results

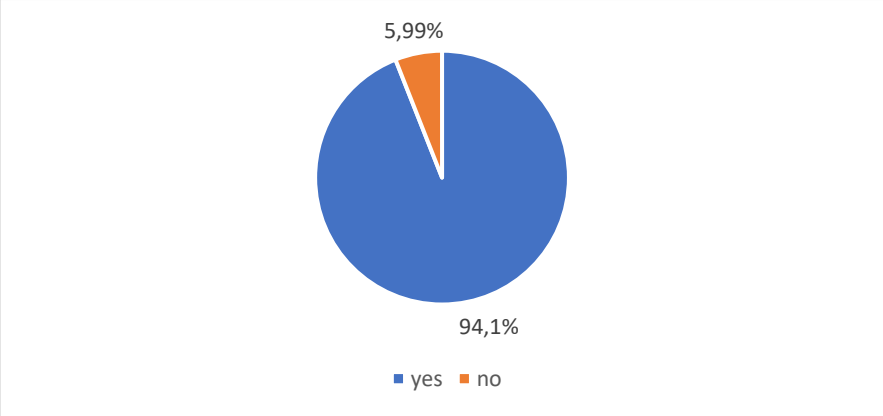

Figure 3
proportion of pet owners (own source)

Of the 568 respondents, 94.01% said they had some kind of pet, which shows that we managed to find the right group of pet owners to get real answers. Of all respondents, 67.96% only have dogs and 12.85% have dogs and some other small animal, such as a turtle. I also asked respondents what breed of dog they had, and surprisingly, most answered that they had a mixed breed, followed by Labrador and Golden Retriever, then Dachshund and Yorkshire Terrier. These are the five most

common dog breeds among respondents. This question was only asked to those who own a dog.

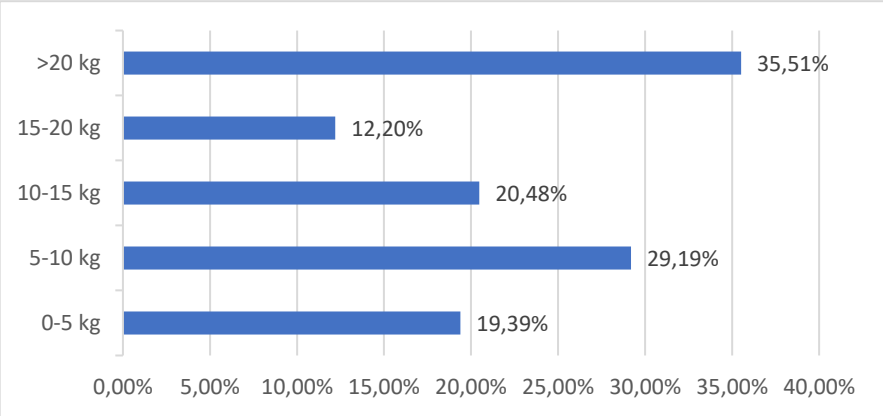

Figure 4
dog size (own source)

35.51% of respondents keep dogs weighing more than 20 kilograms, 29.19% keep dogs weighing between 5 and 10 kilograms, and almost the same proportion keep dogs weighing between 10 and 15 kilograms and/or between 0 and 5 kilograms. The smallest number of respondents have dogs weighing between 15 and 20 kilograms. Many people work from morning until late afternoon, so they may not necessarily have time to take their pets to service providers. I asked them if they would use an animal transport service, and 36.6% of respondents answered yes, which means that the vast majority would rather take care of transporting their pets themselves, but if such an option were available, more than a third of respondents would use this service.

In the next step, I asked whether the respondent was interested in dog grooming services, so I tried to filter out those respondents who, because they are not interested in this type of service, would probably indicate the lowest price in the price-related questions, which would not have given realistic results due to the irrelevance of the question. The filtered result was 274 respondents, whom I asked if they would be interested in having a dog groomer come to their home. Surprisingly, more than half of the respondents were interested, from which we can conclude that there would be demand for this service as well. There are people who are unable to take their dogs to various treatments for health or behavioural reasons, so home visits would be an excellent alternative in these cases.

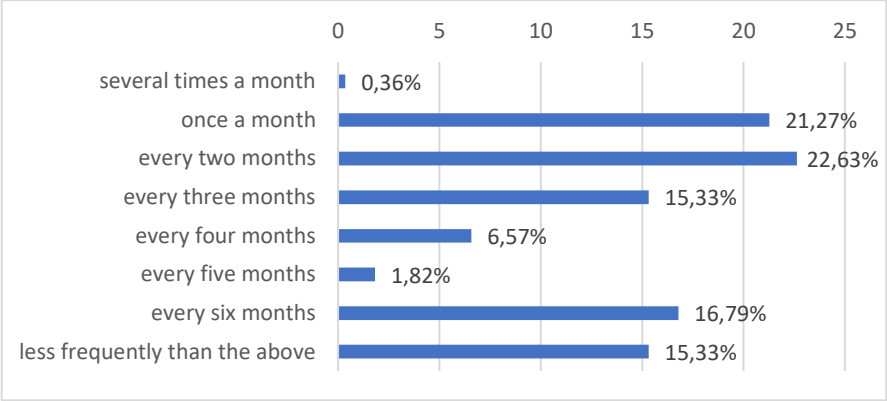

Figure 5
Frequency of using dog grooming services (own source)

I also asked them how often they use dog grooming services. More than half of the respondents take their dogs to the groomer at least once every three months, which is very important because regular customers are the most important source of income. More than three-quarters of respondents consider their dog's grooming to be very important, which is an important factor because it also has a significant influence on the frequency of visits to the dog groomer. This should not be interpreted as directly proportional for all dog breeds, as short-haired animals visit dog groomers less often than long-haired animals, even if grooming is very important to them. In the next step, I asked how much they were willing to pay for a full dog grooming service, taking into account the size of the dogs and the length of their hair. One category is short-haired animals and the other is long-haired animals. Professionally, long, double, curly, wire and wiry coats belong to separate categories, but for the sake of clarity, I classified them all as long-haired in the questionnaire. In the case of small long-haired dogs, most people would pay 8,000-9,000 forints, but there are some who would be willing to pay over 15,000 forints. In the case of short-haired small dogs, most people would pay 5,000-6,000 forints, but there are also respondents who would be willing to pay more than 10,000 forints. In the case of long-haired medium-sized dogs, 5.74% would pay more than 10,000-11,000 forints, while 11-13,000 forints would receive the highest percentage of votes for this criterion. However, less than 2% of respondents would be willing to pay more than 25,000 forints. In the case of short-haired medium-sized dogs, the vast majority of respondents would pay less than 10,000 forints, with the highest amount that still received votes being in the 17,000-20,000 forint category. In the case of long-haired, large dogs, the 10,000-15,000 forint category received the most votes, but there are those who would pay more than 40,000 forints. These results show that there is a huge variation, and it is striking to me that many people are unaware of market prices. I examined the price lists of various dog groomers and, on average, prices in Budapest are higher in this area as well, and based on

experience, customers in Budapest have more respect for professionals. I asked respondents if they would be interested in creative dog grooming, and only 14.86% answered yes. The majority of those who answered yes would pay 11,000-13,000 forints for such a service. After that, I moved on to questions about dog boarding and dog daycare. Of the 568 respondents, 41.9% said they were interested in dog boarding services. Most would pay between 5,000 and 6,000 forints per night, while the second largest group, less than 1% behind the first, would pay less than 5,000 forints. The yes answer also received a value close to 41% when I asked if they would be interested in a service where a qualified carer would visit their home every day to take care of their pet while they were away, including feeding, watering, administering medication if necessary, and walking the pet. This could also be an alternative service for those who prefer their dog to be at home while they are away.

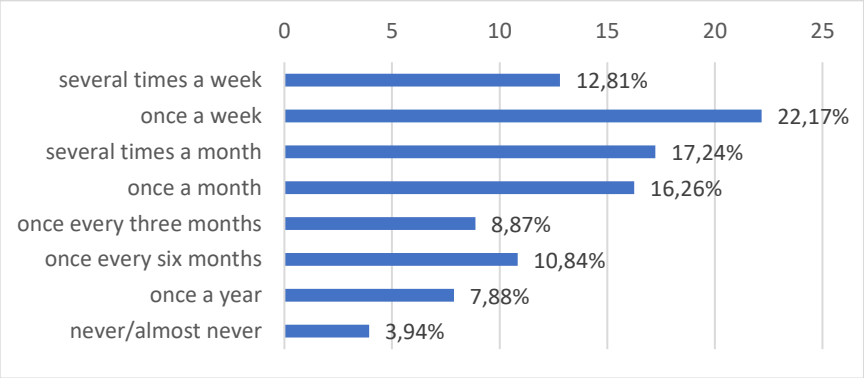

Figure 6
Use of dog daycare (own source)

Dog daycare is of interest to 35.74% of respondents, with more than 50% of the 203 interested respondents saying they would use the service several times a month and 68.48% saying they would use it at least once a month. Most respondents, approximately 34%, would pay a daily fee of between 4,500 and 5,500 forints, followed by those willing to pay less than 4,500 forints, and nearly 3% who would be willing to pay more than 9,500 forints.

The next questions were about dog fitness and dog sparring. From the results, I learned that 105 of the 568 respondents, or 18.49%, would be interested in dog fitness, with most willing to pay between 2,000 and 3,000 forints for such a training session, followed by 3,000-4,000 forints. 000 forints for such a training session, followed by 3,000-4,000 forints in second place. A dog fitness training session primarily refers to treadmill training in this case, or possibly even simpler exercises, i.e. not those that require a physiotherapist. Dog spas are similarly popular, with 18.13% of respondents expressing interest. The majority, 31.07%, would pay less than 6,000 forints, 30.1% would pay 6,000-7,000 forints, and in third place, 16.50%

would pay between 9,000 and 10,000 forints. The lowest percentage, 3.88%, was for the category above 12,000 forints. Next, I looked at online dog training schools. Of the 568 respondents, 29.93% are interested in an online dog training school, 63% of those interested think that videos would be the ideal way to deliver the curriculum, 35% vote for live online classes, and only 1.18% favour PDFs. 50.59% of respondents consider personalised training, 37.06% consider experienced trainers and 12.35% consider flexible scheduling to be the most important aspects of online dog training services.

I also asked a question about whether they would be willing to purchase dog products (food, accessories) at a dog service location, and 62.5% of respondents answered yes. I asked this question because a dog service provider can sell dog-related products to its customers as a supplement, as an owner may only take their dog for a grooming session but then see what good brushes and healthy food are available to buy, so the customer may make an unplanned purchase in addition to using the service. 64.44% of respondents currently use the services of a dog groomer, daycare or boarding kennel, with 63.59% citing reliability, 53.33% quality, 52.8% proximity, 34.36% cited price, and 31.28% cited recommendations as the reason for choosing their current service provider. In addition, I thought it was important to ask whether they would be willing to pay more for premium quality services, with 43.13% answering yes. I asked the respondents what would make a dog service provider attractive to them. Most of them highlighted expertise and the fact that they could be sure their pets were safe. Love for animals and the attitude of the employees are also very important to them, with many writing about their bad experiences, which left a deep impression on them. I believe it is very important for a person working with dogs to have both professional qualifications and an emotional connection to animals, because the goal of a business dealing with animals is not only to make a profit, but also to create and promote animal welfare, which is also an important factor from a business perspective, as it is a way to gain loyal customers who know that their animals are in the best hands.

Almost half of the respondents would be happy to attend educational lectures, which shows that owners want to improve themselves so that they can give even more to their dogs, and possibly other animals as well. Almost half of respondents would also be happy to join dog-friendly tours, and 41% would be happy to participate in charity events, the latter of which gives me a sense of optimism, as I consider social responsibility to be very important in all areas. A dog service provider could play a perfect role in this. With the consent of customers, a charity event could raise a lot of donations, which could greatly contribute to the work of animal welfare organisations and shelters. In addition, social responsibility includes raising awareness of responsible pet ownership and adoption, as well as building community and serving an educational purpose. Dog professionals could also visit kindergartens and schools, where they could participate in promoting a very important and effective social change, which plays an important role in promoting animal welfare and animal protection.

68.62% of respondents learn about new services/promotions primarily through social media platforms. 18.44% learn about them through recommendations and 10.28% from websites, while the remaining less than 3% learn about them from flyers and posters. I also asked respondents if they would be willing to try out the services of a dog service provider as part of a trial package, and 63.36% answered yes, suggesting that such an offer could be attractive to potential customers. In addition, 57.92% of respondents would be willing to purchase a pass for discounted services, which could also strengthen loyalty, because if someone buys a pass somewhere, they will ideally use it, and if they like this type of option, they will continue to be willing to purchase passes because they receive some kind of discount in exchange for their commitment.

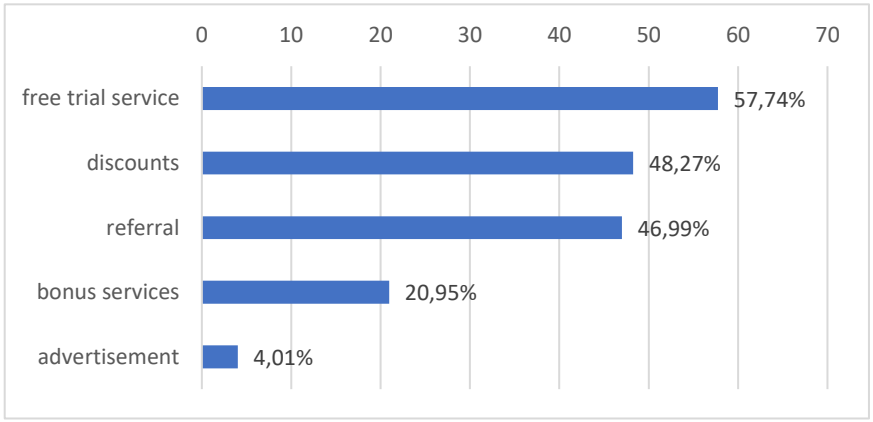

Figure 7
Incentive promotions (own source)

I also asked a question about what kind of promotions would encourage respondents to try a new service provider. Most chose a free trial, followed by discounts, with recommendations coming in a close third. These can be important considerations for a start-up, as it needs to acquire customers in some way. This question allowed us to find out what is most important. To gain a deeper understanding of the data, I performed a Spearman's rank correlation analysis. The purpose of the analysis was to see if there was any correlation between the responses received. Based on the correlation matrix, it can be observed that respondents who own pets are likely to own dogs, as there is a moderately strong positive correlation between these variables. This confirms that the questionnaire was completed by the appropriate target group.

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hosszukistestuar	Correlation	1,000	,663**	,708**	,693**	,612**	0,420	-0,074	,555**
	Sig. (2-tailed)		0,000	0,005	0,002	0,009	0,093	0,387	0,007
rovidkistestuar	Correlation	,663**	1,000	0,494	,764**	,576*	,661**	-0,116	0,286
	Sig. (2-tailed)	0,000		0,072	0,000	0,016	0,004	0,174	0,198
hosszukozepesar	Correlation	,708**	0,494	1,000	,670**	,736*	0,649	-0,001	,933**
	Sig. (2-tailed)	0,005	0,072		0,000	0,024	0,058	0,993	0,001
rovidkozepesar	Correlation	,693**	,764**	,670**	1,000	0,355	0,507	-0,166	,933**
	Sig. (2-tailed)	0,002	0,000	0,000		0,348	0,164	0,160	0,001
hosszunagyar	Correlation	,612**	,576*	,736*	0,355	1,000	,737**	-0,025	0,175
	Sig. (2-tailed)	0,009	0,016	0,024	0,348		0,000	0,815	0,567
rovidnagyar	Correlation	0,420	,661**	0,649	0,507	,737**	1,000	-0,094	-0,396
	Sig. (2-tailed)	0,093	0,004	0,058	0,164	0,000		0,370	0,181
erdeklikreativkozmi	Correlation	-0,074	-0,116	-0,001	-0,166	-0,025	-0,094	1,000	
	Sig. (2-tailed)	0,387	0,174	0,993	0,160	0,815	0,370		
kreativar	Correlation	,555**	0,286	,933**	,933**	0,175	-0,396		1,000
	Sig. (2-tailed)	0,007	0,198	0,001	0,001	0,567	0,181		

Table 1

Correlation table – relationship between dog grooming prices (own source)

The strongest significant correlation ($r = 0.933$; $p < 0.01$) is between the amount spent on grooming for long-haired medium-sized dogs and the amount paid for creative dog grooming services. From this, we can conclude that those who are willing to pay more for the grooming of their medium-sized dogs are more open to creative dog grooming, which is considered a premium service. In addition, willingness to pay for creative dog grooming correlates with the price of grooming for small, long-haired dogs ($r = 0.555$; $p < 0.01$), which means that the owners of these dogs may be more open to creative grooming.

There is a strong correlation between willingness to pay for short-haired medium-sized dogs and the price of grooming services for long-haired small dogs ($r = 0.708$; $p < 0.01$), and between short-haired small dogs and long-haired small dogs ($r = 0.663$; $p < 0.01$). This suggests that owners who are willing to pay more for the grooming of their long-haired dogs are also willing to pay more for their short-haired dogs, but those who would pay less for the grooming of a short-haired dog are also willing to pay less for the grooming of a long-haired dog, indicating that

dog owners determine the price they are willing to pay for their pet's grooming based on similar thinking, regardless of breed type.

There is a strong correlation between interest in dog daycare and boarding ($r = 0.543$; $p < 0.01$), which means that if someone is interested in dog daycare, they are also likely to be interested in boarding. There is also a strong correlation between willingness to pay for dog daycare and boarding ($r = 0.644$; $p < 0.01$). It may be advisable to link the two services with some kind of promotion, for example, regular boarding customers receive a 5% discount on the price of daycare, this would motivate customers to make the most of the available services, which could increase their willingness to purchase and strengthen customer retention.

Summary

In my research, I mapped the service needs and willingness to pay of dog owners in relation to various dog-related services, such as dog grooming, daycare, boarding, dog fitness, and dog training. A total of 568 people took part in the survey, the vast majority of whom were active dog owners. When selecting the sample, I took into account certain characteristics of the dogs, such as their size and coat length, as well as any special needs arising from their owners' lifestyles. In the theoretical background of the research, I emphasized that urban lifestyles, fixed working hours, and the strengthening of emotional bonds with pets have significantly increased the demand for personalized, convenient services. At the same time, I pointed out that the psychological and physiological benefits of human-animal relationships—such as stress reduction, social support, and improved overall health—contribute to the growing social value of dog ownership. I thus established a theoretical basis for the idea that the development of dog-related services should take into account not only the needs of animals but also those of their owners. Based on the results of the data collection, I showed that a significant proportion of respondents regularly use dog grooming services, and more than half are interested in services provided in a home environment. I also analyzed price sensitivity for different services and found that there are significant differences in this area. The demand for dog boarding and daycare is particularly high, while interest in dog fitness, dog spas, and online dog training is more limited to a narrower, specialized target group. Using correlation analyses, I was also able to identify consumer segments that are open to higher-priced or more complex, combined service forms. In summary, I found that there is a conscious consumer segment among Hungarian dog owners who are not only open to regular services, but also prefer safe and convenient solutions tailored to their individual needs. Based on the results of the research, I concluded that there is significant business and social potential in the development of a modern, complex dog service center that not only provides basic care functions but also builds community, plays an educational role, and contributes to the development of animal welfare awareness.

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Characteristics of innovation success - a literature review based on the Hungarian-language literature of the main scientific databases

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Abstract: The study provides a systematic literature review on the topic of innovation success based on the Hungarian academic literature. In the course of the research, 142 review papers were identified from publications collected from six academic databases, of which 35 primary papers were analysed in detail. Balachandra and Friar's four-factor framework of innovation (market, technological, environmental and organisational factors) provided the background for the systematisation of the results. The results show that the Hungarian review literature focuses primarily on market and organisational factors, while environmental and technological aspects are less prominent. The research highlights the relative underrepresentation of Hungarian review articles compared to international literature, and also the methodological shortcomings of Google Scholar and the potential for further use of the articles collected from it.

Keywords: innovation, success, aggregate research

1 Introduction

The economic and social importance of innovation has been a well known and researched topic for decades [1]. Both international and national literature and public communication, in the context of economic growth, raising living standards or even improving competitiveness at the industry level, have focused on innovation as a necessary and highly beneficial activity [2, 3]. Successes are often accompanied by innovation failures, which justifies the need to measure innovation successes, to know their elements and, through them, to make innovation activities more efficient and profitable [4]. Measuring innovation and making it more effective can and should be understood not only on a company level, but also on a regional, national economic and global level [5]. The international literature on this topic is vast and growing daily, both from a practical and academic point of view [6], however, the

present synthesis study, through a structured literature review at , aims to examine the elements and characteristics of innovation success found in the Hungarian-language academic literature and to present a current state of play.

2 Research methodology

The research employed a systematic source material review methodology, with appropriate documentation to support the traceability, reproducibility and verifiability of the research procedure [7]. The processing methodology required a considerable amount of manual work, the steps of which were also recorded. The full-text evaluation of the so-called relevant studies used in the present research and the ordering of the results were based on an innovation framework previously established in an academic work with a significant volume of references.

2.1 Selection of sources

Although the indexability of Hungarian-language material in large databases is significantly limited, the widest possible database coverage was the objective in order to make the research as comprehensive as possible. Accordingly, Embase, MEDLINE, Web of Science Core Collection, and Google Scholar were included and reviewed, which, according to a 2018 survey, were represented in 98.3% of systematic literature reviews [8].

2.2 Processing methodology

Unfortunately, Google Scholar does not offer a download option, for which no better method than the manual solution appears to be available for the time being. Accordingly, the following procedure has been implemented:

1) Google Scholar search for the keywords "innovation" and "success
2) filtering of review articles within Google Scholar
3) Saving the review articles one by one to Google Library
4) Due to the processing limitation of Google Scholar, the entire content of the library is saved to an ENW file in Endnote format
5) Reviewing keywords and abstracts one by one, making decisions on inclusion or exclusion as relevant studies, detailed in section 2.4 Selection of studies
6) Manual editing of ENW for primary studies to add keywords and abstracts

2.3 Selection of studies

To determine whether a study should be considered relevant, i.e. a potential candidate to be a processable study, the Google Scholar review article filtering was set as an inclusion criterion. In the present research, it is acknowledged that this screening method is acceptable and applicable, however, with screening, it is possible that not all review articles may be included in the academic material to be screened and that articles that are not review articles may be included. It is known from previous work that Google Scholar review article filtering is not considered to be fully accurate [9], however, it is the only additional filtering option for Google Scholar results retrieval. The limitations of the resulting filtering are described above, and the title, keywords and abstract of the 142 articles obtained were then analysed individually to determine whether the article actually addresses the analysis of the relationship between innovation and success, whether it contains substantive features, describes a process, a relationship system or provides essential information on the topic.

In some cases, it was necessary to read the whole document to determine its relevance. Following the analysis of the results of the first stage of the systematic review, exclusion criteria were applied to select the primary studies, excluding those which, despite having addressed innovation and success in some way, did not contribute any significant information. We also excluded studies that focused exclusively on some very specific or specialised area (e.g. breeding of meat pigeons or treatment options for cancer) and thus made findings less suitable for generalisation in relation to innovation and success in general. The search process resulted in 142 review papers being shown on Google Scholar, of which 40 were selected as relevant and finally 35 were reviewed as full-text depth articles.

3 Results

Balachandra and Friar, in an innovation framework they developed, classified innovation factors into four main categories [10], as follows: market factor, technological factor, environmental factor and organizational factor. The summary articles in Hungarian were classified and processed according to these four categories.

3.1 Market

The density and diversity of knowledge-sharing networks between companies shows a significant correlation with the growth of the innovation rate in the industry [18, 33]. Regardless of the industry, in a rapidly changing market and regulatory

environment, companies that are able to dynamically track and respond to customer needs are the ones that achieve superior market growth [16, 34]. The use of adaptive financing models to meet operational and innovation challenges becomes even more essential in an unpredictable and rapidly changing environment [38, 39].

3.2 Technology

Digitalisation is slowly becoming not a competitive advantage, but a necessary capability and knowledge set that has a clear positive impact on business operations, shortening product and service development cycles and reducing time to market [11]. The active use of technological capabilities such as artificial intelligence in business innovation enables the creation of hybrid product development models that radically increase the likelihood of innovation initiatives being successful in the market [20, 45].

3.3 Environmental

Geopolitical stability and geographical proximity significantly reduce the transaction costs of innovation collaborations and thus increase their efficiency, especially in sectors with high technological complexity [12]. Recognition and responsible, even proactive, management of environmental side effects act as a catalyst for the creation of both market-based and societal innovations [14]. The adaptive capacity of education systems is identified as a critical success factor in the diffusion and diffusion of innovation attitudes and practices [22, 29].

3.4 Organisational

The quality of internal knowledge-sharing practices and the openness of the organisational culture in knowledge-intensive firms directly influence innovation performance and creative problem-solving capabilities [19]. Corporate strategy and a management attitude that is understanding and supportive of innovation can significantly increase the expected success and benefits of this value-creating activity [17, 21]. Internal systems in firms play a crucial role in the development of organisational capabilities, the effectiveness of knowledge conversion and thus the innovation field [28].

4 Findings

The present research has several important findings, some of which were outside the scope of the original work, however, from a research methodological point of view, they are worth highlighting and are presented in the second part of the findings.

The framework of four main elements (market, technological, environmental and organisational) used earlier by Balachandra and Friar to examine successful innovation is covered in the Hungarian review articles, and is accordingly supported and, in many cases, illustrated by examples from the practical side, in addition to the academic work. Most of the Hungarian literature deals with the market and the organisational part of the cross-section of innovation and success, interestingly the number of environmental elements and the number of articles exceeds the coverage of the technological element, at least according to the review articles. Most of the academic works highlight the organisational side of innovation, exploring the topic from several angles and with considerable professional thoroughness, often with concrete proposals to increase innovation efficiency and effectiveness. The 'under-documentation' of technological capabilities in relation to innovation is striking.

The publication presents an up-to-date picture of how the topic of innovation and related success is dealt with in Hungarian, which is naturally a fraction of the literature available in English. The volume of review articles in Hungarian in this field, as reported by Google Scholar in 2024 with a rate of 1.53%, is one twentieth of the 21% rate of the international literature, indicating a significantly lower proportion of this type of academic work. The reasons for this are not explored in this research, but it is worth highlighting, as review articles published in Hungarian can make a significant contribution to the dissemination and development of innovation in Hungarian science and practice. The coverage of the category of review articles in Google Scholar should also be highlighted; based on the results of the present work and the research conducted in the meantime, it can be stated that Google Scholar does not cover the expected quantitative and qualitative characteristics of the category of "review articles", at least in relation to the keywords included in the present Hungarian search.

It can be interpreted as a research methodological limitation and a research field opportunity that none of the academic works found along the protocol established by the present review article was a work that actually summarised and analysed the factors, circumstances and elements important for innovation success. One reason for this is probably the limitation of the tools used, as documented and detailed in this study, but it is also an indication that no such review article can be found in the search engine of the academic database used in Hungarian literature, which is one of the most widely used in the world. It is worth taking the time and effort to find out exactly why this is the case and to search for reassuring solutions, since scientific works are not written for themselves or for the author(s), but for academic

researchers, students and those interested in the practical side of the field, so that they can expand their knowledge with sound knowledge and research results.

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