

EKONOMSKI VJESNIK ECONVIEWS

Review of contemporary business,
entrepreneurship and economic issues

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 **EFOS**

Josip Juraj Strossmayer
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and Business in Osijek**

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ENTREPRENEURIAL AWARENESS AND SPIRIT OF TEACHERS IN CROATIA

ABSTRACT

Purpose: Entrepreneurial awareness and spirit are necessary for shaping and using entrepreneurial capacities in every national economy. An encouraging climate for the development of entrepreneurial qualities should be present in all phases of the upbringing and education of young people, where teachers play a key role. The aim of the work is to investigate entrepreneurial awareness and spirit of teachers in Croatia.

Methodology: The research was conducted on a sample of 540 teachers (from primary, secondary, and higher education institutions) in Croatia. The methodological framework is derived from the Global Entrepreneurship Monitor (GEM) research, from which entrepreneurial indicators reflecting entrepreneurial awareness and spirit as key drivers of entrepreneurial endeavors and social progress have been extracted.

Results: The research results indicate the potential and confirm the need for the introduction of entrepreneurial education at all levels of education in Croatia.

Conclusion: The main scientific contribution of the work lies in the analysis of contextual and individual GEM indicators of entrepreneurial activity through the prism of teaching staff as the bearers of entrepreneurial education necessary for the development of entrepreneurial spirit in the wider social community, and a conceptual model based on correlations between formal entrepreneurial education, entrepreneurial awareness, and the spirit of teachers in Croatia. Research limitations and guidelines for future research are also outlined in the paper.

Keywords: Entrepreneurial awareness, entrepreneurial spirit, entrepreneurial characteristics, teachers' perceptions, Croatia

1. Introduction

Entrepreneurial activity is the basic premise of creating new values useful in the economic and wider social context (Global Entrepreneurship Research Association [GERA], 2023; Gibb, 2011; Lumpkin & Dess, 1996; Porter, 1990). Entrepreneurship implies a new activity (Guth & Ginsberg, 1990; Zahra, 1991; Zahra, 1993; Sharma & Chrisman, 1999)

that changes market flows (Kirzner, 1999), industrial structures (Swann, 2009; Sharma & Chrisman, 1999), and social circumstances (Miller, 1983). Entrepreneurship encourages change and is a response to change (Gibb, 2011; Drucker, 1985; Shane, 2002). According to Schumpeter's model of "creative destruction" (Schumpeter, 1976) and Christensen's model of "creative creation" and "disruptive innovation" (Christensen, 2002; Christensen et al., 2006),

as well as contemporary theories of the equilibrium role of entrepreneurship (Boudreaux, 1994), change presupposes social growth and development.

For new activities of entrepreneurial processes to lead to socially positive change, it is necessary to develop entrepreneurial awareness and entrepreneurial spirit in society. Culture and society are determinants of individual behavior, including entrepreneurial behavior (Levie & Autio, 2008). An entrepreneurial society emphasizes the importance of entrepreneurship, encourages the development of entrepreneurial competencies and the involvement of all stakeholders in entrepreneurial processes, and emphasizes their social utility (Audretsch & Thurik, 2004; Lumpkin & Pidduck, 2021). Entrepreneurial awareness and entrepreneurial spirit are today's most valuable resources necessary for economic development (Read et al., 2009).

The main goal of this research was to examine the entrepreneurial awareness and spirit of teachers in Croatia, including teachers from primary, secondary, and higher education institutions. The research was conducted because the GEM Entrepreneurship Index (GESI) is a relatively new methodological framework (2017/2018), and the entrepreneurial awareness and spirit of teachers in Croatia have not been sufficiently researched to date. Teachers' perceptions and experiences can have a significant impact on the development of an entrepreneurial culture in society, as they play a key role in the transmission of entrepreneurial education. In accordance with the stated objective, the following research questions were formulated:

RQ1: What is the entrepreneurial awareness of teachers in Croatia?

RQ2: What is the entrepreneurial spirit of teachers in Croatia?

RQ3: Is there a significant relationship between the level of formal entrepreneurial education of teachers and their entrepreneurial awareness?

RQ4: Is there a significant relationship between formal entrepreneurial education of teachers and their entrepreneurial spirit?

The research provides insight into a previously neglected part of the GEM framework, which is important for understanding the entrepreneurial potential within the Croatian education system. The research confirms that formal entrepreneurial education acts as a key predictor of teachers' entrepre-

neurial awareness and spirit. The results presented provide a valuable contribution to educators, researchers, and policymakers in education.

2. Theoretical framework

Below is a brief overview of key concepts; entrepreneurial awareness (2.1), entrepreneurial characteristics, spirit and potential (2.2), and the role of entrepreneurial education (2.3).

2.1 Entrepreneurial awareness

Culture represents the collective awareness of a society, which includes established values, ways of thinking, ways of making decisions, and behavioral patterns of members of that society (Armstrong et al., 2017, p. 141; Solomon et al., 2015, pp. 506–507; Levie & Autio, 2008, pp. 16–17). The GEM methodological framework distinguishes general awareness from entrepreneurial awareness summarized in entrepreneurial culture as an important factor of the entrepreneurial environment. In the entrepreneurial context, entrepreneurial awareness is observed through the prism of perception about entrepreneurial activity, entrepreneurs, and their role in society (Levie & Autio, 2008, p. 17). Entrepreneurial culture, which reflects the awareness of individuals in society about entrepreneurship and entrepreneurs, has a great influence on the ambitions and aspirations of entrepreneurs and the necessary support for entrepreneurial activity (GERA, 2023; Singer et al., 2021; Kelley et al., 2016). Unlike general social values and attitudes, society's perception of entrepreneurship and entrepreneurs is subject to change (Etzioni, 1987, as cited in Levie & Autio, 2008; Singer et al., 2022). It depends on specific social circumstances and changes depending on them. A positive opinion of society about entrepreneurship largely determines the entrepreneurial spirit and the intention of entrepreneurial activity of the wider population (Ajzen, 1991, as cited in Levie & Autio, 2008; Singer et al., 2022).

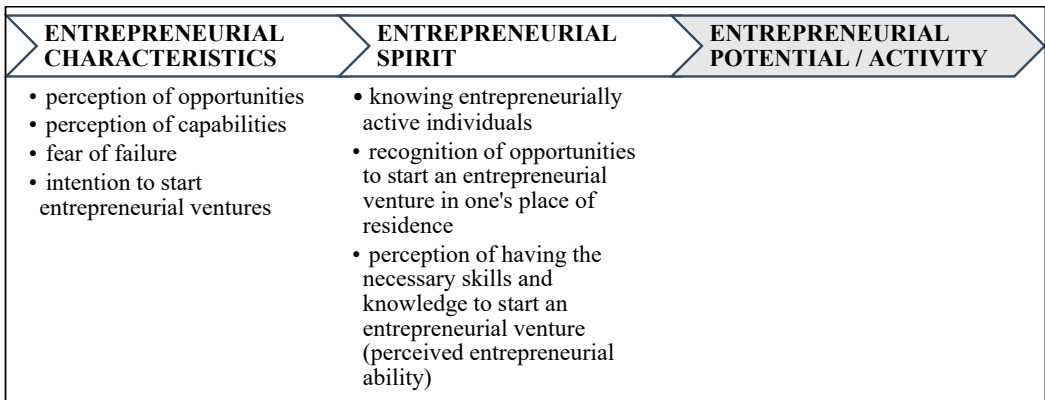
The GEM research results showed that the lack of entrepreneurial culture, which is expressed by a strong fear of failure, a lack of faith in entrepreneurial abilities, and a low perception of opportunities in the environment, is responsible for poor entrepreneurial performance and slow recovery from recessionary events (The World Economic Forum [WEF], 2016).

2.2 Entrepreneurial characteristics, spirit, and potential for entrepreneurial activity

Society’s perception of entrepreneurship indicates the desirability of entrepreneurial activity, while the self-perception of individuals indicates the likelihood of undertaking entrepreneurial activity. The GEM project assesses the probability of entrepreneurial activity depending on the perception of individuals related to the opportunities in the environment and the possession of the necessary skills for entrepreneurial activity. At the same time,

the fear of failure, which can prevent individuals from starting business ventures, is also assessed, and intentions to start business ventures in the next three years are examined. The determinants of entrepreneurial activity are viewed as entrepreneurial characteristics of the population of actual and potential entrepreneurs (Kelley et al., 2016, pp. 12–16; GERA, 2023, pp. 37–46). An overview of entrepreneurial characteristics, entrepreneurial spirit, and potential for entrepreneurial activity is shown in Graph 1.

Graph 1 Entrepreneurial potential for entrepreneurial activity (according to GEM)



Source: Kelley et al. (2016, pp. 12–16); GERA (2018, pp. 29–30); GERA (2023, pp. 37–46); Bosma et al. (2017, p. 67); Singer et al. (2019, pp. 21–24)

2.2.1 Entrepreneurial characteristics and traits

Recognizing the importance of “the role of entrepreneurship in the economic growth of national economies, the emphasis is placed again on Schumpeter’s qualities of boldness, creativity, and imagination necessary for successful entrepreneurial activity, exploiting the entrepreneurial potential described by entrepreneurial characteristics” (Kirzner, 2008, p. 3). Pinchot (1987) points out that imagination is the basis of the competitiveness of entrepreneurial endeavors. It is a prerequisite for proactivity and therefore innovation. Imagination enables the projection of the future and its implementation within existing market flows and organizational structures. Creativity, like imagination, is difficult to define, but when these two determinants of entrepreneurial individuals are placed in an entrepreneurial context, a clear idea of their entrepreneurial usefulness is obtained (Swann, 2009).

Differences in personality determine differences in motivation and consequently differences in entrepreneurial processes (Shane, 2002; Shane & Venkataraman, 2000; Shane et al., 2003). It has been observed that bolder individuals are more optimistic and self-confident. The high failure rate of start-up ventures indicates that novice entrepreneurs often lack sufficient information and exhibit high levels of optimism. It has also been observed that a high degree of self-efficacy, an internal locus of control, and a desire for achievement are frequently associated with the willingness to take risks in a new entrepreneurial activity (Shane & Venkataraman, 2000). Self-efficacy refers to the perception of the ability to apply personal resources, knowledge, skills, and competences to successfully carry out a specific activity (Bandura, 1997). In the aforementioned context, the observed self-efficacy can be explained as the self-confidence needed to successfully perform assigned tasks (Shane et al., 2003). Acceptance of uncertainty

is also an important prerequisite for entrepreneurial activity, the circumstances of which are unpredictable and the outcome uncertain. It is assumed that entrepreneurs are more inclined to accept risk, which is an inevitable part of their role (Shane et al., 2003). Among the characteristics that determine the entrepreneur's motivation is the internal locus of control, which presupposes the individual's perception of the extent to influence on the outcomes of certain activities. Individuals with a pronounced internal locus of control perceive control over events in their environment. They believe that their characteristics and the activities they undertake have an impact on the desired outcomes (Rotter, 1966; Rotter, 1990). Self-efficacy, the acceptance of uncertainty and risk, and the perception of control are the basis of the entrepreneurial characteristics described by the GEM model and thus a prerequisite for entrepreneurial activity (Graph 1).

2.2.2 Entrepreneurial spirit

Entrepreneurial potential is represented by individuals who perceive good opportunities in the environment and believe that they possess the necessary skills and knowledge for entrepreneurial activity (GERA, 2017, pp. 17–21). According to the GEM methodology, the determinants of entrepreneurial potential are also the determinants of the entrepreneurial spirit of individuals (GERA, 2018, pp. 29–30).

According to the 2017 GEM methodological framework, the determinants of entrepreneurial activity, i.e., entrepreneurial characteristics, are called entrepreneurial spirit, which provides an insight into the potential for entrepreneurial activity of individuals, the realization of which depends on personal factors and environmental conditions. The Entrepreneurship Spirit Index (GESI – GEM Entrepreneurship Spirit Index) is measured through variables from the standard GEM indicators of entrepreneurial activity (Graph 1).

2.3 Entrepreneurial education role

Entrepreneurial education and entrepreneurial training are the most frequently mentioned factors of the entrepreneurial environment related to the improvement of the entrepreneurial structure (Levie & Autio, 2008). Learning about entrepreneurship, for entrepreneurship and through entrepreneurship is important for the personal and professional development of the individual and

thus of the entire society (Lackéus, 2015; Oberman Peterka, 2013; Singer et al., 2022, p. 79).

Acquiring entrepreneurial knowledge and skills helps individuals recognize and exploit opportunities in the environment, establish and manage entrepreneurial ventures, achieve satisfactory growth rates, and foster stimulating entrepreneurial attitudes and behavioral patterns among the wider population (Levie & Autio, 2008; Lackéus, 2015).

In entrepreneurship literature, the introduction of entrepreneurial education into technical education modules and business practices is considered especially useful. Hisrich et al. (2011) highlight the knowledge of the target market, and the technology needed to satisfy its specific desires with fundamental entrepreneurial knowledge. If companies do not adapt their way of working to revolutionary technological solutions in the environment, they will not be able to respond to the increasingly complex demands of users (Dutta et al., 2016).

The World Economic Forum (WEF, 2014) continuously warns of the need to change the perception of European society about entrepreneurship. Connecting entrepreneurs with schools and universities is considered one of the long-term useful ways of improving entrepreneurial awareness and the necessary skills for entrepreneurial activity. By including business practice in educational structures, the gap between educational programs and the needs of the labor market could be reduced. At the same time, teachers and professors should be seen as entrepreneurship trainers and should be trained for this responsible role. By introducing people and examples from practice into the performance of the teaching process, entrepreneurial thinking and action can be encouraged among teaching staff and students. By spreading entrepreneurial awareness through networks of local schools, universities, and entrepreneurs, it is possible to influence the general awareness of society (WEF, 2014; Lackéus, 2015; Oberman Peterka & Salihović, 2012).

In the 2020 Action Plan for Entrepreneurship, the European Commission points out that Europe needs more entrepreneurs and defines entrepreneurial education as one of three areas in which changes, updating, and intensive action are needed. The action plan calls on the member states of the European Union to make entrepreneurship education a mandatory part of education at all education levels, which can most effectively influence the at-

titudes of European citizens toward entrepreneurship (Alpeza et al., 2022).

Although education and training for entrepreneurship are most frequently mentioned in entrepreneurship theory as a determinant of entrepreneurial activity, research based on the correlation has been a neglected type of entrepreneurial research for a long time (Levie & Autio, 2008).

The GEM research results indicate a positive correlation between education and entrepreneurial activity (Singer et al., 2022; GERA, 2023). GEM research has shown that, along with the advantages of informal investment, education plays a key role in starting entrepreneurial ventures. Specialized training and entrepreneurial education affect the possibility of commercializing the opportunity, and the social desirability of entrepreneurship, as well as the positive perception of potential entrepreneurs, is a great incentive for entrepreneurial activity (Reynolds et al., 2000; Singer et al., 2022, pp. 49–50; GERA, 2023, p. 92). An appropriate entrepreneurial culture and an entrepreneurial education system contribute to the perception of opportunities in the environment and thus to greater entrepreneurial aspirations and expectations of entrepreneurially oriented individuals (Levie & Autio, 2008). If entrepreneurial education is made a mandatory part of education at all education levels, the entrepreneurial culture and spirit of the wider community can be improved (Alpeza et al., 2022).

2.3.1 GEM grades of entrepreneurial education in Croatia

Primary data is collected by researching contextual and individual indicators of entrepreneurial activity and their interaction; within the GEM model they are integrated into 4 groups: conditions of the entrepreneurial environment, social perception and values, individual attributes of potential entrepreneurs, and entrepreneurial activity.

Using the GEM model to observe entrepreneurial activity at the micro and macro levels—through the interaction between individuals and the entrepreneurial environment, as well as between individual characteristics and social values—provides a multidimensional insight into the entrepreneurial structure and entrepreneurial potential (Singer et al., 2022, pp. 14–20). All observed factors point to the importance of developing entrepreneurial awareness and entrepreneurial spirit as prerequisites and indicators of entrepreneurial activity and, consequently, economic growth and development (GERA, 2018, pp. 21–30; Singer et al., 2022, pp. 14–17). Long-term GEM research has proven that an appropriate entrepreneurial culture and an entrepreneurial education system contribute to the recognition of opportunities in the environment and thus to greater entrepreneurial aspirations and expectations of entrepreneurial individuals (Levie & Autio, 2008).

From the onset of the research, the Croatian GEM team has pointed to the need for coordinated strengthening of entrepreneurial capacity at the individual and institutional level. It is emphasized that at the individual level, it is crucial to enable the development of entrepreneurial competencies and aspirations through the processes of formal and informal learning and encourage self-employment as a response to dissatisfaction with the situation in society. At the institutional level, it is necessary to enable a greater degree of cooperation and coordination of various stakeholders, especially research and educational institutions and companies as the only way to strengthen Croatia's innovation capacity. The GEM reports point out that, to effectively implement the proposed measures, it is necessary to simplify the regulatory framework and develop a stimulating entrepreneurial culture in Croatia through positive media and educational influence (Singer et al., 2018; Singer et al., 2019; Singer et al., 2022).

Table 1 GEM grades of entrepreneurial education in Croatia

Level	2020		2021		2022		2023	
	Grade	Rank	Grade	Rank	Grade	Rank	Grade	Rank
I*	2.4	32/45	2.7	8/19	2.9	6/16	2.9	7/19
II**	3.5	42/45	3.4	18/19	3.8	14/16	4.0	17/19

Note: I* = School (primary and secondary) II** = Post-school (tertiary)

Source: GERA (2024, p. 118); GERA (2023, p. 128); GERA (2022, p. 102); GERA (2021, p. 98)

In the GEM reports (Table 1), Croatia's constant underachievement in entrepreneurial education at school (primary and secondary education levels) is observed, which reduces the potential for the development of the necessary entrepreneurial culture in Croatia (Singer et al., 2021, p. 83; Singer et al., 2022, p. 86). Nevertheless, looking at the period from 2020 to 2023, certain positive shifts in the evaluation of entrepreneurial education across all educational levels can be observed (GERA, 2024, p. 118).

3. Methodology

Quantitative research was conducted in two phases. The first phase, the preliminary research, referred to an oral survey of 30 respondents to check their understanding of the survey questions. In the second phase, a survey with a link to a Google form was distributed via email through the authors' network of contacts from educational institutions with a request for participation and further distribution. Thus, a convenient sample was formed using the snowball method.

The questionnaire, consisting of 39 questions, was developed based on the GEM model framework, focusing on entrepreneurial features and characteristics, entrepreneurial awareness and spirit, and the role of entrepreneurial education. For instance, within the GEM research project, society's perception of entrepreneurship and entrepreneurial culture were assessed by examining opinions on: 1) entrepreneurship as a good career choice, 2) social status of successful entrepreneurs, and 3) media attention focused on entrepreneurship (GERA, 2018, pp. 21–23). The following questions from the questionnaire for the adult population (Adult Population Survey, APS) were used: 1) knowledge of entrepreneurial active individuals, 2) recognition of opportunities for starting an entrepreneurial venture in the place of residence, and 3) opinion about having the necessary skills and knowledge to start an entrepreneurial venture (perceived entrepreneurial ability) (GERA, 2018, pp. 29–30).

Questions of different types (dichotomy, multiple choice and Likert scale) were used, grouped into five groups: 1) demographic characteristics of respondents, 2) perception of respondents about entrepreneurial culture, 3) key entrepreneurial traits, 4) participation of respondents in entrepreneurial education and evaluation of their own level of formal entrepreneurial education, and 5) entrepre-

neurial characteristics of respondents as a reflection of their entrepreneurial spirit.

The research was conducted from December 2023 to February 2024 on a sample of teachers from educational institutions in central and eastern parts of Croatia. A total of 540 respondents participated, i.e., 168 teachers from primary schools, 220 from secondary schools, and 152 teachers from higher education institutions.

The results were processed using the SPSS program. For questions that, as in the GEM questionnaire, were dichotomous, and those that allowed multiple responses, the answers are presented as frequencies, while for questions measured on a five-point Likert scale with grades from 1 to 5, the results are presented as mean values. Correlation, the coefficient of determination and the t-test were used to determine the connection between formal entrepreneurial education and entrepreneurial awareness and between formal entrepreneurial education and the entrepreneurial spirit of teachers (Tables 7 and 8).

In the first part of the following section, the results are analyzed by educational institution level to gain a more detailed insight into the specificities of each group of teachers.

In the second part, when testing the link between formal entrepreneurial education and the variables of entrepreneurial awareness and spirit, the data was pooled to increase the statistical power and reliability of the results. Considering the entire sample enables a more reliable assessment of the relationship between education and key dimensions of entrepreneurial activity.

Emphasis is placed on formal entrepreneurial education since it is recognized as a key prerequisite for involving teachers in the implementation of entrepreneurship-focused teaching modules. Formal education is thus seen as a key predictor of teachers' engagement and as a starting point for understanding their perceptions and readiness to participate in entrepreneurial education.

4. Research results

Table 2 shows the demographic characteristics of respondents grouped according to the type of institution where they are employed (primary, secondary, and higher education institutions).

Table 2 Demographic characteristics of the respondents

N = 540	Educational institutions		
	Primary	Secondary	Higher
	N = 168 (31.11%)	N = 220 (40.74%)	N = 152 (28.15%)
Gender (in %)			
Male	35.72	43.63	52.63
Female	64.28	56.37	47.37
Age (in %)			
18–24	9.52	0.00	0.00
25–34	42.81	20.90	17.11
35–44	27.38	20.00	42.11
45–54	13.09	31.82	22.37
55–64	7.20	24.55	10.53
65–74	0.00	2.73	7.88
Educational level of the respondents (in %)			
High school	1.19	2.73	0.00
Undergraduate study	0.00	3.64	0.00
Graduate study	94.05	87.27	46.05
Master of Science	4.76	6.36	10.52
Doctor of Science	0.00	0.00	43.43

Source: Authors

Table 3 shows the respondents' perception of entrepreneurial culture in Croatia, as well as their views on its role in overall social progress and the role of entrepreneurial education in its development.

Table 3 Entrepreneurial awareness

	Educational institutions		
	Primary	Second.	Higher
	N = 168	N = 220	N = 152
3.1 Necessary factors for the development of entrepreneurial culture: (in %)			
a) Media	5.95	1.81	2.63
b) Education	60.72	63.63	47.37
c) Upbringing	23.81	22.75	36.84
d) Social recognition	8.33	5.45	7.89
e) All of the above	1.19	6.36	5.27
3.2 "Entrepreneurship is an attractive career." (Yes, in %)	15.47	22.73	38.16
3.3 "Entrepreneurs have status and respect in society." (Yes, in %)	14.28	18.18	17.10
3.4 "Successful entrepreneurial stories are featured in the media." (Yes, in %)	14.28	19.09	28.95
3.5 "It is easy to start a new business in Croatia." (Yes, in %)	10.72	13.64	14.47
3.6 "Entrepreneurial culture is a prerequisite for social progress."			
Mean (1–5 scale)	4.07	4.23	4.41
3.7 "Entrepreneurial education is a key prerequisite for the development of entrepreneurial culture."			
Mean (1–5 scale)	4.05	3.97	4.08

Source: Authors

Participants singled out education and upbringing as the most important factors for the development of entrepreneurial culture (3.1, Table 3). Respondents from higher education institutions give almost

equal importance to education (47.37%) and upbringing (36.84%), while respondents from elementary (60.71% vs. 23.81%) and secondary schools (63.63% vs. 22.75%) emphasize education more than upbringing.

The respondents' perceptions of the determinants of entrepreneurial culture in Croatia are shown in their responses to statements 3.2 to 3.5 (Table 3). This indicates that most respondents view Croatia's entrepreneurial culture as poorly developed, while teachers in higher education institutions have a somewhat more positive perception. However, although teachers in higher education institutions are more likely than others to consider entrepreneurship a good career choice (38.16%), only

14.47% agree that it is easy to start a new business in Croatia.

For statements 3.6 and 3.7 (Table 3), the respondents indicate their degree of agreement using a 1–5 Likert scale. Mean values (around 4 and above) indicate that the respondents largely agree with the statements. Again, the highest scores were given by respondents from higher education institutions.

Table 4 presents the results for the key entrepreneurial traits (4.1), the perceived role of entrepreneurship education for the development of entrepreneurial traits (4.2), and the respondents' engagement in development of entrepreneurial traits of their students (4.3).

Table 4 Perception of entrepreneurial traits

	Educational institutions		
	Primary	Secondary	Higher
	N = 168	N = 220	N = 152
4.1 Key entrepreneurial traits: (in %)			
a) Imagination	17.85	5.45	6.59
b) Creativity	21.43	11.82	18.42
c) Need for achievement	10.72	17.27	11.84
d) Boldness	16.67	19.10	25.00
e) Self-confidence	26.19	26.36	10.53
f) Acceptance of uncertainty	7.14	18.18	19.73
g) Feeling of control over events (internal locus of control)	0.00	1.82	7.89
4.2 "Entrepreneurial education is crucial for developing entrepreneurial traits."			
Mean (1–5 scale)	4.18	3.97	4.09
4.3 "Through my work, I encourage the development of entrepreneurial traits in the educational group where I teach."			
Mean (1–5 scale)	3.62	3.98	4.00

Source: Authors

The surveyed teachers evaluated the key entrepreneurial traits differently. For primary school teachers, the key qualities are self-confidence (26.19%) and creativity (21.43%), while for secondary school teachers, these are self-confidence (26.36%) and boldness (19.10%), whereas for higher education teachers, these qualities are boldness (25.00%) and acceptance of uncertainty (19.73%).

Respondents from all educational institutions largely agree that education plays a key role in the development of an individual's entrepreneurial qualities (4.2, Table 4). Ratings for personal en-

couragement of the development of entrepreneurial qualities in students increase with the level of the respondents' educational institution (4.3, Table 4).

Table 5 summarizes the results related to aspirations and involvement in entrepreneurial education, as well as respondents' assessment of their own level of formal entrepreneurial education. Special emphasis is placed on formal entrepreneurial education as a prerequisite for teachers' involvement in entrepreneurship-oriented teaching modules (5.6, Table 5).

Table 5 Involvement in entrepreneurial education

	Educational institutions		
	Primary	Second.	Higher
	N = 168	N = 220	N = 152
5.1 Involvement in entrepreneurial education (in %)	7.14	16.36	38.16
5.2 Desire to be involved in entrepreneurial education (in %)	80.95	71.82	78.95
5.3 Desired role in entrepreneurial education: (in %) (only respondents who expressed a desire to be involved)			
a) Participant	73.54	59.50	26.66
b) Educator	5.88	24.05	25.00
c) Participant and educator	20.58	16.45	48.34
5.4 Implementation of entrepreneurial education in the institution (in %)	7.14	14.54	52.63
5.5 Persons conducting entrepreneurial education: (in %) (only respondents from institutions where training is conducted)			
a) Teachers	83.33	87.50	97.50
b) Non-teaching staff	16.67	12.50	2.50
5.6 Estimated level of respondents' own formal entrepreneurial education			
Mean (1–5 scale)	1.42	2.63	3.81
5.7 "My institution cooperates with entrepreneurs."			
Mean (frequency: 1 = never; 5 = all the time)	2.24	2.87	3.38
5.8 "Technical education helps initiate entrepreneurial activity."			
Mean (1–5 scale)	3.53	3.62	3.82
5.9 "Technical education helps implement entrepreneurial activities."			
Mean (1–5 scale)	3.72	3.77	4.17

Source: Authors

The responses to question 5.1 (Table 5) indicate a very low level of involvement of respondents in the implementation of entrepreneurial education (only 7.14% from primary, 16.36% from secondary, and 38.16% from higher education). On the other hand, the high proportion of respondents across all institutions who expressed a desire to be involved in entrepreneurship education is encouraging (5.2, Table 5). Furthermore, a small proportion of primary (7.14%) and secondary schools (14.54%) implemented educational programs for entrepreneurship (5.4, Table 5), compared to slightly more than half of higher education institutions (52.63%). As for the

assessment of the level of personal formal entrepreneurial education (5.6, Table 5), the lowest mean score was recorded among primary school teachers (1.4), followed by secondary school teachers (2.6), while the highest was observed among higher education teachers (3.8).

Table 6 presents the responses regarding the determinants of entrepreneurial traits and entrepreneurial spirit through the GEM prism (6.1–6.6, Table 6), as well as the results related to the role of entrepreneurial education in entrepreneurial activity (6.7–6.10, Table 6).

Table 6 Entrepreneurial spirit

	Educational institutions		
	Primary	Second.	Higher
	N = 168	N = 220	N = 152
6.1 Do you personally know anyone who has started a business in the last 2 years? (Yes, in %)	67.86	79.09	89.47
6.2 Will there be good opportunities to start a business in the area where you live in the next 6 months? (Yes, in %)	19.05	23.63	40.79
6.3 Do you have the knowledge, skills, and experience needed to start your own business? (Yes, in %)	26.19	47.27	35.52
6.4 Would the fear of failure prevent you from starting your own business? (Yes, in %)	54.76	30.91	50.00
6.5 Are you planning, alone or with others, to start a new business in the next 3 years? (Yes, in %)	22.62	32.72	14.47
6.6 Have you done anything in the last 12 months to start a new business? (Yes, in %)	14.28	24.55	22.37
6.7 “Entrepreneurial education helps identify opportunities.”			
Mean (1–5 scale)	4.21	4.54	4.72
6.8 “Entrepreneurial education reduces the fear of failure.”			
Mean (1–5 scale)	3.51	3.22	3.63
6.9 “Entrepreneurial education increases the perceived ability to act as an entrepreneur.”			
Mean (1–5 scale)	3.24	2.91	4.23
6.10 “Entrepreneurial education affects the success of entrepreneurial ventures.”			
Mean (1–5 scale)	3.53	4.42	4.31

Source: Authors

The results related to the questions 6.1 and 6.2 (Table 6) indicate that teachers in higher education institutions tend to perceive entrepreneurial opportunities in their environment to a greater extent. However, it is interesting that secondary school teachers expressed the strongest intention to engage in entrepreneurial activities (6.3–6.6, Table 6). Finally, the responses related to the role of entrepreneurial education in entrepreneurial activ-

ity (6.7–6.10, Table 6) indicate the highest level of agreement among higher education teachers.

To examine the relationship between teachers’ formal entrepreneurial education and their entrepreneurial awareness, as well as between formal entrepreneurial education and entrepreneurial spirit, the correlation coefficient (*r*), the coefficient of determination (*r*²) and the t-test were calculated (Tables 7 and 8).

Table 7 Correlation between teachers’ entrepreneurial education and entrepreneurial awareness

	correlation (r)	(r ²)	t	t > 2.576 p < 0.01
(3.6) “Entrepreneurial culture is a prerequisite for social progress.”	0.999	0.998	298.03	strong
(5.7) “My institution cooperates with entrepreneurs.”	0.998	0.996	210.53	strong
(5.8) “Technical education helps initiate entrepreneurial activity.”	0.977	0.955	61.45	strong
(4.3) “Through my work, I encourage the development of entrepreneurial traits in the educational group where I teach.”	0.970	0.941	53.28	strong
(5.9) “Technical education helps implement entrepreneurial activities.”	0.912	0.832	29.69	strong
(4.2) “Entrepreneurial education is crucial for developing entrepreneurial traits.”	0.327	0.107	4.62	weak
(3.7) “Entrepreneurial education is a key prerequisite for the development of entrepreneurial culture.”	0.264	0.070	3.65	weak

Source: Authors

For five of the seven statements (Table 7), a strong positive correlation was observed between teachers' formal entrepreneurial education and their entre-

preneurial awareness (statements 3.6, 5.7, 5.8, 4.3, and 5.9), while a weak positive correlation was found for the remaining two statements (4.2 and 3.7).

Table 8 Correlation between teachers' entrepreneurial education and entrepreneurial spirit

	correlation (r)	(r ²)	t	t > 2.576 p < 0.01
(6.7) "Entrepreneurial education helps identify opportunities."	0.993	0.986	111.97	strong
(6.10) "Entrepreneurial education affects the success of entrepreneurial ventures."	0.811	0.658	18.50	strong
(6.9) "Entrepreneurial education increases the perceived ability to act as an entrepreneur."	0.735	0.540	14.46	moderate
(6.8) "Entrepreneurial education reduces the fear of failure."	0.240	0.058	3.30	weak

Source: Authors

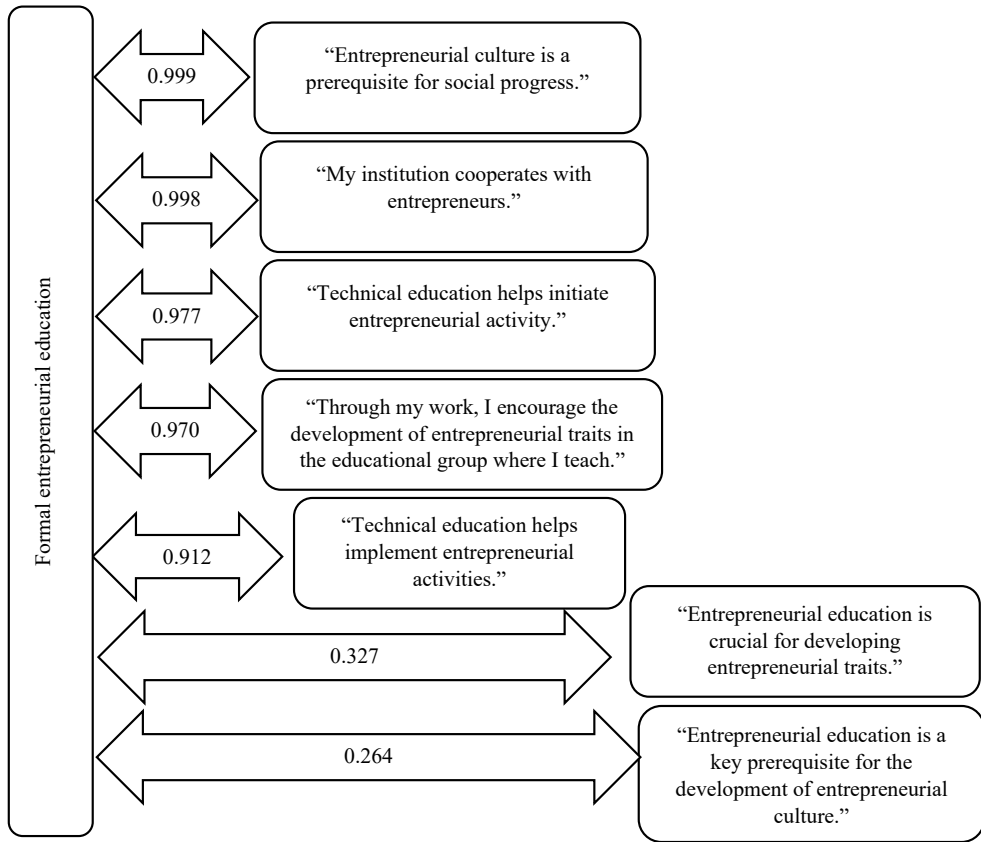
For two of the four statements (Table 8), a strong positive correlation was observed between teachers' formal entrepreneurial education and entrepreneurial spirit (statements 6.7 and 6.10), while the remaining two statements showed a moderate positive correlation (6.9) and a weak positive correlation (6.8), respectively.

The results presented indicate varying degrees of correlation between teachers' formal entrepreneurial education and individual statements reflecting their entrepreneurial awareness and spirit. Strong correlations ($r > 0.8$) confirm a strong connection between formal entrepreneurial education and variables reflecting entrepreneurial awareness and spirit, which indicates that education has a real and

measurable impact on teachers' perceptions and actions. Moderate correlations ($0.5 < r < 0.8$) show a partial but significant impact, while weak correlations ($r < 0.3$) suggest that other factors outside the educational process also influence certain teachers' attitudes. All established connections proved to be statistically significant ($p < 0.01$), which further confirms the reliability of the findings.

Graph 2 presents a conceptual model of the relationship between teachers' formal entrepreneurial education and their entrepreneurial awareness, while Graph 3 illustrates the relationship between formal entrepreneurial education and the entrepreneurial spirit of teachers in Croatia.

Graph 2 Correlation between entrepreneurial education and entrepreneurial awareness of teachers in Croatia

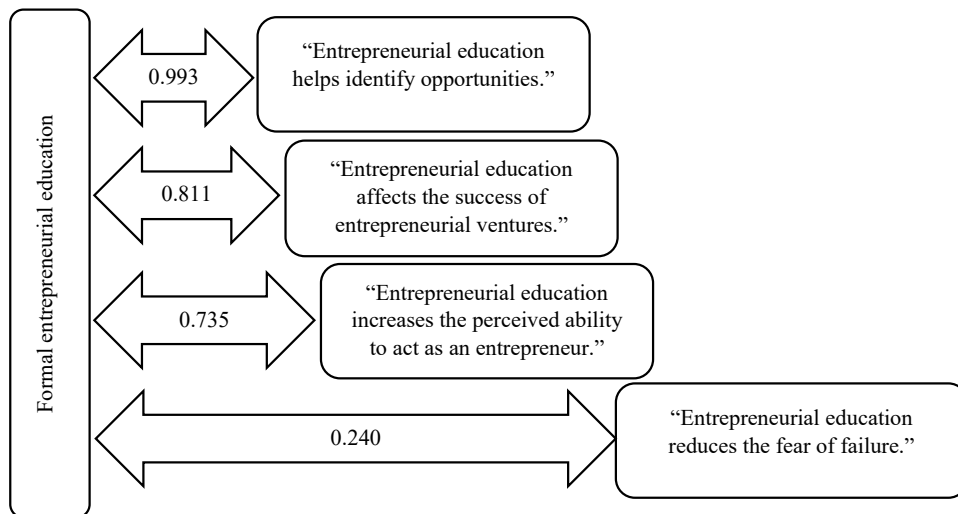


Source: Authors

Graphs 2 and 3 summarize all findings since the analysis was focused on examining the relationship between the estimated level of one's own formal entrepreneurial education (statement 5.6, Table 5) and other statements related to teachers' entrepreneurial awareness and spirit. This allows for a clearer and more comprehensive insight into the relationships between variables and a clearer obser-

vation of patterns of connection. Separate presentations were conducted for each group of educational institutions (primary, secondary, and higher education) in the descriptive analysis, while in this step the aim was to synthesize the data to highlight the general connection between formal education and the key constructs of the GEM framework.

Graph 3 Correlation between entrepreneurial education and the entrepreneurial spirit of teachers in Croatia



Source: Authors

All relationships shown in the graphs are based on correlations and were tested using standard statistical procedures. The correlations obtained were found to be statistically significant at the $p < 0.01$ level, which means that the results are reliable and can be considered a relevant indicator of the relationship between formal entrepreneurial education and other variables. High values of the correlation coefficients ($r > 0.8$ in most statements) indicate a strong connection, while weaker correlations ($r < 0.3$) are also significant, but indicate that these attitudes are also influenced by other factors outside of formal entrepreneurial education.

4.1 Discussion of the results

The results of the conducted research indicate a strong positive connection between formal entrepreneurial education and the following determinants of teachers' entrepreneurial awareness: entrepreneurial culture as a prerequisite for social progress, cooperation between educational institutions and entrepreneurs, technical education that helps initiate entrepreneurial activity, engagement of teachers who encourage the development of entrepreneurship among students, and technical education that helps implement entrepreneurial activities (Graph 2). At the same time, a weak positive connection was observed between formal entrepreneurial education and the assertion that

entrepreneurial education is crucial for developing entrepreneurial traits, and that entrepreneurial education is a key prerequisite for the development of entrepreneurial culture (Graph 2).

Graph 3 indicates a strong positive connection between formal entrepreneurial education and the attitude that entrepreneurial education helps recognize opportunities, and that it also affects the success of an entrepreneurial venture. A medium-strong positive correlation was established between formal entrepreneurial education and the claim that entrepreneurial education increases the perceived ability to act as an entrepreneur, while a weak positive correlation was established between formal entrepreneurial education and the claim that entrepreneurial education reduces the fear of failure. The latter is understandable, given that a higher level of entrepreneurial knowledge also increases awareness of environmental threats and thus fosters greater caution in entrepreneurial activity.

Although it could be assumed from the GEM research results that entrepreneurial education is positively related to the determinants of entrepreneurial awareness and entrepreneurial spirit, the results of the research conducted among teachers in Croatia largely confirmed this, although not entirely. Namely, a weak connection between teachers' formal entrepreneurial education and the attitude that entrepreneurial education is a key prerequisite

for the development of entrepreneurial culture is surprising, since GEM research has proven that an appropriate entrepreneurial culture and an entrepreneurially oriented education system contribute to the recognition of opportunities in the environment and greater entrepreneurial aspirations and expectations among entrepreneurially oriented individuals.

“Teachers, regardless of prior formal entrepreneurial education, do not perceive entrepreneurial education as a key prerequisite for developing an entrepreneurial culture.” This finding can also reflect a weak entrepreneurial culture within the entire Croatian society, which does not pay adequate attention to entrepreneurial education.

Based on the research results presented, the answers to the research questions are as follows:

RQ1: What is the entrepreneurial awareness of teachers in Croatia?

According to the GEM research, society’s perception of entrepreneurship, i.e., entrepreneurial culture, is assessed by examining opinions on 1) entrepreneurship as a good career choice, 2) social status of successful entrepreneurs, and 3) media attention focused on entrepreneurship (GERA, 2018, pp. 21–23).

A minority of respondents believe that entrepreneurship is an attractive career choice (3.2, Table 3), a view shared by 38.16% of higher education teachers and only 15.47% of primary school teachers. A similar ratio of responses is also observed for the statement that successful entrepreneurial stories are represented in the media (3.4, Table 3). Regarding the social status of entrepreneurs (3.3, Table 3), less than 15% of primary school teachers and less than 19% of secondary school and higher education teachers agree that entrepreneurs have a good reputation in society. This points to teachers’ perception of a weak entrepreneurial culture in Croatia. Furthermore, respondents from all educational institutions largely agree (a score around 4 on a 1–5 scale) that entrepreneurial culture is a prerequisite for social progress (3.6, Table 3), as well as that entrepreneurial education is a key prerequisite for the development of entrepreneurial culture (3.7, Table 3), which indicates the existence of entrepreneurial awareness among teachers (and it increases with the level of the educational institution they come from).

RQ2: What is the entrepreneurial spirit of teachers in Croatia?

The assessment of entrepreneurial spirit also provides an insight into the potential for entrepreneurial activity. This examines: 1) knowledge of entrepreneurially active individuals, 2) recognition of opportunities for starting an entrepreneurial venture in the place of residence, and 3) opinion about having the necessary skills and knowledge to start an entrepreneurial venture (perceived entrepreneurial ability). Determinants of entrepreneurial spirit are also determinants of entrepreneurial potential, whereby the fear of failure that can prevent individuals from starting business ventures is also assessed (GERA, 2018, pp. 29–30).

Among the respondents, entrepreneurial characteristics and entrepreneurial spirit can be observed, with both being more pronounced among teachers in secondary schools and higher education institutions (6.1–6.3, Table 6). The highest entrepreneurial potential was observed among secondary school teachers, who showed the highest degree of confidence in their own knowledge needed to start an entrepreneurial venture, the least fear of failure, as well as the highest level of readiness to start their own entrepreneurial venture (6.3–6.6, Table 6).

RQ3: Is there a significant relationship between the level of formal entrepreneurial education of teachers and their entrepreneurial awareness?

Graph 2 provides a systematic overview of the relationship between the estimated level of teachers’ own formal entrepreneurial education and other entrepreneurial awareness variables. All correlations shown are statistically significant ($p < 0.01$), with strong correlations indicating a strong influence of education, while weaker correlations indicate that additional factors are also at play. The strongest correlations were observed for statements related to entrepreneurial culture as a prerequisite for social progress, cooperation with entrepreneurs, and the role of technical education in initiating and implementing entrepreneurial activity. Such results confirm the GEM research findings, which highlight the importance of entrepreneurial education for strengthening awareness at the individual and institutional levels (Singer et al., 2022; GERA, 2023). On the other hand, weaker correlations for statements such as “entrepreneurial education is a key prerequisite for the development of an entrepreneurial culture” indicate that entrepreneurial

awareness also arises from a broader social and cultural context, and not only from formal education.

RQ4: Is there a significant relationship between formal entrepreneurial education of teachers and their entrepreneurial spirit?

Graph 3 systematically presents the correlations between the estimated level of teachers' own formal entrepreneurial education and other entrepreneurial spirit variables. All correlations shown are statistically significant ($p < 0.01$), with strong correlations confirming the pronounced influence of formal entrepreneurial education, and weaker ones confirming the presence of influence of other factors. The strongest links were observed in the recognition of entrepreneurial opportunities and the assessment that formal entrepreneurial education influences the success of entrepreneurial ventures, which is in line with previous findings that entrepreneurial knowledge reduces uncertainty and encourages proactive behavior (Levie & Autio, 2008; Lackeus, 2015). A moderate connection was found in the assessment of teachers' own ability to act as an entrepreneur, while the weakest correlation was observed in the statement that education reduces the fear of failure, which indicates that individual characteristics and the environment also play an important role. Overall, the results show that formal entrepreneurial education systematically contributes to the development of the entrepreneurial spirit, but that this influence is conditioned by personal attitudes and broader social circumstances.

4.2 Practical implications

The research results have important practical implications for the education system and the design of educational policies in Croatia.

First, a strong connection between formal entrepreneurial education and the development of entrepreneurial awareness and spirit among teachers was observed, which indicates the need for systematic integration of entrepreneurial education into all levels of education. By introducing mandatory entrepreneurial education modules into curricula, it is possible to encourage not only the development of entrepreneurial competencies among teachers, but also to increase their engagement in transferring this knowledge and skills to students.

Second, the finding that teachers express a strong desire to engage in entrepreneurship education, although they simultaneously assess their level of

formal education as low, indicates a gap between desired and actual competencies. This gap suggests a need for professional development programs for teachers to ensure their adequate preparation for implementing entrepreneurial content in practice.

Third, the results indicate that teachers from different levels of educational institutions have different priorities and perceptions of entrepreneurial competences. Therefore, it is necessary to develop differentiated approaches: in primary and secondary schools, greater emphasis should be placed on developing students' creativity, self-confidence and courage, while in higher education, stronger connections between teachers and the business sector with more real cases in the courses are necessary.

Finally, the research confirms that formal entrepreneurial education acts as a key predictor of teachers' entrepreneurial awareness and spirit. This finding has broader implications for educational policy: investing in systematic teacher education in entrepreneurship can, in the long term, lead to a stronger entrepreneurial culture in society, increased innovation, and greater development potential of the national economy.

5. Conclusion

Entrepreneurship is more dynamic in a society that has a built-in entrepreneurial culture, in which entrepreneurial education is represented at all levels of education, and in which emphasis is placed on the development of entrepreneurial traits and characteristics. The aim of the paper was to investigate the entrepreneurial awareness and spirit of teachers in Croatia, as the bearer of entrepreneurial activity and implementer of entrepreneurial education, as well as the connection between teachers' formal entrepreneurial education and their entrepreneurial awareness and spirit.

Entrepreneurial culture reflects society's awareness of entrepreneurship and influences the entrepreneurial spirit of that community. Developing societal awareness of the importance of entrepreneurship and fostering an entrepreneurial spirit are key to launching new ventures in turbulent and challenging circumstances. Entrepreneurial education has a positive effect on the formation of an entrepreneurial spirit and positive attitudes about entrepreneurship in society (entrepreneurial awareness), i.e., it makes it easier for individuals recognizing and exploiting opportunities in the environment,

as well as starting and managing entrepreneurial ventures.

The respondents' answers confirmed the negative image and perception of entrepreneurship in Croatian society. Respondents from all educational institutions perceive entrepreneurial opportunities in the environment, but teachers from middle-level educational institutions expressed the greatest intention for entrepreneurial activity, less fear of failure, as well as a greater perception of self-efficacy (possessing the necessary knowledge, skills and experience to start an entrepreneurial venture). Secondary school teachers showed the highest level of entrepreneurial spirit; therefore, it is recommended that their perceived entrepreneurial potential be channeled into the implementation of entrepreneurial educational programs.

The results indicated a desire among teachers at all educational levels to be involved in entrepreneurial education, both as educators and as learners. The observed potential should be used through appropriate government programs and policies to introduce entrepreneurial education programs at all levels of education, which includes learning about entrepreneurship but also fosters entrepreneurial awareness and spirit by both learning for entrepreneurship and learning through entrepreneurship.

Practical implications of the research point to several important directions. First, the importance of including entrepreneurship education modules at all educational levels is highlighted by a strong positive correlation between formal entrepreneurship education and entrepreneurial awareness and spir-

it. Second, the necessity of targeted training programs and continuous professional development highlights the discrepancy between the relatively low assessment of teachers' own formal education and their desire to engage in entrepreneurship education. Third, differentiated approaches are needed: in primary and secondary school education, the emphasis should be on creativity, self-confidence, and courage, while in higher education, it is important to establish stronger links with the business sector and examples from business practice. These results offer policymakers a clear direction: expanding formal entrepreneurship education for teachers is a long-term investment that can positively impact the national economy and the entrepreneurial ethos of society.

Limitations arise from the type and size of the sample used. The results should be considered indicative, not representative, since the research was conducted on a convenient sample of teachers from central and eastern Croatia.

Future research should be conducted on a representative sample of teachers from all regions of Croatia, and through continuous monitoring of teachers' entrepreneurial awareness and spirit. In addition, it would be useful to conduct comparative studies of the entrepreneurial orientation of teachers in Croatia and other EU member states, with a particular emphasis on the ways in which systematic professional development in entrepreneurship can promote the entrepreneurial culture of both students and teachers.

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SELF-DISCLOSURE, SELF-ESTEEM, AND BODY POSITIVITY AMONG INSTAGRAM INFLUENCERS AND USERS

ABSTRACT

Purpose: This paper explores the relationship between self-disclosure, self-esteem, and exposure to body-positive content among Instagram users following influencers. It aims to examine evolving beauty standards and emphasises the impact of social perception on individual self-esteem and identity formation. It considers the emergence of the #bodypositivity movement as a reaction to unrealistic beauty ideals propagated on social media and stresses its role in promoting inclusivity.

Methodology: A structured questionnaire was used to collect data from 218 Instagram users. The study used Partial Least Squares Structural Equation Modelling (PLS-SEM) to analyse the data and assess the relationships between the variables.

Results: The results show that the constructs Polarity and Intent have a significant and positive impact on Self-esteem. Self-esteem has a significant and positive relationship with Body-positive content.

Conclusion: This research underscores the importance of body-positive content on social media in challenging traditional beauty standards and promoting inclusivity. Positive self-disclosure emerges as a critical factor in boosting self-esteem and advocating body-positive narratives. The findings suggest that self-esteem is positively influenced when individuals disclose in a positive, intentional, and authentic manner, but too much disclosure or overly personal sharing may harm self-esteem. The study offers valuable insights for influencers, marketers, and researchers into fostering healthier self-perception through social media. Limitations are acknowledged, and recommendations for future research are provided.

Keywords: Self-disclosure, self-esteem, body positivity, Instagram

1. Introduction

Instagram is the preferred social media for users interested in travel, entertainment, fashion (Eggerstedt et al., 2020), and beauty (Koetz, 2019; Duffy & Hund, 2015; Raun & Christensen-Strynø, 2022). Instagram celebrities, e.g., influencers, are the ones with large networks of followers and represent a

trusted source of information for followers (De Veirman et al., 2016); they are labelled as the Instagram famous (Abidin, 2016; Dewey, 2014).

Beauty standards are always important, even if they are not identical in different cultures (Chua & Chang, 2016). Perception of a person's beauty can influence other people's judgments of their

personality (Eggerstedt et al., 2020), resulting in higher salaries (Pilgrim & Bohnet-Joschko, 2019), and presentation of life success (Ando et al., 2021). Even in the educational system, research showed that prettier children enjoyed priority treatment by teachers (Jacobson et al., 2020).

Over time, ethical standards (Abidin, 2016), media responsibility (Khan et al., 2020), and regulation (Grbavac & Grbavac, 2014) on social media have become more pivotal, as the growing importance and role of social media have led to increased use of a variety of tools on social media to enhance ideals of body perfection. Beauty standards, especially those related to the body, are highlighted on Instagram, a platform devoted to the visual presentation of ideal bodies, resulting in the ever-growing use of various tools aimed at creating the impression of perfect bodies, which are, in fact, unrealistic (Cohen et al., 2019; Makarim et al., 2020) and predominantly shaped by digital platforms, e.g., Instagram (Marengo et al., 2018; Cohen et al., 2019). Since such an idealistic approach seems to be stressful for the female population, the key questions refer to the ethics of false presentation or even the need to have only one presentation of female beauty. The #body-positivity movement (Cohen et al., 2019) emerged as a counterpoint to the ideal of body perfection, promoting acceptance and appreciation of imperfection as a unique form of female beauty. The body positivity movement intersects with self-esteem by challenging narrow beauty standards and promoting acceptance of diverse body types, fostering a more inclusive and affirming environment for individuals to develop healthier self-esteem (Orth & Robins, 2014). Self-esteem refers to a person's subjective overall assessment of their own worth and performance, and encompasses a person's beliefs, feelings, and attitudes towards themselves, including their abilities, appearance, and characteristics (Kourakou et al., 2021; Gözütok et al., 2024).

Self-disclosure has been widely studied since the 1970s, both as a personal choice to share private information and as part of parent-child relationships (Tilton-Weaver et al., 2014). According to self-presentation theory (Goffman, 1978), people try to shape how others see them, especially on social media. This is part of a larger process called impression management (Krämer & Winter, 2008). With the rise of the internet and social media, self-disclosure has become increasingly important. Online, self-presentation helps form a social identity, and self-disclosure plays a key role in that process. Often, people's behaviour on social media is driven

by the desire to present themselves in a certain way or by the influence of key online figures.

Recent research findings reveal that increased social media usage and social media influencers are not damaging young women's image and self-esteem (Eagan, 2022). Also, LoweCalverley and Grieve (2021) found that individuals who viewed influencer posts experienced greater negative mood and body dissatisfaction compared to those who did not. Similarly, exposure to such content does not increase exercise behaviour but is associated with worsened mood and greater body dissatisfaction (Prichard et al., 2020). Prior studies have examined self-esteem and body positivity separately, but there is limited empirical research on how these constructs interact with self-disclosure in the context of social media (Vogel et al., 2014; Robinson, 2021). This study addresses this gap by examining how the authenticity and intentionality of self-disclosure impact self-esteem, and how self-esteem, in turn, influences engagement with body-positive content. The main objective is to understand these interrelationships in the Instagram environment, where idealised and digitally altered images are prevalent (Tiggemann & McGill, 2004; Thompson, 2018). By focusing on social media influences rather than historical beauty practices, this research contributes to a clearer understanding of how digital self-presentation affects psychological well-being and perceptions of beauty in contemporary youth culture.

Based on the background, the central research questions were reformulated into the following objectives: to examine how the different dimensions of self-disclosure on Instagram (e.g., amount, polarity, accuracy, and intent) affect users' self-esteem, to analyse how self-esteem affects users' engagement with body-positive content on Instagram, to explore the relationship between self-disclosure, self-esteem, and body positivity in the context of Instagram use, to investigate how Instagram, as a visually driven and socially influential platform, influences users' self-perception and body image, and to study how psychological and behavioural mechanisms related to self-disclosure and self-esteem interact in shaping body image perceptions on social media.

2. Literature review and hypotheses development

2.1 Self-disclosure and self-esteem

Self-disclosure on social media involves sharing personal information through various forms of on-

line communication, including posts, comments, stories, and videos. It is characterised by the degree and depth of personal information an individual chooses to reveal to others (Sprecher et al., 2013). On platforms like Instagram, self-disclosure is particularly prominent, often reflecting individuals' emotions, experiences, and internal states as part of their broader digital identity.

This study adopts Wheeless and Grotz's (1976) framework for measuring self-disclosure, which includes four key dimensions: 1) Amount and depth, which refers to how much personal information is shared and the intimacy level of that content, 2) Polarity (valence), which involves the emotional tone or valence of disclosure, particularly the tendency to present oneself positively, 3) Accuracy, which measures how truthful or honest individuals perceive their self-disclosures to be, and 4) Intent, which reflects the level of awareness and purpose behind one's self-disclosure on social media (Jacobson et al., 2020; Lai & Yang, 2015). These dimensions allow for a nuanced understanding of how individuals manage and present their identities and self-presentation on social media.

Prior research supports the significance of self-disclosure in digital environments. For example, Lai and Yang (2015) found a positive correlation between self-disclosure and interpersonal popularity on micro-blogging platforms. Jacobson et al. (2020) noted that the visibility of users' self-disclosure also benefits marketers, suggesting that sharing personal content can create value in both social and commercial contexts. Furthermore, Zhao et al. (2016) linked the usefulness of content, alongside perceived value and user identification, to increased self-disclosure. This aligns with earlier findings in organisational research, where Sussman and Siegal (2003) highlighted usefulness as a critical factor influencing the acceptance of information or advice.

According to recent findings, valence and honesty in self-disclosure are positively associated with psychological well-being, while the quantity of disclosure is not significantly related (Chu et al., 2022). Thus, the quality and intentionality of self-disclosure, rather than its frequency, drive positive psychosocial outcomes. These findings also confirm the multidimensionality of self-disclosure, aligning with Wheeless's framework used in this study (Wheeless & Grotz, 1976). On the other hand, intimate self-disclosure among social media influencers enhances parasocial relationships and purchase intentions when there is self-congruence between influencers and their followers. This indicates

that authenticity and relatability in self-disclosure strengthen social bonds and persuasive effects, elements also critical to self-esteem and body-positivity processes (Koay et al., 2023). Haywood et al. (2025) provide evidence from adolescent samples showing that authenticity, trustworthiness, and self-disclosure about mental health are perceived as key factors in making influencers credible and helpful in mental health interventions. Adolescent audiences interpret influencer self-disclosure as both a source of relatability and therapeutic modelling, reinforcing the social validation pathway theorised by Chu et al. (2022).

Building on this foundation, this study proposes that higher levels of meaningful self-disclosure on Instagram may be associated with increased self-esteem. This assumption is grounded in the idea that engaging actively and authentically on social media platforms can enhance self-confidence through greater opportunities for self-expression, social validation, and identity exploration. Users who frequently post, interact, and reflect on their experiences may, over time, develop a more positive self-image and higher perceived self-worth.

Based on the above theoretical considerations, the following hypotheses are proposed:

H1a: Amount and depth are positively related to perceived self-esteem.

H1b: Polarity is positively related to perceived self-esteem.

H1c: Accuracy is positively related to perceived self-esteem.

H1d: Intent is positively related to perceived self-esteem.

2.2 Self-esteem and body positivity

Low self-esteem affects more than 50% of teenagers, often driven by unrealistic beauty standards that idealise traits such as thinness, long eyelashes, smooth skin, and light complexion (Dara, 2018). These rigid beauty standards can contribute to negative self-perception, especially among adolescents navigating identity development in a visually focused digital environment like Instagram.

One of the most widely used tools for measuring self-esteem is Rosenberg's Self-Esteem Scale (RSES), developed by Rosenberg (1965), recently used for correlations between self-esteem and online behaviour (Cohen et al., 2021). This scale is grounded in a two-dimensional model that evaluates both self-worth and self-competence. For ex-

ample, Miller et al. (2010) applied this framework in educational contexts, while Kielkiewicz et al. (2020) used a self-esteem-positive vs. self-esteem-negative framework to explore the influence of spirituality on self-esteem. These findings reinforce the multi-dimensional nature of self-esteem and its susceptibility to a range of social and psychological factors. Over time, the RSES has demonstrated strong cross-cultural validity and has been successfully adapted and translated for use in various countries and demographic groups, including children and adults in Greece (Kourakou et al., 2021), Turkey (Gözütok et al., 2024), and other contexts (Monteiro et al., 2022).

Another closely related concept is body image, which refers to an individual's subjective perception of their own body, often shaped by societal and media ideals. This perception frequently emphasises thinness or a "perfect" weight as the standard (Mills et al., 2017; Samosir, 2015). Distorted body image has been linked to negative mental health outcomes, including depression and eating disorders (O'Keeffe et al., 2011).

In response to these issues, the body positivity movement emerged, originally rooted in the Fat Acceptance movement of the late 1960s and later formalised through platforms like *bodypositive.org* in the 1990s (Chrisler, 2015). Since 2012, the movement has promoted the belief that everyone—regardless of body size, shape, race, gender, or ability—deserves to feel positively about their

body (Lazuka et al., 2020). As outlined by Cohen et al. (2021), the core goals of body positivity include challenging socially constructed ideals, promoting acceptance of all body types, and fostering self-confidence without judgment.

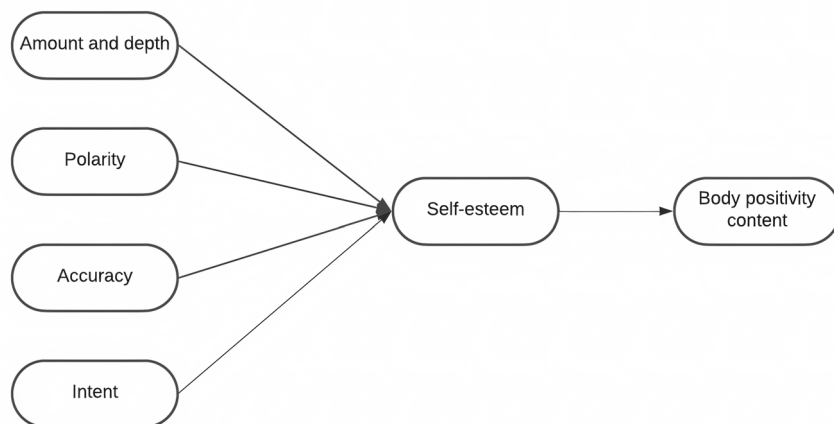
Social media, particularly Instagram, has become a central space for promoting body-positive messages. Prior research shows that engagement with body-positive content can positively influence self-esteem by fostering a sense of inclusion and self-acceptance (Spears & Singh, 2004; Zhao et al., 2016). Users who interact with such content may find reassurance, inspiration, or community, which can enhance their satisfaction with their own body image and their overall sense of self-worth. Bi and Zhang (2023) demonstrated that *parasocial relationships* and *influencer credibility* mediate followers' purchase intentions, while *self-esteem* moderates these effects. Lower self-esteem increases reliance on influencer cues, reflecting the psychological compensatory processes that may also manifest in body image dynamics.

Based on the reviewed literature and the observed relationship between social media use, self-esteem, and body image, the following hypothesis is proposed:

H2: Self-esteem is positively related to body-positive content.

Based on the hypotheses developed above, the conceptual model of the study is shown in Figure 1.

Figure 1 Conceptual model of the study



Source: Authors

3. Methodology

To test the formulated hypotheses, an empirical study was conducted using survey methodology. A self-administered structured questionnaire served as the measuring instrument. The relevant literature was used in the construction of the measurement instrument, whereby the questions were tailored to the requirements of this study. The questions in the questionnaire are mainly of a structured type, and the funnel principle was used, starting with general questions about the amount of use of social networks and knowledge of the body positivity movement, and ending with questions to measure the perception of the individual's emotional state and to collect socio-demographic data. The questionnaire is divided into four groups and follows the funnel principle. A 5-point Likert scale was utilised, with response options ranging from 1 ("not important at all/strongly disagree") to 5 ("very important/strongly agree"). The participants rated their level of agreement with the questionnaire items. The construct of self-disclosure is observed through the four key dimensions—Amount and depth, Polarity, Accuracy, and Intent—developed by Wheless and Grotz (1976) and later used by Lai and Yang (2015) and Jacobson et al. (2020) for social media self-disclosure surveys. Self-esteem was examined based on the adopted Rosenberg (1965) scale. Spears and Singh (2004) developed a body positivity construct related to fashion influencers, which was adopted for this survey in the context of beauty body positivity.

The survey was conducted as a Google online survey, exclusively on social networks, from March to June 2022. The sample was obtained through non-probability convenience sampling via Instagram. This approach was chosen due to the targeted nature of the research, i.e., active Instagram users familiar with body positivity discourse. In a screening question, respondents were asked whether they had an active Instagram account. Following the correction of inaccuracies and the exclusion of missing data, a total of 218 fully completed questionnaires were obtained and included in the subsequent analysis.

The collected data were analysed using PLS-SEM as it effectively identifies relationships between theoretical constructs in small samples and facilitates the analysis of complex models with numerous manifest variables and theoretical constructs. Furthermore, as a non-parametric method, PLS-SEM does not impose any special requirements on the distribution of the manifest variables. The choice of PLS-SEM over CB-SEM is justified by both the characteristics of the data and the research objec-

tives. PLS-SEM is particularly suitable for studies with relatively small to medium sample sizes, complex models with multiple constructs and indicators, and data that may not conform to multivariate normality (Hair et al., 2019). Unlike CB-SEM, which emphasises theory testing and requires larger samples, PLS-SEM is prediction-oriented and allows robust estimation in exploratory contexts such as the present study. The adequacy of the sample size was assessed following the "10 times rule" (Barclay et al., 1995), which recommends a minimum of ten observations per indicator or per maximum structural path pointing to a construct. In our model, the largest number of paths is four, suggesting a minimum of 40 cases, which our sample of 218 comfortably exceeds. A post-hoc power analysis using G*Power also confirmed that the study achieved sufficient statistical power ($\beta > 0.80$) to detect medium effect sizes. Participation was voluntary and uncompensated. To reduce potential nonresponse bias, incomplete responses were excluded, and comparisons between early and late respondents revealed no significant differences.

Out of a total of 218 respondents, 79.82% were women, and 20.18% were men. Most of the respondents (51.38%) belonged to the 18–25 age group. Other respondents were in the age groups 14–18 (2.75%), 26–35 (11.93%), 36–45 (10.09%), 46–55 (19.27%), 56–65 (2.75%), and 66 and over (1.38%). The most represented level of education was graduate study (40.37% of respondents). The remaining respondents were distributed as follows: elementary school (1.83%), postgraduate studies (MSc, MBA, PhD) (5.96%), undergraduate studies and higher professional education (33.49%), and high school (18.35%). In terms of employment status, most respondents were students and full-time employees, accounting for 44.95% and 43.12% of the respondents, respectively.

4. Results

All variables were checked for outliers, and none were found. A two-step analytical approach was used to test the hypotheses. In the first step, the reliability, internal consistency, and convergent validity of the measurement scales were evaluated. In the second step, the research model was evaluated.

4.1 Measurement model results

The research model is evaluated through an analysis of convergent validity (factor loadings and average variance extracted, AVE), internal consistency (Cronbach's alpha and composite reliability), and discriminant validity (Heterotrait-Monotrait ratio, HTMT).

Table 1 Outer model evaluation

Code of constructs/variables	Outer loadings	Cronbach's alpha	Composite reliability	AVE
Amount and depth		0.852	0.883	0.604
I usually talk about myself on social media for extended periods.	0.822			
I often discuss my feelings about myself on social media.	0.890			
I often express my personal beliefs and opinions on social media.	0.640			
I typically reveal information about myself on social media without intending to do so.	0.710			
I often disclose intimate, personal information about myself on social media without hesitation.	0.798			
Polarity		0.857	0.883	0.719
I usually disclose positive information about myself on social media.	0.806			
I normally express positive feelings about myself on social media.	0.761			
Overall, my self-disclosures on social media are more positive than negative.	0.963			
Accuracy		0.934	0.945	0.813
Overall, my self-disclosures on social media are more positive than negative.	0.909			
My self-disclosures on social media are completely accurate reflections of who I really am.	0.927			
My self-disclosures on social media can accurately reflect my own feelings, emotions, and experiences.	0.884			
My statements about my own feelings, emotions, and experiences on social media are always accurate selfperceptions.	0.885			
Intent		0.910	0.943	0.848
When I express my personal feelings on social media, I am always aware of what I am doing and saying.	0.945			
When I reveal my feelings about myself on social media, I consciously intend to do so.	0.870			
When I self-disclose on social media, I am consciously aware of what I am revealing.	0.945			
Self-esteem		0.888	0.917	0.690
Overall, I am satisfied with myself.	0.808			
I feel that I have a number of good qualities.	0.763			
I feel I do not have much to be proud of.	0.862			
I wish I thought more highly of myself.	0.879			
I take a positive attitude towards myself.	0.837			
Body positivity		0.960	0.965	0.755
Body-positive content is a significant part of my life.	0.860			
I am very interested in body-positive content.	0.817			
Body-positive content is an important part of my life.	0.873			
I am very much involved in/with bodypositive content.	0.880			

Code of constructs/variables	Outer loadings	Cronbach's alpha	Composite reliability	AVE
I pay a lot of attention to body-positive content.	0.892			
Making purchase decisions for bodypositive content is significant to me.	0.894			
I think a lot about my choices when it comes to body-positive content.	0.872			
I attach great importance to bodypositive content purchases.	0.871			
I feel a sense of personal satisfaction when I follow body-positive influencers.	0.861			

Source: Authors

Table 1 presents values that indicate satisfactory levels for all metric attributes. Five indicator variables from the Self-esteem construct, with outer loadings less than 0.4, were eliminated from further analysis. Manifest variables have outer factor loadings ranging from 0.713 to 0.965 and were all retained for further analysis (Hair et al., 2019).

The indicator variable AMOD3 with an outer loading of 0.640 (ranging between 0.4 and 0.7) was retained because the values for the composite reliability (CR) and the Cronbach's alpha coefficient exceeded the recommended threshold of 0.7. In addition, the average variance extracted (AVE) for

the indicators was above 0.5, and removing this variable would not significantly improve the values of these coefficients (Nunnally & Bernstein, 1994; Hair et al., 2019).

Both Cronbach's alpha and CR coefficients above 0.75 indicate satisfactory internal consistency across all factors (Nunnally & Bernstein, 1994). In addition, the AVE values are above the required minimum threshold of 0.5, confirming that the constructs explain more than half of the variance in their associated indicators (Malhotra, 2010).

The discriminant validity was assessed using the Heterotrait-Monotrait ratio (HTMT), presented in Table 2.

Table 2 Heterotrait-Monotrait ratio

	Accuracy	Amount and depth	Body positivity	Intent	Polarity
Amount and depth	0.464				
Body positivity	0.319	0.365			
Intent	0.581	0.143	0.192		
Polarity	0.680	0.674	0.446	0.540	
Self-esteem	0.170	0.160	0.193	0.346	0.158

Source: Authors

The values of the Heterotrait-Monotrait ratio (HTMT) ranged from 0.143 to 0.680 and were therefore well below the recommended thresh-

old value of 0.9. This shows that the measurement model successfully demonstrates discriminant validity.

Table 3 Variance inflation factor inner model matrix

	Accuracy	Amount and depth	Body positivity	Intent	Polarity	Self-esteem
Accuracy						1.969
Amount and depth						1.363
Body positivity						
Intent						1.673
Polarity						2.212
Self-esteem			1.000			

Source: Authors

Table 3 presents the results of the variance inflation factors (VIF), which indicate that all the values are below 5, with the highest being 2.212, so no multicollinearity is detected. This result indicates that common method variance is not a concern in our model and supports the discriminant validity and reliability of the constructs.

4.2 Hypotheses testing

A bootstrapping procedure with 5,000 subsamples was employed to test the hypotheses. The coefficient of determination (R^2) revealed that the endogenous variable Self-esteem is moderately explained by the exogenous variables Amount, Depth, Accuracy, Body Intent, and Polarity, accounting for 14.6% of its variance. Meanwhile, the endogenous

variable Body Positivity is weakly explained by the exogenous variables, accounting for only 2.9% of its variance. The PLSpredict procedure was applied to assess the predictive relevance ($Q^2_{predict}$) of the research model. All Q^2 values were greater than zero, with 0.003 for Body Positivity and 0.105 for Self-esteem. These results suggest that the exogenous variables provide an adequate basis for predicting the endogenous variables, and the model demonstrates acceptable predictive relevance (Hair et al., 2019).

Table 4 presents the estimated path coefficients, standard deviations, t-values, p-values, and confident intervals of the research model.

Table 4 Structural model assessment

	β	STDEV	t- statistics	p-value	Supported
H1a Amount and depth \rightarrow Self-esteem	-0.263	0.122	2.224	0.026	✓
H1b Polarity \rightarrow Self-esteem	0.159	0.088	1.970	0.049	✓
H1c Accuracy \rightarrow Self-esteem	0.020	0.071	0.152	0.879	x
H1d Intent \rightarrow Self-esteem	0.239	0.101	2.417	0.016	✓
H2 Self-esteem \rightarrow Body-positive content	0.222	0.073	3.024	0.003	✓

Source: Authors

The results indicate that the constructs Polarity ($\beta = 0.159$; $p < 0.05$), and Intent ($\beta = 0.239$; $p < 0.05$), have a significant and positive effect on Self-esteem. Therefore, H1b and H1d are supported. The construct Amount and depth ($\beta = -0.263$; $p < 0.05$) has a significant and negative effect on Self-esteem, while Accuracy ($\beta = 0.020$; $p > 0.05$) has a non-significant and positive effect on Self-esteem, thus confirming H1a and not supporting H1c.

Self-esteem has a significant and positive relationship with Body-positive content ($\beta = 0.222$; $p < 0.05$), confirming hypothesis H2.

The relatively low explanatory power for body positivity requires careful interpretation. While the relationship between self-esteem and body-positive content is statistically significant, the variance explained is limited. This indicates that other important predictors not included in the model likely

contribute to engagement with body positivity content. Potential omitted variables include internalised beauty standards, frequency of exposure to idealised influencers, and individual differences in resilience to social comparison. Additionally, measurement issues may partly account for the low β , as the adopted items capture interest and involvement with bodypositive content but may not fully reflect broader behavioural or attitudinal dimensions of the construct.

5. Discussion and conclusion

The development of social networks has given marketers access to valuable, effective data on consumer demographics and purchasing habits. Individuals who are successful on social media and have the power to influence their followers have become known as influencers. Social networks and influ-

encers are becoming more important every day in the virtual world of beauty and glamour. Attractive aspects of a person differ from culture to culture, but all cultures around the world share one thing in common – an appreciation and admiration of beauty. Many societal beauty standards are based on prototypes of the ideal man or woman within a particular culture. The categorisation of people and the creation of perfect body proportions for men and women have created a need for resistance, leading to a movement against imposed beauty standards and body ideals known as the body positivity movement.

This research provides useful insights into the relationships between self-disclosure and self-esteem factors. In this way, it contributes to the theory of influencer marketing by investigating the effect of Amount and depth, Polarity, Accuracy, and Intent on Self-esteem, which influences the Body-positive content.

This study confirms a significant role that dimensions of self-disclosure, particularly Polarity and Intent, play in enhancing self-esteem among Instagram users, which is in line with findings by Jacobson et al. (2020) and Lai and Yang (2015), who emphasised the psychological importance of positive self-presentation and intentional content sharing in digital environments. The unexpected negative effect of Amount and depth on self-esteem contrasts with prior literature that links frequent sharing to increased perceived popularity and social capital (Sprecher et al., 2013). This may suggest a saturation effect or content fatigue, where excessive self-disclosure dilutes perceived authenticity or invites negative social comparison, as noted by Vogel et al. (2014). The results align with Chu et al.'s (2022) observation that quality-based dimensions of self-disclosure are more beneficial for psychological well-being than mere quantity. As shown by Koay et al. (2023) and Chen et al. (2025), self-disclosure promotes perceived intimacy and relatedness, which in turn strengthens users' identification with influencers or online communities. This may explain why participants with higher self-esteem in this study also engaged more with body-positive content, mirroring the relational mechanisms observed in influencer–follower interactions.

A non-significant role of Accuracy may reflect a shift in user values where curated authenticity is more socially rewarded than factual self-representation (Toma et al., 2008). Importantly, the study

establishes a positive relationship between self-esteem and engagement with bodypositive content, expanding on research by Lazuka et al. (2020) and Cohen et al. (2021), which emphasised the empowering role of inclusive imagery. Our findings suggest that individuals with higher self-esteem are more receptive to or influenced by such content, which may function as a reinforcement loop: positive self-view encourages engagement with affirming narratives, which in turn stabilises or boosts self-image.

Previous studies have investigated whether people seek advice from influencers, whether fashion bloggers portray their brand personalities as funny female characters (Duffy & Hund, 2015), the relationship between influencers and the consumers who follow them, the relationship between content posted on Instagram and users' personality traits (Ferwerda & Tkalcic 2018), and have endeavoured to better understand body positivity messages on social media (Lazuka et al., 2020; Haywood et al., 2025).

The aim of this research was to determine whether influencers actually influence perceptions of beauty and how much respondents know about body-positive influencers. Several key findings emerged from the empirical analysis. The research results confirmed that there is a positive influence of Polarity, Accuracy, and Intent on Self-esteem, which is in line with the research findings of several studies (Jacobson et al., 2020, Bi & Zhang, 2023). This study also reveals a positive impact of Self-esteem and Body-positive content, which represents the novelty of this research.

Previous research has provided a sufficient basis for the study conducted, and the findings of the influence of influencers on beauty perceptions have opened up the possibility of examining stronger relationships between constructs more concretely and expanding the area of interest. From a practical standpoint, marketers and influencers should interpret Polarity and Intent not just as content strategies but as emotional cues that reinforce user identity. Influencers and brands promoting body positivity should aim to engage users with higher self-esteem as amplifiers of inclusive messaging.

6. Practical implications, limitations and future research directions

Several practical implications for companies and organisations can be derived from the results of this

study. The results show that Polarity and Intention have a significant and positive impact on Self-esteem, which emphasises the importance of fostering a positive environment and user intentions on platforms. Therefore, social platform developers should focus on creating positive, intention-driven interactions that enhance users' self-esteem. Strategies such as promoting supportive and constructive content, implementing features that encourage user intentions, and providing tools for self-expression can enhance these aspects. Organisations should strive to provide content in a balanced way, avoid information overload, and ensure that content is digestible and user-friendly. Simplifying the presentation of content and ensuring clarity and relevance can help mitigate the negative impact on self-esteem. Given the findings on the psychological effects of curated self-presentation and unrealistic beauty ideals, social media platforms should implement guidelines promoting transparency of photo alterations, algorithmic amplification of diverse body types, and mental health literacy. Influencer marketing regulations should also mandate disclosure of filters and editing to reduce harm among impressionable audiences. Educational initiatives aimed at fostering critical digital literacy and body-neutral messaging are recommended as preventative strategies.

As Self-esteem is significantly and positively related to body-positive content, organisations should prioritise the promotion of body positivity on their platforms. This can be achieved by showing diverse and inclusive representations, spreading positive messages about the body, and creating a community that supports self-acceptance and positivity.

A non-significant impact of Accuracy on Self-esteem suggests that while accuracy in self-disclosure is important, it does not have a direct impact on self-esteem. However, it remains critical to overall platform credibility and user trust.

Developers and marketers should work together to create user-centred experiences that take into account the key factors identified in the study. By prioritising positive interactions, balanced content, and positive messaging, companies can improve users' self-esteem and perceptions, ultimately driving adoption and usage of their platforms.

These results should be interpreted in the light of certain limitations, which also offer a valuable foundation for future research. The focus of this research is on specific constructs and the potential discrepancy between intention and actual behaviour. This

study relies on self-reported data, particularly in areas like self-esteem and body image perception. Participants may overstate positive attributes or engagement with body-positive content to align with socially acceptable standards. This could skew the observed strength of certain relationships. On the other hand, the sample is composed of Instagram users who voluntarily participated in an online survey, leading to potential selection bias and limitations in generalisability. The dominance of younger female respondents (aged 18–25) may not be representative of broader age and gender populations. While this group represents a key demographic of Instagram users, the skewed distribution limits the generalisability of findings to older populations, male users, or users of other platforms. Consequently, the results should be interpreted as indicative of patterns among young female Instagram users rather than universally applicable. Future studies should employ stratified sampling across gender, age, and platform use to increase representativeness and examine whether the observed relationships hold across more diverse populations.

Additional constructs such as internalised beauty standards, frequency of influencer exposure, or resilience to social comparison should be incorporated to improve the explanatory power of the model, particularly regarding body positivity. Researchers should explore longitudinal designs to examine causal relationships over time, particularly regarding the directionality between self-esteem and body-positive engagement. Furthermore, the moderating role of gender, age, or social comparison tendencies could be investigated. Expanding to other platforms, such as TikTok, would allow for comparative analysis of platform-specific affordances on self-disclosure and self-perception. Cross-platform comparisons and the use of mixed methods could provide further insights into users' decision-making processes on social media platforms. Integrating qualitative methods could provide deeper insights into subjective experiences behind disclosure behaviour.

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INCOME DISPARITIES AND CONVERGENCE ACROSS GLOBAL REGIONS

ABSTRACT

Purpose: This paper explores global income distribution and inequality from 1990 to 2023, analyzing 183 countries across 10 regions.

Methodology: Using PPP-adjusted GDP *per capita* data for 183 countries, the study assesses income dynamics across ten world regions through β -convergence (linear regression), σ -convergence (standard deviation), and the catch-up index (relative dynamics of income).

Results: The results reveal a complex picture: while overall income disparities between countries have decreased (β -convergence), regional comparisons with the U.S. as a benchmark show diverse trends. Of the nine analyzed regions (excluding the U.S.), five exhibit convergence, while four show divergence, based on σ -convergence and the catch-up index. Eastern Europe and South Asia have made the most progress in narrowing the income gap, whereas the Middle East & North Africa and Sub-Saharan Africa have fallen further behind. Despite maintaining minimal disparities with the U.S., Western Europe and the Western Offshoots have exhibited signs of mild divergence. These results highlight the heterogeneity of income dynamics across regions.

Conclusion: This study provides a nuanced perspective on convergence dynamics, emphasizing that the process of economic catch-up is neither uniform nor guaranteed. The results highlight that regions characterized by political stability, strong institutional capacity, and sustained investment in education and technology, such as Eastern Europe, are advancing more effectively. In contrast, regions facing persistent political instability, weak institutional frameworks, and limited investment—particularly Sub-Saharan Africa and the Middle East & North Africa—continue to fall behind. These findings point to the importance of targeted policy interventions aimed at fostering inclusive and balanced global economic development.

Keywords: Global inequality, income distribution, economic convergence, economic growth, world, global regions

1. Introduction

Understanding the global distribution of income and its evolution over time remains a central question in contemporary economic research. The sig-

nificance of this issue is underscored by the 2024 Nobel Prize in Economic Sciences, awarded to scholars investigating the fundamental determinants of large cross-country differences in income per capita (Acemoglu et al., 2001).

This topic has long been debated in political, professional, and academic circles. Barro and Sala-i-Martin (1991, p. 107) raised critical questions about whether the poorer countries of Africa, South Asia, and Latin America would grow faster than developed nations, whether southern Italy would catch-up with the north, and similar concerns. However, as noted by Jarco (2018), who reviewed empirical studies on the convergence hypothesis, the literature does not provide a clear consensus. The ongoing debate on economic convergence remains unresolved, reinforcing the need for further research in this area.

This paper analyzes income distribution among the 183 member countries of the World Bank (WB) and the International Bank for Reconstruction and Development (IBRD), both at a general level and across various global regions, using the U.S. as the benchmark country during the period from 1990 to 2023. Quantitative methods are employed to investigate convergence processes and developmental disparities. The focus lies on the application of β - and σ -convergence, as well as the catch-up index, allowing precise measurement of the dynamics in income disparity reduction between countries and regions.

Beta convergence estimates the rate at which lower-income countries catch up with higher income ones (commonly measured through linear regression), while σ -convergence tracks the reduction in income variability across countries/regions over time (calculated using standard deviation). The catch-up index enables comparisons of how quickly countries or regions progress in narrowing the gap with leading economies. PPP-adjusted GDP *per capita*, expressed in constant 2021 international dollars, is used as the indicator of income differences.

The necessity for this analysis stems from existing contradictions in the scientific literature. While some authors argue that global convergence is occurring (e.g., Barro & Sala-i-Martin, 1991, 1995; Milanovic, 2016), others highlight the deepening disparities between developed and less developed countries (Pritchett, 1997; Bourguignon & Morrison, 2002). To contribute to this debate, this study utilizes purchasing power parity (PPP) adjustments data to ensure greater comparability between regions.

To achieve a deeper understanding of global and regional trends, the world is divided in this paper

into ten regions based on geographic, economic, and developmental criteria, which is also the added value. In this paper, the regions were not literally adopted according to the World Bank classification; instead, they were independently formed based on the specified criteria. For example, the World Bank's region Europe and Central Asia is divided in this study into three regions: Western Europe, Eastern Europe, and Central Asia, due to their different developmental, economic, geographic, cultural, and historical criteria (partly political as well). This approach provides deeper insight into and facilitates the identification of global convergence trends among regions that are not at the same initial level of development.

This segmentation allows for the identification of region-specific characteristics and provides broader insights into developmental dynamics. Particular emphasis is placed on the role of the United States as a global economic leader and a reference point for assessing the progress of other regions (a benchmark country).

The aim of this study is to provide empirically grounded insights into global and regional trends in income distribution, offering new perspectives on the developmental challenges and potential across different parts of the world.

The paper is structured into five sections. Following the introduction, the second section explains the concept of convergence and reviews relevant academic and professional literature on global economic convergence. The third section outlines the research methodology, and presents the results based on β - and σ -convergence and the catch-up index. Section 4 discusses the findings and their policy implications. The final section presents the main conclusions of the paper, including research findings, open questions, and suggestions for further research.

2. Literature review

The analysis of world income distribution has been a central topic in economics, particularly in the context of globalization and regional disparities. This literature review synthesizes key theoretical frameworks and empirical findings, highlighting both their contributions and limitations. The concept of economic convergence is deeply embedded in growth theories, with differing perspectives on

the potential for convergence from neoclassical and endogenous growth models.

Traditional neoclassical economic theory (Solow, 1956) considers convergence between developed and less developed countries to be realistic due to diminishing returns on capital investments. However, the modern version of neoclassical growth theory (Sato, 1966) incorporates technological progress, explaining why real convergence has yet to be fully realized. In this framework, while capital investments face diminishing returns, technological advancements drive faster growth in developed countries.

In contrast to neoclassical theory, endogenous growth theory (Romer, 1986; Lucas, 1988) argues that convergence is not inevitable. It emphasizes that growth factors such as knowledge, R&D investments, human capital, and technology do not exhibit diminishing returns, enabling sustained growth predominantly in resource-rich developed countries.

A substantial body of empirical research has examined whether convergence or divergence characterizes global income trends. The findings yield mixed results on the convergence hypothesis, varying by time period, geographical focus, and methodology.

Early studies by Barro and Sala-i-Martin (1991; 1995) identified regional income convergence in U.S. states between 1880 and 1988, and slow convergence in Europe, Japan, and the U.S., estimating a 2% annual reduction in income disparities. Barro (2015) later described this as the “iron law of convergence,” where income gaps close gradually, often over generations.

Pritchett (1997) provided a contrasting view, arguing that the income gap between rich and poor countries widened significantly between 1870 and 1990. Despite evidence of convergence among wealthier nations after 1960, Pritchett emphasized that global income inequality persisted.

Schultz (1998) found evidence of faster income growth among poorer nations (β -convergence) and a reduction in income inequality (σ -convergence). His findings suggest that while global income inequality increased between 1960 and 1968, it has decreased since the mid-1970s, though this decline is less evident if China is excluded.

Maddison (2001) concluded that global economic development over the last millennium (from the

year 1000 to the end of the 20th century) has been highly uneven, with significant disparities between regions in terms of growth rates and living standards. Despite general progress, economic differences between regions, such as those between the United States and Africa, have become vast, and the gap between developed and developing regions continues to widen. While recent decades have seen progress in Asia, global economic growth has slowed since 1973, and stagnation in other regions has reduced overall global progress.

Bourguignon and Morrisson (2002) examined income trends over two centuries, highlighting the growing divergence between industrialized Western countries and less developed regions in Africa and South Asia. They argued that this divergence was exacerbated by colonial histories and uneven industrialization. Similarly, Cole and Neumayer (2003) found limited evidence of absolute convergence but noted conditional convergence, where poorer countries experience faster growth under certain conditions.

Sala-i-Martin (2006) analyzed eight measures of global income inequality from 1970 to 2000, finding reductions in global inequality during the 1980s and 1990s. Milanovic (2011) also noted that after two decades of income divergence, the trend reversed in 2001, with poorer countries, particularly in Africa, post-Communist countries, and Latin America, experiencing higher growth rates. Milanovic (2016) emphasized the decline in inequality between countries but the rise within countries, opening up a discussion of long-term trends. He identified the winners and losers of globalization, noting that the middle class in developing countries and the global elite benefit, while the middle class in developed countries loses out.

Despite some positive findings, other studies highlight persistent divergence. Rey and Peron (2012) found no evidence of convergence among Indian Ocean Zone countries from 1950 to 2008. Bičanić and Deskar-Škrbić (2019) point out that throughout history, there has been no strong evidence supporting absolute convergence. However, with the rise of China, India, and some African countries, alongside the slowdown of developed economies after the Great Recession, such evidence is gradually becoming more apparent.

Analyzing cross-country economic growth over the past 50 years, Johnson and Papageorgiou (2020)

conclude that developing countries, as a group, have not significantly closed the income gap with advanced economies. A review of the literature on absolute convergence supports this finding, though research on cross-individual inequality suggests a decline since 2000.

Using a catch-up index, Kant (2019) demonstrated mixed results in Sub-Saharan Africa and South Asia between 1992 and 2013. While some countries showed signs of catching up, others fell behind over longer periods. He demonstrated that 28 of the 46 countries in Sub-Saharan Africa and South Asia showed signs of catching up between 1992 and 2013, using the U.S. as the benchmark, while others fell behind. Sub-Saharan Africa shows no possibility of catching up from the earliest base period, while South Asia does, at an annual rate of 0.30%, resulting in full convergence in 865 years when the U.S. is used as the benchmark country. Darvas (2019) found that global income inequality decreased due to income convergence in China and India. Without these two countries, global interpersonal income inequality across 143 countries would have been higher in 2015 compared to 1988, indicating that half of the world has not truly become more equal.

Hong, et al. (2020) estimated global income distribution trends from 1960 to 2020. Their analysis revealed significant reductions in inequality in the 2000s, driven by China and India, while Sub-Saharan Africa's contribution to inequality increased. Similarly, Patel et al. (2021) argued that since the mid-1990s, developing countries have outpaced developed ones, challenging long-held beliefs about divergence, middle-income traps, and unstable growth in poorer nations. This era of unconditional convergence marks a historic break from centuries of divergence since the Industrial Revolution.

Chatterjee and Chatterjee (2022) present findings indicating that in the post-globalization era, countries have been converging both in absolute and conditional terms. Additionally, the declining variance suggests the presence of σ -convergence.

Van Kreveld (2023) demonstrated unconditional GDP convergence but also unconditional divergence of Inclusive Wealth. His study, covering a sample of 140 countries from 1990 to 2010, suggests that the episode of income convergence may be unsustainable in the long term due to the divergence in countries' capacities to generate income.

Martinho (2023) provides evidence that the indicators of convergence vary across different income levels and regions, as classified by the World Bank methodology, emphasizing the concept of convergence clubs. While the COVID-19 pandemic disrupted global convergence trends, its impact appears to have been less severe compared to the global financial crisis.

Some studies focusing on future projections indicate a slower pace of convergence in the 21st century compared to the convergence rate during the 20th century (Burgess et al., 2023). Silva Lopes (2024) notes that while some countries, led by China and India, have been catching up with rich countries at an unprecedented speed, this process seemed to lose momentum about ten years ago, and for many countries, convergence appears to have become elusive once again. In his forecasting model, based on a sample of 86 countries over a 42-year and 82-year horizon, he concludes that a large majority of these countries will still be lagging by 2060, with living standards significantly below that of U.S. citizens. In the 82-year projection until 2100, this gap is expected to persist for many nations.

Through an analysis of labor productivity convergence from 1970 to 2019, Lähdemäki (2024) finds evidence of convergence in the OECD, the EU, APEC, Europe, and Asia, while the trend remains uncertain in Africa and South America. Global β -convergence was observed throughout the period, with σ -convergence emerging after 2000.

The literature offers diverse perspectives on income convergence, ranging from optimistic views grounded in neoclassical theory to more skeptical interpretations informed by endogenous growth models. Empirical evidence remains inconclusive, reflecting the sensitivity of convergence dynamics to regional and temporal contexts, as well as methodological approaches. This study contributes to the ongoing debate by examining income convergence across all World Bank member countries grouped into ten global regions. By adopting a comprehensive approach, it aims to provide new insights into a deeper understanding of global patterns of economic convergence.

3. Methodology and research results

A review of the existing literature reveals controversial findings in the research on world income distribution across regions and time. The aim of

this paper is to contribute further to the discussion by using β - and σ -convergence methods, as well as the catch-up index. Beta convergence measures the speed at which low-income countries grow faster than high-income countries, which is examined through regression analyses comparing initial income levels with subsequent growth rates. Sigma convergence analyzes income variability among countries/regions over time. A reduction in income dispersion (measured by standard deviation) indicates the presence of σ -convergence. The catch-up index provides a direct comparison of the pace at which countries are narrowing the gap with leading nations, highlighting the relative income level of each region in comparison to the U.S.

Most research on convergence processes uses β - and σ -convergence. This paper employs both β - and σ -convergence, as well as the catch-up index. Additionally, the paper discusses the limitations of β -convergence. Specifically, β -convergence can reflect a situation where wealthier countries converge toward even wealthier ones, while poorer countries stagnate or diverge further. In this context, the catch-up index offers a more useful tool for analyzing the relative convergence of poorer countries/regions toward wealthier ones.

For the purposes of this study, the world is divided into ten regions based on geographic, economic, and developmental criteria. The grouping is partly based on models used by international organizations such as the World Bank but adapted to the specific needs of this research (the list of regions and corresponding countries can be found in Appendix A). The regions are as follows:

- Central Asia (countries of the former Soviet Union in Central Asia)
- East Asia and Pacific (excluding Australia and New Zealand, as they do not fit this group economically and developmentally)
- Eastern Europe (countries of Central and Eastern Europe, former communist and socialist countries)
- Latin America and the Caribbean (countries of Central and South America, including the Caribbean Islands)
- Middle East and North Africa (Arab world countries, Iran, and Turkey; due to cultural, historical, and political ties with the Middle East, Turkey is often included in this region,

despite geographically belonging to South-eastern Europe and Western Asia)

- South Asia (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka)
- Sub-Saharan Africa (Africa south of the Sahara Desert)
- Western Europe (Western European countries that established a capitalist economic system after World War II)
- Western Offshoots (USA, Canada, Australia, and New Zealand, with the United States excluded as the benchmark country)
- United States (defined as the reference point for analysis)

The regions were not literally adopted according to the World Bank classification; instead, they were independently formed based on the specified criteria. For example, the World Bank's region Europe and Central Asia is divided in this study into three regions: Western Europe, Eastern Europe, and Central Asia, due to their different developmental, economic, geographic, cultural, and historical criteria (partly political as well). According to data from the World Bank (WB) and the International Bank for Reconstruction and Development (IBRD), 189 countries are members of the WB. Due to missing data, 183 countries are considered in this research and are subsequently grouped into ten world regions based on previously defined criteria.

The analysis is based on PPP-adjusted GDP *per capita*, expressed in constant 2021 international dollars, covering the period from 1990 to 2023. Using World Bank data, average PPP-adjusted GDP *per capita* and average annual growth rates were calculated for defined regions, forming the basis for further statistical analysis.

Beta convergence is assessed through linear regression, while σ -convergence is calculated using standard deviation, and the catch-up index provides additional insights into the relative dynamics of income across regions. Particular attention is given to the selection of the benchmark country, with the United States chosen due to its sustained economic growth and historical role as a global standard for wealth and prosperity.

The European Union was not chosen as the benchmark country due to its continuous expansion since

1973. The accession of less developed countries from Central and Eastern Europe has significantly lowered the average income *per capita*, which could lead to erroneous conclusions about the narrowing gap between poorer countries and the EU. Similarly, the OECD, which was founded in 1961 with 20 member countries, has expanded to 38 members, including countries with lower levels of development than the founding members. These changes in the composition of the EU and the OECD make them unreliable for global convergence analysis.

3.1 Results of β -convergence analysis

The concept of β -convergence describes the process by which countries or regions with lower initial income levels grow faster than those with higher income levels, thereby reducing income disparities over time. The income indicator used is GDP *per capita* at purchasing power parity (PPP), expressed in constant 2021 international dollars. The paper first presents the results of β -convergence for 183 World Bank member countries, followed by results for the defined world regions.

The statistical formula for calculating β -convergence between countries/regions in the standard regression form is given as:

$$g_i = \alpha + \beta \cdot \ln(y_{i,0}) + \varepsilon_i \tag{1}$$

where

- $g_i = \frac{1}{T} \ln\left(\frac{y_{i,T}}{y_{i,0}}\right)$ is the average annual growth rate of real GDP *per capita* in the country/region over the period from 0 to T (number of years, 33),
- $\ln(y_{i,0})$ is a natural logarithm of the initial GDP *per capita* at PPP in country/region,
- α is a constant,
- β is the beta convergence coefficient we aim to estimate, obtained from the linear regression model,
- and ε_i is the random error term.

If $\beta < 0$, it indicates the presence of convergence, meaning that countries or regions with lower initial income levels tend to grow faster than those with higher income, thereby reducing income disparities over time.

Conversely, if $\beta > 0$, it indicates a lack of convergence, suggesting that countries with lower initial income levels are not catching up with wealthier ones, leading to persistent or even increasing income disparities.

Table 1 presents the results of the linear regression analysis for β -convergence among 183 member countries of the International Bank for Reconstruction and Development (IBRD) and the World Bank (WB).

Table 1 Regression results for β -convergence among 183 countries (1990-2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)

	β	R ²	F(1, 183)
PPP-based GDP per capita	-0.003**	.059	16.22**

** p < .05

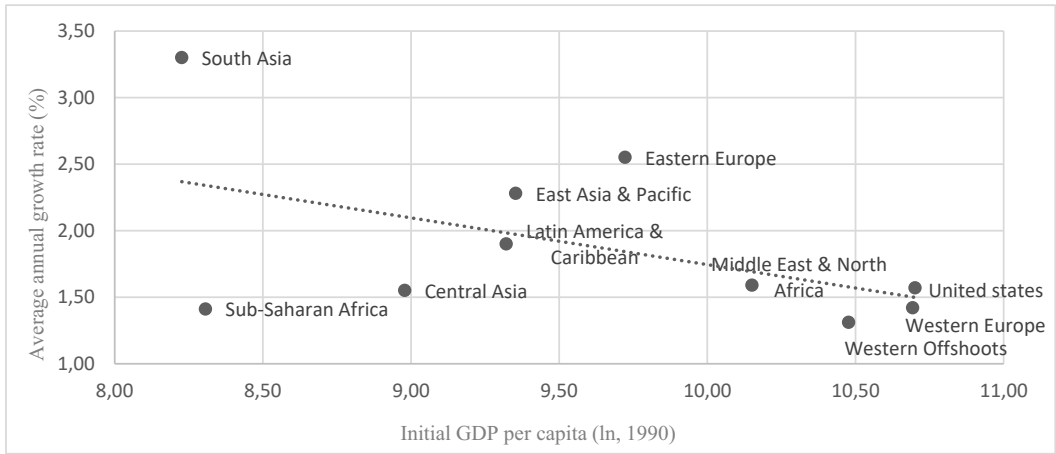
Source: Author's calculation based on World Bank data

The analysis of β -convergence indicates that convergence occurs when the β coefficient is negative and statistically significant (p < 0.05). The estimated β coefficient of -0.003 is statistically significant and suggests that each unit increase in the logarithmic value of initial GDP *per capita* (PPP-adjusted) corresponds to a decrease in the growth rate by 0.003 units. However, the low coefficient of determination (R² = 0.059) in the linear regression model indicates that only 5.9% of the variation in average annual GDP *per capita* growth rates can be explained

by the initial GDP *per capita* level of the countries. In other words, the initial income level has very weak predictive power in explaining differences in GDP *per capita* growth rates across countries. This finding highlights the need for further research into other factors that contribute to economic growth.

Figure 1 and Table 2 show the results of β -convergence for a sample of 10 selected world regions.

Figure 1 Beta convergence across world regions (1990-2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)



Source: Author's calculation based on World Bank data

Figure 1 shows that regions with lower initial income levels (positioned on the left side of the x-axis) generally experienced higher growth rates (higher on the y-axis), whereas wealthier regions (on the right) tended to grow more slowly. The negative slope of the trend line visually confirms the

presence of β -convergence, although the relationship is not statistically significant. The dispersion of data points around the regression line indicates notable deviations, some low-income regions did not grow rapidly, and conversely, certain high-income regions achieved relatively strong growth.

Table 2 Regression results for β -convergence among ten world regions (1990-2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)

	β	R ²	F(1, 8)
PPP-based GDP per capita	-.380	.259	2.870

p > .05

Source: Author's calculation based on World Bank data

Despite the negative β coefficient, which suggests convergence (i.e., lower-income regions tend to grow faster), the results are neither strong nor statistically significant enough to confidently confirm the presence of β -convergence among the analyzed regions.

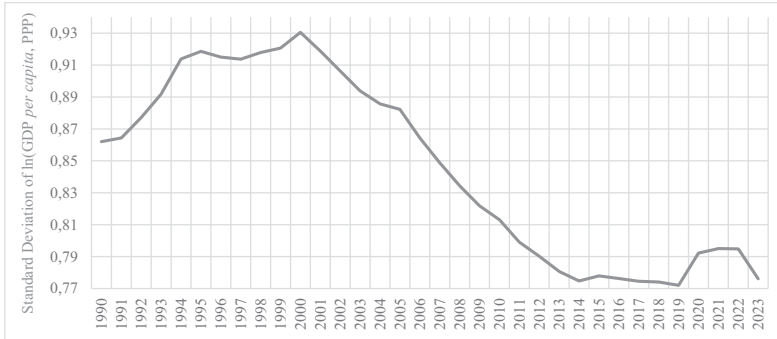
The regression results indicate statistically significant evidence of overall convergence among IBRD and WB member countries (Table 1), but only weak and statistically insignificant convergence among defined world regions (Figure 1 and Table 2). However, this does not necessarily indicate a meaningful reduction in the development gap between high-income and low-income countries or regions. It is possible that convergence is occurring primarily among wealthier countries, while poorer regions continue to lag behind. This issue will be further

investigated by applying σ -convergence and the catch-up index.

3.2 Results of σ -convergence analysis

Sigma convergence examines income variability among countries or groups of countries over time. If income dispersion, measured by standard deviation, decreases, it indicates convergence among the observed groups of countries. In this analysis, income is represented by the natural logarithm of PPP-based GDP per capita, expressed in constant 2021 international dollars. Figure 2 illustrates the **overall σ -convergence among ten world regions** (including the United States) during the period 1990–2023, based on the standard deviation of the natural logarithm of PPP-adjusted GDP per capita.

Figure 2 Sigma convergence among selected world regions (1990–2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)



Source: Author's calculation based on World Bank data

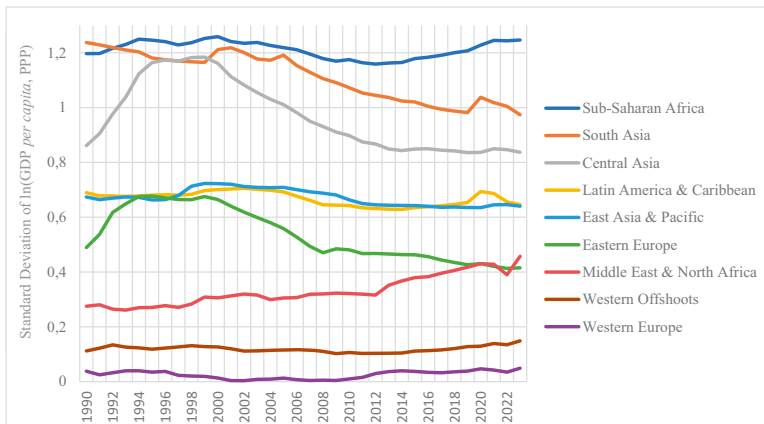
Figure 2 illustrates the evolution of σ -convergence among ten world regions over the period 1990–2023. During the 1990s, the data reveal a pattern of divergence, as income dispersion increased across regions. However, from the early 2000s onward, a clear trend of convergence emerged, marked by a gradual decline in the standard deviation, indicating a reduction in relative income differences. This process of convergence persisted consistently until 2019. In the final years of the observed period (2020–2023), the trend appears to stagnate or even slightly reverse, likely influenced by global shocks such as the COVID-19 pandemic and heightened geopolitical instability.

Overall, the results indicate a moderate but notable degree of σ -convergence. Between 1990 and 2023,

the standard deviation decreased by nearly 10%, suggesting that relative income disparities across the ten world regions have modestly diminished. While the convergence was not particularly strong, the sustained decline in income dispersion reflects a gradual narrowing of differences in GDP per capita levels over the long term.

Having established a moderate overall σ -convergence among the defined world regions, the analysis now turns to examining **bilateral convergence relative to the United States**. This step aims to determine whether all regions have exhibited convergence toward the U.S. benchmark, or whether the overall pattern has been driven only by some regions. The results of this analysis are presented in Figure 3 and Table 3.

Figure 3 Sigma convergence of the world regions relative to the United States (1990–2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)



Source: Author's calculation based on World Bank data

Figure 3 displays the results of bilateral σ -convergence analysis between each world region and the United States, which serves as the benchmark country. Downward-sloping trends indicate convergence, i.e., a reduction in income dispersion relative to the U.S.

The analysis shows that five of the nine regions experienced σ -convergence during the observed period (1990–2023). South Asia stands out as the strongest performer, reducing income dispersion relative to the United States by 21.77% (Table 3). Eastern Europe follows, with a reduction of 14.29% (Table 3), despite temporary divergence episodes in the 1990s. If the year 2000 is taken as the starting point for Eastern Europe, the degree of convergence becomes even more pronounced, reaching 37.51%. These two regions demonstrated the most substantial convergence toward U.S. income levels. Additional regions displaying moderate to weak convergence include Latin America and the Caribbean

(-5.8%), East Asia & Pacific (-4.48%), and Central Asia (-2.33%) (Table 3).

By contrast, four of the nine regions diverged from the United States over the period. Notably, Sub-Saharan Africa currently exhibits the largest income gap relative to the U.S., despite not holding this position in 1990. At the start of the period, South Asia had the widest gap, but experienced the strongest convergence over time, while Sub-Saharan Africa diverged by 4.17% (Table 3). The region most affected by divergence was the Middle East and North Africa, where income dispersion increased by a substantial 64.29% (Table 3), indicating a strong trend of divergence relative to the U.S.

Finally, the analysis reveals that income disparities between the U.S. and other high-income regions, such as Western Europe and the Western Offshoots, remained relatively small and stable, although with slight indications of divergence.

Table 3 Summary of σ -convergence (standard deviation (SD) of \ln GDP per capita) by region (1990–2023) (based on the natural logarithm of PPP-adjusted GDP per capita, in constant 2021 international dollars)

Region	SD1990	SD2023	Absolute Change	Percentage Change
South Asia	1.24	0.97	-0.27	-21.77
Eastern Europe	0.49	0.42	-0.07	-14.29
Latin America & Caribbean	0.69	0.65	-0.04	-5.8
East Asia & Pacific	0.67	0.64	-0.03	-4.48
Central Asia	0.86	0.84	-0.02	-2.33
Sub-Saharan Africa	1.20	1.25	0.05	4.17
Western Europe	0.04	0.05	0.01	25
Western Offshoots	0.11	0.15	0.04	36.36
Middle East & North Africa	0.28	0.46	0.18	64.29

Source: Author’s calculation based on World Bank data

Table 3 confirms the observed σ -convergence patterns, with South Asia and Eastern Europe showing the most progress toward the U.S. benchmark, while regions such as Sub-Saharan Africa and the Middle East and North Africa diverged. These results highlight the heterogeneity of income dynamics across regions. In the next section, this analysis is complemented by examining the catch-up index, which offers additional insight into the speed and depth of convergence relative to the U.S. benchmark.

3.3 Catch-up index

To further assess income convergence among the analyzed world regions, a catch-up index was calculated. The United States serves as the benchmark country, and the indicator used is PPP-adjusted GDP per capita, expressed in constant 2021 international dollars. The catch-up index captures the extent to which countries or regions are narrowing the income gap with the benchmark economy over time. It is calculated as the ratio of a region’s GDP

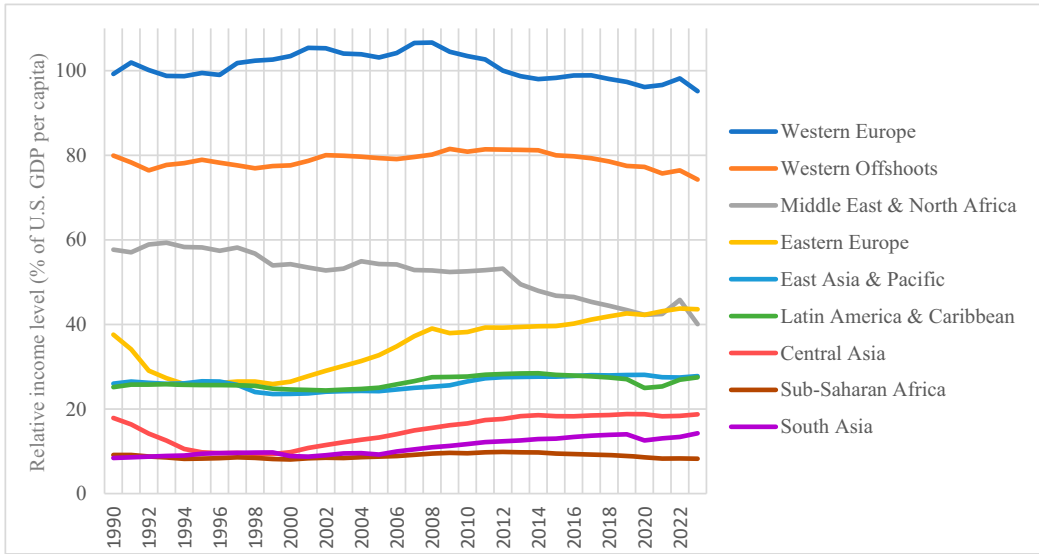
per capita to that of the United States in a given year, expressed as a percentage:

Catch – up index_t = |

$$\left(\frac{\text{PPP-adjusted GDP per capita (regions)}_t}{\text{PPP-adjusted GDP per capita (U.S.)}_t} \right) \cdot 100. \quad (2)$$

A value below 100 indicates that the country or region is lagging behind the United States, while a value above 100 suggests a higher income level. An upward trend in the catch-up index over time signals convergence, whereas a downward trend indicates divergence. The results of the analysis are presented in Figure 4.

Figure 4 Relative income level compared to the United States (1990–2023) (based on PPP-adjusted GDP per capita, in constant 2021 international dollars)



Source: Author's calculation based on World Bank data

The analysis of the catch-up index provides valuable insights into the relative income dynamics of world regions compared to the United States, which serves as the benchmark country. The index expresses each region's GDP per capita as a percentage of the U.S. level, thus indicating the extent of convergence or divergence over time.

Between 1990 and 2023, five of the nine regions exhibited convergence in relative income levels. Eastern Europe recorded the most significant relative improvement, increasing its catchup index from 37.59% to 43.59%, marking a 6% gain (Table 4), making it the strongest performer in terms of convergence. South Asia also showed considerable progress, with a 5.84% increase (Table 4) of the U.S. income level. Other regions, such as Latin America

& the Caribbean, East Asia & Pacific, and Central Asia, experienced modest convergence, each improving their relative positions by 0.87–2.31% (Table 4). While the gains were limited, they nonetheless indicate gradual alignment toward higher income levels.

In contrast, four of the nine regions exhibited relative stagnation or divergence. For instance, Sub-Saharan Africa and Middle East & North Africa either maintained a low relative position or experienced a decline, indicating persistent structural gaps. High-income regions such as Western Europe and the Western Offshoots remained close to the U.S. income level throughout the period, although they exhibited a slight divergence over time.

Table 4 Summary of the catch-up index by region (1990–2023) (based on PPP-adjusted GDP per capita, in constant 2021 international dollars)

Region	Catch-up index (1990)	Catch-up index (2023)	Change (1990-2023)
Eastern Europe	37.59	43.59	6.00
South Asia	8.42	14.26	5.84
Latin America & Caribbean	25.17	27.49	2.31
East Asia & Pacific	25.99	27.78	1.79
Central Asia	17.87	18.74	0.87
Sub-Saharan Africa	9.12	8.26	-0.86
Western Europe	99.21	95.16	-4.06
Western Offshoots	79.94	74.26	-5.68
Middle East & North Africa	57.69	40.07	-17.62

Source: Author’s calculation based on World Bank data

Overall, the findings portray a nuanced picture of global income convergence; while a few regions have made meaningful progress in narrowing the gap with the U.S., others continue to face structural barriers that hinder such advancement. The analysis therefore provides only partial support for the convergence hypothesis, revealing that income alignment is progressing in some areas but remains absent in others. This uneven pattern underscores the limited reach of convergence and the enduring structural inequalities that characterize the global economic landscape.

4. Discussion and implications

The empirical findings of this study provide nuanced evidence regarding the global convergence hypothesis. While the β -convergence analysis confirms that, on average, lower income countries have grown faster than wealthier ones over the 1990–2023 period, the weak explanatory power of the model suggests that initial income levels alone are insufficient to explain growth dynamics. This calls for a broader examination of additional structural factors influencing economic performance.

The σ -convergence analysis further highlights the complex nature of convergence dynamics. While five of the nine regions reduced their income dispersion relative to the United States, most notably South Asia and Eastern Europe, the remaining four regions, including the Middle East & North Africa and Sub-Saharan Africa, exhibited divergence. This

underscores persistent income disparities and uneven development trajectories across global regions.

Results from the catch-up index corroborate these patterns, indicating relative improvement in the same five regions identified through the σ -convergence analysis, particularly Eastern Europe and South Asia, while the remaining four regions—most notably the Middle East & North Africa and Sub-Saharan Africa—regressed in their income position relative to the U.S. High-income regions, such as Western Europe and the Western Offshoots, remained closely aligned with U.S. income levels throughout the period, yet exhibited mild signs of divergence, suggesting a potential plateau in their relative economic performance.

Taken together, the results suggest that global income convergence is not a uniform process but one marked by considerable regional heterogeneity. Convergence appears more feasible where countries or regions have implemented institutional reforms, invested in education and infrastructure, and maintained political stability. Eastern Europe and South Asia exemplify such trajectories, likely benefiting from democratization, global market integration, and in the case of Eastern Europe, EU accession processes.

Conversely, regions facing persistent structural and political challenges, such as Sub-Saharan Africa and the Middle East & North Africa, continue to lag behind. This underscores the pivotal role of institutional quality, governance, and human capital

investment in shaping long-term economic development.

These findings align with the broader literature emphasizing the role of inclusive institutions and rule-based systems in promoting economic prosperity (Acemoglu et al., 2001). The 2024 laureates (Acemoglu, Johnson, and Robinson) demonstrated that inclusive institutions—those that uphold property rights, the rule of law, democratic governance, and political participation—are associated with stronger economic performance. In contrast, extractive institutions, characterized by elite-controlled wealth and power, limited citizen rights, and a lack of transparency, tend to correlate with higher corruption, inequality, and economic stagnation.

In this context, Eastern Europe—the region that has exhibited the highest convergence—provides a compelling case. Its economic progress can be attributed to institutional strengthening, democratic reforms, and legal framework improvements, driven in part by its transition from socialism and, more significantly, by structural reforms undertaken to meet EU accession criteria. Similarly, South Asia, which also demonstrated strong convergence, has seen rapid economic transformation, partly due to increasing integration into global markets and institutional reforms.

Conversely, the Middle East and North Africa—the region with the most pronounced divergence—faces persistent political instability and institutional weaknesses, factors that likely hinder economic convergence. This finding underscores the critical role of political stability and institutional quality in shaping long-term economic trajectories (Trpeski et al., 2024). The assumptions outlined in this section regarding the importance of institutional quality for long-term economic growth are intended to be examined in subsequent research.

Despite its insights, this study has several methodological limitations. First, the relatively short research period (33 years) may not fully capture long-term convergence trends. Additionally, the exclusion of certain countries due to data unavailability or classification constraints limited the sample to 183 of the 189 WB and IBRD member countries. Another methodological consideration is the choice of a single development indicator, namely PPP-based GDP *per capita*, which does not account for broader socio-economic factors influencing convergence. Future research will seek to incorpo-

rate additional determinants of economic growth, particularly indicators of institutional quality, in order to investigate which factors contribute most significantly to long-term economic performance.

To accelerate global convergence, targeted investments in persistently lagging regions, particularly Sub-Saharan Africa, are crucial. Key policy recommendations include strengthening institutional frameworks by promoting good governance, anti-corruption measures, and legal reforms; increasing infrastructure investments, particularly in energy, transport, and digital connectivity, to enhance economic productivity; and ensuring access to quality education and technology. By addressing these challenges, policymakers can facilitate inclusive and sustainable economic growth, fostering stronger convergence trends at the global level.

5. Conclusion

This paper analyzed global income convergence across 183 countries grouped into ten regions from 1990 to 2023, using β -convergence, σ -convergence, and the catch-up index. The findings offer a nuanced view of convergence dynamics. On a global scale, β -convergence is present, as lower-income countries have generally experienced higher growth rates than their wealthier counterparts. However, this convergence is only partial and statistically modest, particularly when viewed through the lens of σ -convergence and the catch-up index. Regionally, only five of the nine regions demonstrated convergence toward the United States benchmark, particularly Eastern Europe and South Asia, while the remaining four regions, including the Middle East & North Africa and Sub-Saharan Africa, exhibited divergence. These results indicate that the process of catching up is neither uniform nor inevitable.

The main scientific claim emerging from this study is that global convergence exists, but it is conditional and highly context-dependent. While β -convergence confirms that some countries are growing faster than others, this alone is not sufficient to close the income gap. β -convergence among countries was statistically significant but explained only 6% of the variation in average annual GDP *per capita* (PPP-adjusted) growth rates by the initial GDP *per capita* level, indicating that initial income levels account for only a small portion of growth differences. In contrast, β -convergence

among world regions was not statistically significant.

General σ -convergence among regions was present but modest (the standard deviation decreased by nearly 10%), with only a limited reduction in income dispersion over the observed period. Bilateral σ -convergence, measured relative to the United States, revealed that five of the nine regions converged, while the remaining four did not. Similar patterns were observed in the results of the catch-up index. Both σ -convergence and the catch-up index suggest that real economic alignment is occurring only in regions with specific enabling conditions, such as strong institutional frameworks, political stability, and integration into global markets. Conversely, regions characterized by institutional fragility or persistent structural barriers are continuing to fall behind. These findings challenge the idea of universal convergence and underscore the significance of regional heterogeneity and developmental trajectories in shaping long-term economic outcomes.

The results also raise important questions for further research. If the initial income level has very weak predictive power in explaining differences in GDP *per capita* growth rates across countries or regions, then what factors do? To what extent do institutional quality, education systems, demographic trends, technological advancement and innovation, or international openness influence the convergence process? These findings highlight the need for further research into the broader determinants of economic growth.

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Appendix A. List of Regions and Countries

Central Asia (4 of a total of 5)

- **Countries:** Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan.
- **Note:** The region includes countries of the former Soviet Union in Central Asia. Turkmenistan is excluded from the sample due to data unavailability.

East Asia and Pacific (27 of a total of 29)

- **Countries:** Brunei Darussalam, Cambodia, China, Fiji, Indonesia, Japan, Kiribati, Korea Rep., Lao PDR, Malaysia, Marshall Islands, Micronesia Fed. Sts., Mongolia, Myanmar, Nauru, Palau, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Thailand, Timor-Leste, Tonga, Tuvalu, Vanuatu, Viet Nam.
- **Note:** Australia and New Zealand, as developed countries, are excluded from the sample and included in the Western Offshoots region.

Eastern Europe (23 of a total of 27)

- **Countries:** Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Estonia, Georgia, Hungary, Latvia, Lithuania, Montenegro, North Macedonia, Poland, Moldova, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Ukraine.
- **Note:** The region includes former communist and socialist countries. Greece, Cyprus, and Malta are excluded due to their different historical context and are instead grouped under Western Europe based on economic and developmental criteria. Kosovo is not included due to data unavailability.

Latin America and the Caribbean (31 of a total of 32)

- **Countries:** Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama,

Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay.

- **Note:** Venezuela RB is excluded due to data unavailability.

Middle East and North Africa (19 of a total of 20)

- **Countries:** Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates.
- **Note:** Yemen Rep. is excluded due to data unavailability. Turkey is included due to its cultural, historical, and political ties to the Middle East, despite its geographical location in Southeastern Europe and Western Asia.

South Asia (8)

- **Countries:** Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka.

Sub-Saharan Africa (46 of a total of 48)

- **Countries:** Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo Dem. Rep., Congo Rep., Cote d'Ivoire, Equatorial Guinea, Eswatini, Ethiopia, Gabon, Gambia The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, Zimbabwe.
- **Note:** Eritrea and South Sudan are excluded due to data unavailability.

Western Europe (21)

- **Countries:** Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece,

Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Malta, Portugal, San Marino, Spain, Sweden, Switzerland, United Kingdom.

Western Offshoots (4)

- **Countries:** U.S., Canada, Australia, New Zealand.
- **Note:** The U.S. is the benchmark country, while the other three are included in the sample.

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WOMEN IN LOCAL POLITICS AND BUDGET CREDIBILITY IN CROATIA AND SLOVENIA

ABSTRACT

Purpose: The position of women and their participation in political life are among the key issues in global gender equality debates. This paper examines the relationship between female representation in local politics and budget credibility in Slovenia and Croatia, addressing whether greater female involvement enhances budget transparency and accountability at the local level.

Methodology: The share of female council members is expressed as the percentage of all councillors, while the presence of a female mayor is represented by a dummy variable equal to one if the mayor is female, and zero otherwise. Budget credibility is assessed by budget deviations, calculated as the absolute difference between planned and actual total expenditures divided by planned total expenditures. Cluster analysis was conducted for all 212 Slovenian urban municipalities and municipalities and 556 Croatian cities and municipalities for the year 2023.

Results: The analysis reveals a negative relationship between the share of female councillors and total expenditure deviations. Local governments with a greater proportion of women in representative bodies tend to have higher budget credibility, indicating improved budget credibility associated with greater female representation.

Conclusion: Enhancing female representation in local councils promotes higher budget credibility, offering important policy implications for gender equality and fiscal governance in Slovenia and Croatia. These findings underscore the value of women's political participation in strengthening local financial management.

Keywords: Female representation, budget credibility, cluster analysis, local councils, local governments

1. Introduction

According to the European Institute for Gender Equality (2016), women remain underrepresented in local political life, highlighting the need to promote greater participation, especially at the local level. In 2021, women accounted for approximately 52% of the population in Croatia and 50% in Slove-

nia (Croatian Bureau of Statistics, 2024; Statistical Office of the Republic of Slovenia, 2024), yet their representation in politics remains significantly lower. Although the share of women in local politics has gradually increased over the last three election cycles in both countries, it remains modest. Currently, women hold executive positions in about

14% of Slovenian and 11% of Croatian local governments. Representation among local councillors is somewhat higher but still below parity—33% in Slovenia and 28% in Croatia.

Both countries have adopted legislative frameworks to promote gender balance in political representation. Under the Act on Local Elections (2007) in Slovenia and the Gender Equality Act (2017) in Croatia, electoral lists must include at least 40% of each gender. However, these quotas apply only to candidate lists and do not necessarily translate into equal representation after elections. In Slovenia, gender quotas are firmly implemented in both national and local elections. The Equal Opportunities for Women and Men Act (2002) and the Act on Local Elections (2007) require political parties to alternate male and female candidates (the so-called zipper system) on the top half of the list, ensuring real opportunities for women to be elected. Non-compliance can even lead to the rejection of the candidate list. In Croatia, although similar 40% quotas apply, enforcement has been weaker. Financial penalties for non-compliance exist but are inconsistently applied, and women remain underrepresented in higher positions. Nevertheless, the law represents an important step toward balanced political participation. Overall, while both countries meet EU normative frameworks on gender equality, Slovenia has achieved more effective implementation through stricter validation mechanisms and institutional oversight.

Budget credibility refers to the extent to which actual revenues and expenditures correspond to those planned in the approved budget (Prijaković, 2024; Prijaković, 2025). It is typically measured by budget deviations—the difference between planned and actual amounts divided by the planned amounts. Accurate budget forecasts are critical for sound policy formulation. Overestimated revenues often lead to mid-year spending cuts and reduced provision of public goods. Conversely, underestimating revenues or overestimating expenditures may be used as risk management tools or to comply with balanced-budget rules while masking fiscal optimism. Persistent overestimation of revenues can result in debt accumulation, diminishing resources available for local service provision and undermining long-term fiscal sustainability.

Gender representation and equality are recognised as essential components of good governance (OECD, 2014). This paper contributes to the

literature by investigating whether female political representation influences local budget credibility. The analysis focuses on Croatia and Slovenia, two neighbouring EU member states with similar legal and institutional frameworks, using 2023 data for all 212 Slovenian and 556 Croatian local governments. Cluster analysis and linear regression are applied to identify fiscal performance patterns and assess whether gender composition in councils and executive leadership affects total expenditure deviations. The paper proposes two hypotheses: (1) a higher share of women in local councils is associated with lower total expenditure deviations; and (2) local governments led by female mayors exhibit lower total expenditure deviations.

This paper is organised as follows. Section 2 gives a review of the literature on budget deviations and female representation in local politics. Section 3 describes the data, while Section 4 focuses on the methodology and results, and Section 5 presents conclusions, limitations and recommendations.

2. Literature review and theories

Recent studies emphasise the importance of institutional factors such as budget transparency, the quality and timeliness of budget reporting, and organisational capacity for robust forecasting and planning. These factors consistently correlate with increased budget credibility and reduced deviations between planned and actual outcomes. Moreover, political determinants—including political ideology, party fragmentation, election cycles, decentralisation, and the competitiveness of the political environment—play a significant role in explaining variations in budget credibility within local governments. For example, Beetsma et al. (2013) and Sarr (2015) provide evidence that enhanced transparency and external audit capacity positively influence budget credibility across sectors. More recently, Markovič Hribernik et al. (2025) identify a comprehensive set of political and economic determinants that affect the credibility of local government budgets. These findings are corroborated by international assessments, such as the Fiscal Transparency Handbook (IMF, 2018), which concludes that strong institutional capacity, transparent reporting, and political accountability correlate with smaller deviations between planned and executed budgets.

In addition to institutional and political influences, gender-related factors have also been linked to fis-

cal performance. Previous research suggests that increased female participation in decision-making enhances efficiency, transparency, and accountability (Dollar et al., 2001; Esarey et al., 2019; Sung, 2003). However, the role of women in local politics remains underexplored, with relatively few studies addressing this issue (Cuadrado-Ballesteros et al., 2022; Ríos et al., 2023; Stanić et al., 2020; Stanić, 2023; Stanić et al., 2025). Most prior research on local budget deviations has focused on political and economic determinants such as ideology, party fragmentation, unemployment, or income (e.g., Boukari & Veiga, 2018; Goeminne et al., 2008; Guillamón et al., 2024; Jorge et al., 2023; Ríos et al., 2018; Sedmihradská & Čabla, 2013). Gender aspects have been explicitly examined in only two studies: Cuadrado-Ballesteros et al. (2022) on Spanish municipalities, and the recent study by Stanić et al. (2025) on Croatian cities, which found that gender differences may influence spending priorities and thus shape fiscal behaviour.

Holman (2017) observes that women remain underrepresented in most local political positions, and gender diversity has not yet received sufficient attention, particularly at the local level. Research on local female political representation highlights disparities in women's preferences for the distribution of public funds and the positive effect of women's roles on public sector efficiency (Park, 2020). Female politicians tend to prioritise sectors such as education, healthcare, and social welfare—areas closely linked to long-term societal well-being and development (e.g., Lodi et al., 2024). Studies have also found a correlation between higher female representation and lower levels of corruption, suggesting that women may foster more transparent and accountable governance (e.g., Bauhr & Charron, 2020). Furthermore, women are often associated with more cautious and socially responsive fiscal management, leading to more effective and equitable use of public resources (e.g., Funk & Philips, 2019). Female leaders frequently adopt collaborative and participatory decision-making styles, enhancing policy implementation and responsiveness to citizens' needs (de Araujo & Tejedo-Romero, 2016). Collectively, these factors contribute to improved outcomes and greater trust in public institutions. Gender-responsive budgeting, defined as incorporating a gender perspective at every budgeting stage, aims to advance gender equality and

deliver economic and social benefits to society as a whole (World Bank, 2001).

Three theories are commonly invoked to explain the impact of female representation in politics. First, *social role theory* (Eagly, 1987) argues that gender stereotypes evolve from established social structures and community roles, where women and men are assigned specific social functions. This theory posits that females are expected to be more open and available than males, thereby mitigating information asymmetries. Consequently, female representation may enhance local government efficiency through more responsible behaviour. Second, *critical mass theory* (Kanter, 1977) suggests that a minority group remains ineffective unless it reaches a critical mass, typically between 20% and 40%, enabling it to influence group outcomes. Groups may be classified as uniform (0% women and 100% men or 100% women and 0% men), skewed (0–20% women and 80–100% men, or vice versa), tilted (20–40% women and 60–80% men, or vice versa), and balanced (40–60% women and 40–60% men), with significance attributed to attaining a critical mass. Third, the *citizen-candidate model* (Besley & Coate, 1997; Osborne & Slivinski, 1996) proposes that politicians' policy preferences vary with their individual characteristics, such as gender. Gender differences may thus translate into distinct perspectives on budgetary priorities and spending. This paper draws on all three theories—social role theory, critical mass theory, and the citizen-candidate model—to support the claim that women, being more socially and ethically sensitive, may produce more credible budgets.

A government's actual revenue and expenditure frequently differ from its planned budget (Goeminne et al., 2008). Expenditure or revenue overestimation occurs when planned amounts exceed actual amounts, while underestimation occurs when actual expenditures or revenues exceed planned amounts. Various papers have sought to explain the causes of budget deviations across countries and governance levels. Local governments may overestimate revenues (optimistic forecasting) to offer more public services or meet balanced budget requirements without immediate tax increases (Mayper et al., 1991), contributing to fiscal illusion (Campbell, 2004). Fiscal illusion theory holds that voters often fail to fully comprehend the costs of public goods, thereby enabling politicians to avoid tax rises by accumulating debt, as citizens overesti-

mate revenue and misjudge spending capacity (Buchanan & Wagner, 1977; Puviani, 1976). Conversely, pessimistic revenue estimates may help buffer against unexpected fiscal shocks, whereas underestimating expenditures can negatively impact financial management. Overestimating expenditures, however, may serve to maintain budget surpluses and financial resilience.

While empirical research increasingly examines economic, institutional, and political determinants of local budget credibility related to expenditures (e.g., Benito et al., 2015; Boukari & Veiga, 2018; Guillamón et al., 2024; Rfös et al., 2018; Siregar & Susanti, 2019), only two papers have incorporated gender as an explanatory factor. Cuadrado-Ballesteros et al. (2022) analysed 140 Spanish municipalities from 2008 to 2018 and found that female mayors and higher proportions of female councillors correlate with improved fiscal outcomes; specifically, greater female representation is associated with healthier local government finances. Stanić et al. (2025) analysed 128 Croatian cities from 2016 to 2021 and found that the share of women in city councils has a nonlinear (U-shaped) relationship with budget credibility. At low levels of female representation, cities tend to overestimate revenues and underestimate expenditures, resulting in overly optimistic and less credible budgets. Once women surpass roughly 30% of council seats (for revenues) and 40% (for expenditures), the pattern reverses: cities become more fiscally cautious, tending to underestimate revenues and overestimate expendi-

tures, which enhances budget discipline and budget credibility.

Based on the literature and the three theoretical frameworks outlined, this study formulates the following hypotheses to address gaps in the current research:

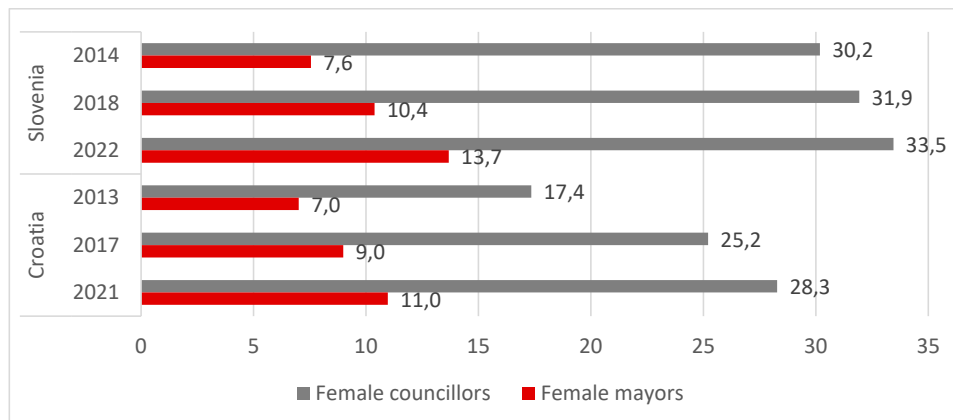
H₁: A higher percentage of women in local councils leads to lower total expenditure deviations.

H₂: Local governments led by female mayors exhibit lower total expenditure deviations.

3. Data

The paper examines the budgets of 128 cities and 428 municipalities in Croatia, and 12 urban municipalities and 200 municipalities in Slovenia, a total of 768 local governments across the two neighbouring EU countries for the year 2023. Political female representation is measured as the percentage of female councillors in local councils. Graph 1 shows the average share of female councillors based on Slovenia's 2014, 2018, and 2022 local elections and Croatia's 2013, 2017, and 2021 local elections. The proportion of female representatives has been steadily increasing in both countries; however, Slovenian local governments consistently exhibit higher female representation than those in Croatia. On average, smaller municipalities have more female mayors but fewer female councillors compared to larger municipalities.

Graph 1 Percentage of female councillors and female mayors at local elections in Slovenia and Croatia, in %



Source: Author's calculation

Total expenditure deviations were calculated using the following formula:

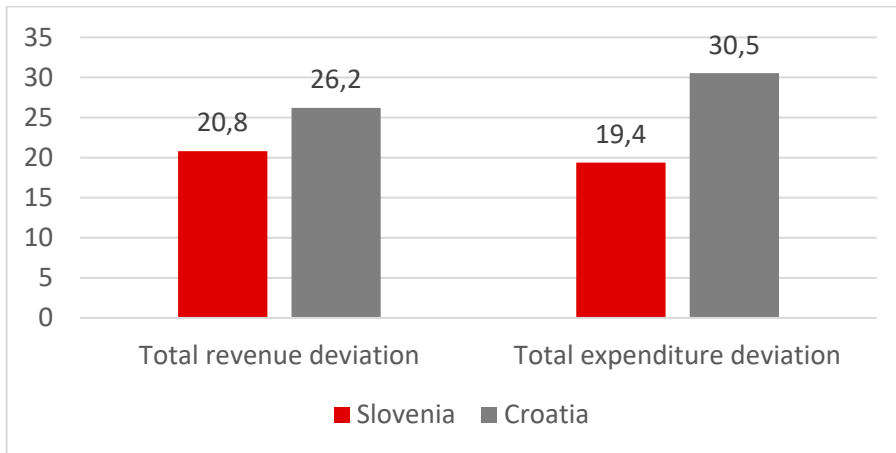
$$\text{total expenditure deviation} = \left| \frac{\text{planned total expenditure} - \text{executed total expenditure}}{\text{planned total expenditure}} \right|$$

The executed budget (end-year report) should be equal to the planned budget (enacted budget), but this is not always the case. Deviations can therefore be positive (indicating an overestimation of total expenditures) or negative (indicating an underestimation of total expenditures). In this paper, total expenditure deviations are expressed as absolute values, with smaller deviations considered better.

Graph 2 presents the deviations in total revenues and total expenditures. The results show that Slovenian local governments perform better than Croatian ones in budgetary planning. Slovenian local governments are slightly more accurate in planning total expenditures than total revenues, whereas Croatian local governments perform worse in planning total expenditures than total revenues (with an average total expenditure deviation of 31% across

all Croatian local governments). Accurate planning of total expenditures is particularly important for several reasons. While total revenues are often influenced by market fluctuations and external factors (e.g., economic conditions), total expenditures mainly result from internal decisions. Local governments have greater control over their expenditures than over their revenues. Inaccurate expenditures planning can lead to budget deficits and debt accumulation. If expenditures are planned too high, resources may be unnecessarily locked up; if they are planned too low, financial constraints can occur. Unlike revenues, which are largely based on projections and forecasts, expenditures represent concrete commitments that must be fulfilled. For these reasons, this paper focuses on total expenditure deviations rather than total revenue deviations.

Graph 2 Average total revenue and total expenditure deviations in local governments in Slovenia and Croatia in 2023, in %



Source: Author's calculation

Variables that may influence expenditure deviations include population size and local governments' own revenues per capita (all variables used are described in detail in Table 1). Population has been examined in numerous papers (e.g., Benito et al., 2015; Bohn & Veiga, 2021; Cuadrado-Ballesteros et al., 2022; Ríos et al., 2018). Evidence from Spanish

local governments suggest that municipalities with more inhabitants tend to exhibit lower expenditure deviations (Cuadrado-Ballesteros et al., 2022; Ríos et al., 2018), so a similar negative relationship might be expected in this paper. Local governments' own revenues have also been widely analysed as a determinant of expenditure deviations (e.g., Boukari

& Veiga, 2018; Guillamón et al., 2024; Jorge et al., 2023). Higher levels of own revenues, reflecting greater fiscal autonomy and economic independence, are typically associated with lower expenditure deviations, as such local governments are less likely to manipulate their planned expenditures. Consequently, a negative relationship is also anticipated here.

For robustness, the linear regression analysis also includes four additional control variables: grants per capita, political ideology represented by left and right dummy variables, and the Herfindahl index.

Similar control variables have been used in previous studies to account for fiscal capacity, political orientation, and market concentration effects. For instance, prior research has shown that grants per capita often influence budget credibility, political ideology can affect spending priorities and redistribution policies, while the Herfindahl index is commonly included to capture the degree of political or economic concentration that may impact policy outcomes (e.g., Cuadrado-Ballesteros et al., 2022; Guillamón et al., 2024; Ríos et al., 2018; Stanić et al., 2025).

Table 1 Description of local governments' data

Variable	Description	Source
<i>Total expenditure deviation</i>	Calculated for 2023 as $\left \frac{\text{plan} - \text{executed}}{\text{plan}} \right $.	Executed amounts are from the Ministry of Finance database (MoF, 2024a; 2024b), and planned amounts are from enacted budgets on local governments' official websites; author's calculation.
<i>Population</i>	Total number of inhabitants in every LG, population estimates for 2023.	Statistical Office of the Republic of Slovenia (2024) Croatian Bureau of Statistics (2024)
<i>Own revenues per capita</i>	Calculated as operating revenues minus grants in 2023.	MoF (2024a)
<i>Grants per capita</i>	Revenues from grants in 2023.	MoF (2024b)
<i>Female mayor</i>	The dummy variable, one if the mayor is female and zero otherwise. Based on the local elections in Croatia (2021) and Slovenia (2022).	State Electoral Commission of the Republic of Slovenia (2024) State Electoral Commission of the Republic of Croatia (2024)
<i>Female councillors</i>	Share of female councillors in local councils, in %. Based on the local elections in Croatia (2021) and Slovenia (2022).	
<i>Left</i>	The political ideology of the mayor, represented as a dummy variable taking the value one if the mayor is from a left-wing party, and zero otherwise.	
<i>Right</i>	The political ideology of the mayor, represented as a dummy variable taking the value one if the mayor is from a right-wing party, and zero otherwise.	
<i>Herfindahl</i>	Measures the concentration of political or councillor power among parties in local councils, with higher values indicating less fragmentation and greater concentration. It is calculated as $\sum_{i=1}^n \frac{S_i^2}{S^2}$, where S is the total number of councillors in the local council and S_i is the number of councillors of party i .	

Source: Author

4. Methodology and results

Cluster analysis is a useful method for classifying data according to their characteristics. Clusters should exhibit high within-cluster homogeneity and high between-cluster heterogeneity (Hair et al., 1995). This paper applies Ward’s method, employing both hierarchical clustering and k-means clustering to group local governments into three or four clusters based on the closest mean values.

Cluster analysis was conducted for all 556 local governments in Croatia and all 212 local governments in Slovenia. Correlation matrices are provided in the Appendix (Tables A1 and A2), showing no high correlations among the variables used. Descriptive statistics are presented in Table 2 and indicate substantial differences between the two countries in terms of local government characteristics.

In 2023, the lowest total expenditure deviations were recorded in Vrsi (0.02) in Croatia and Črenšovci (0.51) in Slovenia. Conversely, the high-

est expenditure deviations were found in eight Croatian local governments (Čabar, Čeminac, Desinić, Donja Stubica, Gornja Stubica, Kali, Komiža, and Krapinske Toplice) and in Črna na Koroškem (100%) in Slovenia. Following the most recent local elections, female mayors were elected in 61 Croatian local governments (11%) in 2021 and in 29 Slovenian local governments (14%) in 2022. Certain local governments have no female councillors, i.e., five (2%) in Slovenia and 22 (4%) in Croatia. In contrast, women hold a majority of council seats in Osilnica (71%) in Slovenia and in Kraljevec na Sutli (71%) in Croatia. Civljane is the smallest local government in Croatia, with 157 inhabitants, whereas Osilnica is the smallest in Slovenia, with 336 inhabitants. The most populated local governments are Zagreb (772,122) in Croatia and Ljubljana (298,227) in Slovenia. Own revenues per capita range from EUR 803 in Turnišče to EUR 2,749 in Solčava (in Slovenia), and from EUR 145 in Proložac to EUR 3,200 in Kolan (in Croatia).

Table 2 Descriptive statistics

Croatian local governments				
	Minimum	Median	Mean	Maximum
Total expenditure deviation	0.02	27.48	30.66	100
Population	157	2,591	6,946	772,122
Own revenues per capita	145.1	535.9	689.4	3,199.8
Female mayor	0	0	0.11	1
Female councillors	0	28.57	28.28	71.43
Slovenian local governments				
	Minimum	Median	Mean	Maximum
Total expenditure deviation	0.51	16.23	19.37	100
Population	336	5,048	10,030	298,227
Own revenues per capita	803	1,076	1,147.5	2,749
Female mayor	0	0	0.14	1
Female councillors	0	33.33	33.45	71.43

Source: Author

Cluster analysis results for total expenditure deviations are presented in Tables 3 and 4 for all Croatian and Slovenian local governments, respectively. The cluster mean values suggest a negative relation between total expenditure deviations and the percentage of female councillors in local government. The main finding is that local governments

with the lowest total expenditure deviations tend to have the highest proportion of female councillors. Conversely, local governments with the highest total expenditure deviations have the lowest share of female councillors. In addition, local governments led by female mayors exhibit lower total expendi-

ture deviations. Therefore, both hypotheses are confirmed.

Croatian local governments form four clusters with various contributions of variables (Table 3). The

most important variable is *female mayor*, ranging from -0.35 (Clusters 1, 2, and 4) to 2.85 (Cluster 3). The lowest contribution of the variable *population* ranges from -0.09 (Cluster 4) to 0.35 (Cluster 2).

Table 3 Average values of variables for Croatian cities and municipalities

Cluster	Number of local governments	% of local governments	Total expenditure deviation	Population	Own revenues per capita	Female mayor	Female councillors
1	187	34	22.54 (-0.38)	5,441 (-0.04)	545.72 (-0.31)	0 (-0.35)	37.5 (0.70)
2	90	16	25.45 (-0.24)	19,087 (0.35)	1,498.14 (1.76)	0 (-0.35)	28.2 (-0.01)
3	61	11	29.81 (-0.04)	5,020 (-0.06)	616.77 (-0.16)	1 (2.85)	36.1 (0.59)
4	218	39	40.00 (0.44)	3,763 (-0.09)	498.96 (-0.41)	0 (-0.35)	18.2 (-0.77)

Note: Cluster means (standardised values) are reported in parentheses.

Source: Author

Cluster 1 can be described as consisting of the best performers. In this cluster, Croatian local governments exhibit the lowest total expenditure deviations, meaning their budget deviations tend to approach zero. These local governments demonstrate stronger expenditure planning capacity, as their executed expenditures are more closely aligned with planned amounts. They also support the hypothesis concerning female representation in local politics, having higher percentages of female councillors. Conversely, Cluster 4 represents the worst performers, where Croatian local governments show

the highest total expenditure deviation and the lowest percentage of female councillors. This pattern is accompanied by the lowest levels of own revenues per capita and the lowest number of inhabitants.

Slovenian local governments form three clusters with different contributions of variables (Table 4). The greatest contribution is that of *female mayor*, ranging from -0.40 (Clusters 1 and 3) to 2.51 (Cluster 2). The lowest contribution is that of *own revenues per capita*, ranging from -0.12 (Cluster 1) to 0.28 (Cluster 2).

Table 4 Average values of variables for Slovenian cities and municipalities

Cluster	Number of local governments	% of local governments	Total expenditure deviation	Population	Own revenues per capita	Female mayor	Female councillors
1	100	47	15.52 (-0.25)	15,078 (0.22)	1,113.44 (-0.12)	0 (-0.40)	42.4 (0.67)
2	29	14	21.85 (0.16)	6,185 (-0.17)	1,226.94 (0.28)	1 (2.51)	36.3 (0.22)
3	83	39	23.14 (0.24)	5,291 (-0.21)	1,160.70 (0.05)	0 (-0.40)	21.6 (-0.89)

Note: Cluster means (standardised values) are reported in parentheses.

Source: Author

Cluster 1 can be highlighted as containing the best performers, as these Slovenian local governments exhibit the lowest total expenditure deviations

(tending toward 0%). They demonstrate stronger capacity for expenditure planning, with executed expenditures more closely aligned with planned

amounts. The results also support our hypothesis that local governments with higher percentages of female councillors tend to have lower expenditure deviations. This relationship is further associated with a higher number of inhabitants and higher own revenues per capita. Conversely, Cluster 3 can be highlighted as comprising the worst performers, where Slovenian local governments exhibit the highest total expenditure deviations and the lowest percentage of female councillors. This pattern is accompanied by the lowest number of inhabitants.

To further comment on female mayors, the average values in each cluster are calculated (Tables 3 and 4). Clusters 1, 2, and 4 (Croatia) and Clusters 1 and 3 (Slovenia) have no female mayors, while Cluster 3 in Croatia and Cluster 2 in Slovenia have female mayors. Thus, total expenditure deviations in clusters with female mayors exhibit an average of almost 30% in Croatian and almost 22% in Slovenian local governments. It is interesting that there are more female councillors in local governments with female mayors—in 11% of Croatian and in 14% of Slovenian local governments, female councillors account for an average of 36% of council members. In local governments where the mayor is a man—89% in Croatia—women councillors account for 27% on average, while in Slovenia (86% of local governments), they account for 33%. Cluster 3 in Croatia encompasses local governments with female mayors and a high percentage of female councillors; with an average of EUR 617 in revenues per capita and around 5,000 inhabitants. Cluster 2 in Slovenia also includes local governments with female mayors, a high percentage of female councillors, and the highest own revenues per capita (EUR 1,227) and around 6,200 inhabitants.

To ensure the robustness of the cluster analysis results, linear regression was conducted using the variables from cluster analysis, with four additional control variables included: grants per capita, political ideology (left and right), and the Herfindahl index, following the approach of research recently published by Stanić et al. (2025). Our findings support a negative relationship between the share of female councillors and total expenditure deviation in the pooled sample of all local governments in Croatia and Slovenia (Table 5). In other words, local governments with higher percentages of female councillors exhibit smaller deviations between executed and planned total expenditures, implying potential benefits of gender diversity in local councils.

However, the effect of having a female mayor is not statistically significant, which is consistent with the findings of Stanić et al. (2025).

Table 5 Linear regression results for the pooled sample of Slovenia and Croatia

Total expenditure deviation	OLS
Population	-0.0001** (-2.08)
Own revenues	-0.0058*** (-3.27)
Female mayor	-1.2773 (-0.52)
Female councillors	-0.0974* (-1.7)
Left	-2.7609 (-1.32)
Right	-4.2383** (-2.53)
Herfindahl	0.2186*** (4.77)
Grants	0.0042** (2.35)
Constant	27.05*** (8.78)
Number of observations	768
Prob > F	0.0000
R-squared	0.0894

Note: t-test values are given in parentheses.
Source: Author

Regression analysis presented in Table 5 examines the factors influencing total expenditure deviations in local governments using an OLS model, which is statistically significant overall. Population size has a small but significant negative effect, indicating that larger local governments tend to experience lower expenditure deviations, likely because of greater administrative capacity. Similarly, a higher share of own revenues is significantly associated with reduced deviations, suggesting that greater fiscal autonomy enhances budgetary discipline. Political orientation indicates that right-wing mayors significantly reduce expenditure deviations, pointing to a more conservative approach to fiscal management, while left-wing mayors show a non-significant negative effect. Political concentration, measured

by the Herfindahl index, significantly increases expenditure deviations, likely because lower political competition weakens accountability. Finally, higher revenues from grants are associated with larger deviations, reflecting the challenges of precise budget implementation when local governments rely heavily on external funding sources.

To conclude, the hypothesis that Croatian and Slovenian local governments with the lowest total expenditure deviations have the highest percentages of female councillors is confirmed (Cluster 1 in both countries). Moreover, in Croatian and Slovenian local governments led by female mayors, there is also a higher share of female councillors and lower total expenditure deviations. Conversely, local governments with the highest total expenditure deviations tend to have the lowest proportions of female councillors and the smallest populations in both countries. The linear regression results support our hypothesis about female representation in local politics, aligning with the findings for 140 Spanish municipalities in the period 2008–2018 (Cuadrado-Ballesteros et al., 2022) and for 128 Croatian cities in the period 2016–2021 (Stanić et al., 2025). Greater female political representation appears to contribute to improved budget outcomes, as the participation of female councillors and mayors enhances the financial performance of local governments.

5. Conclusion

This paper contributes to the ongoing discussion of gender disparity in public administration and women's role in improving governance quality. Its main objective was to examine whether gender influences local government budget credibility, specifically whether female representation in local leadership—through female mayors and/or a higher share of female councillors—affects budget credibility as reflected in total expenditure deviations. The analysis covered 2023 budgets of all 556 Croatian and 212 Slovenian local governments. A comparative analysis of Croatia and Slovenia in the context of local government budgets and women's political representation is particularly valuable given their shared historical and institutional foundations. Both countries encounter comparable challenges, including territorial fragmentation and limited decentralisation, which undermine local governance capacity and budget credibility.

The results show that local governments with the highest share of female councillors exhibit the lowest total expenditure deviations. Moreover, those led by female mayors tend to have more female councillors and smaller deviations in total expenditures. Conversely, local governments with the largest deviations record the smallest shares of female councillors in both countries. These findings confirm both hypotheses: higher female political representation contributes to better-planned and better-executed budgets, implying improved financial management. The results align with the findings of Cuadrado-Ballesteros et al. (2022) and Stanić et al. (2025), while this paper extends the evidence by providing the first cross-country local-level study for Croatia and Slovenia.

From a policy perspective, since greater female representation is associated with lower expenditure deviations, policymakers should strengthen mechanisms that promote women's political participation. Although gender quotas exist in legislation, their effect depends largely on proper enforcement. Quotas are often weakly applied or circumvented, and sanctions for non-compliance are rarely imposed. To ensure that gender quotas lead to genuine political participation and improved budget credibility, authorities must prioritise consistent enforcement, transparent oversight, and stronger accountability mechanisms.

The main policy implication is clear: female representation matters for local government budget credibility in both Croatia and Slovenia. Municipalities with a higher percentage of women councillors tend to have lower total expenditure deviations, while those led by female mayors show medium but still improved fiscal discipline. Future research could expand these findings by employing panel data over multiple years, examining political budget cycles, or including additional determinants such as mayoral tenure and educational background of councillors. Overall, this study demonstrates that women's representation in local politics is not only a question of fairness but also a driver of more credible and disciplined fiscal governance. Enhancing gender balance in political institutions should therefore be viewed as an investment in equality and effective public financial management.

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Appendix

Table A1 Correlation matrix for all Croatian local governments

	Total expenditure deviation	Population	Own revenues per capita	Female mayor	Female councillors	Left	Right	Herfindahl	Grants
Total expenditure deviation	1								
Population	-0.13	1							
Own revenues per capita	-0.14	0.15	1						
Female mayor	-0.01	-0.02	-0.06	1					
Female councillors	-0.03	0.03	0.05	0.21	1				
Left	-0.06	-0.01	0.12	0.07	0.15	1			
Right	-0.05	-0.04	-0.15	-0.10	-0.15	-0.47	1		
Herfindahl	0.14	-0.13	-0.14	-0.03	0.08	-0.01	0.20	1	
Grants	0.06	0.03	-0.24	0.18	0.11	-0.09	0.08	0.08	1

Source: Author

Table A2 Correlation matrix for all Slovenian local governments

	Total expenditure deviation	Population	Own revenues per capita	Female mayor	Female councillors	Left	Right	Herfindahl	Grants
Total expenditure deviation	1								
Population	-0.13	1							
Own revenues per capita	0.32	-0.03	1						
Female mayor	0.06	-0.07	0.11	1					
Female councillors	-0.03	0.19	0.09	0.09	1				
Left	-0.08	0.09	-0.08	-0.06	0.01	1			
Right	-0.05	-0.07	-0.15	-0.08	-0.12	-0.15	1		
Herfindahl	0.01	-0.14	0.08	0.05	0.11	-0.08	0.15	1	
Grants	0.38	-0.13	0.51	0.15	-0.02	-0.10	-0.08	-0.13	1

Source: Author

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SOCIO-ECONOMIC DETERMINANTS OF CO₂ EMISSIONS: EVIDENCE FROM ARDL PANEL DATA ANALYSIS IN BRICS-T COUNTRIES

ABSTRACT

Purpose: This study examines the relationship between carbon dioxide (CO₂) emissions and socioeconomic drivers, including human development (HD), education, financial development (FD), and household consumption for the BRICS-T countries from 2001 to 2022.

Methodology: The study discusses both short- and long-run dynamics while accounting for cross-sectional dependency and heterogeneity across countries by using the panel autoregressive distributed lag (ARDL) model. Data sources include the United Nations and the World Bank hosted databases. Expected years of schooling (EYS) are used as a proxy for educational attainment.

Results: The results indicate significant heterogeneity across the BRICS-T countries. The longrun findings also point to the fact that higher HDI and education levels reduce CO₂ emissions, which shows that sustainable governance and environmental awareness are highly essential for carbon reduction. However, FD has a dual effect, promoting growth as well as carbon-intensive activities. The hypothesis of the environmental Kuznets curve is supported by the findings which indicate that as household consumption structures evolve toward less carbon-intensive activities (reflecting development), there is an associated adjustment toward the long-run equilibrium.

Conclusion: The findings reveal that correction mechanisms are significant for Brazil, India, South Africa, and Türkiye. The study makes a significant contribution to the literature by offering a sophisticated understanding of the socioeconomic factors influencing CO₂ emissions, emphasizing policy directions geared toward sustainable development. The conclusions of this study would be embedded in strategies for striking an appropriate balance between economic growth and environmental sustainability in emerging economies.

Keywords: CO₂ emissions, sustainable development, HDI, panel ARDL analysis, BRICS-T

1. Introduction

Global economic growth, particularly in emerging economies, has been accompanied by environmental challenges, most notably in the form of increasing CO₂ emissions. The BRICST countries of Brazil, Russia, India, China, South Africa, and Türkiye have been very important in this regard, given their rapid industrialization and economic expansion. These countries are among the largest emitters of CO₂ into the atmosphere, largely due to their dependence on fossil fuels and energy-intensive industries (Baloch & Danish, 2022). Economic advances in these nations often involve trade-offs between environmental sustainability and efforts aimed at improving the living standard and rising HD levels.

This turns into a fragile balance where sustainable development requires a simultaneous combination of economic growth, social inclusion, and protection of the environment. In this respect, HDI is a general measure of social and economic development in a country, reflected in health, education, and living standards. While higher HDI levels generally indicate better living conditions, they may also coincide with increased energy use and carbon emissions, making it difficult to achieve environmental sustainability as well (Wang et al., 2019).

Accordingly, education is a vital indicator of HDI, though its role may be complex in this analysis due to e.g. increased ability/requirement for environmental awareness applying sustainable practices. This process may be counterbalanced, as higher educational attainment can make people more economically active, which may result in higher energy-related increased emissions. Understanding the global impact of education on resulting CO₂ emissions will greatly inspire effective policy design (Li & Ullah, 2022).

The other important variable in this matter is FD. A better-developed financial sector could enable investments in clean energy technologies and energy-efficient infrastructure, possibly lowering emissions. At the same time, it may also lead to stimulating industrial activities and increasing consumerism, thereby raising CO₂ emissions. The impact of FD on environmental quality is still under debate (Baloch & Danish, 2022). Similarly, household consumption patterns are crucial drivers of emissions. As income levels rise, consumption tends to increase, but over time, structural changes

in preferences and technology can shift consumption toward cleaner and more sustainable goods and services (Wang et al., 2019).

Hence, the present study attempts to examine the influence of socio-economic factors, namely HD and education, on the environmental performance of BRICS-T countries. While economic growth may imply a rise in living standards, it more often than not leads to greater CO₂ emissions due to increased energy use. On the other hand, education can act as a mitigating factor by increasing awareness and promoting more sustainable consumption. In this context, the central research will be conducted based on the effects of HD, education, FD, and household consumption on CO₂ emissions within these countries.

Although each of these factors (independent variables) has been studied individually in relation to its influence on CO₂ emissions, research examining their combined effects is notably scarce, particularly in BRICS-T countries. Given the distinct economic structures and developmental trajectories of these nations, further analysis is necessary to understand how these factors interact and contribute to CO₂ emissions.

This study explores the dynamic interrelationships among HDI, education, FD, household consumption, and CO₂ emissions in BRICS-T countries from 2001 to 2022. By employing a panel ARDL model, the research captures both short-term and long-term effects, offering valuable insights into the relationship between HD and environmental sustainability. This approach distinguishes between the immediate and enduring impacts of development indicators on environmental outcomes, providing crucial guidance for policymakers aiming to balance economic growth with environmental conservation.

The study relies on international datasets from sources such as the United Nations and the World Bank, covering a period marked by significant economic and environmental changes in BRICS-T nations. The findings reveal key patterns. While consumption expenditure and HD reduce emissions in the long run, which is consistent with economic development and sustainability theories, FD increases emissions in the long run. This highlights the carbon-intensive nature of industrialization in BRICS-T countries. Education has a significant long-run effect in reducing emissions, indicating the importance of investing in human capital. The relation-

ship between FD and emissions is complex. Empirical evidence suggests that FD has a short-term negative impact on emissions, potentially reflecting the transient investments in green infrastructure. Conversely, HDI indicates a positive effect in the short run, suggesting that initial development stages may still rely on carbon-intensive activities.

The structure of this paper is as follows: Section 2 presents the literature review, which outlines the theoretical framework and examines relevant empirical studies on the connections between development, education, and environmental sustainability, with an emphasis on the BRICS-T countries. Section 3 outlines the methodology employed, provides an overview of the data sources, defines the variables, and details the econometric model used in the analysis. This includes the panel ARDL framework and the rationale for employing PMG and MG estimators. Furthermore, the empirical results are presented, followed by a discussion of the key findings related to the short-term and long-term impacts of HD, education, FD, and household consumption on CO₂ emissions. Finally, the conclusion summarizes the main insights from the study, discusses policy implications, and offers suggestions for future research.

2. Literature review

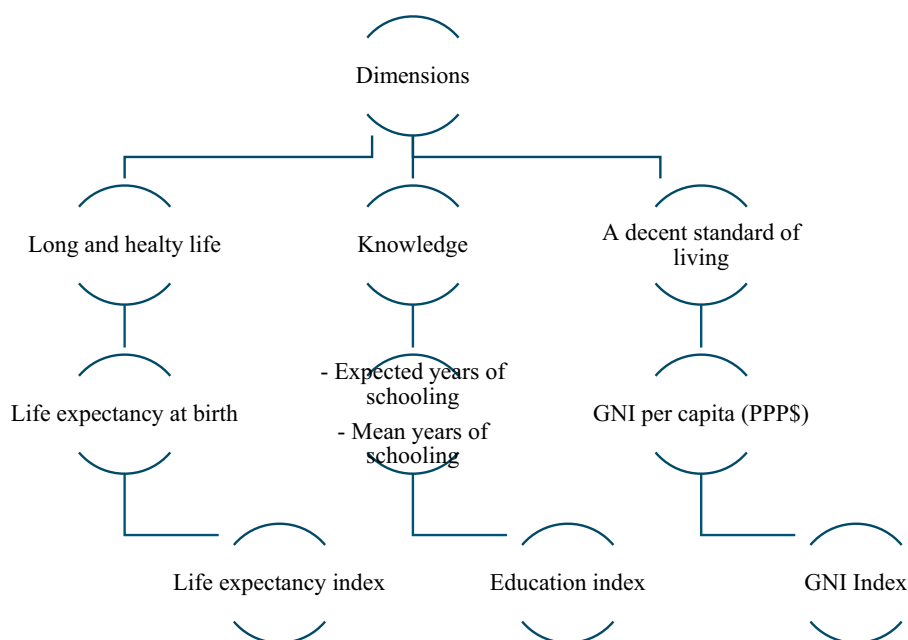
The environmental consequences of socio-economic development have long been debated within the sustainability literature. This study evaluates the contribution of each of the variables regarding socio-economic development in a univariate approach, i.e., education, HDI, household consumption, and FD, to CO₂ emissions. In other words, this section synthesizes key theoretical and empirical contributions that inform the present study and clarifies how each socio-economic factor interacts with CO₂ emissions in the BRICS-T context.

Education and ecological balance are both necessary for a rich and healthy life (Docrat et al., 2019). The higher the level of education, the more influence there is on behavioral aspects and the more environmentally aware the citizens are, which can also affect carbon emissions. With higher levels of education, environmental consciousness could be raised and the practice of sustainable activity that lowers emissions can be promoted. On the other hand, by promoting industrialization and economic expansion, education may likewise raise emissions.

Therefore, the relationship between education and the quality of the ecological environment, including both the direct impact and a mediating role of education, has been shown by current empirical literature (Zhu et al., 2021). Hence, it is widely accepted that education levels directly affect CO₂ emissions including developing and developed countries (Ntanos et al., 2019; Sarwar et al., 2021). For instance, Zhu et al. (2021) state that there is a significant relationship between education level and environmental quality and carbon emissions in China. Similarly, Shobande and Asongu (2022) focus on Eastern and Southern Africa, using third-generation panel unit root and cointegration tests, as well as a panel Granger causality approach. They find that education is a main driver for mitigating carbon emissions. Moreover, Nowotny et al. (2018) point out that sustainability requires development of clean energy technologies; therefore, students' demand for energy education is rising. Yin et al. (2022) evaluated the issue of education within the framework of the COVID-19 period in China. It was concluded that electricity consumption decreased with the increase in online education during that period, and carbon emissions decreased with the elimination of student transportation. Accordingly, Yin et al. (2022) stated that education models are critical to CO₂ reduction and a sustainable environment.

While HD is considered as the process of providing individuals with freedom and opportunities for their well-being, HDI has recently been widely used to measure national well-being and national development (Ahmad et al., 2020; Akbar et al., 2021; Sadiq et al., 2022). In this context, UNDP (2025) points out that *"The HDI was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone."* HDI comprises three core dimensions: a long and healthy life, knowledge, and a decent standard of living, as depicted in Figure 1. The three dimensions also include three different indices. These indices are the life expectancy index for the long and healthy life dimension, the education index for knowledge, and the GNI index for a decent standard of living dimension. The life expectancy index is derived from life expectancy at birth, the education index incorporates both expected and mean years of schooling, and the GNI index is based on GNI per capita.

Figure 1 HDI dimensions and indicators



Source: Sen & Anand, 1994

As suggested by Sen and Anand (1994), HDI is a widely utilized economic indicator with a close relationship to industrial development and air quality. For instance, Pervaiz et al. (2021) examine the relationships between HDI and CO₂ emissions in Brazil, China, India, and South Africa, using panel cointegration tests for the 2000Q1–2014Q4 period. Their findings indicate that HDI and CO₂ exhibit a long-term integrated relationship, with HDI having a negative impact on CO₂ emissions. Conversely, other studies have found a robust positive relationship between HDI and carbon emissions. A study conducted by Adekoya et al. (2021) examines the nexus between HDI and CO₂ over the period from 2000 to 2014, focusing on 126 countries. The findings of this study demonstrated a positive relationship between HDI and CO₂ emissions. This observation aligns with the hypothesis that an increase in HDI typically corresponds to an increase in a country's energy consumption and a subsequent rise in CO₂ emissions. However, the relationship is complex and varies across different countries and at different stages of development (Li et al., 2022).

Like many other factors, household consumption is also hypothesized to show a significant role in explaining CO₂ emissions (Zhang et al., 2017). Effec-

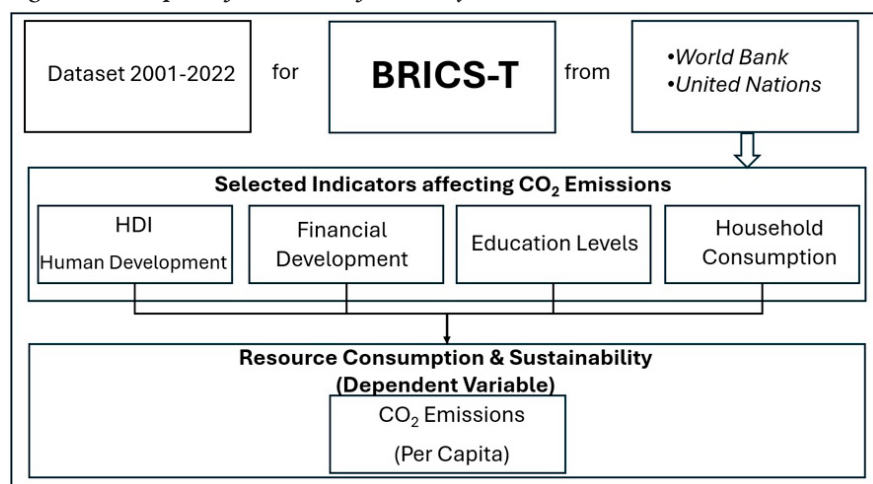
tive management of household energy demand is essential to achieve carbon neutrality goals. Several studies have addressed this issue; among them, the works of Dai et al. (2012) have performed an analysis of the impacts of household consumption on CO₂ emissions in China for the period 2005–2050. Their findings showed a positive relation between household consumption and CO₂ emissions. Li and Wei (2021) concentrated on China to work out the interactions of household consumption and CO₂ emissions using provincial data from 1995 to 2017. It appeared that a higher rate of household consumption is associated with higher CO₂ emissions. Zhou and Gu (2020) emphasize that reducing emissions from household demand requires optimizing energy use and promoting ecological lifestyles. Finally, Zhang (2013) incorporated input-output analysis with some decomposition techniques and analyzed the induced CO₂ emissions by household consumption in China for the period extending from 1987 to 2007. Results indicate that in urban areas CO₂ emissions are liable to increase on a faster scale compared to those in rural areas on account of ascending consumption. These studies underline that managing consumption behavior can significantly reduce environmental degradation.

The market effect associated with financial crises has gone up, while most scholars have always linked FD with economic growth and development but also pointed out its possible impacts on environmental quality and carbon emissions (Zhang, 2011; Jiang & Ma, 2019). FD, characterized by the expansion of financial markets and institutions, shows a dual impact on carbon emissions. Financial development expands access to credit and investment, which may fund cleaner technologies or, conversely, increase industrial activity and energy use. Acheampong et al. (2020) explored the nexus of financial market development with carbon emissions intensity for 83 countries over the period from 1980 to 2015. In this respect, the study showed that FD, proxied by both market depth and efficiency, is associated with reduced CO₂ emissions for both developed and developing economies. Using province data from 1995 to 2017, Liu et al. (2021) concentrated on China to determine the relationship between

FD and CO₂ emissions. Their analysis revealed a positive relationship between FD and CO₂ emissions. Li and Wei (2021) argued that carbon emissions limit the impact of financial and technological development on economic growth. With respect to BRICS countries, Asif et al. (2024) examined the effects of FD, new technologies, economic growth, and trade openness on environmental sustainability. Utilizing data from 2004 to 2023 and employing fixed effect models, the findings indicated that FD has a significant and positive impact on environmental sustainability and CO₂ emissions. In this context, it is suggested that government organizations, in the form of initiatives, must appropriately assess the relationship between FD and emission reduction.

This comprehensive synthesis provides the foundation for understanding the conceptual framework of this research, as illustrated in Figure 2.

Figure 2 Conceptual framework of the study



Source: Created by authors

3. Methodology

This paper employs an extensive econometric analysis to investigate the level of CO₂ emissions in relation to a number of socio-economic and financial variables such as HDI, levels of education, FD, and household consumption for the BRICS-T economies over the period 2001–2022. The estimation method adopts a panel ARDL approach, which accommodates heterogeneity and cross-section dependence between countries, with the objective of

jointly outlining both short-run dynamics and long-run equilibrium relationships.

For clarity and consistency, a unified set of terms and symbols is adopted throughout the paper, and measurement units are reported alongside all estimates. Table 1 is provided to define each variable together with its measurement unit and data source. ARDL coefficients are interpreted with respect to these units (e.g., CO₂ in metric tons per capita; education in years; consumption as % of GDP). Estima-

tor abbreviations (PMG, MG, DFE) are introduced once and then used uniformly, and units are indicated in every results table so that magnitudes and

signs can be read unambiguously. In this way, the meaning of each symbol and the interpretation of each coefficient are made transparent at a glance.

Table 1 Definitions of variables

Abbr.	Variable Description	Measurement Unit	Source
CO ₂	Carbon dioxide emissions per capita	Metric tons per capita	World Bank (WDI)
HDI	Human Development Index	Index (0–1 scale)	UNDP Human Development Reports
EDU	Education (Expected years of schooling)	Years	UNDP Human Development Reports
FD	Financial Development Index	Composite index (normalized)	IMF & World Bank Global Financial Development Database
CONS	Final household consumption expenditure	% of GDP	World Bank (WDI)
ECT	Error correction term	Coefficient (unitless)	Derived from the ARDL model

Source: Created by authors

The model utilizes several econometric tests and models for the robustness of results. The initial step involves the implementation of tests to assess the presence of cross-sectional dependence. The interdependence of countries within the panel is determined through the application of three distinct tests; the Breusch-Pagan LM test by Breusch and Pagan (1980), the scaled LM test by Pesaran (2004), and the CD test by Pesaran et al. (2008) are used to find out the interdependence of countries within the panel. Secondly, slope homogeneity tests are conducted. The Hsiao test is conducted in order to determine whether slope coefficients are homogeneous across countries (Hsiao, 1986). The third step involves the application of panel unit root tests. Initially, the ADF-Fisher-type test proposed by Maddala and Wu (1999) is employed. Subsequently, the PP-Fisher-type test, presented by (Choi, 2001), is utilized to determine the order of integration of the series.

In the present study, after applying preliminary tests and stationarity analysis, cointegration analysis was further applied. The long-term relationship among the variables has been detected by using the Pedroni cointegration tests (Pedroni, 1999; 2004), the Kao test (Kao, 1999), and the Johansen Fisher panel cointegration test. The latter is a combination of Johansen’s cointegration test (Johansen, 1988; 1991) and Fisher’s (1928) combined test. It involves the application of Johansen’s methodology in the

context of panel data using Fisher type aggregation techniques. It is applied and refined by prominent econometricians including Maddala and Wu (1999) and Pedroni (1999). The panel ARDL model is estimated using the Pooled Mean Group (PMG) estimator and the Mean Group (MG) estimator proposed by Pesaran et al. (1999). The primary advantage of the PMG estimator is that it constrains the assumption of homogeneity across countries with regard to long-run coefficients, while allowing for heterogeneity in the short run. In contrast, the MG estimator allows for heterogeneity in both short- and long-run coefficients. The Hausman test is conducted to determine the best model specification. The error correction term in the panel ARDL model is utilized to determine the speed of adjustment toward longrun equilibrium. The panel ARDL model is expressed as:

$$\Delta Y_{i,t} = \alpha_i + \sum_{j=1}^p \beta_{i,j} \Delta Y_{i,t-j} + \sum_{j=1}^p \gamma_{ik} \Delta X_{i,t-k} + \lambda_i (Y_{i,t-1} - \phi_i \Delta X_{i,t-1}) + \varepsilon_{i,t}.$$

In the model, the dependent variable (CO₂ emissions) for country i at time t is represented by $Y_{i,t}$, while the independent variables (HDI, EYS, FIN_DEV, CON_EXP_GDP) are represented by $X_{i,t}$. Additionally, the model incorporates country-specific effects (α_i), short-run coefficients (β_{ij} , γ_{ik}), long-run coefficients for independent variables (ϕ_i), speed of adjustment parameters (λ_i), and error terms ($\varepsilon_{i,t}$).

The error correction model is formulated as:

$$\Delta Y_{i,t} = \alpha_i + \sum_{j=1}^{p-1} \beta_{i,j} \Delta Y_{i,t-j} + \sum_{k=1}^{q-1} \gamma_{i,k} \Delta X_{i,t-k} + \lambda_i COINTEG_{i,t-1} + \varepsilon_{i,t},$$

where $COINTEQ_{i,t} = Y_{i,t} - \phi_i X_{i,t-1}$ is the error correction term. λ_i is expected to be a negative and statistically significant value.

Panel ARDL analysis can deal with mixed-integration-order variables, including I(0) and I(1). Thus, both the short- and long-run dynamics are estimated within a single framework. The estimation method also permits heterogeneity across countries, which is highly valued for drawing accurate policy implications. Such a robust analysis will ensure that the levels of CO₂ emissions are pursued with value-added insight into the individual and collective dynamics of the BRICS-T countries.

4. Results and findings

This study examines the impact of HDI, education, FD, and household consumption on the CO₂ emissions of the BRICS-T countries from 2001 to 2022. The time period under examination is selected on the basis of data availability. Data on HDI and edu-

cation levels are gathered from the United Nations database, while FD and household consumption data are sourced from the World Bank database. Expected years of schooling (EYS) is employed as a proxy for educational achievement. A panel Autoregressive Distributed Lag (ARDL) model is constructed using the aforementioned data, incorporating both pooled mean group (PMG) and mean group (MG) approaches to analyze long-term and short-term dynamics.

The initial preliminary tests entail the examination of cross-sectional dependence among the countries within the panel, and the assessment of homogeneity of the slope coefficient in the long-run equation. The notion that the individual units are independent represents a significant challenge that inevitably arises in the context of panel data analysis. This issue has the potential to influence the estimation of parameters and the interpretation of inferences. The concept of “between-group” dependence has been a prominent feature of social sciences since the 1930s, a considerable period preceding the advent of panel data econometrics (Sarafidis & Wansbeek, 2012). In this context, the term “cross-sectional dependence” is used to indicate whether there is inter-country dependency.

Table 2 Cross-sectional dependence and homogeneity tests

Test	Statistic	Prob.
Breusch-Pagan LM	14.05541	0.5213
Pesaran scaled LM	-0.172458	0.8631
Bias-corrected scaled LM	-0.339125	0.7345
Pesaran CD	-0.15406	0.8776
Specification Tests of Hsiao (1986)		
Hypotheses	F-Stat	
H1	557.7847	6.93E-93
H2	16.08071	2.04E-22
H3	756.8078	9.39E-87
“H1 = Null Hypothesis : Panel is homogeneous vs Alternative Hypothesis : H2”		
“H2 = Null Hypothesis : H3 vs Alternative Hypothesis : Panel is heterogeneous”		
“H3 = Null Hypothesis : Panel is homogeneous vs Alternative Hypothesis : Panel is partially homogeneous”		

Source: Created by authors

As demonstrated in Table 2, all four tests consistently indicate the absence of cross-sectional dependence, as evidenced by p-values exceeding 0.05.

This result fails to reject the null hypothesis, which suggests the absence of cross-sectional dependence. This suggests that the countries included in

the analysis are sufficiently independent with respect to their residuals. Furthermore, the test results point out that there is no evidence of a correlation between countries' unobserved factors and CO₂ emissions. To test for heteroskedasticity, the White (1980) test is employed. The nR² statistic is calculated using the squared residuals as the dependent variable and compared with the critical values of the chi-square distribution. The results demonstrate that there is no evidence of heteroscedasticity.

In view of these diagnostics, the use of first-generation unit root tests that assume cross-sectional independence is warranted, and slope heterogeneity is addressed explicitly at the estimation stage. Moreover, the panel ARDL framework with an error-correction representation (Pesaran et al., 1999) helps to mitigate endogeneity and omitted-variable concerns by capturing dynamic feedback through lags and by conditioning on the long-run relationship. Autocorrelation is likewise handled by the lag structure (selected via Akaike information criteria (AIC)) and by the negative, statistically significant error-correction term reported below. This sequence—cross-sectional checks, unit-root testing under independence (Choi, 2001; Maddala & Wu, 1999), multiple cointegration tests, and ARDL-ECM estimation—follows established practice for panel settings where cross-sectional dependence is not detected (Sarafidis & Wansbeek, 2012).

The Hsiao test indicates that the slope coefficients in the model are not homogeneous. In light of the outcomes of the cross-sectional dependence and homogeneity tests, the subsequent phase of panel data analysis will utilize first-generation unit root tests that assume heterogeneity while accounting for cross-sectional independence.

Table 4 Cointegration tests

Test	Statistic	Prob.	Null Hypothesis	Conclusion
Pedroni Test (withindimension)			No cointegration	Mixed evidence
Panel v-Statistic	-1.236952	0.8919	Fail to reject	No cointegration
Panel rho-Statistic	1.638319	0.9493	Fail to reject	No cointegration
Panel PP-Statistic	-1.810399	0.0351	Reject	Evidence of cointegration
Panel ADF-Statistic	-0.9535	0.1702	Fail to reject	No cointegration
Pedroni Test (betweendimension)			No cointegration	Mixed evidence
Group rho-Statistic	1.87848	0.9698	Fail to reject	No cointegration
Group PP-Statistic	-2.272901	0.0115	Reject	Evidence of cointegration
Group ADF-Statistic	0.543444	0.7066	Fail to reject	No cointegration

Table 3 Unit root tests

Variables/Tests	ADF – Fisher Chi-square	PP – Fisher Chi-square	
D(CO2)	67.7462a (0.0000)	5.4063a (0.0000)	I(1)
D(HDI)	19.5251a (0.0766)	34.1929a (0.0006)	I(1)
D(EYS)	51.4709a (0.0000)	67.0123a (0.0000)	I(1)
FIN_DEV	23.6636b (0.0226)	13.9281b (0.3053)	
D(FIN_DEV)	33.9528a (0.0007)	3.7194a (0.0000)	I(1)
CON_EXP_GDP	28.9744b (0.0040)	18.3921b (0.1043)	
D(CON_EXP_GDP)		76.6779a (0.0000)	I(1)

Note: The numbers in parentheses are the probability values related to unit root tests. Δ is a processor indicating that the first differences of variables are taken. The Schwarz information criterion has been used to determine the optimal delay number. a: none, b: constant.

Source: Created by authors

The variables CO₂ emissions, HDI, expected years of schooling, consumer expenditures in GDP, and FD are stationary at the first difference, as indicated by the first-generation unit root tests (Table 3).

In the subsequent phase of the analysis, the cointegration relationship between the variables is investigated through the use of the Pedroni cointegration test, the Kao test, and the Johansen Fisher test. The results of the aforementioned tests are presented in Table 4.

Test	Statistic	Prob.	Null Hypothesis	Conclusion
Kao Test	ADF	-1.202181	0.1146	Fail to reject
Johansen Fisher Test			No cointegration	Strong evidence of cointegration at multiple ranks
None	246.6 (Trace), 141.1 (Max)	0	Reject	Strong evidence of cointegration
At most 1	163.6 (Trace), 80.25 (Max)	0	Reject	Strong evidence of cointegration
At most 2	102.6 (Trace), 43.87 (Max)	0	Reject	Strong evidence of cointegration
At most 3	78.23 (Trace), 53.73 (Max)	0	Reject	Strong evidence of cointegration
At most 4	54.36 (Trace), 54.36 (Max)	0	Reject	Strong evidence of cointegration

Source: Created by authors

The application of the Pedroni, Kao, and Johansson Fisher tests to the dataset enables the identification of subtle insights into the existence of cointegration across countries. The Pedroni test, which accounts for cross-sectional heterogeneity, yields inconclusive results, with the Panel PP and Group PP statistics indicating evidence of cointegration. In contrast, the Kao test, which assumes homogeneity, is unable to detect cointegration. The Johansen Fisher test offers most compelling evidence, consistently rejecting the null hypothesis of no cointegration at all hypothesized ranks. However, it does not explicitly address heterogeneity. Overall, the evidence

suggests the presence of a cointegrating relationship among the variables.

The subsequent step is to estimate the ARDL model proposed by Pesaran et al. (1999). This model assumes a long-run relationship among the variables, following the establishment of cointegration. In this study, the ARDL (1,1,2,1,1) model is selected based on the AIC, which ensures an optimal balance between model complexity and explanatory power. Table 5 presents the estimated coefficients for both the pooled mean group (PMG) and the mean group (MG) models, which capture the dynamics of the relationships in both the short run and the long run.

Table 5 PMG and MG model coefficients

Variable	Pooled Mean Group (PMG)			Mean Group (MG)		
	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
Long-run Coefficients						
CON_EXP_GDP	-0.096265	-4.879918	0.0000	-0.003474	-0.067565	0.9463
EYS	-0.111808	-2.07342	0.0405	0.507005	0.61673	0.5388
FIN_DEV	0.059324	14.22425	0.0000	0.02944	1.701075	0.0921
HDI	-9.023453	-4.828372	0.0000	-17.97303	-0.987344	0.3259
Short-run (Mean-Group) Coefficients						
COINTEQ	-0.416667	-2.341926	0.021	-0.892343	-4.120264	0.0001
D(CON_EXP_GDP)	0.03032	0.567481	0.5716	0.006248	0.39625	0.6928
D(EYS)	-0.285124	-0.954778	0.3418	-0.398255	-1.070567	0.287
D(EYS(-1))	0.284379	1.999714	0.0481	-0.068689	-0.238742	0.8118
D(FIN_DEV)	-0.021511	-3.551505	0.0006	-0.030855	-2.130643	0.0356
D(HDI)	19.23082	2.479104	0.0147	11.16962	1.179206	0.2412
C	7.836227	2.23872	0.0272	6.485917	2.104959	0.0379

Source: Created by authors

In order to ascertain which of the PMG and MG models is superior, a Hausman test is employed. The results are exhibited in Table 6. In the context of the Hausman test, the null hypothesis states that the PMG model is preferred. The results of the test indicate a statistically significant difference between the PMG and MG estimators (P-value < 0.05). Therefore, the MG estimator is preferable over the PMG estimator. However, the PMG estimator is statistically similar to the Dynamic Fixed Effect (DFE) estimator, indicating that PMG is a superior alternative to DFE. Given that PMG is designed to handle heterogeneity in short-run dynamics across countries (a crucial consideration for BRICS-T nations with diverse economic profiles), and that it is not rejected against DFE, the PMG estimator is the preferred option for the analysis.

Table 6 PMG Hausman specification test

Estimator	Stat.	p-Value
Mean Group	38.082977	0.0000
Dynamic Fixed Effects	4.943653	0.2931

Source: Created by authors

In the PMG model, all long-run coefficients are statistically significant. Consequently, a one-unit increase in consumption expenditure as a percentage of GDP leads to a reduction in CO₂ emissions by 0.0963 units in the long run. This finding is consistent with the environmental Kuznets curve hypothesis (1955), which suggests that as consumption increases, BRICS-T countries transition toward less

carbon-intensive consumption patterns. A one-unit increase in educational attainment reduces CO₂ emissions by 0.1118 units in the long run. It seems reasonable to posit that improvements in education enhance environmental awareness across BRICS-T countries. A one-unit increase in FD is associated with a 0.0593 unit increase in CO₂ emissions in the long run. In BRICS-T countries, FD appears to support industrial expansion and infrastructure development, which are often carbon-intensive. A one-unit increase in HDI reduces CO₂ emissions by 9.0235 units in the long run. Higher HD often coincides with better governance, improved energy efficiency, and adoption of cleaner technologies, which collectively contribute to a reduction in emissions.

The COINTEQ coefficient is negative and statistically significant, indicating that approximately 41.67% of deviations from the long-run equilibrium are corrected annually. This adjustment process is relatively rapid, with BRICS-T countries reaching long-run equilibrium within a few years (approximately 2.4 years). The coefficients for FD and education are significant in the short run. A one-unit short-term increase in FD reduces emissions by 0.0215 units. This is in contrast with the long-run effect, which suggests that short-run financial flows may support low-carbon investments or temporary shifts in economic activity. Short-term changes in HDI are associated with an increase in carbon emissions by 19.2308. This may reflect the initial growth effects of development, where increasing HDI in the short term often accompanies carbon-intensive activities.

Table 7 Bounds tests

Bounds Test for Levels Relationship			
Country	F-Stat.	t-Stat.	Decision on Cointegration
Türkiye	5.276192	-3.321853	Weak evidence at 10% level
Brazil	18.62785	-5.010737	Strong evidence (1% level)
Russia	1.880167	-1.632892	No evidence
India	8.543802	-4.246945	Strong evidence (1% level)
China	4.125407	-0.771953	No evidence
South Africa	9.501309	-5.602375	Strong evidence (1% level)

Source: Created by authors

This study employs an ARDL bounds testing approach to investigate the existence of a levels relationship among variables across six countries. The

null hypothesis of “no levels relationship” is evaluated through the use of F-statistics and t-statistics for each country. The results are then compared

against the critical values for all series that are found to be stationary at level I(1). The findings are presented in Table 7. For Brazil, India, and South Africa, the Fstatistics exceed the upper bound critical values at all levels of significance, providing substantial evidence for rejecting the null hypothesis and indicating cointegration. In the case of Türkiye, the F-statistic exceeds the critical value at the 10% significance level, but not at the 5% level, indicating that the evidence of cointegration is weak. F-

statistics for Russia and China are below the critical value bounds, failing to reject the null hypothesis. The t-statistics yield analogous results. The sole distinction is that the t-statistic for Türkiye fails to provide evidence of cointegration. The error correction term is negative and statistically significant for Türkiye, Brazil, India, and South Africa, confirming the adjustment toward long-run equilibrium as illustrated in Table 8.

Table 8 Error correction coefficients

Short-Run and Long-Run Coefficients (Key Variables)				
Country	Variable	Coefficient	t-Stat.	Prob.
Türkiye	COINTEQ	-0.90823	-5.438181	0.0002
D(FIN_DEV)	-0.036472	-3.160329	0.0082	
Brazil	COINTEQ	-0.243954	-7.239694	0.0000
D(CON_EXP_GDP)	-0.037754	-5.369192	0.0002	
Russia	COINTEQ	-0.2057	-1.121642	0.284
D(CON_EXP_GDP)	-0.079471	-2.87707	0.0139	
India	COINTEQ	-0.056116	-2.469494	0.0295
D(FIN_DEV)	-0.020938	-3.727341	0.0029	
China	COINTEQ	-0.057336	-0.702653	0.4957
D(EYS)	-1.663139	-1.679436	0.1189	
South Africa	COINTEQ	-1.028663	-6.830662	0.0000
D(CON_EXP_GDP)	0.284438	3.917386	0.002	

Source: Created by authors

In conclusion, the results provide strong evidence of cointegration for Brazil, India, and South Africa, as evidenced by both the F-statistics and the error correction terms. In contrast, Türkiye exhibits only weak evidence of cointegration, while Russia and China fail to demonstrate any significant levels relationship. These findings highlight the varying long-run dynamics across countries, emphasizing the heterogeneity in the relationship between economic variables and environmental or development indicators.

5. Discussion and conclusion

The present study focuses on the cointegration analysis between HDI, education, FD, household consumption, and CO₂ emissions for the BRICS-T countries over the 2001–2022 period. Utilizing panel ARDL models, this study provides both

general and country-specific aspects related to the long- and short-run dynamics of these associations.

The findings reveal strong heterogeneity across the countries analyzed. While substantial evidence of cointegration is observed for Brazil, India, and South Africa, indicating the presence of a stable long-run relationship between the variables in these countries, the evidence for Türkiye is comparatively weak, and no significant relationship is observed in the case of Russia and China. Such variation underlines the fact that BRICS-T countries are at different stages of development and, consequently, possess distinct policy environments.

The long-run results show that improvements in education and HD significantly reduce CO₂ emissions. This confirms the view that higher HDI levels and greater environmental awareness promote sustainability through better governance and cleaner

technologies. However, FD presents a mixed effect. It supports growth and infrastructure development but also increases carbon-intensive activities, especially in rapidly industrializing economies like those of the BRICS-T.

Household consumption also plays a complex role. The study finds a negative long-run relationship between consumption expenditure and emissions, which aligns with the Environmental Kuznets Curve hypothesis. As countries advance, consumption patterns shift toward less carbon-intensive goods and services, contributing to lower emissions in the long term.

A deeper examination of the short-run results of the study reveals the presence of rapid adjustment mechanisms within the BRICS-T countries. The COINTEQ coefficient suggests that deviations from equilibrium are relatively quickly corrected, especially for Brazil, India, South Africa, and Türkiye. The short-run dynamics reflect transitional economic activities that may lead to temporary emission increases, as evidenced by changes in HDI.

To contextualize the short-run HDI result, note that HDI is scaled 0–1 and annual changes are typically small. Under the PMG estimate reported in Table 5 ($\Delta\text{HDI} \approx 19.23$, $p < 0.05$), a 0.01 increase in HDI implies an increase of about 0.19 tons of CO₂ per capita in the short run (19.23×0.01). This magnitude is therefore moderate and consistent with transitional dynamics: rapid improvements in health, schooling, and income can temporarily raise energy use before efficiency gains and cleaner technologies diffuse. This interpretation is also consistent with our negative long-run HDI coefficient, which indicates that higher HD ultimately aligns with lower emissions; similar short-run/long-run contrasts are reported in peer-reviewed studies on human development/human capital and emissions in emerging economies (Adekoya et al., 2021; Wang et al., 2019).

The findings of this study are consistent with previous research in the literature. For example, Zhu et al. (2021) and Shobande and Asongu (2022) report a positive role of education in emissions reduction. The bidirectional effect of FD also supports

the findings of Acheampong et al. (2021) and Liu et al. (2021). However, the observed heterogeneity among BRICS-T countries highlights the importance of incorporating regional and country-specific factors into policy design for sustainable development.

The study emphasizes that achieving balanced economic growth with environmental sustainability necessitates customized strategies with policy interventions prioritizing investments in education, sustainable financial systems, and clean technologies, while promoting consumption patterns aligned with carbon neutrality goals. The findings provide valuable insights for policymakers and researchers who aim to address the pressing challenges posed by climate change in emerging economies. In this regard, the importance of education should be highlighted, as it is crucial for achieving long-term emissions reductions by fostering environmental awareness and green innovations. HD initiatives must incorporate low-carbon measures, and long-term policies should aim to redirect FD toward sustainable practices that impact carbon emissions.

This study relies on the best available annual data for BRICS-T (2001–2022); some institutional or technology variables could not be observed directly. These are the primary limitations of research. The dynamic ARDL–ECM design and diagnostic sequence help mitigate simultaneity, autocorrelation, and spurious long-run inference, but endogeneity cannot be ruled out entirely (Pesaran et al., 1999). Cross-sectional dependence was not detected in our sample; nonetheless, time-varying common shocks remain a general caveat (Sarafidis & Wansbeek, 2012). These points do not alter the main conclusions but mark natural directions for future work, e.g., testing structural breaks when longer series are available or exploring instrumented estimators as additional sensitivity. Future research could include additional socio-economic variables and extend the inquiry to other developing regions to gain a more comprehensive understanding of these dynamics.

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A SIMULATION-BASED APPROACH TO CALIBRATING TARGET FUND LEVELS FOR INVESTOR COMPENSATION SCHEMES

ABSTRACT

Purpose: Investor compensation schemes (ICSs) provide a safety net for retail investors when investment firms fail. However, the optimal level of ex-ante funding remains largely undefined. This paper proposes a quantitative framework to calibrate target fund size, based on operational risk logic.

Methodology: The study applies a Monte Carlo model incorporating firm-level exposure data, supervisory risk classifications (SREP), and stochastic loss distribution (Beta-distributed loss given default). The simulation estimates expected ICS liabilities across 100,000 simulations, capturing low-frequency, high-severity loss patterns.

Results: The model confirms a highly skewed distribution of losses. Based on data from the Croatian market, while most simulations result in no payout, the 99th percentile loss reaches EUR 18.7 million, with a maximum payout exceeding EUR 96 million. The results validate the use of risk-sensitive approaches over fixed-percentage benchmarks and highlight the importance of confidence intervals in reserve planning.

Conclusion: This paper contributes a novel, adaptable methodology to size ICS funds based on probabilistic modelling. It supports regulators in transitioning from static to evidence-based reserve targets. Future refinements could involve dynamic monitoring, enhanced estimation of loss given default, and integration of SREP scores into contribution mechanisms.

Keywords: Investor compensation scheme, target fund level, SREP

1. Introduction

Investor compensation schemes (ICSs) are a core component of the regulatory architecture that governs capital markets and protects retail investors (Burke, 2009). While often compared to deposit

guarantee schemes (DGSs), ICSs differ in both purpose and systemic significance. DGSs are designed not only to safeguard depositors but also to preserve financial stability and prevent bank runs. By contrast, ICSs are aimed primarily at investor pro-

tection and market integrity rather than systemic risk mitigation.

Modern financial regulation employs a layered framework to manage investor risk. This includes disclosure obligations, conduct-of-business rules, prudential requirements, and ultimately compensation schemes. ICSs serve a critical function within this framework by providing coverage for retail investors unable to recover assets from failed investment service providers. They are underpinned by both microeconomic and macroeconomic rationales: at the micro level, ICSs mitigate agency problems between investors and intermediaries, particularly given the informational disadvantages retail clients face (Llewellyn, 1999); at the macro level, they support confidence in market infrastructure and institutional trust (Garcia & Prast, 2004). Importantly, ICSs only activate when mechanisms such as asset segregation or compliance oversight fail, making them a residual but essential element of investor protection (Moloney, 1999, p. 455).

Despite their practical importance, ICSs remain underexplored in the academic literature, particularly with respect to the calibration of ex-ante funding models. While a rich body of work addresses target fund levels for DGSs, there is a noticeable absence of comparable analysis for ICSs. This is especially relevant given that Directive 97/9/EC (Investor Compensation Schemes Directive, or ICSD) requires EU Member States to establish such schemes but provides no guidance on how to determine appropriate funding levels. As a result, national ICSs vary widely in terms of funding structures, reserve accumulation strategies, and governance models.

This paper seeks to fill that gap by proposing a novel methodology for determining the target level of an ICS fund. Drawing on frameworks used in operational risk modelling—well-established in banking supervision under the Basel framework—we conceptualise ICS losses as operational risk events. These are typically low-frequency but high-impact failures arising from mismanagement, fraud, or administrative breakdowns in investment service providers. This framing allows us to leverage established quantitative techniques from risk management to estimate loss distributions, set reserve levels at specific confidence intervals (e.g., 95% or 99%), and simulate payout scenarios under stressed conditions.

Our contribution to the literature is threefold. First, we bring an analytical structure to an area that has largely relied on qualitative judgment or political negotiation. Second, the proposed model is flexible and adaptable to different jurisdictional settings: it can incorporate variation in investment service types (e.g., execution of orders, portfolio management, safekeeping of assets), local market practices, and regulatory frameworks. Third, the approach supports evidence-based supervision by linking target fund levels to measurable inputs, improving both transparency and policy defensibility.

The central hypothesis of this study is that ICSs can—and should—adopt risk-sensitive approaches to ex-ante fund sizing. Relying on static contributions or arbitrary targets does not sufficiently reflect the underlying risk distribution of potential compensation events. A data-driven, probabilistic model, grounded in operational risk logic, offers a more effective and credible approach to reserve planning.

Accordingly, the research goals of the paper are:

- (1) to advance a conceptual rationale for treating ICS exposures as operational risks;
- (2) to develop a simulation-based methodology that uses Monte Carlo techniques to estimate potential ICS liabilities at various confidence thresholds; and
- (3) to demonstrate how this methodology can be tailored using service-level and firm-level parameters, making it both scalable and jurisdiction-specific.

Methodologically, the paper introduces a Monte Carlo simulation framework that integrates firm-level failure probabilities, service-specific exposure data, and loss given default distributions to estimate aggregate ICS liabilities. The use of stochastic modelling allows for the incorporation of volatility in retail trading activity and client asset profiles, particularly for services like order execution, where exposure is more variable. Unlike credit risk-based models or fixed multiplier approaches, the proposed method reflects the heterogeneous risk landscape of investment service providers and their clients.

The paper is structured as follows. After this introductory section, the next section sets out the theoretical and conceptual background of ICSs, distinguishing them from DGSs and explaining their place in the regulatory ecosystem. The meth-

odology section follows, detailing the simulation framework and key modelling assumptions. The subsequent empirical section presents the simulation results and discusses their implications for ICS target levels. Finally, the paper concludes with observations on limitations, policy relevance, and areas for future research.

2. Theoretical and conceptual framework

The academic literature addressing the optimal sizing of ICSs remains strikingly limited. Shkolnyk et al. (2017) attempt to approach this challenge by applying a modified Markowitz portfolio model to determine the ICS fund size. However, their model avoids quantifying potential compensation levels, citing the difficulty of predicting loss events and defining plausible boundaries. Saad and Elsayed (2016), in turn, evaluate the capital adequacy of the Egyptian Investor Protection Fund using historical indicators such as premiums collected, market capitalisation, and the number of investors, traders, and listed companies, but without proposing a generalisable or risk-based methodology.

Other contributions focus on the structural characteristics of national ICSs. Bogna (2009) and Kazandzhieva and Mladenov (2008) conduct comparative assessments of the Polish and Bulgarian schemes, respectively, against broader European standards. A more recent study by Kazandzhieva and Ralinska (2024) highlights the low public awareness of the ICS in Bulgaria, contrasting it with the DGS.

From a regulatory standpoint, efforts have been made to bring more structure to ICS funding. In its 2011 proposal to the ICSD, the European Parliament recommended that ICSs adopt mandatory ex ante funding with a target level equal to 0.5% of the value of monies and financial instruments held, administered or managed by investment firms, to be reached within ten years (Lamandini et al., 2011, p. 9). This approach closely resembles deposit guarantee funding models in several Member States (Oxera, 2005, p. 83). However, this paper argues that such fixed-percentage models are suboptimal for ICSs. They do not reflect the probability of asset loss following a firm failure, nor do they rely on jurisdiction-specific data or empirical claims experience. Moreover, they are particularly ill-suited for small jurisdictions with limited numbers of investment service providers.

By contrast, deposit guarantee has inspired a broader body of academic work. Some of this literature focuses on pricing mechanisms (Chan et al., 1992; Bernet & Walter, 2009), others examine how insurance levels affect social welfare (Dávila & Goldstein, 2023), and several papers explore the behavioural responses of market participants (Manz, 2009). Studies also address how to determine the optimal capital size of a deposit insurance fund. This is usually conceptualised as a trade-off between financial safety and moral hazard: higher protection levels improve depositor confidence but may disincentivise prudent risk management by banks and depositors (Bernet & Walter, 2009, p. 48). Three groups of models can be found.

In more sophisticated models, the optimal fund size is a function of risk exposure, typically determined by the probability of failure, volume of covered deposits, and loss given default (Bernet & Walter, 2009; O’Keefe & Ufier, 2017). Some frameworks also account for contagion effects and the DGS diversification potential. These models express expected losses (EL) for the DGS as the sum of products of all exposures at default (EAD), probabilities of default (PD), and losses given default (LGD) (Ogjenovic, 2017, p. 166):

$$EL = \sum EAD_i \times PD_i \times LGD_i \quad (1)$$

EAD_i is the amount of covered deposits in a member bank “i” which has a probability of failure PD_i. LGD_i is the share of losses the DGS will suffer in case a particular bank fails (the amount that is not recovered). While default probability estimates may be informed by ratings, CDS spreads, or option prices, these models are limited by a lack of past statistical and empirical data, and assumptions of loss independence, which are unlikely to hold during systemic crises. Furthermore, statistical calculations are made difficult by the presupposed skewed distribution function of losses, where long periods of low losses contrast with short periods of high losses (Bernet & Walter, 2009, pp. 48–50).

A second group of models is based on historical experience. Given sufficient data on failure costs, it is possible to determine the level of losses that the DGS should be able to absorb. However, countries with limited experience in closing failed banks will lack sufficient data to develop an accurate empirical loss distribution and may have difficulty estimating the likelihood of low-probability, high-loss events.

From this perspective, models based on credit risk appear better suited as they are forward-looking and more adaptable to jurisdictions with limited empirical data. They also allow stress-testing of assumptions and adapt to current economic or institutional realities (O’Keefe & Ufier, 2017, p. 5)

Finally, a third methodological category for determining the target fund size is expert opinion. This approach is inherently discretionary, relying on judgment or regulatory “feeling” rather than a formalised methodology. In practice, many DGSs adopt this approach by setting the target level arbitrarily, typically using a bottom-up cumulative method. Under this method, the fund is sized to cover the potential failure of a given number of the smallest credit institutions, or in some cases, a few medium-sized ones. In contrast, banks considered “systemic” for DGSs and financial resolution are generally excluded from this calculation, as their potential failures are expected to be managed through broader safety-net mechanisms involving multiple authorities (Ognjenovic, 2017, pp. 160–162).

The same logic applies to ICSs. However, although deposit guarantee models can inform ICS design, there are crucial differences. Deposits are direct liabilities of credit institutions and typically lack legal safeguards such as segregation from the credit institutions’ own assets. In contrast, client assets held by investment firms often benefit from protective mechanisms, including segregation and custodian arrangements, that reduce the LGD in case of the investment firm’s default. Still, these mechanisms are not fail-proof. Failures can result from operational lapses, misappropriation, or regulatory loopholes, thus justifying the need for ICSs as a residual safety net.

Furthermore, ICS-eligible entities span a wider spectrum, including investment firms, credit institutions, and fund managers authorised to provide MiFID services. In this paper, we call them collectively investment service providers. Business models vary considerably, as do risks stemming from service types such as order execution, safe-keeping, portfolio management, and underwriting of financial instruments. The European regulatory framework, particularly Directive 2014/65/EU (MiFID II), requires “adequate arrangements” to protect client assets (Art. 16, paras. 6, 8–10) but leaves specifics to national implementation. This regulatory ambiguity generates cross-country variation in risk exposure and practices. For example, some

jurisdictions require client assets to be held with third-party custodians, while others permit internal segregation, creating divergent failure pathways (Oxera, 2005, pp. 112–113).

Given this complexity, the use of standard deposit guarantee methodologies to size ICS funds is questionable. Importantly, although the default of an investment service provider may result from credit or market risk, loss of client assets originates from operational risks. Hence, this paper proposes to reconceptualise ICS fund sizing within an operational risk framework.

The proposed methodology draws theoretical support from the well-established field of operational risk modelling, particularly as developed under the Basel II and Basel III regulatory frameworks for banking supervision. Under these frameworks, operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people, systems, or external events. This includes losses from fraud, mismanagement, legal uncertainty, or system failures —risk categories that closely align with the potential failure modes covered by ICSs.

Although ICSs operate outside the core banking prudential framework, their loss characteristics exhibit features comparable to operational risk. Specifically, ICS-related losses arise not from market or credit failures, but from events such as fraud, improper asset segregation, or failure of client protection protocols. These events are typically low-frequency but potentially high-severity, with outcomes dependent on legal enforceability and operational resilience. The nature of these risks makes them poorly suited to traditional credit risk models but amenable to loss distribution approaches, which form the backbone of advanced measurement approaches under the Basel framework.

Incorporating this conceptual lens enhances the methodological robustness of ICS fund sizing. By applying a Monte Carlo simulation based on distributions of exposure and LGD, the paper mirrors the loss distribution approach used by banks to model extreme operational events. This theoretical mapping supports the use of skewed, bounded distributions (such as the Beta distribution) for estimating potential losses, while also justifying the application of high confidence intervals (e.g., 99th percentile) in fund adequacy assessments. Embedding ICS modelling within this framework strengthens the rationale for moving away from static or purely

heuristic fund targets toward a more risk-sensitive and forward-looking methodology.

To our knowledge, this is the first academic effort to apply operational risk theory to ICSs. This perspective allows for a stronger assumption of independence between loss events (compared to correlated bank failures) and enables the use of simulation tools to model tail risks and low-frequency, high-severity losses. Monte Carlo simulations, informed by firm-level failure probabilities, client exposure distributions, and ICS payout caps, can offer more precise and defensible estimates of target fund size.

Recent advances in operational risk modelling have introduced more sophisticated estimation techniques, including Bayesian inference, extreme-value theory, and copula-based dependence structures to capture tail correlations between loss events (see e.g. Shevchenko, 2011; Chernobai et al., 2007; Chernobai & Rachev, 2007). Although these methods have not yet been applied to ICSs, they provide a conceptual foundation for future extensions of the framework proposed in this paper.

3. Methodology

This section presents the methodological framework used to estimate the optimal target fund size for ICSs. It combines a conceptual mapping of ICS losses to operational risk events with a quantitative Monte Carlo simulation. The framework consists of two main components. Section 3.1 describes the data sources and assumptions underlying the estimation of exposures, while Section 3.2 outlines the modelling approach, including the derivation of default probabilities, the specification of loss distributions, and the structure of the simulation.

3.1 Data collection

Publicly available data on exposures relevant to ICS is extremely limited, making empirical modelling and simulation exercises inherently challenging. Despite its age, Oxera (2005) remains the most comprehensive publicly available source on ICSs. The report notes that most schemes do not maintain records of protected client monies or securities held by participating firms. Furthermore, it finds that only a small number of ICSs have conducted rigorous assessments of their funding adequacy, with the majority relying instead on simplistic heuristics to determine their target fund size.

For this study, we constructed a representative dataset using limited publicly available information on Croatian investment service providers and a series of approximations. While these approximations are necessarily crude, their limitations do not undermine the theoretical validity of the proposed methodology. In practical application, financial regulators would have access to more granular firm-level data and could tailor the model accordingly. We focus on the Croatian market for two reasons: first, the authors possess detailed knowledge of its institutional contexts, allowing for effective application of reality checks; second, the 2024 amendments to the Croatian Capital Market Act introduced a legal obligation for the national regulator to determine a target fund size for the ICS (Article 280, paragraph 8), making this a timely and policy-relevant case study.

The modelling framework requires service-specific estimates of ICS exposure, which we define as the potential loss of eligible client assets. In this study, we focus on three core services: (1) reception, transmission, and execution of orders, (2) portfolio management, and (3) safekeeping and administration of financial instruments. We exclude the service of underwriting and placing of financial instruments despite its theoretical relevance, as it is infrequently offered in the Croatian market. Notably, this service also lacks detailed asset segregation requirements, introducing additional risk. As with other services, the critical risk driver is not merely the failure of the investment firm, but the effectiveness of legal safeguards designed to protect client assets, and the probability of those safeguards failing due to operational errors or fraud.

To contextualise our data approximations, it is useful to summarise the Croatian regulatory framework governing client asset protection. Article 80 of the Capital Market Act sets out core obligations: investment service providers must implement safeguards to preserve clients' property rights, prevent proprietary use of client financial instruments without explicit consent, and—for non-bank investment service providers—ensure that client money is not used for proprietary purposes. Segregation is typically implemented through internal record-keeping rather than third-party custodianship. Crucially, client assets are legally separate from the firm's estate and are excluded from liquidation or bankruptcy proceedings. Moreover, client cash held in deposit accounts at credit institutions is protected

from creditor claims in the event of the bank's failure. These rules enhance asset protection but could benefit from more detailed secondary legislation to eliminate interpretative ambiguity—particularly regarding cross-border custodianship, securities lending, margin accounts, etc.

Our study includes 19 investment service providers covering the entire Croatian market: five investment firms, ten credit institutions, and four fund management companies authorised to provide portfolio management services.

To approximate exposure from the service of reception, transmission, and execution of orders, we used publicly available data on market share (measured by the number of transactions), assumed an average trade size of EUR 3,200 per eligible investor, and estimated that 470 eligible investors were active daily on the Zagreb Stock Exchange. With an

average of 21 trading days per month, this yields an annual retail turnover of approximately EUR 379 million, closely aligned with retail trading figures provided by the Zagreb Stock Exchange (EUR 390 million in 2024). Assuming a settlement period of T+2, we estimate exposure over a three-day horizon. Furthermore, based on audited accounts from two leading firms, we assume that Croatian investors trade 1.27 times more frequently on foreign exchanges than on the Zagreb Stock Exchange. While these are rough estimates, they align with market data and do not compromise the conceptual integrity of the model. One limitation is the simplifying assumption that each day's cohort of eligible clients is unique, potentially overstating exposure. Individual investment service provider figures are detailed in Table 1.

Table 1 Total eligible client assets per relevant service (in EUR)

Investment service provider	Order transmission and execution	Portfolio management	Safekeeping of financial instruments	Total
IF1	1,583,641	2,307,329	176,779,957	180,670,927
IF2	86,244	80,619	1,749,623	1,916,486
IF3	1,370,230	0	186,109,561	187,479,791
IF4	883,484	3,624,918	79,549,374	84,057,776
IF5	1,768,177	2,447,134	1,092,364	5,307,675
CI1	1,459,969	0	140,808,954	142,268,923
CI2	213,695	5,763,768	5,997,806	11,975,269
CI3	150,978	3,984,334	65,348,187	69,483,499
CI4	0	0	2,440,968	2,440,968
CI5	298,797	0	56,769,930	57,068,727
CI6	322,122	12,271,753	70,788,058	83,381,933
CI7	0	0	19,388,256	19,388,256
CI8	1,008,303	0	125,256,504	126,264,807
CI9	0	0	5,230,645	5,230,645
CI10	1,103,094	0	175,470,693	176,573,787
FM1	0	44,110,448	0	44,110,448
FM2	0	46,563,782	0	46,563,782
FM3	0	58,650,551	0	58,650,551
FM4	0	48,545,219	0	48,545,219
TOTAL	10,248,759	228,349,855	1,112,780,878	1,351,379,469

Note: IF = investment firms, CI = credit institutions, FM = fund managers

Source: Authors' own calculations

Exposure from portfolio management services was modelled using available public data and firm-level disclosures. Asset volumes per provider category were drawn from official sources, while detailed figures for the three largest managers (representing 75% of total assets) were extracted from their audited statements. Portfolio sizes for investment firms and banks were estimated at EUR 20,000 or EUR 50,000, depending on provider size, while average portfolios at the three largest fund managers ranged from EUR 250,000 to EUR 350,000. Because fund managers are not authorised to safeguard financial instruments directly, they use third-party custodians. Details are provided in Table 1. For modelling purposes, we assume 2,572 eligible clients, each above the EUR 20,000 compensation cap.

For safekeeping services, total exposure was estimated using public figures by provider type, supplemented by audited reports where available. We assumed that 3% of assets under custody at credit institutions and 75% at investment firms were held on behalf of eligible clients. This translates to roughly 5% of total custodial assets. As with portfolio management, it is assumed that all clients exceed the EUR 20,000 coverage limit. While these estimates are imprecise, their purpose is to illustrate the model's structure rather than provide precise risk measures. As shown in Table 1, safekeeping poses the largest risk in terms of eligible client assets, followed by portfolio management. Order execution services contribute the least, which is consistent with the relatively low liquidity of the local market and limited retail trading activity. Table 1 also highlights variation in per-client exposure based on firms' business models, with firm IF1 standing out due to its significant custody-related risk. It is important to note that the figures presented in Table 1 reflect gross exposures of eligible clients. The actual exposure of the ICS fund is significantly lower in practice due to the EUR 20,000 per-client compensation cap established by the scheme.

3.2 Modelling

To estimate expected losses for the ICS, this paper develops a modelling framework inspired by the credit risk model presented in Section 2, adapted specifically to the operational realities of the investment services industry. Like credit risk models, it uses exposure at default (EAD), probability of default (PD), and loss given default (LGD). However,

instead of relying on a static formula, the proposed approach employs Monte Carlo simulations to model stochastic elements of exposure and loss.

Exposure at default (EAD) is determined at the level of each relevant investment service, as outlined in Section 3.1. Because exposures from order transmission and execution services are inherently volatile, the model does not use the static averages presented in Table 1. Instead, a nested Monte Carlo simulation is employed to simulate fluctuations in retail trading volumes, assuming that eligible clients exhibit highly correlated behaviour in response to market conditions. This simplification is defensible, given that retail investor flows are often driven by common external factors. It also allows us to assume that the standard deviation of trading volume of any single investor is equal to the standard deviation of trading volume of the retail market divided by the number of clients. The standard deviation of daily orders is approximated by dividing the monthly retail turnover estimate by the square root of the number of trading days, applying the standard square-root-of-time rule under the assumption of independent daily fluctuations. To model this volatility, a lognormal distribution is applied to capture the nonnegative, skewed nature of trading volumes. The distribution parameters (μ and σ) are derived from the mean and standard deviation of the underlying data.

In contrast, exposures related to portfolio management and safekeeping services are relatively stable and are therefore treated as static inputs in the model. At the firm level, exposure is generated by combining the number of eligible clients, the volume of assets per client, and the ICS coverage cap of EUR 20,000. A simplifying assumption is made that clients across services are distinct and all exposed at the average volume of assets, which likely overstates total exposure but simplifies modelling in the absence of client-level data.

We propose to derive the probability of failure for each investment service provider using the supervisory review and evaluation process (SREP) classification and scores, which offer a structured regulatory assessment of firm risk. Traditional proxies such as credit ratings or CDS spreads are often unavailable for small firms, making SREP scores a more suitable alternative. These scores are widely applied by regulators under harmonised EU guidance (EBA & ESMA, 2022) and can be reliably used in regulatory simulations. SREP scores are not publicly

available. They are ratings from 1 to 4 that reflect an entity's risk profile, with 1 indicating low risk and 4 indicating high risk. For this paper, they were assigned by the authors based on informed judgment, using observable firm characteristics such as size, business model, and service complexity. These assumptions serve solely to demonstrate the structure and functioning of the proposed model rather than to reproduce actual supervisory assessments. In applied settings, financial market regulators would substitute these illustrative inputs with official SREP data.

Firm-specific probabilities of default (PD_i) are calculated using the following equation:

$$PD_i = \text{Base_}PD_i \times (1 + \text{AdjSREP_}os_i + \text{AdjSREP_}gs_i \times \text{AdjServices}_i), \quad (2)$$

where:

- Base_ PD_i represents the baseline probability of default corresponding to the firm's supervisory class, as shown in Table 2.
- AdjSREP_ osi is an adjustment reflecting the firm's overall SREP score, capturing its general risk profile across business, capital, and liquidity dimensions.
- AdjSREP_ gsi is an adjustment derived from the SREP internal governance score, serving as a proxy for operational risk and internal control quality.
- AdjServices i represents an adjustment for the number of MiFID II services and activi-

ties the firm provides, as a measure of operational complexity.

The model adjusts the base probability of default using a set of additive modifiers representing risk factors. Each risk factor (the overall SREP score, the internal governance SREP score, and the number of services provided) adjusts the base probability by a given amount, reflecting increased or reduced risk. This approach allows for proportional yet bounded variation in firm-level default probabilities.

Table 2 presents the assumed base probabilities of default by SREP classification. These are based on the firm's systemic importance, business model, and size. While these estimates are based on judgment rather than historical data, they are consistent with public disclosures by ICSs such as EdW (Germany) or FGDR (France), which report annual failure rates of less than 1% for small investment firms. The rationale behind base probabilities of default is that larger investment service providers involved in riskier activities are subject to stricter supervision and capital requirements, resulting in lower base probabilities of default. In addition, these entities are more likely to benefit from resolution procedures in case they fail or are likely to fail.

In the next step, idiosyncratic adjustments are applied to reflect each firm's individual risk characteristics. These include the SREP overall score (SREP_ osi), the SREP internal governance score (SREP_ gsi), and the number of services provided (Services $_i$).

Table 2 SREP category and base probabilities of default

Category	Description	Base probability of default
Class 1	Credit institutions and systemically important investment firms	0.001
Class 2	Investment firms exceeding the threshold for not being classified as small and non-interconnected but not treated as Class 1	
Class 2, Category 1	Total assets and off-balance sheet exposures > EUR 1 bln; or > EUR 250 mln and engages in dealing on own account and underwriting/placing on a firm commitment basis	0.003
Class 2, Category 2	Total assets and off-balance sheet exposures < EUR 1 bln and > EUR 250 mln, and engages in neither dealing on own account or underwriting/placing on a firm commitment basis	0.004
Class 2, Category 3	Total assets and off-balance sheet exposures < EUR 250 mln and do not meet the conditions for Class 3	0.005
Class 3	Small and non-interconnected firms as defined in Article 12 of the Regulation (EU) 2019/2033	0.005

Source: EBA & ESMA (2022), authors' estimates

The base probability of default is adjusted by 0 for SREP score 1 (the lowest risk), 0.25 for SREP score 2, 0.5 for SREP score 3, and 2 for SREP score 4 (the highest risk). The SREP internal governance score is treated as a proxy for operational risk, given that failures in internal controls are the primary channel through which client assets may be compromised despite legal protection.

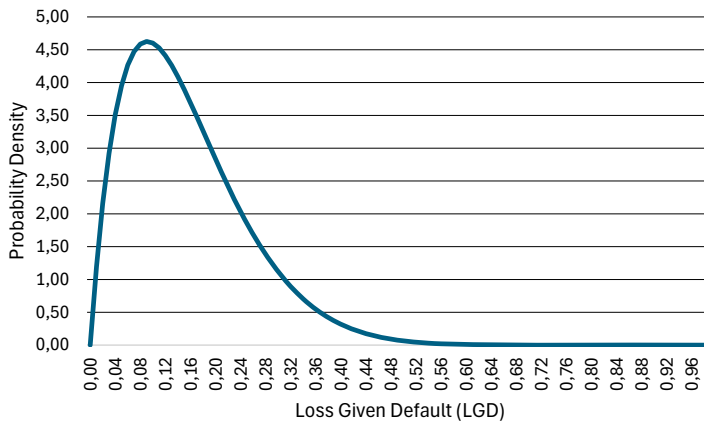
Operational complexity is proxied by the number of MiFID II services and activities a firm is authorised to provide. Each additional service implies new operational systems and regulatory obligations, increasing potential points of failure. This modular approach allows the model to reflect varying firm profiles with minimal data input. The base probability of default is decreased by 0.25 for firms offering only one service and increased by 0.25 for firms offering four or five services.

Loss given default (LGD) is modelled as a random draw from a Beta(2,11) distribution. The Beta distribution is particularly suitable for LGD because it is confined to the (0,1) interval and allows flexible skewness depending on its parameters. It is also widely used in credit and operational risk literature

to model low probabilities of high losses (e.g., Arias-Serna et al, 2024; Bruche & Gonzalez-Aguado, 2010; Gupton & Stein, 2002; Peters & Sisson, 2006; Huang & Osterlee, 2011; Gelman et al., 2013). The specific parameters $\alpha=2$ and $\beta=11$ were selected to reflect the authors' informed belief that extreme losses of client assets are very rare, consistent with the presence of robust segregation and custody safeguards. This configuration produces a right-skewed distribution with a mean loss of approximately 15.4% and a modal loss of approximately 9.1%, implying that most losses are small, but severe events remain possible. In Bayesian terms, this corresponds roughly to a prior of one extreme event and ten non-extreme events. While the parameters are not empirically estimated, the resulting distribution captures the qualitative expectation that ICS losses are infrequent yet potentially material, and it can be readily recalibrated as supervisory or claims data become available.

Chart 1 presents the Beta(2,11) probability density function, highlighting the concentration of values near zero and the tapering tail representing more severe loss scenarios.

Chart 1 Beta(2,11) probability density function



Source: Authors' own calculations

The full simulation model is implemented in Python. The Monte Carlo Simulation runs 100,000 iterations, in which each investment firm may default based on its PD. A failure is marked as 1; no failure is marked as 0. In each simulated failure event, ICS exposure at the client and investment service level is calculated by applying the respective LGD and

EUR 20,000 cap. In the next step, ICS exposure for each service provider is calculated by multiplying the number of clients by capped average client assets. The total ICS exposure is obtained by aggregating losses for each defaulted service provider and the respective service. Table 3 shows the simulation inputs.

Table 3 Monte Carlo simulation inputs

Firm_ID	Service	PD	Eligible_Clients	Avg_Client_Assets	μ	σ
IF1	Execution	0.011250	495	3,200	7.883075	0.61292
IF1	Portfolio	0.011250	115	20,000		
IF1	Safekeeping	0.011250	3,536	50,000		
IF2	Execution	0.026250	27	3,200	7.883075	0.61292
IF2	Portfolio	0.026250	4	20,000		
IF2	Safekeeping	0.026250	87	2,000		
IF3	Execution	0.003750	428	3,200	7.883075	0.61292
IF3	Portfolio	0.003750	0	0		
IF3	Safekeeping	0.003750	1,241	150,000		
IF4	Execution	0.008750	276	3,200	7.883075	0.61292
IF4	Portfolio	0.008750	181	20,000		
IF4	Safekeeping	0.008750	530	150,000		
IF5	Execution	0.011250	553	3,200	7.883075	0.61292
IF5	Portfolio	0.011250	122	20,000		
IF5	Safekeeping	0.011250	55	20,000		
CI1	Execution	0.001750	456	3,200	7.883075	0.61292
CI1	Portfolio	0.001750	0	0		
CI1	Safekeeping	0.001750	535	263,007		
CI2	Execution	0.001250	67	3,200	7.883075	0.61292
CI2	Portfolio	0.001250	288	20,000		
CI2	Safekeeping	0.001250	120	50,000		
CI3	Execution	0.001500	47	3,200	7.883075	0.61292
CI3	Portfolio	0.001500	199	20,000		
CI3	Safekeeping	0.001500	436	150,000		
CI4	Execution	0.002000	0	0	0	0
CI4	Portfolio	0.002000	0	0		
CI4	Safekeeping	0.002000	49	50,000		
CI5	Execution	0.001750	93	3,200	7.883075	0.61292
CI5	Portfolio	0.001750	0	0		
CI5	Safekeeping	0.001750	194	292,068		
CI6	Execution	0.001500	101	3,200	7.883075	0.61292
CI6	Portfolio	0.001500	245	50,000		
CI6	Safekeeping	0.001500	242	3,200		
CI7	Execution	0.001250	0	0	0	0
CI7	Portfolio	0.001250	0	0		
CI7	Safekeeping	0.001250	129	150,000		

Firm_ID	Service	PD	Eligible_Clients	Avg_Client_Assets	μ	σ
CI8	Execution	0.001750	315	3,200	7.883075	0.61292
CI8	Portfolio	0.001750	0	0		
CI8	Safekeeping	0.001750	429	292,068		
CI9	Execution	0.005000	0	0	0	0
CI9	Portfolio	0.005000	0	0		
CI9	Safekeeping	0.005000	105	50,000		
CI10	Execution	0.001750	345	3,200	7.883075	0.61292
CI10	Portfolio	0.001750	0	0		
CI10	Safekeeping	0.001750	546	321,130		
FM1	Execution	0.006250	0	0	0	0
FM1	Portfolio	0.006250	882	50,000		
FM1	Safekeeping	0.006250	0	0		
FM2	Execution	0.005000	0	0	0	0
FM2	Portfolio	0.005000	145	321,130		
FM2	Safekeeping	0.005000	0	0		
FM3	Execution	0.005000	0	0	0	0
FM3	Portfolio	0.005000	223	263,007		
FM3	Safekeeping	0.005000	0	0		
FM4	Execution	0.005000	0	0	0	0
FM4	Portfolio	0.005000	166	292,068		
FM4	Safekeeping	0.005000	0	0		

Note: IF = investment firms, CI = credit institutions, FM = fund managers

Source: Authors' estimates

The aggregated losses across simulations form a probability distribution of ICS liabilities, which is then used to estimate the target fund level at various confidence intervals.

4. Results

The Monte Carlo simulation results provide three main insights: (i) the frequency of failures, (ii) the distribution and magnitude of potential payouts, and (iii) the implications for determining a target fund level for the ICS.

First, the simulation generated 10,272 instances of investment service provider failures across 100,000 iterations. Failures occurred in 9,808 of the 100,000 runs, or 9.81% of the total, reflecting the low base-line probabilities of default assigned to individual firms. Among these, 95.37% involved a single failure, 4.53% involved two simultaneous failures, and

only 0.10% involved three. No simulation resulted in more than three concurrent failures. This supports the underlying assumption of independence across defaults and reflects the policy rationale that ICSs are not designed to absorb losses arising from systemic market crises. This is further reinforced by the legal framework of most ICSs, which presumes that simultaneous firm failures and widespread fraud or operational breakdowns are highly unlikely in regulated markets with robust asset protection mechanisms. To reflect this assumption, loss given default was modelled using a Beta(2,11) distribution.

Second, the simulation output reveals a highly skewed distribution of potential ICS payouts. As shown in Table 4, the mean payout across all iterations was EUR 656,204, while the median payout was EUR 0, underscoring that the majority of simulations resulted in no default. The standard

deviation of EUR 3,943,291 indicates significant dispersion around the mean. At the tail of the distribution, the 95th percentile reached EUR 2.9 million, and the 99th percentile EUR 18.66 million. The maximum simulated payout was EUR 96.04 million. Among the 9.81% of simulations with non-zero outcomes, the average payout rose to EUR 6.69 million, demonstrating a heavy concentration of losses in the tail. The calculated skewness of 9.68 confirms the pronounced right-skewed shape of the distribution, consistent with the low-frequency, high-severity nature of compensation events in ICSs.

Table 4 Distribution of losses

Statistic	Value
Mean	656,204
Mean of non-zero payouts	6,690,494
Median	0
Standard deviation	3,943,291
95th percentile	2,900,000
99th percentile	18,664,321

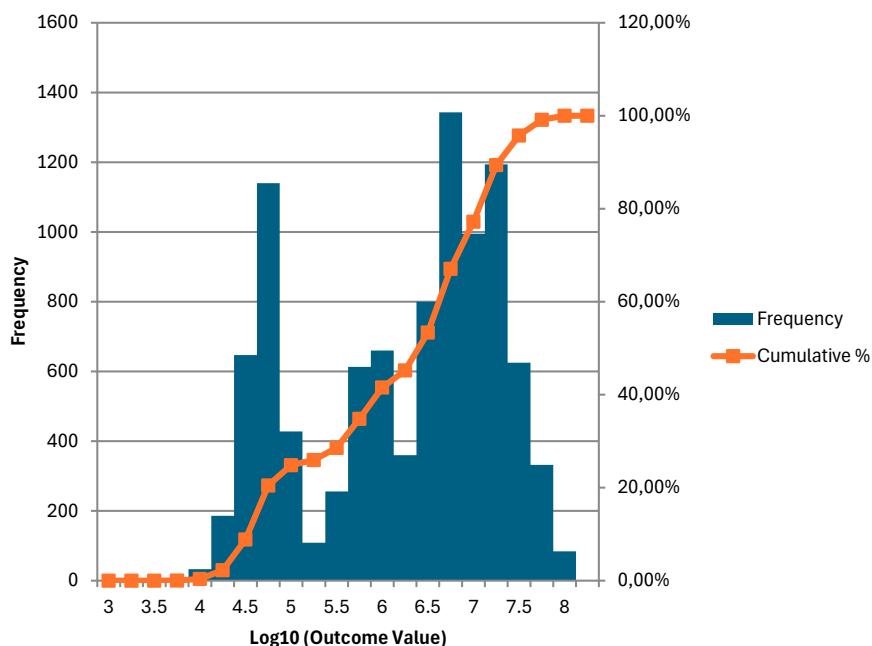
Statistic	Value
Maximum payout observed	96,043,863
Number of observations with payout >0	9.81%
Skewness	9.68

Source: Authors' calculations

These results support the rationale for employing risk-sensitive methodologies—such as Monte Carlo simulations—over static or heuristics-based fund-sizing approaches. The model illustrates that while most events result in low or zero payouts, the ICS must remain capable of addressing rare but severe events involving large exposures or multiple failures.

As illustrated in Chart 2, a log10 transformation was applied to non-zero simulation outcomes to visualise the tail more clearly. Of the 100,000 total simulations, 90.19% yielded zero payout, while the remaining 9,808 ranged from log10 values of approximately 3.52 to 7.98, corresponding to payouts between EUR 3,351 and EUR 96 million.

Chart 2 Distribution of non-zero simulation outcomes (log10 scale)



Source: Authors' own calculations

The resulting loss distribution can be used in three ways. First, it allows policymakers to determine the level of ex-ante funding required to meet specific confidence thresholds, for instance, by setting the target fund size at the 99th percentile. Second, it provides a basis for evaluating the adequacy of current ICS reserves against the spectrum of modelled liabilities. Third, it enables stress testing of the ICS under extreme but plausible scenarios.

5. Discussion

The primary objective of modelling ICS losses is to inform a robust and transparent framework for setting the target fund level. While the final choice of confidence interval (e.g., 95th vs. 99th percentile) remains a policy decision, this framework provides a data-driven foundation for that choice. It is essential to recognise that ICSs are not intended to cover systemic market-wide failures. Such failures would require not only the simultaneous default of numerous investment service providers but also the widespread collapse of asset protection mechanisms—an extremely rare scenario in jurisdictions with mature regulatory frameworks.

Indeed, the most plausible systemic risk to ICSs may arise not from coordinated fraud but from judicial decisions that undermine segregation rules, e.g., court rulings requiring client assets to be pooled with bankruptcy estates. This underscores the critical importance of ensuring that asset segregation frameworks are both legally sound and practically enforceable. Risk may arise, in particular, in cross-border operations.

The simulation results also highlight model sensitivity to the assumed probabilities of default. A marginal increase in PDs raises the likelihood of multiple failures, thereby increasing the estimated payout distributions. This sensitivity reinforces the importance of carefully calibrating default probabilities, whether derived from SREP scores or historical data.

As a complementary perspective, the loss distribution can be used to assess the fund's ability to withstand actual defaults. For instance, a fund sized at the 99th percentile (EUR 18.66 million) would be sufficient to fully cover liabilities—assuming a 100% LGD—for any investment service provider but the one with the single largest exposure to eligible clients (IF1). From a cumulative standpoint, the same fund could fully cover simultaneous defaults of the

seven smallest providers. This aligns with the “bottom-up” approach used in some deposit guarantee schemes (Ognjenovic, 2017, p. 119), where fund levels are calibrated to cover a specified number of small or medium-sized entities.

It is also important to consider the nature of client exposures. The EUR 20,000 compensation cap appears relatively modest, especially for portfolio management and safekeeping services, where average client holdings may far exceed this limit. As a result, the ICS may only partially compensate affected investors in the event of failure, particularly where larger firms are involved. Alternative investor protection mechanisms, such as robust disclosure rules and effective asset segregation, remain the primary defence.

Finally, ICSs must maintain access to supplementary funding sources in cases where ex-ante reserves are insufficient. In Croatia, for example, the ICS may borrow (Capital Market Act, Art. 283) but cannot levy extraordinary contributions, contrary to standard practice across the EU (Oxera, 2005, p. 34). Thus, while a well-sized ex-ante fund is essential, it should be viewed as part of a broader financial safety net that includes contingent resources and robust regulatory safeguards.

6. Conclusion

This paper proposes a novel, risk-sensitive methodology for determining the optimal target fund size for ICSs. Drawing from operational risk modelling and Monte Carlo simulations, the framework departs from static or politically negotiated funding benchmarks and offers a data-driven alternative grounded in firm-level exposures and failure probabilities.

The findings confirm the hypothesis that ICSs should adopt risk-sensitive approaches to ex-ante fund sizing. ICS exposures exhibit low-frequency, high-severity characteristics. Most simulations result in no payout, yet rare defaults can generate significant liabilities. The resulting loss distribution is highly skewed, supporting the case for sizing ICS funds based on defined confidence intervals—such as the 95th or 99th percentile—rather than fixed-percentage heuristics.

Key contributions of the paper include: (i) conceptualising ICS exposures through an operational risk lens; (ii) applying SREP scores as proxies for default

probabilities; and (iii) integrating service-specific data to simulate aggregate ICS liabilities.

This paper offers a practical, risk-based methodology for determining ICS fund targets. The proposed framework represents a clear methodological advance over static or heuristically derived approaches. Its transparent structure and modular design make it particularly suitable for smaller jurisdictions, where data limitations often preclude complex empirical modelling. As supervisory and regulatory information progressively expands, the model can be refined to deliver increasingly accurate and risk-sensitive assessments of the required fund size, thereby strengthening the contribution of ICSs to overall market stability. In addition, it encourages coordination between ICS managers and supervisors and could serve as a template for EU-wide best practices in the absence of harmonised funding standards.

Nevertheless, the model is not without limitations. Key assumptions, particularly regarding default probabilities, client asset concentration, and loss given default distributions, are based on approximations due to limited public data. These can be improved through access to regulatory datasets and expanded empirical calibration.

Future research should address several areas. First, further refinement of the loss given default assumptions could be achieved through approaches such as extreme value theory, allowing better characterisation of the tail behaviour of losses. Second, developing a dynamic model to adjust the target level over time would improve the framework's responsiveness to changing market and risk conditions. Third, leveraging SREP scores for risk-based pricing of ICS contributions could align funding requirements more closely with firm-specific risk.

In addition, several open questions remain. The current model assumes independence of defaults.

Although arguments in favour of this assumption are presented throughout the paper, in reality, the failure of investment service providers may be correlated through macro-financial shocks or common operational vulnerabilities. Exploring dependency structures between defaults—possibly through copula or network models—would enhance realism and allow stress-testing of systemic scenarios. Moreover, reliance on expert judgment in parameter estimation, especially for default probabilities and loss given default, introduces subjectivity; future work should examine data-driven calibration techniques based on supervisory and claims experience. Finally, further research could analyse systemic risk transmission between ICSs, DGSs, and broader market safety nets to understand how cross-sectoral linkages might affect the resilience of investor protection systems.

In future applications, the assumed Beta(2,11) distribution for loss given default could be further refined through a Bayesian updating process as supervisory or historical data on actual ICS losses become available. In Bayesian terms, the Beta distribution is a “conjugate prior” to the binomial likelihood—meaning that as new evidence (e.g., observed recovery rates or loss frequencies) is incorporated, the posterior distribution remains Beta-shaped but with updated parameters. This allows the model to progressively “learn” from experience while retaining analytical simplicity.

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EFFECTIVENESS OF THE INTEREST RATE TRANSMISSION CHANNEL UNDER DIFFERENT EXCHANGE RATE REGIMES: EMPIRICAL FINDINGS FROM THE TURKISH ECONOMY

ABSTRACT

Purpose: The primary aim of this paper is to investigate the effectiveness of the interest rate transmission channel in the Turkish economy for different exchange rate regimes.

Methodology: In this study, the TVAR model is estimated covering the period from 2002:1 to 2023:12. Furthermore, impulse response functions obtained from the linear VAR model are also included for comparison. The endogenous variables vector consists of the short-term interest rate, the nominal exchange rate, industrial production, and consumer prices, whereas the annual percentage change in the nominal exchange rate is used as the threshold factor.

Results: Based on empirical findings, 12.21% is calculated as the optimal threshold value. Thus, periods of higher exchange rates are defined as periods in which the nominal exchange rate increases at or above this value. The empirical results from the threshold VAR model, the interest rate transmission channel is only effective for the Turkish economy in the lower exchange rate regime.

Conclusion: The study concludes that, to increase the efficiency of the interest rate channel, the central bank should also consider the exchange rate markets.

Keywords: Interest rate transmission channel, exchange rate, threshold VAR

1. Introduction

The effectiveness of monetary policies depends heavily on achieving inflation targets, which are defined and publicly announced by central banks. On the other hand, monetary policy instruments are designed to guide aggregate demand and infla-

tion expectations accordingly. Changing monetary policy affects the real economy through monetary transmission mechanisms, in which changes first occur in monetary policy instruments, influencing economic agents' decision-making processes, resulting in fluctuations in production and gen-

eral price. Monetary transmission determines the degree to which changes in monetary policy affect aggregate demand and production, and determines the time lag with which these changes take place (Yalçın & Gürel, 2020, p. 444).

Changing central bank economic objectives may result in a change in monetary policy regimes, which may have a positive or negative effect on the functioning of monetary transmission channels. The Central Bank of the Republic of Turkey (CBRT) has changed its policy instruments and economic objectives several times since the early 2000s. For example, following the 2001 economic crisis, the government implemented the Transition to a Strong Economy Program, adopting an inflation targeting regime along with various structural reforms. During this period, the CBRT made price stability its ultimate goal, with the CBRT being granted operational independence. However, following the 2008 global financial crisis, central banks worldwide adopted a new approach toward financial markets. Similar to many central banks, starting in 2010, the CBRT incorporated financial and price stability into its objectives (Güvenoğlu & Serel, 2020, pp. 446–447). To this end, it expanded its use of traditional monetary policy instruments while adopting a new approach.

This study examines the effectiveness of the interest rate channel with the nonlinear Threshold Vector Autoregression (TVAR) model in which the annual percentage change of the nominal exchange rate was used as the threshold factor. For comparison purposes, the results of the linear VAR model are also included in the study. The analysis used monthly data when the Turkish economy adopted an implicit inflation-targeting regime, specifically from January 2002 to December 2023. The endogenous variables included in the VAR model were the shortterm interest rate, exchange rate, industrial production, and consumer price indexes.

The next section provides theoretical explanations of the monetary transmission, particularly the interest rate transmission channel. This is followed by a general overview of monetary policies implemented in the Turkish economy since the implicit inflation-targeting period. The third section presents selected empirical studies from the literature on the interest rate transmission channel. The fourth section explains data and the TVAR model. Finally, after interpreting the findings, the study ends with the conclusion.

2. Monetary transmission mechanism and monetary policies implemented in Turkey

The monetary transmission reveals the impacts of monetary policy decisions on economic activity and the overall price level. The extent, channels, and time lag over which these effects occur can also be assessed through monetary transmission mechanisms. Because these mechanisms may vary depending on the condition, size, and openness of the economic structure, these functions can be different across countries (Cengiz, 2009, p. 226).

The central bank, economic agents, the financial sector, and policies enacted by both domestic and international authorities are the components of this mechanism (Warjiyo & Juhro, 2019, p. 115). In spite of its effectiveness, monetary policy may occasionally produce undesirable consequences, and therefore, policymakers need to carefully assess not only the potential impacts, but also the timing of monetary interventions (Mishkin, 1995, p. 4). Generally, there are four main transmission channels: interest rates, asset prices (stocks and credit), exchange rates, and expectations. These transmission channels influence economic activity and price levels through the decisions of the central bank. For example, based on the interest rate transmission channel, a decrease in policy rates following monetary expansion reduces the cost of capital, leading to an increase in investment expenditures. This increase in investment spending, in turn, induces aggregate demand, and the transmission is complemented by an increase in output level (Mishkin, 1996, p. 2). An essential feature of the monetary transmission is that transmission channels do not operate independently, but rather as complementary elements of related transmissions (CBRT, 2013, pp. 5–7).

Domestic and global crises, the state of the economy, and developments in financial markets often influence the policy regimes adopted by central banks (Balmumcu & Süslü, 2017, p. 11). For instance, in the aftermath of the 2001 economic crisis, the CBRT introduced a floating exchange rate regime and implemented structural reforms to achieve its main objective of price stability. Additionally, the central bank gained operational independence, allowing it to determine its own monetary policy and instruments. The new regulation also prevented using resources of the central bank for public financing. Consequently, the CBRT revised its policy

framework by adopting an inflation-targeting regime, prioritizing price stability and utilizing short-term interest rates as the main policy instrument (CBRT, 2018, pp. 14–15). Countries adopting an inflation-targeting regime while operating under a floating exchange rate system can draw on several technically different approaches to determining the primary policy instrument. However, short-term interest rates are revealed through changes in the balance sheet size of the central bank (Kara, 2015, p. 3). If the short-term policy interest rate is the primary tool, then the transmission of interest rate shocks through specific monetary transmission channels and the extent to which these channels can affect macro-financial risks are not key concerns. In other words, for the monetary authority, the key objective is to steer inflation back toward the target. However, for a monetary authority that values financial stability, it may be insufficient to rely solely on the policy interest rate. Instead, it may be necessary to investigate both the exchange rate and the credit channels separately (Kara, 2012, p. 7).

In the last quarter of 2008, economic policymakers implemented policies to mitigate the adverse effects of the global financial crisis. In order to maintain the effectiveness of the credit markets and the financial system, the CBRT provided liquidity support and lowered interest rates. The post-crisis increase in short-term capital inflows to emerging economies contributed to the appreciation of the Turkish lira and facilitated easier access to credit. Accordingly, the Turkish economy experienced a greater divergence between domestic and external demand. The weight of portfolio investments and short-term capital inflows increased in order to finance the resulting current account imbalance. Due to growing concerns about financial and macroeconomic stability, alternative policy approaches have been proposed. Consequently, from 2010, the CBRT began to address macro-financial risks in its policy statements (Başçı & Kara, 2011, pp. 2–4).

The CBRT has strengthened its inflation-targeting framework by including both price and financial stability as key objectives. In addition to employing short-term interest rates as its primary policy tool, the central bank has introduced complementary instruments, such as interest rate corridors, reserve option mechanisms, and reserve requirements. Through these new instruments, the CBRT focused on credit and exchange rate channels to sustain both price and financial stability (CBRT, 2013, pp.

12–13). Following the normalization of global monetary policies, a new roadmap has been defined. Accordingly, starting in August 2015, the central bank narrowed the interest rate corridor and simplified the funding provided to other commercial banks (CBRT, 2018, p. 15).

Following the declaration of the new coronavirus (COVID-19) pandemic by the World Health Organization in 2020, central banks have been forced to reassess their monetary policies to minimize its economic effects. In order to minimize the effects of the pandemic on Turkey's financial and real economies, the CBRT continued to reduce interest rates, which began in July 2019, and continued to do so between March and May 2020. In this period, the one-week repo auction interest rate was the most frequently used tool of monetary policy. Meanwhile, the bank employed expansionary policies to boost consumer confidence, reduce financing costs, and increase employment and growth (Ülger Danacı, 2022, p. 118; CBRT, 2020). As a result of the monetary expansion during the pandemic, there has been an increase in the overall price level and exchange rate volatility, as well as a crisis in the balance of payments. The CBRT responded to these developments by implementing monetary tightening measures in November 2020 (Kuzucu, 2022, p. 276), but by 2021 it reverted to expansionary monetary policy measures. To be more specific, the policy interest rate was gradually reduced by 500 basis points between September and December 2021. In this period, the Turkish lira depreciated by approximately 50% against the U.S. dollar (İlhan, 2024, p. 286). The base effect reduced the rate of increase in the nominal exchange rate in 2022, but the depreciation continued. In June 2023, the bank once again tightened its monetary policy.

3. Literature review

In the empirical literature, the interest rate transmission mechanism has primarily focused on determining the effects of policy interest rates on the overall price level and production. The number of studies on the pass-through of interest rates has also increased in recent years. There is also an interesting aspect of the literature related to the general tendency to use VAR models (Bagliano & Favero, 1998: 1170). Despite its simplicity, this approach has the advantage of demonstrating the effects of monetary policy shocks on the economy by using a minimal number

of restrictions. VAR models assume all variables are endogenous, which is a significant advantage for investigations into dynamic interrelationships within the economic system. This framework also provides insight into the specific transmission channels through which these effects are propagated (Örnek, 2009, p. 105; Bayır, 2020, p. 72).

Employing the panel VAR model, Papadamou et al. (2015) investigated the impact of central bank transparency on the interest rate channel across 23 emerging markets over the period 1998–2010. The empirical findings indicate that monetary policy is more effective during the higher transparency periods. Saldías (2017) employed the TVAR approach to assess the effectiveness of the interest rate channel under varying financial stress regimes in Australia, Canada, the U.K., and the U.S. from January 1984 to October 2014. The results suggest that monetary policy exerts a stronger influence on output during periods of lower financial stress. Using a panel VAR methodology, Brownbridge et al. (2017) investigated the role of financial inclusion in shaping monetary policy transmission mechanisms across four African countries between 2001Q1 and 2016Q4, finding that economies with higher levels of financial inclusion exhibit more effective transmission channels. Montes and Gea (2018) analyzed the effect of central bank transparency on monetary policy transmission across 48 economies from 1998 to 2014, reporting that greater transparency is associated with lower policy interest rates and reduced volatility.

Employing the dynamic factor model, Lopez-Buenache (2019) examined the effectiveness of the U.S. monetary transmission channel from April 1973 to May 2016. The impulse response functions derived from the model display consistent patterns up until the onset of the Great Recession, after which they diverge significantly. Examining the 2000:1–2019:7 period for four Eurozone countries using the VAR method, Durcova (2021) showed that responses to interest rate shocks are consistent with theoretical expectations but neither strong nor stable. Li et al. (2021) applied a nonlinear autoregressive distributed lag (NARDL) model to weekly data from the first week of 2015 to the last week of 2018 to examine the transmission of the interest rate channel in the Chinese economy. The findings indicated that the effect of interest rate liberalization on the transmission mechanism was not as strong as expected. At the same time, policy inter-

est rate cuts also did not have the desired effect on the real economy.

Using panel data analysis for 37 African economies over the period 1990–2017, Fiador et al. (2022) reported that financial development enhances the effectiveness of monetary policy transmission. Galindo and Steiner (2022) employed ARDL and NARDL to study the Colombian economy from 2002:5 to 2022:1. The researchers found that the policy interest rate is a significant factor in setting deposit and loan retail interest rates, whereas interest rate pass-through differs across types of products. Using the ARDL method, Oyadeyi (2023) investigated the effect of financial development on interest rate pass-through in the Nigerian economy for 1981–2021. Financial development weakens the impact of monetary policy on transmission. Taş and Yılmaz (2023) used panel data analysis to examine the effectiveness of the interest rate channel in developed economies from 1995 to 2021. Panel causality tests and structural break panel cointegration analysis were conducted, followed by a panel VAR model specification. The results showed that interest rate shocks had only limited effects on economic activity, while the general price level responded weakly to interest rate shocks.

Several studies have examined the interest rate transmission channel for the Turkish economy. For instance, Doğan (2012) employed the VAR model to assess the effectiveness of this channel using quarterly data from 2000Q1 to 2011Q3. The results indicate that production volume decreased following the interest rate shock, whereas general prices increased in the short term. Saraç and Uçan (2013) examined data from 1990Q1 to 2011Q4 by means of the Kalman filter and identified narrowing and expansionary periods. Based on the results, it was concluded that the inflation-targeting regime not only effectively reduced inflation but also improved the transmission of interest rates. Using the VAR model with the Discrete Sample Chow Test, Arabacı and Baştürk (2013) examined the effectiveness of the channel from May 2001 to May 2008. In light of the initial findings, the sampling period was divided into two sub-periods: 2001–2004 and 2004–2008. Based on the impulse response functions derived for these sub-periods, the interest rate transmission channel appears to have become more effective after 2004.

Employing the ARDL model, Şıklar et al. (2016) examined the transmission mechanism of the policy

interest rate for the Turkish economy with monthly data between 2003 and 2013. Based on the findings, the pass-through of the policy rate to individual interest rates in the banking sector is more substantial than its impact on economic activity and prices. Moreover, the policy interest rate has positive and negative effects on economic activity and prices, respectively. Taking into account the divergence between market and policy interest rates in Turkey due to the unconventional monetary policies, Binici et al. (2019) examined the interest rate transmission mechanism in the Turkish economy by using alternative interest rates. Specifically, researchers conducted the panel data approach from June 2010 to December 2014 to investigate the interactions between distinct short-term interest rates and credit/deposit rates regarding the transmission mechanism. Results indicated that credit/deposit interest rates were more sensitive to effective interest rates than to policy rates. In particular, monetary transmission was driven by the interbank interest rate. Using the TVAR model, Özdemir (2020) analyzed the reaction function of the central bank under different exchange rate regimes from 2002:1 to 2017:8. The findings show that the effectiveness of interest rate channels is asymmetric, depending on the prevailing exchange rate regime. In particular, the Taylor rule holds for the high exchange rate regime. Lastly, Baştav (2020) used Toda-Yamamoto and Granger causality tests to investigate the effectiveness of the interest rate channel from 2011Q1 to 2018Q2. The findings indicated that the interest rate channel was not effective. More specifically, an increase in demand resulted in an upward movement in prices, thereby affecting interest rates.

4. Dataset and methodology

The CBRT adopted implicit inflation-targeting for the first time in 2002. Hence, the present study examines the impacts of the interest rate transmission channel on Turkey's economy under different exchange rate regimes from this year using monthly frequency data from 2002:1 to 2023:12, depending on the availability of the data set. The variables included in the analysis were derived from the Federal Reserve Economic Data and International Financial Statistics.

In this study, the short-term interest rate (*int*), the nominal exchange rate (*er*), and the industrial production index (*ip*) represent monetary policy, exchange rate, and economic activity variables, re-

spectively. The nominal exchange rate is defined as the value of the U.S. dollar against the Turkish lira, while the industrial production index is preferred to represent economic activity due to its larger sample size and higher frequency. Finally, the general price level is indicated by the consumer price index (*cpi*).

The estimated VAR model is expressed in the following linear form:

$$Y_t = \sum_{i=1}^p A_i Y_{t-i} + \varepsilon_t \quad (1)$$

In this model, the vector of endogenous variables at time t is represented by $[int_t \ er_t \ ip_t \ cpi_t]'$. In the system of equations above, where the coefficient matrix is denoted by the symbol A , the structural shocks at time t are represented by ε_t .

The linear VAR models developed by Sims (1980) describe the relationships among variables and reveal how shocks are transmitted dynamically within the system. However, these models may be inadequate in the presence of regime shifts (Koç & Akgül, 2013, p. 45). For this reason, after estimating the linear VAR model, the effectiveness of the interest rate transmission mechanism is also examined in a nonlinear structure. Instead of predefining potential regime changes, the TVAR model, which allows for the endogenous investigation of regime shifts, analyzes the nonlinear nature of monetary transmission. The state process is the key difference that distinguishes threshold regression or TVAR models, which allow for regime change analysis, from Markov Regime Switching (MS) models. The state process, which reflects nonlinear dynamics, is latent (implicit) in MS models. On the other hand, in the prediction process of threshold models, nonlinear effects are maintained through observable changing variables (Chan et al., 2017, p. 159).

The estimated TVAR model is defined based on Balke (2000) and Atanasova (2003) as follows:

$$Y_t = A^1 Y_t + B^1(L) Y_{t-1} + (A^2 Y_t + B^2(L) Y_{t-1}) I(c_{t-d} < \gamma) + U_t \quad (2)$$

In this equation, t and d represent the time dimension and the lag parameter, respectively. As previously stated, Y_t consists of a vector of endogenous factors. The polynomial lag matrices are represented by $B^1(L)$ and $B^2(L)$, and U_t denote the error terms, which are independent and identically distributed. The threshold variable, which indicates the regime in which the system operates, and its optimal values,

calculated endogenously, are represented by α and β , respectively. The dummy indicator function, denoted as $I(\cdot)$, is equal to 1 when the threshold variable reaches or exceeds its optimal ($c_{t-d} \geq \gamma$). In contrast, when ($c_{t-d} < \gamma$), the dummy variable function takes a value of 0. In the TVAR model, in addition to the changes in the lag polynomials depending on the regime, the contemporaneous relationships between the variables may also differ. Thus, the coefficients A^1 and A^2 represent the structural contemporaneous dynamics of the variables in two different regimes (Balke, 2000, p. 344; Atanasova, 2003, p. 6; Çatık & Martin, 2012, p. 1441; Çatık & Karaçuka, 2012, p. 1238).

In the model, the threshold variable is defined as the annual percentage change in the nominal exchange rate. That is, in addition to the linear VAR results, the study evaluates the effectiveness of the interest rate transmission channel under both higher and lower exchange rate regimes. Before estimating the TVAR model, specific preliminary analyses must be conducted. More specifically, the test developed by Tsay (1998) should be used to examine whether the estimated model is linear. This test is designed to test the nonlinearity of threshold effects in a multivariate model, specifically for situations where the model might exhibit nonlinearity in a single equation-ordered regression setting.

After defining the lag parameter d using the $C(d)$ test, the optimal value of the threshold, denoted by γ , must be determined. To identify the optimal threshold value, the model is estimated separately for all potential breakpoints of the threshold variable using the least squares method. In simpler terms, the threshold variable is divided into reference lines (a grid) that encompass all potential breakpoints before the TVAR model is calculated separately for each reference value. The value that minimizes the chosen selection criterion is defined as the optimal threshold value (Balke, 2000, p. 345). After determining the threshold value, the values greater than or equal to the threshold are defined as belonging to the higher regime, whereas the values smaller than the threshold are defined as belonging to the lower regime. By calculating the impulse response functions for both regimes, the researcher can then determine how the behavior of the interest rate transmission mechanism changes in line with the specific exchange rate regime.

In a linear VAR, the responses remain constant over time and are symmetric with respect to the magnitude and direction of structural shocks. However, linear responses may fail to accurately capture the effects of the shock when the likelihood of regime

shifts during the response period is non-negligible. These foundational assumptions are relaxed in nonlinear models such as the TVAR model. Accordingly, Koop et al. (1996) introduced generalized impulse response functions, which account for the possibility that certain shocks may induce transitions between regimes (Tsagkanos et al., 2018, p. 389).

Considering the nonlinear structure of the TVAR model, given the knowledge of the value of an external shock, i.e., u_t , the generalized impulse response functions are identified as the change in the conditional expectation of Y_{t+k} (Balke, 2000, p. 346; Atanasova, 2003, p. 9):

$$E[Y_{t+k}|\Omega_{t-1}, u_t] - E[Y_{t+k}|\Omega_{t-1}]. \quad (3)$$

Here, the information set up to period t is represented by Ω_{t-1} , while u_t represents the error terms in the standard linear VAR model. The vector containing the responses of the variables at the horizon k is Y_{t+k} (Tsagkanos et al., 2018, p. 389). According to the above model, calculating the generalized impulse responses requires knowing the quantitative magnitude and direction of u_t , as well as the initial conditions, i.e., Ω_{t-1} . The conditional expectations, i.e., $E[Y_{t+k}|\Omega_{t-1}, u_t]$ and $E[Y_{t+k}|\Omega_{t-1}]$, are obtained through model simulation (Atanasova, 2003, p. 10).

5. Empirical findings

Before model estimation, time series exhibiting seasonality were adjusted for these effects using the TRAMO-SEAT method. The interest rate is considered at its level value, while the other variables included in the analysis were log-transformed. The stationarity properties of the series were examined using the Lee and Strazicich (2003) unit root test, which allows for two structural breaks. The test defines structural breaks in two ways: Model A (Crash Model), which incorporates breaks in the intercept, and Model C (Trend Break Model), which encompasses breaks in both the intercept and the trend (İlhan & Akdeniz, 2020, p. 264). The test results are displayed in Table 1.

The test results show that, for the level values of the series, the short-term interest rate and exchange rate variables in Model A contain a unit root. In contrast, the consumer price index at the level value is not stationary for either Model A or Model C. The results for the first differences of the variables indicate that all the series are stationary. The break dates for the level values of the variables indicate that both local and global shocks caused breaks in the series.

Table 1 Lee-Strazicich structural unit root test

Variables	Model A (Crash Model)		Model C (Trend Break Model)		
	Level	LM Statistics	Break Dates	LM Statistics	Break Dates
<i>int</i>		-2.276	2005:1–2018:7	-5.823***	2006:3–2008:10
<i>er</i>		-1.826	2018:7–2021:10	-4.950*	2013:4–2021:2
<i>ip</i>		-5.181***	2007:11–2018:7	-6.676***	2008:7–2010:12
<i>cpi</i>		-1.655	2005:7–2018:9	-4.116	2010:2–2020:1
First Difference	LM Statistics	Break Dates	LM Statistics	Break Dates	
<i>int</i>		-5.282***	2005:6–2012:12	-8.956***	2005:9–2018:10
<i>er</i>		-3.491*	2010:9–2016:12	-14.428***	2008:3–2021:8
<i>ip</i>		-11.201***	2009:5–2018:11	-21.531***	2016:11–2020:7
<i>cpi</i>		-6.055***	2018:7–2021:10	-10.182***	2018:6–2021:5

Note: *, **, *** denote the statistical significance levels of 10%, 5%, and 1%, respectively. The optimal lag length was selected based on the general-to-specific modeling approach.

Source: Authors' estimation

After the unit root analysis, the threshold nonlinearity test was conducted as part of the preliminary tests necessary for estimating the TVAR model. The results, presented in Table 2, show that the proba-

bility values for the test statistics are significant for all delay parameters, which indicates that the usage of the nonlinear model is appropriate.

Table 2 C(d) Test statistics

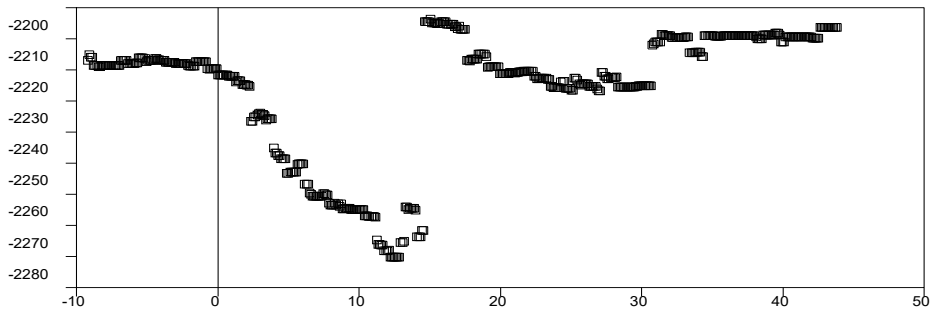
Delay Parameter	Recursive Estimates	Test Statistics	Probability Values
1	50	52.38	0.000
1	100	50.08	0.000
2	50	36.43	0.013
2	100	35.52	0.017
3	50	44.37	0.001
3	100	39.70	0.005
4	50	43.86	0.001
4	100	43.05	0.002

Source: Authors' estimation

Recursive estimation was performed for the potential threshold points of the threshold variable. In calculating its optimal value, the 10-90 percentiles were defined as the breakpoints, while the TVAR model was estimated separately for each of the 500 reference lines using the Akaike Information Criterion (AIC). The value where this criterion was minimized was defined as the optimal value of the

threshold variable. Figure 1, which presents the AIC values calculated for each breakpoint, indicates that the optimal value of the threshold is obtained at an AIC value of -2270.196, corresponding to 12.213. In other words, the higher exchange rate regime becomes valid where the threshold value reaches 12.213.

Figure 1 AIC values for arranged regression and break points

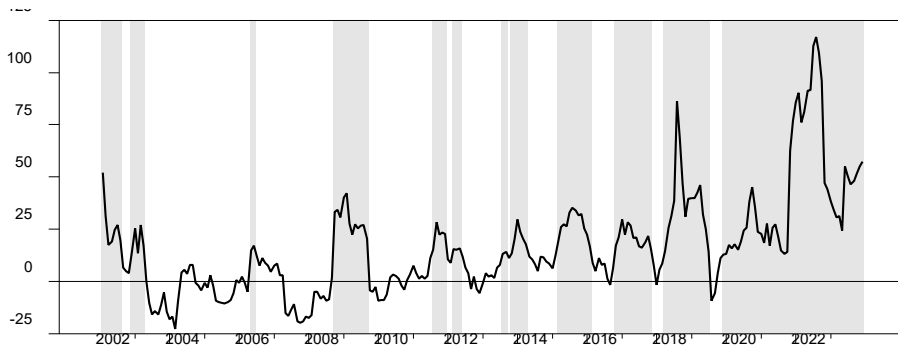


Source: Authors' estimation

Figure 2 provides a graphical representation of the threshold variable, with the dark bands represent-

ing those periods when the higher exchange rate regime is valid.

Figure 2 Threshold variable

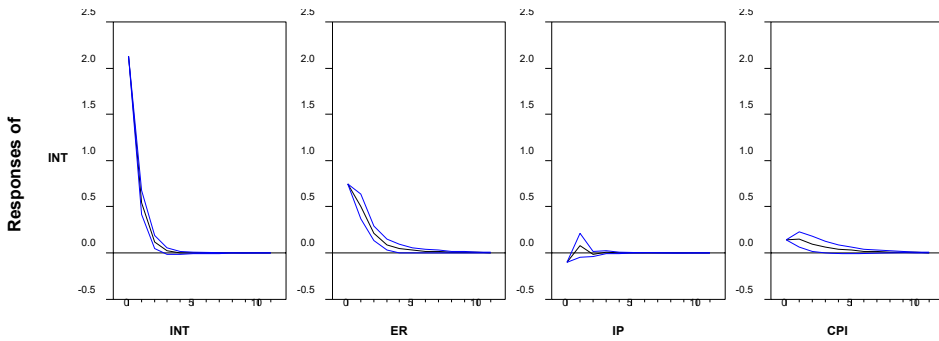


Source: Authors' estimation

As shown in Figure 2, the exchange rate in Turkey fluctuated sharply between 2002 and 2023. In particular, due to structural reforms and the prevailing economic environment, the Turkish lira appreciated significantly after the 2001 financial crisis. The most extended period of the lower exchange rate regime was from 2003 to 2008, before the global financial crisis led to a significant increase in exchange rate volatility, with the nominal exchange rate sharply rising due to capital outflows. On the other hand, global monetary expansion mitigated the effects of the crisis as capital inflows into emerging economies, including Turkey, accelerated. To minimize the negative effects of capital flows, the CBRT began reducing the policy rate and expanding the interest rate corridor downward from the end of 2010 (CBRT, 2012, p. 34). Therefore, between 2010 and 2014, the lower exchange rate regime generally

dominated. However, this relatively stable period was disrupted in 2018 due to a political crisis with the United States, leading to sharp increases in the exchange rate. In September 2018, for example, the Turkish lira depreciated by nearly 80% against the U.S. dollar (İlhan et al., 2023, pp. 164–165). In response to the exchange rate shock, the CBRT made an active monetary policy to help curb the Turkish lira's depreciation (Ulug et al., 2023, p. 2864). The tight monetary policy during this period allowed for monetary easing during the early months of the pandemic. The CBRT significantly reduced the policy interest rate to stimulate production, which led to inflation and exchange rate increases after the pandemic. Accordingly, as shown in Figure 2, the higher exchange rate regime has generally dominated since 2018.

Figure 3 Linear VAR responses



Source: Authors' estimation

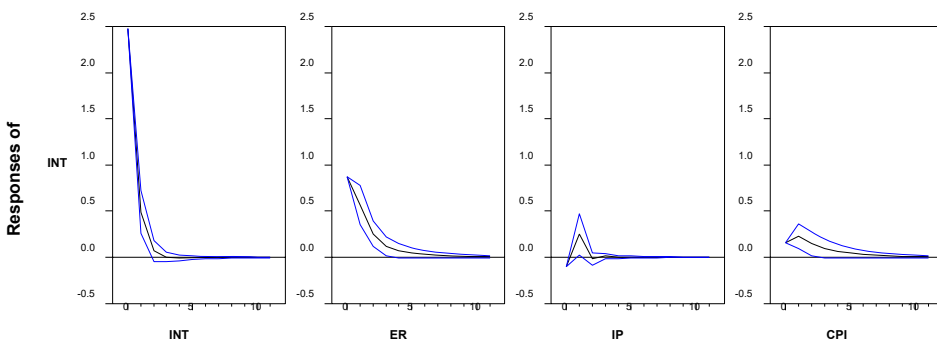
Before estimating the TVAR model, the impulse response functions derived from the linear VAR can be compared. Figure 3 shows the responses of the components of the endogenous variable vector over 12 periods following a positive shock to the short-term interest rate.

As shown in Figure 3, the response of the short-term interest rate to its shock is positive and gradually diminishes over time. Similarly, the nominal exchange rate responds positively to a contractionary policy shock, with this response ceasing by the end of the 5th period. As expected, the industrial production index reacts negatively to an interest rate increase. However, this response is statistically significant only in the first period. Finally, the response of the consumer price index to a contractionary

policy shock is statistically significant, although its positive direction suggests that the monetary transmission does not function as expected.

Based on the linear VAR model responses in Figure 3, it is not possible to claim that the interest rate transmission channel operated effectively during the sample period. Figures 4 and 5 present the responses of the endogenous variable vector to a contractionary monetary policy under the higher and lower exchange rate regimes, as defined by the TVAR model for a 12-period horizon. They show that, following a positive shock to the short-term interest rate, the responses under the higher exchange rate regime are similar to those derived from the linear VAR.

Figure 4 Higher exchange rate regime



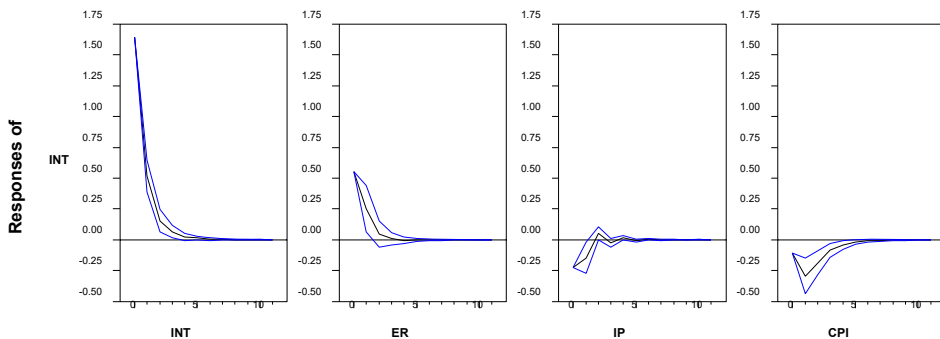
Source: Authors' estimation

More specifically, the response of the short-term interest rate to its shock is positive and gradually converges to zero. Likewise, the response of the nominal exchange rate to a contractionary policy shock is also positive but diminishing after the 5th period. The industrial production index, which represents economic activity, reacts negatively but is significant only in the first period following the shock. Like the responses obtained from the linear VAR model, the consumer price index reacts positively and statistically significantly to the short-term monetary policy shock, which contradicts the theoretical expectations of the monetary transmission mechanism.

Figure 5, which presents the responses obtained from the threshold VAR model under a lower exchange rate regime, shows that when the shock is

applied to the short-term interest rate, the response of each variable to its shock is positive and gradually diminishing. Similarly, the response of the nominal exchange rate to a contractionary monetary policy shock is also positive and statistically significant up to the 3rd period. The response of the industrial production index to the contractionary policy shock is negative and remains significant until the end of the 2nd period. The response of the consumer price index to a positive policy shock is negative, which is different from the responses in the other models, which gradually decrease closer to zero after the 5th period. Based on the results obtained from both the linear VAR and TVAR models, it can be concluded that the interest rate channel is effective under the lower exchange rate regime.

Figure 5 Lower exchange rate regime



Source: Authors' estimation

6. Conclusion

Researchers examining the effects of monetary policies on the real economy do not agree on how the intermediate phases of this process function. These uncertainties in studies regarding the effects of monetary policy have led to the characterization of the monetary transmission mechanism as a “black box” (Bernanke & Gertler, 1995, p. 27).

Due to the complex nature of the monetary transmission and its effectiveness, which may vary depending on the implemented monetary policy and the instruments used, it is more appropriate to use nonlinear models for empirical analysis. In this context, the TVAR model is employed to examine

the effectiveness of the interest rate channel in the Turkish economy for the period from 2002:1 to 2023:12. The threshold value is obtained based on the annual percentage change in the nominal exchange rate because the stability of the price level is critically dependent on it (Büyükcakın et al., 2009, p. 187).

Results indicate that the high exchange rate regime occurs at or above the estimated optimal threshold of 12.21%. The study also presents results from linear VAR models for comparison purposes. The findings from the linear model suggest that the exchange rate responds positively to contractionary shocks, whereas economic activity responses are generally insignificant. In contrast to the transmis-

sion mechanism, contractionary monetary policy shocks lead to an increase in the price level. Endogenous variables also behave similarly to policy shocks in the higher exchange rate regime. Conversely, under the lower regime, an interest rate shock results in a decline in prices. This aligns

with theoretical expectations. Furthermore, the exchange rate responds positively to contractionary monetary policy, whereas economic activity reacts in the opposite direction. Overall, empirical evidence supports the analysis of Özdemir (2020) within a nonlinear framework of the Taylor model.

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KEY FACTORS THAT INFLUENCE THE DIASPORIC WILLINGNESS TO (RE)VISIT THE ANCESTRAL HOMELAND: THE CASE OF THE CROATIAN DIASPORA IN CANADA

ABSTRACT

Purpose: The purpose of this study is to research the key factors that influence diasporic future travel intentions to (re)visit the motherland. The paper deals with the Croatian diaspora residing in Canada, as a case study.

Methodology: The data were collected through an online survey. The chi-squared test (with Fisher's exact test) was used for data analysis.

Results: The findings indicate that the characteristics of the Croatian Canadian diaspora do not significantly influence future travel intentions. The motives that play significant roles in determining future travel plans share an emotional dimension and are strongly linked to identity and family. An increased intention to visit the homeland is associated with a more positive perception of most social and tourism attributes. The findings indicate that there is a significant relation between satisfaction with social security and safety, intangible cultural heritage, and the plan to visit Croatia.

Conclusion: The study contributes to the literature on diasporic travel behavior and enables tourism policymakers to improve their marketing efforts and attract this market niche, which travels throughout the year.

Keywords: Croatian diaspora, motivations, tourism and social development, satisfaction, future travel intentions

1. Introduction

Throughout history, people have emigrated in search of a better life, new opportunities, or due to insecurity in their own countries caused by political or armed conflicts, climate change, and other dis-

asters. The United Nations estimates that there are around 281 million migrants in the world, which makes up 3.6% of the global population (IOM UN Migration, 2024). Croatia has a long tradition of migration and is considered a traditional *emigra-*

tion state (Knezović & Grošinić, 2017). According to data from the Central State Office for Croats Abroad, the emigration of Croatian citizens can be divided into several periods: from 1880 until the First World War, from 1918 until the Second World War, at the end of the Second World War, after 1965, and after 1990. Emigration during the 1990s to Western European countries and overseas destinations, such as Canada, the USA, New Zealand, and Australia, was mainly connected to the Homeland War in Croatia and the departure of Croatian citizens from war-torn areas.

It is estimated that 3.2 million Croatian emigrants and their descendants reside abroad, including approximately 250,000 in Canada. The largest concentrations of Croats in Canada are found in the provinces of Ontario, British Columbia, Alberta, Quebec, and Manitoba (Central State Office for Croats Abroad, 2024). Many emigrants have maintained their national identity, while a significant number, particularly among the younger generations, have successfully assimilated into their new environment, adopting the cultural and social values of the host country.

There are several studies that provide insights into various aspects of diaspora communities in Canada. For example, Singh (2012) explored the political activities of the diaspora and their influence on Canadian foreign policy, with a particular focus on the Indo-Canadian community, Singh and Singh (2014) examined the political engagement and identity of Tamil communities in Canada, Giri (2025) addressed the challenges faced by Nepalese communities in Canada, Kaufmann (2021) and Caxaj and Gill (2017) focused on diasporic homeland identity and integration policy, while Ramachandran and Crus (2020) investigated diaspora engagement in the implementation of the Sustainable Development Goals.

Some papers have focused on the political activities of the Croatian diaspora in Canada (Winland, 2012), students' attitudes toward studying in Croatia (Sršen et al., 2019), and characteristics and nature of the homecoming journeys (Peručić et al., 2023). There has been a lack of research on diasporic behavior as potential travelers and the factors that may influence their homecoming journeys.

The current study intends to explore the key factors that drive the Croatian diaspora residing in Canada to (re)visit the ancestral homeland, using quantitative methodology. The objectives are to investigate whether characteristics of diasporic travelers such as age, education, gender, and generation may influ-

ence travel intentions, to identify the motives that influence future travel behavior, and to examine the effects of satisfaction with tourism and social development on visitation intentions.

The analysis used the chi-squared test (with Fisher's exact test) to address the following research questions:

1. Is there a statistically significant relationship between the intention to visit Croatia in the future and the sociodemographic characteristics of diasporic travelers?
2. Which motives play a significant role in determining future homecoming journeys?
3. Is a higher intention to visit the homeland associated with satisfaction with attributes related to social development, tourism infrastructure, safety and security, cultural heritage, and other aspects of destination attractiveness?
4. What do respondents perceive as missing for the further development of diaspora tourism in Croatia?

This paper offers new empirical insights into the field of diaspora tourism, with a particular focus on the Canadian context, which remains relatively underexplored compared to other Croatian diaspora communities, such as those in Australia. By focusing on the specific sociocultural and migratory features of the Croatian Canadian community, this research enhances understanding of the factors influencing diasporic travel decisions. The paper first provides a review of the relevant literature on diasporic travel behavior, followed by a presentation of the methodological approach used to assess the factors influencing diasporic travelers' willingness to (re)visit their homeland. The findings contribute to a deeper understanding of travel behavior of the Croatian-Canadian diaspora. Finally, directions for future research are proposed.

2. Current research

Diaspora travel motivations to the homeland are among the most discussed topics. Members of the diaspora (re)visit the country of origin for various reasons ranging from visiting homeland, relatives and friends, attending national and religious events, participating in educational programs, searching for their "roots", to taking holidays for medical purposes. For example, the key motives for the Indian diaspora in South Africa for visiting the homeland were vacation and visiting friends and

relatives (Du Preez & Govender, 2020). For Chinese residing in overseas countries the main factors that determined the ancestral homeland journeys were nostalgia, transnationalism, cultural (re)connectivity and hybrid self-identity (re)constructions (Zhu et al., 2021). Important motives for the Croatian diaspora in Australia to (re)visit the motherland were visiting homeland, family and friends, often combined with attending important family events, searching for the roots, having a beachside holiday and visiting tourist attractions (Peručić et al., 2022), while for the Macedonian diaspora in Australia, these motives include visiting friends and family and having a holiday often associated with “roots tourism” (Ben-Moshe et al., 2012). For members of the Timorese diaspora residing in Portugal, Indonesia, and Australia the dominant reason for visiting the homeland was to visit family and friends. The second most important motive for visiting the homeland for diaspora members residing in Indonesia and Australia was to attend important family events, while holidays were an extremely important motive for the Timorese diaspora residing in Australia, but less significant for those living in Indonesia and Portugal (Wong et al., 2017). For the CroatianCanadian community the primary reasons for travelling to the homeland were associated with visiting family and friends, visiting the homeland, and having a beachside holiday (Peručić et al., 2023). According to Mathijssen and Mathijssen (2020), frequent diasporic motives to visit the homeland for medical reasons were time availability, communication, dissatisfaction with the current system, healthcare insurance status, and healthcare quality. Otoo et al. (2021) pointed out that diasporic motivations contributed to destination evaluations; evaluations of the homeland are strongly associated with diasporic tourist satisfaction and satisfaction influences future travel intentions.

Several studies have focused on the connection between diaspora and their motherland and the diasporic experience with the homeland. All researchers argue that homeland attachment and tourist satisfaction determine travel intentions and experience. According to Abu (2022), the relationship between the homeland and the diaspora significantly influences the formation of their national and social identity. Immigrants' connection with the homeland also influences the length and frequency of diaspora tourism trips (Huang et al., 2013) and homeland attachment is positively related to their travel intentions (Otoo et al., 2021). Proyrungroj (2022) explored how the first- and second-generation Thai diaspora tourists differ in

their sense of ancestral homeland attachment. The findings showed that the first generation of the Thai diaspora residing in Western countries (the U.S., Australia, Germany, Sweden, and France) had a higher level of attachment to the homeland than the second generation and their connection grew with each visit to the motherland. Peručić et al. (2024) examined the profile of Croatian diaspora members in Australia who showed more interest in traveling to the homeland in the future across generations. They pointed out that diaspora members who feel more at home in their country of origin express greater interest in undertaking diasporic travel in the future. Huang et al. (2013) found that second-generation immigrants in the U.S. who felt a sense of belonging to both America and their ancestral homeland took the highest number of trips to their country of origin. Connections with the homeland and host societies also influence the experience of diaspora tourists (Huang et al., 2015). According to Huang and King (2002), the level of diasporic integration into the host society and the preservation of their “original” culture significantly determine the mode of travel, motives, and experience of the homeland. Proyrungroj (2022) observed that diaspora tourism experience helped migrants feel more connected to the country. Adding emotional value with a conative image of the destinations would have a positive effect on the arrival of diaspora tourists to the homeland (Fu et al., 2025).

3. Methodology

The data were collected through an online survey from January to March 2022. The questionnaire was distributed via social networks to the members of the Croatian diaspora in Canada, the Canadian-Croatian Chamber of Commerce, and the Canadian Croatian Folklore Federation. Convenience sampling was used to collect data. The sample encompassed 230 respondents. The questionnaire consisted of questions regarding sociodemographic characteristics of the respondents, national identity, motives and travel characteristics, satisfaction with Croatian tourism, social attributes, and future travel intentions.

The questionnaire was created using the Google Forms platform. Once the surveys were completed, the data were imported into SPSS (version 26.0, SPSS Inc., Chicago, IL, USA) for the purposes of tabulation and detailed analysis. Automated edit checks were performed to identify any inconsistencies or errors in the responses. Custom tabulation

queries were then developed to generate tables for both the report and further in-depth analysis.

Statistical methods (the chi-squared test with Fisher's exact test) were used to explore the impact of various factors on planning a visit to the ancestral country. Data analysis was conducted to determine whether there were statistically significant deviations between different independent variables related to gender, age, education, occupation, migration history, travel motives, perception of the quality of tourism facilities and social development, activities during trips in Croatia, and the respondents' intentions to visit Croatia in the future.

4. Results

The research results provided the basic sociodemographic characteristics of the respondents, as well as descriptive information about their homeland journeys. The majority of study participants were between the ages of 36 and 55 (63%), followed by those between 18 and 35 (24%). Most respondents were female (64%), employed (88%), and had higher

or university-level education (69%). Twenty-eight percent of the respondents were born in Croatia, while 72% were born in Canada. Regarding their place of residence in Canada, 78% of respondents lived in Ontario, 12% in Alberta, and 10% in other parts of the country. The largest group of respondents emigrated to Canada between 1986 and 1995 (36%), followed by those who emigrated between 1966 and 1975 (27%) (Peručić et al., 2023).

About 98% of respondents have visited Croatia at least once. In terms of length of stay, more than half of the respondents spent an average of up to one month in Croatia. The findings indicate that the respondents are motivated to undertake diasporic travel in the future. More than 80% of the respondents are definitely planning to visit Croatia again (Peručić et al., 2023).

Table 1 presents the results of a Pearson chi-square test analyzing the relationship between various demographic characteristics of the Croatian diaspora in Canada and their intention to (re)visit Croatia in the future.

Table 1 Future travel intentions of the respondents to (re)visit Croatia depending on their characteristics

Pearson chi-square test		Are you planning to visit Croatia in the future
Gender	chi-square	.122
	df	3
	Sig.	.989
Age	chi-square	16.715
	df	15
	Sig.	.336
Where do you live in Canada	chi-square	11.880
	df	15
	Sig.	.688
Occupation	chi-square	20.418
	df	15
	Sig.	.156
Education	chi-square	6.140
	df	9
	Sig.	.726
Generation of diaspora	chi-square	12.417
	df	21
	Sig.	.928
Period of emigration	chi-square	13.320
	df	18
	Sig.	.772

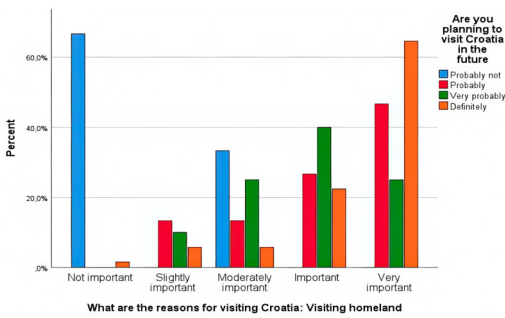
Source: Authors' analysis

The analysis of the significance level showed that none of the demographic characteristics had a statistically significant relationship with the respondents' intention to visit Croatia in the future. All p-values are well above the conventional threshold of 0.05. This indicates that characteristics such as gender, age, occupation, education, or generation of diaspora do not significantly influence travel intentions. The findings suggest that other factors such as emotional attachment, cultural identity or satisfaction with tourism and social development might play a more important role.

Based on the purpose of travel, homeland trips were primarily motivated by visiting the homeland, visiting family and friends, enjoying a beachside

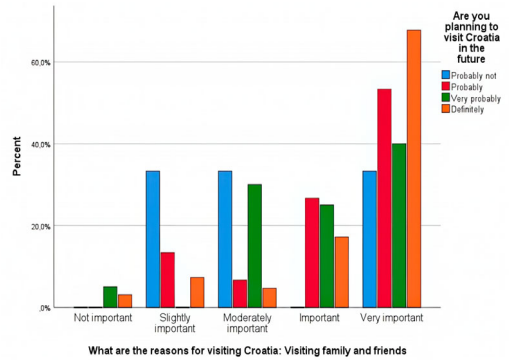
holiday, nostalgia or homesickness, sightseeing or visiting tourist attractions, attending important family events, and searching for family roots. Regarding respondents' intention to visit Croatia in the future, statistically significant differences were identified for three motives: "visiting family and friends" ($p = 0.004$), "visiting the homeland" ($p = 0.000$), and "attending important family events, birthdays, family reunions, etc." ($p = 0.006$). These values, determined by the chi-square test ($p < 0.05$), indicate that these travel motives play a significant role in shaping respondents' future travel plans. All three motives are strongly influenced by emotional attachment to the homeland, family and cultural roots. The strength of these motives increases with a higher likelihood of visiting Croatia.

Figure 1 Importance of the motive "visiting homeland" in relation to future travel intentions



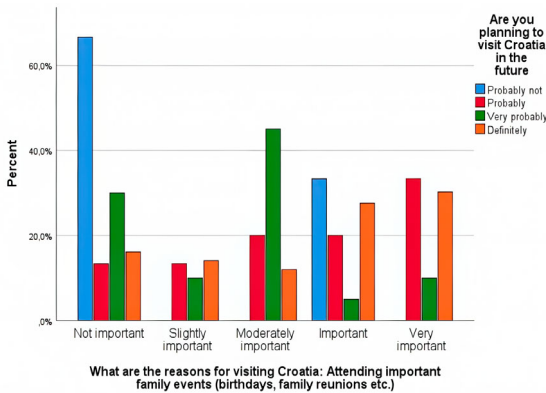
Source: Authors' analysis

Figure 2 Importance of the motive "visiting family and friends" in relation to future travel intentions



Source: Authors' analysis

Figure 3 Importance of the motive "attending important family events (birthdays, family reunions, etc.)" in relation to future travel intentions



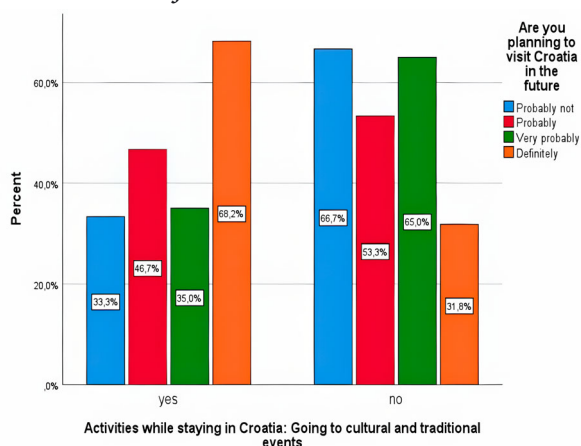
Source: Authors' analysis

Respondents who intend to “definitely” visit Croatia (87% important and very important) place the highest importance on the motive “visiting homeland” (Figure 1). The motive “visiting family and friends” was stated as an “important” or “very important” reason by 84.9% of respondents who will “definitely” visit Croatia in the future (Figure 2). The motive “attending important family events” is a “very important” or “important” reason for homecoming journeys for 57.8% of the respondents who will definitely visit Croatia (Figure 3). These motives are anticipated to remain consistently significant for diaspora members, particularly those who maintain a strong emotional connection to their homeland, have familial ties in Croatia, and travel there regularly for personal reasons. Other motives appear to have a limited impact on their homecoming inten-

tions. The findings suggest that emotionally driven campaigns emphasizing connections to the homeland, traditional and family values, as well as cultural and religious events, may prove to be effective.

In terms of activities during trips in Croatia, respondents stated that the most preferred activities were visiting family and friends, attending cultural and traditional events, city sightseeing, dining at restaurants, visiting historical buildings, museums, national parks, and protected natural areas, swimming, attending family events, and shopping. The only activity with a statistically significant association with future travel intentions is “attending cultural and traditional events” ($p = 0.008$) (the value of the chi-square test is $p < 0.05$).

Figure 4 Importance of the activity “going to cultural and traditional events” during the trip to Croatia in relation to future travel intentions



Source: Authors’ analysis

For the respondents who indicated they will “definitely” visit Croatia (68.2%), cultural and traditional events are very important and may be a key factor in their decision to visit their homeland. A higher intention to travel is associated with greater interest in cultural and traditional experiences in Croatia. Other activities do not play a crucial role in the decision to visit Croatia. However, cultural and traditional events should be further emphasized in promotional campaigns, as their emotional value influences the final decision to visit the homeland.

Regarding satisfaction with Croatian social and tourism development, attributes related to the

standard of living, tourism infrastructure, safety, investment opportunities, cultural heritage, and other aspects were evaluated. Diasporic travelers who positively evaluate their homeland are likely to be satisfied with their visit (Otoo et al., 2021). According to respondents’ answers, the most highly rated attributes were tourist accommodation facilities, cultural/traditional events, gastronomy (variety and quality), and the uniqueness of the destination (natural resource attractions, historical heritage, and cultural identity). Respondents expressed lower levels of satisfaction with political development, investment opportunities, health tourism, and ecological awareness (Table 2).

Table 2 Assessment of social and tourism development attributes of Croatia in relation to future travel intentions

Pearson chi-square tests		Are you planning to visit Croatia in the future?
Economic development	chi-square	7.385
	df	15
	Sig.	.946
Political development	chi-square	12.001
	df	15
	Sig.	.679
Tourism development	chi-square	14.726
	df	15
	Sig.	.471
Social security and safety	chi-square	27.367
	df	15
	Sig.	.026 [*]
Standard of living	chi-square	11.537
	df	15
	Sig.	.714
Ecological awareness	chi-square	16.322
	df	15
	Sig.	.361
Investments opportunities	chi-square	7.806
	df	15
	Sig.	.931
Uniqueness of the destination (natural resource attraction, historical heritage, and cultural identity)	chi-square	11.477
	df	12
	Sig.	.489
Intangible cultural heritage (oral traditions, local knowledge, traditional skills, etc.)	chi-square	22.115
	df	12
	Sig.	.036 [*]
Tourist accommodation facilities	chi-square	11.863
	df	12
	Sig.	.457
Gastronomic offer (variety and quality)	chi-square	9.325
	df	15
	Sig.	.860
Recreational facilities	chi-square	20.553
	df	15
	Sig.	.152
Nightlife	chi-square	20.663
	df	15
	Sig.	.148
Cultural/Traditional events	chi-square	13.587
	df	12
	Sig.	.328
Value for money	chi-square	4.687
	df	15
	Sig.	.994

Pearson chi-square tests		Are you planning to visit Croatia in the future?
Cleanliness and maintenance of beaches and tourist attractions	chi-square	12.458
	df	15
	Sig.	.644
Shopping opportunities	chi-square	13.609
	df	15
	Sig.	.555
Traffic infrastructure (quality of roads, transport, etc.)	chi-square	20.476
	df	15
	Sig.	.154
Nautical tourism infrastructure	chi-square	7.346
	df	15
	Sig.	.947
Health tourism infrastructure	chi-square	12.270
	df	15
	Sig.	.658
Tranquility, rhythm of life	chi-square	14.451
	df	12
	Sig.	.273

* Note: The chi-square statistic is significant at the .05 level.

Source: Authors' analysis

Two assessments, "social security and safety" (Sig. = 0.026) and "intangible cultural heritage (oral traditions, local knowledge, traditional skills, etc.)" (Sig. = 0.036), showed a statistically significant relationship with respondents' intention to visit Croatia in the future (the chi-square test value $p < 0.05$). Other factors, such as economic development, political development, tourist accommodation facilities, gastronomic offer, nightlife, traffic infrastructure, etc., do not have a statistically significant impact on visit planning (most p-values are greater than 0.05).

Respondents (N = 225) rated various attributes of Croatia on a scale from "very poor" to "very good". They were grouped according to their expressed intention to visit into: "Probably not", "Probably", "Very probably", "Definitely". Satisfaction with the social and tourism attributes of Croatia in relation to respondents' future travel intentions varies depending on their stated intention to visit the homeland. The findings show that respondents who stated they would "definitely" visit Croatia have significantly more positive opinions on almost all aspects of destination attractiveness. "Very good" ratings increase with a stronger intention to visit, especially for the following attributes: uniqueness of the destination (60.6% of respondents who will "definitely" visit Croatia), cultural/traditional events (55.3%), cleanliness and maintenance of tourist at-

tractions (47.3%), variety and quality of the gastronomic offer (47.3%), tourism development (42.6%), and security and safety (37.8%).

The attribute "intangible cultural heritage" received the highest rating from the respondents who will definitely visit Croatia (75% rated it as good or very good), while 67.6% of those who will definitely visit Croatia rated "social security and safety" as good or very good. The findings indicate that there is a significant connection between satisfaction with social security and safety and intangible cultural heritage, and the planning of a visit to Croatia. These two attributes have a significant impact on return visits.

Croatia is recognized as a tourist destination, especially among members of the diaspora who are planning a visit the country. Tourism development, social security and safety, and cultural heritage, especially intangible cultural heritage, are Croatia's main strengths. Positive destination evaluation and satisfaction increase the diaspora's future travel intentions. Croatia's image, built on culture, safety, and tourism facilities, is crucial for attracting the diaspora, while lesser-known aspects require stronger communication and greater investment in promotion.

The most commonly identified needs for the development of diaspora tourism among respond-

ents who definitely plan to visit Croatia (“agree” and “strongly agree” responses) include better air transport connections (67.1%), attractive programs specifically designed for the diaspora (65.6%), improved cooperation with Croatian institutions

(57.7%), greater awareness of cultural and historical heritage (55.8%), strengthened cooperation with diaspora communities (59.4%), and enhanced online promotion (54.8%).

Table 3 Respondents’ assessment of what is lacking for the development of diaspora tourism in relation to the future travel intentions

		Are you planning to visit Croatia in the future										p
		Probably not		Probably		Very probably		Definitely		Total		
		N	%	N	%	N	%	N	%	N	%	
Greater awareness of Croatian intangible heritage	Strongly disagree	0	0.0%	1	6.7%	0	0.0%	7	3.6%	8	3.5%	.023
	Disagree	0	0.0%	1	6.7%	2	10.0%	38	19.8%	41	17.8%	
	Undecided	0	0.0%	2	13.3%	4	20.0%	36	18.8%	42	18.3%	
	Agree	1	33.3%	6	40.0%	11	55.0%	76	39.6%	94	40.9%	
	Strongly agree	0	0.0%	4	26.7%	3	15.0%	24	12.5%	31	13.5%	
	Can't say	2	66.7%	1	6.7%	0	0.0%	11	5.7%	14	6.1%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	
Greater awareness of cultural and historical heritage	Strongly disagree	0	0.0%	0	0.0%	0	0.0%	6	3.1%	6	2.6%	.001
	Disagree	0	0.0%	1	6.7%	2	10.0%	44	22.9%	47	20.4%	
	Undecided	0	0.0%	1	6.7%	3	15.0%	28	14.6%	32	13.9%	
	Agree	1	33.3%	8	53.3%	11	55.0%	75	39.1%	95	41.3%	
	Strongly agree	0	0.0%	4	26.7%	4	20.0%	32	16.7%	40	17.4%	
	Can't say	2	66.7%	1	6.7%	0	0.0%	7	3.6%	10	4.3%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	
Better perception of Croatia as a tourist destination	Strongly disagree	0	0.0%	0	0.0%	2	10.0%	18	9.4%	20	8.7%	.154
	Disagree	0	0.0%	3	20.0%	4	20.0%	59	30.7%	66	28.7%	
	Undecided	0	0.0%	1	6.7%	5	25.0%	31	16.1%	37	16.1%	
	Agree	1	33.3%	5	33.3%	6	30.0%	55	28.6%	67	29.1%	
	Strongly agree	1	33.3%	5	33.3%	3	15.0%	23	12.0%	32	13.9%	
	Can't say	1	33.3%	1	6.7%	0	0.0%	6	3.1%	8	3.5%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	

		Are you planning to visit Croatia in the future										p
		Probably not		Probably		Very probably		Definitely		Total		
		N	%	N	%	N	%	N	%	N	%	
Better cooperation between Croatia and Croatian communities in the diaspora	Strongly disagree	0	0.0%	0	0.0%	0	0.0%	6	3.1%	6	2.6%	.172
	Disagree	0	0.0%	1	6.7%	3	15.0%	19	9.9%	23	10.0%	
	Undecided	1	33.3%	1	6.7%	6	30.0%	33	17.2%	41	17.8%	
	Agree	0	0.0%	4	26.7%	4	20.0%	60	31.3%	68	29.6%	
	Strongly agree	0	0.0%	8	53.3%	5	25.0%	54	28.1%	67	29.1%	
	Can't say	2	66.7%	1	6.7%	2	10.0%	20	10.4%	25	10.9%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	
Better cooperation between state, educational, and cultural institutions with Croatian communities in the diaspora	Strongly disagree	0	0.0%	0	0.0%	1	5.0%	3	1.6%	4	1.7%	.383
	Disagree	0	0.0%	1	6.7%	2	10.0%	16	8.3%	19	8.3%	
	Undecided	0	0.0%	1	6.7%	5	25.0%	35	18.2%	41	17.8%	
	Agree	1	33.3%	4	26.7%	3	15.0%	56	29.2%	64	27.8%	
	Strongly agree	0	0.0%	8	53.3%	5	25.0%	55	28.6%	68	29.6%	
	Can't say	2	66.7%	1	6.7%	4	20.0%	27	14.1%	34	14.8%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	
Attractive tourist programs for the diaspora (e.g. cultural and artistic programs, programs tailored to different groups such as students, seniors, etc.)	Strongly disagree	0	0.0%	0	0.0%	1	5.0%	3	1.6%	4	1.7%	.548
	Disagree	0	0.0%	1	6.7%	2	10.0%	20	10.4%	23	10.0%	
	Undecided	0	0.0%	3	20.0%	6	30.0%	31	16.1%	40	17.4%	
	Agree	2	66.7%	3	20.0%	4	20.0%	72	37.5%	81	35.2%	
	Strongly agree	0	0.0%	6	40.0%	5	25.0%	54	28.1%	65	28.3%	
	Can't say	1	33.3%	2	13.3%	2	10.0%	12	6.3%	17	7.4%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	
Better online promotion of Croatia as a tourist destination (on social media, YouTube, etc.)	Strongly disagree	0	0.0%	0	0.0%	1	5.0%	10	5.2%	11	4.8%	.317
	Disagree	0	0.0%	2	13.3%	4	20.0%	32	16.7%	38	16.5%	
	Undecided	1	33.3%	2	13.3%	5	25.0%	32	16.7%	40	17.4%	
	Agree	1	33.3%	4	26.7%	0	0.0%	59	30.7%	64	27.8%	
	Strongly agree	0	0.0%	5	33.3%	9	45.0%	46	24.0%	60	26.1%	
	Can't say	1	33.3%	2	13.3%	1	5.0%	13	6.8%	17	7.4%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	

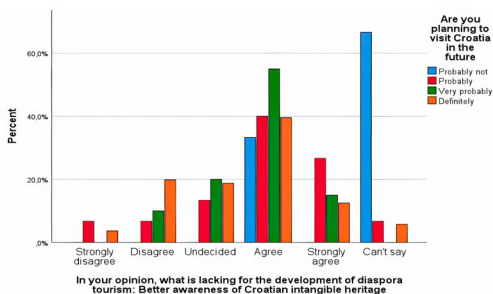
		Are you planning to visit Croatia in the future										p
		Probably not		Probably		Very probably		Definitely		Total		
		N	%	N	%	N	%	N	%	N	%	
Better air transport connections	Strongly disagree	0	0.0%	0	0.0%	1	5.0%	5	2.6%	6	2.6%	.947
	Disagree	0	0.0%	1	6.7%	1	5.0%	24	12.5%	26	11.3%	
	Undecided	0	0.0%	2	13.3%	1	5.0%	20	10.4%	23	10.0%	
	Agree	1	33.3%	3	20.0%	6	30.0%	55	28.6%	65	28.3%	
	Strongly agree	1	33.3%	7	46.7%	9	45.0%	74	38.5%	91	39.6%	
	Can't say	1	33.3%	2	13.3%	2	10.0%	14	7.3%	19	8.3%	
	Total	3	100.0%	15	100.0%	20	100.0%	192	100.0%	230	100.0%	

Source: Authors' analysis

Two variables have a statistically significant impact on travel planning: “greater awareness of Croatian intangible heritage” and “greater awareness of cultural and historical heritage” (the value of the chi-square test is $p < 0.05$).

A total of 52.1% of respondents who will definitely visit Croatia strongly agree or agree with the statement that “greater awareness of Croatian intangible heritage” is needed, while 55.8% strongly agree or agree with the statement that there should be “greater awareness of cultural and historical heritage.”

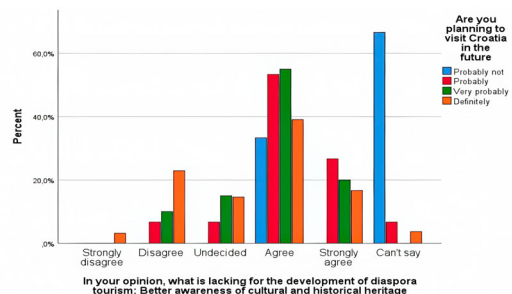
Figure 5 Importance of “greater awareness of Croatian intangible heritage” in relation to future travel intentions



Source: Authors' analysis

The results indicated that awareness of tangible and intangible heritage has a greater influence on the homecoming travel plans of potential visitors from the diaspora than other factors. Other factors did not show a statistically significant relationship with the intention to visit (all p-values > 0.05). This finding can serve as a foundation for developing promotional strategies focused on strengthening cultural identity and heritage awareness. It is necessary to enhance the knowledge and promotion of Croatia's cultural and historical heritage,

Figure 6 Importance of “greater awareness of cultural and historical heritage” in relation to future travel intentions



Source: Authors' analysis

especially its intangible heritage. To successfully develop diaspora tourism, strategic focus should also be placed on improving other aspects, such as the perception of Croatia as a tourist destination, cooperation with the diaspora and institutions, online promotion, tailor-made tourist and cultural programs, and transport connections. Promotion, particularly through digital channels, is essential for reaching younger generations of diaspora travelers. Respondents most interested in traveling to Croatia expect these shortcomings to be addressed.

5. Conclusion

Based on the findings of this study, certain key factors have been identified that influence diasporic travel intentions to visit the motherland. The analysis showed that the characteristics of the Croatian diaspora in Canada do not significantly influence their future travel intentions. This finding contrasts with the study by Peručić et al. (2024), which reported that characteristics of the Croatian diaspora residing in Australia, such as age, place of birth, migration history, degree of integration into the new society, homeland attachment, and national identity, have a direct impact on their future travel behavior. However, the lack of influence of personal characteristics among the Canadian diaspora does not necessarily imply that such characteristics have no impact on future travel intentions to the motherland.

Croatian Canadians who intend to “definitely” (re)visit their country of origin place the highest importance on the motives of “visiting family and friends,” “visiting the homeland,” and “attending important family events.” This study confirms that travel motives strongly influenced by homeland attachment, family, and cultural identity significantly affect future travel behavior among the diaspora (Wong et al., 2017; Peručić et al., 2024; Zhu et al., 2021; Lee et al., 2020).

The present study suggests that a positive perception of Croatia among the diaspora in Canada significantly influences their intentions to visit. Respondents who stated that they would “definitely” visit Croatia have a significantly more favorable opinion of almost all social and tourism development attributes. The finding that satisfaction increases future travel intentions to the ancestral

homeland supports previous research (Otoo et al., 2021; Prayag, 2009; Prayag et al., 2017; Hosany et al., 2017). A higher intention to travel among the Croatian diaspora in Canada is associated with greater interest in cultural and traditional experiences. Enhancing knowledge of Croatia’s cultural and historical heritage, particularly its intangible heritage, is crucial for encouraging visits from the Canadian diaspora. Positive future travel intentions will also depend on improved transport connections, cooperation with Croatian institutions, attractive programs specifically designed for the diaspora, and online promotion.

The current findings provide a better understanding of the behavior of diasporic travelers and the key factors influencing their future plans to (re)visit their country of origin. The diaspora represents an attractive niche market that requires more attention, especially in the context of diaspora tourism. This study contributes to the literature on diaspora as potential travelers and can serve as a guide for destination managers to enhance marketing efforts and develop diaspora tourism strategies.

However, the study has certain limitations. In terms of the research sample, the majority of respondents were from two Canadian provinces (Ontario and Alberta) and belonged to the first generation or to a generation whose parents had both emigrated from Croatia to Canada, suggesting that ties with the homeland remain strong. Future studies should include other generational groups within the diaspora. It would also be valuable to examine the key factors that drive members of the Croatian diaspora residing in different countries to (re)visit the motherland, as this would allow for comparisons of their travel behavior.

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IS BIGGER BETTER? NONLINEAR EFFECTS OF GOVERNMENT SPENDING ON GROWTH

ABSTRACT

Purpose: This study analyses the impact of public expenditures on economic growth within the framework of the Armeý curve. The Armeý curve posits an inverted U-shaped relationship between government size and growth, implying that public spending promotes economic activity up to an optimal point, beyond which its marginal contribution becomes negative. The study empirically examines this nonlinear relationship using data from 47 emerging economies for the period 1991–2019.

Methodology: In the study, the Method of Moments Quantile Regression (MMQREG) technique, which can capture marginal effects that differ according to income levels, was applied. The robustness of the findings is tested with Dynamic OLS (DOLS) and Driscoll-Kraay methods.

Results: The results obtained show that public expenditures increase growth up to a certain threshold, and if this threshold is exceeded, it has negative effects on growth. While the optimal level of public expenditure for low-income countries is approximately 15 per cent of GDP, this ratio increases to 19 per cent in high-income countries. This shows that the impact of public expenditures on growth varies according to country conditions.

Conclusion: The study reveals that the effect of public expenditures on economic growth cannot be explained by a universal policy ratio and that each country should develop differentiated fiscal policies in line with its income level and institutional structure.

Keywords: Government expenditures, economic growth, Armeý curve, panel data analysis

1. Introduction

Economic growth is one of the main objectives of fiscal policy and government expenditures are a key policy instrument for achieving this goal. For example, in the Solow (1956) model, which forms the basis of neoclassical growth theory, it is predicted that fiscal policy instruments such as an increase in government expenditures affect only

the level of production in the long run and have no permanent effect on the growth rate. However, endogenous growth models developed in the 1990s (Barro, 1990; King & Rebelo, 1990; Barro & Sala-i Martin, 1992) challenged this approach by arguing that government expenditures and tax policies can have a direct impact on the rate of economic growth. The increase in government expenditures relative to GDP in many countries over time has led

to the need to reassess the impact of the size of government on growth. In this context, the relationship between government size and economic growth has increasingly been analysed through nonlinear frameworks that point to diminishing marginal returns to public spending. The Armeý curve, derived from Barro's (1990) endogenous growth model and characterised by an inverted U-shape, provides one of the most widely used representations of this mechanism. The basic logic of both curves suggests that a small-scale public sector can stimulate growth, while an over-expanded public sector can create restrictive effects on growth, thus pointing to an optimal level of government expenditure that maximises growth (Varol İyidođan & Turan, 2017).

As this framework shows, the relationship between economic growth and the size of the state has long been a subject of debate in the economic literature. Economic theory has developed various theoretical tools and methods to explain the impact of government on economic activities. These nonlinear approaches, including the Armeý curve, the Rahn curve, and the BARS framework, which consists of the initials of Barro (1989), Armeý (1995), Rahn and Fox (1996), and Scully (1994), collectively emphasise that government size may enhance growth up to a certain threshold, beyond which additional expansion becomes counterproductive (Altunc & Aydın, 2013). In addition, Keynesian theory highlights that public expenditure can generate a 'crowding-in' effect when it complements private investment, while excessive public expansion may create a 'crowding-out' effect through higher taxes or borrowing requirements (Keynes, 1937; Barro, 1990; Engen & Skinner, 1992; Pevcin, 2004; Schaltegger & Torgler, 2006).

Although the general consensus predicts an inverted U-shaped relationship between the size of the public sector and economic growth, the question of whether "big government" has positive or negative effects on economic growth has not yet found a clear answer within the framework of existing empirical studies and has continued to be investigated by many economists (Colombier, 2015; Churchill et al., 2017; Brändle, 2020). Two main questions stand out in this debate: first, whether there is a threshold value for the size of the public sector that favours or hinders growth, and second, which indicators would be more appropriate to use in measuring the size of the public sector. In the existing literature, various criteria are used to determine the size of

the public sector. Among these measures, variables such as the share of general, central or local government expenditures in GDP, the ratio of tax revenues to national income, government consumption and transfer expenditures, and government investments come to the fore. However, the most emphasised basic indicator in the literature is the ratio of government expenditures to GDP (Vedder & Gallaway, 1998; Nijkamp & Poot, 2004; Gemmell & Au, 2013; Churchill et al., 2017; Hajamini & Falahi, 2018; Colombier, 2024). At this point, the correct determination of the composition and level of government expenditures is of great importance in terms of achieving the desired effects on growth.

In particular, government consumption expenditures, which affect aggregate demand and directly support economic activities, are expected to create a multiplier effect on economic growth (Barro, 1990). Building on this discussion, recent theoretical work by Vasilev (2020) further demonstrates that the inverted U-shaped Armeý mechanism can also be derived within a dynamic Keynesian framework, where lagged public expenditure affects private investment in a nonlinear manner. Empirical applications commonly estimate this relationship using the share of government expenditure in GDP and its squared term, where a positive linear coefficient and a negative quadratic coefficient confirm the inverted U-shape (Asimakopoulos & Karavias, 2016).

Regarding the impact of the government sector on economic growth, two main approaches are prominent in the literature. According to the first view, the growth of the public sector distorts the efficient allocation of resources and creates an exclusionary effect on private sector investments. This leads to a decline in aggregate productivity and thus to a slowdown in economic growth. Although it is accepted that basic government expenditures have positive effects on growth, it is argued that this positive effect may reverse if these expenditures increase beyond the core functions of the public sector (Barro, 1990; Scully, 1994). On the other hand, the second approach argues that the public sector should assume an active role in order to ensure economic growth. According to this approach, the state, as an actor with the capacity to mobilise physical and human capital, should take a central position in the growth and development process (Asoni, 2008). Facchini and Melki (2011), on the other hand, attribute the positive effects of government expenditures to the elimination of market

failures and the negative effects to the costs caused by structural failures of the state, and argue that the Armeý curve is a combination of these two mechanisms. Schaltegger and Torgler (2006), on the other hand, stated that the relationship between the size of the public sector and growth differs according to the level of development of countries; negative effects may be dominant in developed countries, while positive effects may be dominant in less developed countries. In conclusion, the impact of government expenditures on economic growth is shaped by a combination of many factors such as the institutional structure of countries, the level of corruption, bureaucratic efficiency, fiscal discipline, policy delays, and the power to penetrate the economic structure.

This study evaluates the impact of government consumption expenditures on economic growth within the framework of the Armeý curve, which captures the diminishing marginal returns of public spending and its nonlinear effects on growth. In the analysis conducted using panel data for 47 emerging countries selected according to data availability for the period 1991–2019, the Method of Moments Quantile Regression (MMQREG), which can capture marginal effects varying by income level, is applied; the robustness of the results is ensured by testing the findings using DOLS and Driscoll-Kraay methods. The contribution of the study to the literature is multilayered in the sense that it reveals the impact of government expenditures on growth not only at the average level but also within the framework of varying thresholds for countries in different income groups and shows how this relationship is shaped by structural, managerial, and institutional differences. In this respect, the study not only tests the validity of the Armeý curve in the context of emerging countries but is also expected to make a unique contribution to the literature on public finance and growth by highlighting the necessity of differentiated fiscal policy designs for countries with different income levels.

The remainder of the study is systematically structured. First, the literature on the Armeý curve is comprehensively reviewed, and the findings and approaches of previous studies are evaluated. Following this section, the data set used in the study, the empirical model, and the methodological approach adopted are presented in detail. Finally, the findings are analysed, and the study is concluded with a comprehensive discussion of the results.

2. Relevant literature

The view that the relationship between the size of the public sector and economic growth is nonlinear has gained an important place in the literature. In this framework, Armeý (1995) was one of the first scientists to graphically present the nonlinear relationship between government expenditures and economic growth. In the literature, this curve is sometimes referred to as the BARS curve, but the more common term is the Armeý curve (Yüksel, 2019). According to Armeý (1995), the effect of government expenditures on growth is positive up to a certain level, but if this optimal threshold is exceeded, the marginal contribution of government expenditures decreases and affects growth negatively (Asimakopoulos & Karavias, 2016). Inspired by the Laffer curve, Armeý (1995) tried to explain the relationship between the size of government and social welfare. According to him, the main role of the state is to maintain social order, prevent anarchy, and provide public services. However, when it grows excessively beyond these roles, the state starts to have a diminishing effect on both individual freedoms and social welfare (Armeý, 1995, pp. 91–93). The existence of this nonlinear relationship has been tested by empirical studies in many countries and the idea that there is an optimal level at which government expenditures support growth has gained strength in the literature.

On the other hand, in the literature analysing the effect of public sector size on economic growth, it is observed that the optimal size levels differ depending on the type of government expenditure used. In particular, estimations based on total government expenditures, consumption expenditures, and investment expenditures are important for revealing the extent to which the public sector affects growth through different expenditure channels.

Empirical studies based on total aggregate government expenditures show that the optimal size of the public sector varies widely. For example, Altunc and Aydın (2013) estimated optimal government expenditure levels of 25.21% for Türkiye, 20.44% for Romania, and 22.45% for Bulgaria. Vedder and Gallaway (1998) reported 17.45% for the United States, 20.97% for the United Kingdom, 21.37% for Canada, 26.14% for Denmark, 22.23% for Italy, and 19.43% for Sweden. In their study on EU countries, Forte and Magazzino (2010) found that the rates at which government expenditures supported growth

the most were 35.39% (Belgium), 38.63% (Denmark), 41.99% (Germany), 44.47% (Ireland), and 43.50% (the United Kingdom). The fact that these rates are quite high is due to the extent of welfare state practices in Europe and the historically larger role of the public sector. Şen et al. (2023) examine the relationship between the size of the public sector and economic growth in Türkiye using annual data from 1974 to 2019. In their study, they used total public expenditures and subcomponents of public expenditures to represent the size of the public sector and tested nonlinear effects using Hansen's threshold autoregression model. The findings reveal that there is an inverse U-shaped relationship between the size of the public sector and economic growth, consistent with the Armey/BARS curve, and that the threshold values of the public sector size that maximise growth vary between approximately 4.3% and 15.2%, depending on the indicator used. Benazza & Layati (2025) analyse the relationship between total public spending and economic growth in Algeria using annual data from 1990 to 2021 within the framework of the Armey curve. The findings show that there is an inverse U-shaped relationship between public spending and growth, and that the optimal level of public expenditure that maximises growth is approximately 29.6%.

Studies based on government consumption expenditures show that the optimal size values are concentrated at lower levels. In this context, in their threshold regression analysis for the Taiwanese economy, Chen & Lee (2005) found that the effect on growth becomes negative when the ratio of government consumption expenditures to GDP exceeds 14.97%. Samimi et al. (2010) conducted a panel threshold analysis for eight Islamic countries for the period 1980–2007 and their findings largely support the nonlinear relationship predicted by the Armey curve. Thresholds and effects by country are determined as follows: Iran (24.6%, positive below threshold and negative above the threshold), Pakistan (11.9%, positive/negative), Türkiye (13.96%, positive but not significant above the threshold), Egypt (16.53%, positive/negative), Algeria (16.54%, positive/negative), Indonesia (7.0%, positive/negative), Oman (26.11%, positive/negative), and Jordan (26.09%, positive but not significant above the threshold). These results reveal that the effect of government expenditures on economic growth is positive up to a certain level, but if this level is exceeded, the effect turns negative. Abounoorie

& Nademi (2010) analysed the data for the Iranian economy for the period 1959–2006 and found that the rate of government consumption expenditure that supports economic growth the most is 23.60%. Chiou-Wei et al. (2010) found that government consumption expenditure thresholds in East Asian economies such as South Korea, Singapore, and Taiwan are around 11.00 per cent, and showed that low levels of such expenditures create a more favourable environment for growth.

Working on large country panels, Asimakopoulos & Karavias (2016) determined the threshold value of consumption expenditures as 19.12% in developed countries and 17.96% in emerging countries in their analysis for 129 countries. Thanh & Hoai (2014) set the threshold value of consumption expenditures at 25.69% in their threshold analysis for ASEAN countries and stated that government expenditures above this level restrain growth. Varol İyidoğan & Turan (2017) tested the validity of the Armey curve within the framework of the threshold regression model using data for the period 1998:1–2015:1 for the Turkish economy. The findings of the study strongly suggest that there is a nonlinear relationship between government expenditures and economic growth. As a result of the analyses, the optimal threshold level as a percentage of GDP was found to be 12.6% for government consumption expenditures. Abdillah (2023) analyses the relationship between public consumption expenditures and economic growth in Indonesia using data from 1966–2021 and the ARDL model. The findings indicate that the Armey curve hypothesis holds. Rashdan et al. (2024) examine the relationship between public final consumption expenditures and economic growth in Egypt using annual data from 1990 to 2023. The findings obtained using the ARDL cointegration method show that government final consumption expenditures have a negative and statistically significant effect on economic growth in both the short and long term, and that excessive public spending suppresses growth in a manner consistent with the Armey curve.

These findings on government consumption expenditures show that the optimal size of the public sector may vary not only according to the level of development of the country, but also according to the quality of public services, efficiency of expenditures, and governance structure. Nevertheless, the general tendency is that consumption expenditures support growth between 12% and 20%, while

above this threshold, productivity losses, waste of resources, and deterioration in cost efficiency may have negative effects on growth. Moreover, considering the relative stability of consumption expenditures, its role in ensuring the continuity of basic public services such as health, education, and security, and the long-term effects of these services on growth, this expenditure item should be preferred as a more meaningful indicator representing the size of the public sector.

It is observed that the thresholds obtained in analyses based on investment expenditures are lower compared to consumption and total expenditures. For example, Chen & Lee (2005) reported that the threshold at which government investment expenditures support growth is 7.30% for Taiwan. Abounoori & Nademi (2010) show that the impact on growth weakens if the threshold level, estimated at 8.00% for Iran, is exceeded. This can be interpreted as indicating that government investment expenditures competes more directly with private sector investments, and that the type and quality of investment matter. Similarly, Hok & Bartha (2023) examine the nonlinear relationship between the size of the public sector and economic growth for Cambodia using annual data from 1971 to 2015. In the study, the size of the public sector is measured using two main expenditure components: public final consumption expenditures and public investment expenditures. The findings reveal an inverse U-shaped relationship with growth for both public consumption and public investment expenditures; the threshold values that maximise growth are approximately 5.4% for public investments and approximately 7.2% for public final consumption expenditures.

All these findings show that the optimal size of the public sector varies significantly not only according to the income level or institutional capacity of the country, but also according to the type of government expenditure used. When total expenditures are considered, the optimal size ranges between 17% and 44%, while for consumption expenditures it is generally concentrated in the range of 12% to 20%, and for investment expenditures it is even lower, at 7% to 8%. This differentiation reveals that the impact of the public sector on growth should be evaluated on a component-by-component basis and that policymakers should carefully review the composition of expenditures.

This study defines the size of the public sector only in terms of consumption expenditures. This choice

is based on the fact that consumption expenditures more directly reflect the permanent and structural effects of the public sector on the economy. Moreover, the relative stability of consumption expenditures and their direct relationship with the provision of social services make this type of expenditure a more reliable indicator for measuring the effects on growth. Findings in the literature also show that consumption expenditures support growth up to a certain level, but if this level is exceeded, negative effects emerge. Therefore, the choice of government consumption expenditures as the focal point of the study is based on both theoretical justifications and empirical evidence.

3. Methodology

3.1 Data

This study uses a balanced panel dataset covering 47 emerging countries over the period from 1991 to 2019. The data were compiled from two main sources: the World Development Indicators (WDI) and the Penn World Table (PWT, version 10.01). The empirical strategy is grounded in the Armeij curve framework, which examines the nonlinear relationship between government size and economic performance. Accordingly, the dataset includes five core macroeconomic variables. GDP per capita, measured in constant 2015 US dollars, serves as the dependent variable. Government consumption expenditure, expressed as a percentage of GDP, represents the size of the public sector. Adding an employment-related variable to the model enables a more accurate analysis of growth dynamics. Indeed, according to Okun's Law, higher growth rates reduce unemployment, while lower growth rates increase unemployment (Vedder & Galloway, 1998). This situation points to the necessity of considering labour market indicators in addition to the relationship between growth and government expenditures. The employment-to-population ratio, covering individuals aged 15 and older, is included to account for labour market dynamics. Capital stock relative to real GDP represents capital intensity. Total factor productivity (TFP) reflects the efficiency of production and captures broader productivity effects beyond capital and labour inputs. All variables are transformed into natural logarithms to address heteroskedasticity, normalise scale differences, and allow for elasticity interpretation of the estimated coefficients.

Table 1 Variable summary

Variable	Description	Source	Unit/Measurement
lngdp	Natural logarithm of GDP per capita in constant 2015 US\$	WDI	Constant 2015 US\$
lngov	Natural logarithm of general government final consumption expenditure (% of GDP)	WDI	% of GDP
lnstock	Natural logarithm of capital stock to real GDP ratio at constant 2017 national prices	PWT 10.01	Ratio (millions 2017 US\$)
lnemp	Natural logarithm of employment-to-population ratio, ages 15+ (%)	WDI	% (ILO modelled estimate)
lntfp	Natural logarithm of total factor productivity at constant national prices	PWT 10.01	Index (2017 = 1)

Note: WDI refers to the World Development Indicators, published by the World Bank.

PWT refers to the Penn World Table, version 10.01, developed by the University of Groningen.

Source: Authors' own calculations

Table 2 presents summary statistics for the variables. Each variable shows considerable variation, reflecting diverse economic conditions across emerging economies. Skewness and kurtosis values deviate from those expected under normality, with most variables exhibiting negative skewness and kurtosis differing from 3. The Jarque-Bera tests

also confirm nonnormality at the 1% significance level for all variables, except for the government expenditure stock variable (lnstock), which does not reject the null hypothesis. To address these issues, the analysis employs the Method of Moments Quantile Regression (MMQREG), which is robust to non-normality and heteroskedasticity.

Table 2 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	JB p-value
lngdp	1363	8.024	1.077	5.240	10.177	-0.352	2.422	0.0000
lngov	1363	2.638	0.356	0.716	3.582	-0.822	5.437	0.0000
lngov2	1363	7.088	1.793	0.513	12.829	-0.112	3.548	0.0012
lnstock	1363	1.127	0.397	-0.052	2.321	-0.131	3.034	0.1355
lnemp	1363	4.017	0.207	3.435	4.463	-0.371	2.563	0.0000
lntfp	1363	-0.018	0.181	-1.179	0.768	-0.404	7.613	0.0000

Source: Authors' own calculations

3.2 Model

This study tests the Armey curve hypothesis, which posits a nonlinear relationship between government size and economic performance. According to this framework, there exists an optimal level of government expenditure that maximises economic growth; beyond this point, additional government activity becomes inefficient and harmful to output (Armey, 1995; Pevcin, 2004; Bergh & Henrekson, 2011).

To capture this nonlinearity, the following quadratic specification is employed:

$$\ln gdp_{it} = \alpha + \beta_1 \ln gov_{it} + \beta_2 \ln gov_{it}^2 + \gamma_1 \ln stock_{it} + \gamma_2 \ln emp_{it} + \gamma_3 \ln tfp_{it} + \varepsilon_{it} \quad (1)$$

Here, α is the constant term, and β_1 and β_2 represent the linear and quadratic effects of government consumption, capturing the inverted-U pattern proposed by the Armey curve. The variables correspond to capital stock, employment, and total fac-

tor productivity, respectively. Capital stock, reflecting capital accumulation, is expected to positively influence income, as emphasised in neoclassical growth models (Solow, 1956; Mankiw et al., 1992). The employment-to-population ratio, indicating labour market engagement, should contribute positively to output, consistent with empirical growth studies (Barro, 1990). TFP, measuring technological efficiency, is a critical driver of long-run growth (Solow, 1957). The subscripts *i* and *t* denote country and year.

If the Armey curve holds, we expect > 0 and < 0 , indicating a non-monotonic relationship between government size and growth. Given this quadratic specification in the logarithm of government consumption, the turning point in log terms is:

$$Ingov^* = -\beta_1 / 2\beta_2, \tag{2}$$

so that the optimal share of government consumption in GDP is

$$gov^* = \exp(-\beta_1 / 2\beta_2). \tag{3}$$

Empirical studies have consistently supported this inverted-U shape. Jain et al. (2021) find the Armey curve pattern holds in BRICS and other emerging economies using GMM methods. Altunc & Aydın (2013) report similar findings for Türkiye, Romania, and Bulgaria using the ARDL bounds testing approach. Asimakopoulos & Karavias (2016) confirm the existence of an optimal government size for both developed and emerging countries using a nonlinear GMM framework. These studies provide a broad empirical foundation for applying a nonlinear specification to the government size–growth relationship in the context of emerging countries.

3.3 Methodology

This study investigates the Armey curve hypothesis, examining the nonlinear relationship between government size and economic performance across 47 emerging countries from 1991 to 2019. A robust econometric framework is implemented in two stages to ensure reliable estimation. The first stage involves diagnostic tests on the balanced panel data to assess cross-sectional dependence, slope heterogeneity, and stationarity, thereby establishing the suitability of the data for analysis. The second stage applies the Method of Moments Quantile Regression (MMQREG) to estimate the quadratic relationship between government consumption and GDP per

capita, accounting for heterogeneity across income distributions. Figure 1 outlines the econometric procedure, with details elaborated below.

Figure 1 Steps in research methodology

STEP 1	Data Collection WDI & PWT 10.01, 47 countries, 1991–2019
STEP 2	Descriptive Statistics Skewness, kurtosis, Jarque–Bera test
STEP 3	Cross-Sectional Dependence Pesaran CD test
STEP 4	Slope Heterogeneity Pesaran & Yamagata test
STEP 5	Unit Root Testing Pesaran CIPS test
STEP 6	Cointegration Analysis Westerlund (2007) panel cointegration test
STEP 7	Main Estimation MMQREG – Machado & Santos Silva (2019)
STEP 8	Robustness Checks DOLS & FE with Driscoll–Kraay standard errors

Source: Prepared by the authors

The analysis begins by examining cross-sectional dependence, which arises when economic shocks in one country are likely to affect others, potentially biasing estimates if unaddressed (Pesaran, 2004). A test developed by Pesaran (2004) evaluates the average correlation of residuals across units. The test statistic is computed as follows:

$$CSD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=j}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right), \tag{4}$$

where *N* represents the number of countries, *T* denotes time periods, and $\hat{\rho}_{ij}$ is the pairwise correlation coefficient of residuals. The null hypothesis assumes no cross-sectional dependence, while rejection indicates interdependence, necessitating methods robust to such effects.

The next step involves testing for slope heterogeneity, as uniform coefficients across countries may not hold in diverse emerging economies. A test by Pesaran & Yamagata (2008) evaluates whether slope parameters vary across cross-sections, using a modified statistic:

$$\hat{\Delta} = \sqrt{N} \left(\frac{N^{-1} \hat{S} - K}{\sqrt{2K}} \right). \tag{5}$$

The adjusted version accounts for finite sample bias:

$$\sqrt{N} \left(\frac{2k(T-k-1)}{T-1} \right)^{\frac{1}{2}} \left(\frac{1}{N} \bar{S} - 2K \right), \quad (6)$$

where N is the number of countries, k is the number of regressors, T refers to time periods, and is a modified Swamy statistic. The null hypothesis suggests homogeneous slopes, while the alternative posits heterogeneity, guiding the choice of estimation techniques.

After addressing dependence and heterogeneity, stationarity is then verified to ensure the variables are suitable for long-run analysis. Given potential cross-sectional dependence, a test by Pesaran (2007) augments individual unit root regressions with cross-sectional averages, yielding a statistic:

$$CIPS = \frac{1}{N} \sum_1^n CADF_i. \quad (7)$$

The null hypothesis of the CIPS test states that all panel series contain a unit root (i.e., are nonstationary). Rejection of the null hypothesis implies that at least some cross-sectional units are stationary, which supports the validity of further econometric modelling involving level variables or cointegration analysis.

Following the confirmation of unit root properties, the Westerlund (2007) panel cointegration test is used to investigate the presence of a long-run relationship among the variables. Unlike first-generation panel tests, Westerlund's approach accounts for cross-sectional dependence and heterogeneity—key features in a panel of emerging economies with diverse institutional and economic structures. Using an error-correction framework, it tests the null hypothesis of no cointegration by examining whether deviations from equilibrium are corrected over time. Group-mean statistics (Gt, Ga) assess cointegration for at least one unit, while panel statistics (Pt, Pa) evaluate it for the entire panel. Cointegration evidence supports employing MMQREG to estimate long-run relationships across quantiles, addressing panel heterogeneity.

In the second stage, MMQREG, proposed by Machado & Santos Silva (2019), is applied to estimate the nonlinear effects of government size on economic growth across different quantiles of log GDP per capita. MMQREG is advantageous for its robustness to non-normality and heteroskedasticity, as evidenced by the skewness and kurtosis of the dataset, and its ability to capture varying impacts of government size at different income levels. By including fixed effects, it controls for unobserved

country-specific factors, reducing bias. The approach also ensures non-crossing quantile estimates, enhancing reliability across the GDP distribution. The model is specified as follows:

$$Q_y(\tau|X) = (\alpha_i + \theta_i q(\tau)) + X'_{it} \beta + Z'_{it} \gamma q(\tau), \quad (8)$$

where α_i and θ_i are fixed effects, includes government expenditure, its square, capital stock, employment, and TFP, is a subset of transformed variables, and captures quantilespecific effects. Parameters are estimated using the MMQREG procedure as a one-step generalised method-of-moments (GMM)/method-of-moments estimator, following Machado and Santos Silva (2019).

To ensure robustness, Dynamic OLS (DOLS), proposed by Stock & Watson (1993), is employed as an alternative estimator for the cointegrated relationship among the variables. DOLS corrects for endogeneity and serial correlation by incorporating leads and lags of differenced regressors, thereby addressing biases arising from interdependent variables. Additionally, to account for cross-sectional dependence, serial correlation, and heteroskedasticity, the model is re-estimated using Driscoll-Kraay (1998) standard errors. This approach ensures valid inference in the presence of cross-unit interdependence. Together, these estimators complement the MMQREG framework by delivering consistent long-run results, strengthening the empirical analysis of the Armey curve's nonlinear dynamics in emerging economies.

A potential concern is the endogeneity of government consumption, as fiscal policy may respond to income dynamics and political-economy factors. Our empirical strategy mitigates some of these issues through the inclusion of standard growth controls (capital, employment, and TFP), country fixed effects and a cointegration framework in which the long-run relationship is also estimated using DOLS and Driscoll-Kraay standard errors. Nonetheless, these features cannot fully eliminate reverse causality or omitted time-varying shocks. Accordingly, the results should be interpreted as long-run conditional associations rather than as strictly causal effects.

3.4 Findings

This section presents the findings of the econometric analysis of the Armey curve hypothesis, examining the nonlinear relationship between government size and economic performance across 47 emerging countries from 1991 to 2019. The analysis follows the two-stage methodology outlined earlier, beginning with diagnostic tests to validate the panel data

properties, followed by the Method of Moments Quantile Regression (MMQREG) to estimate the quadratic effects of government consumption.

We begin with testing for cross-sectional dependence (CSD), essential for robust panel data estimation. Table 3 presents the Pesaran (2004) CD test results, which reject the null hypothesis of cross-

sectional independence for most variables at the 1% significance level, except for lnemp. The relatively high mean absolute correlations, ranging from 0.35 to 0.76, confirm substantial interdependence among the variables. These findings suggest that economic shocks in one emerging country may influence others, reflecting interconnected economies.

Table 3 CSD test analysis

Variables	CD-test	mean abs (ρ)
lngdp	99.928***	0.76
lngov	10.835***	0.35
lngov2	11.104***	0.36
lnemp	0.043	0.43
lnstock	12.147***	0.44
Intfp	3.935***	0.48

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.
 Source: Authors' own calculations

Following the cross-sectional dependence test, slope heterogeneity is examined to assess coefficient uniformity across countries. Table 4 reports the Pesaran & Yamagata (2008) slope homogeneity test results. The Delta statistic of 40.114 and the adjusted Delta statistic of 46.056, both with p-values

of 0.000, strongly reject the null hypothesis of homogeneous slopes. The findings posit diverse economic relationships across emerging economies, supporting the use of heterogeneous estimation methods.

Table 4 Slope homogeneity test

Slope homogeneity tests	Stat.	p-value
Delta	40.114	0.000
adj.	46.056	0.000

Note: H_0 suggests that the slope coefficients are homogeneous.
 Source: Authors' own calculations

Stationarity is tested to ensure suitability for long-run analysis. Table 5 reports the CIPS test results (Pesaran, 2007), accounting for cross-sectional dependence. At level, no variables are stationary

under either intercept or intercept and trend specifications. At first difference, all variables achieve stationarity at the 1% significance level, justifying the use of cointegration analysis in the next step.

Table 5 Unit root test (CIPS)

Variables	At level Intercept	At level Intercept & Trend	At first diff. Intercept	At first diff. Intercept & Trend
lngdp	-1.858	-2.003	-4.068***	-4.235***
lngov	-2.055	-2.400	-5.044***	-5.100***
lngov2	-2.060*	-2.407	-5.087***	-5.138***
lnemp	-1.164	-2.117	-3.607***	-3.813***
lnstock	-1.421	-2.395	-4.403***	-4.582***
Intfp	-1.570	-2.332	-4.622***	-4.808***

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively.
 Source: Authors' own calculations

Table 6 reports the results of the Westerlund (2007) cointegration test. Given the earlier evidence of cross-sectional dependence, interpretation relies on the robust p-values. The robust p-values for Pt and Pa are both 0.000, providing strong evidence to reject the null hypothesis of no cointegration. While Gt does not indicate significance ($p = 0.600$), Ga shows moderate evidence against the null hypothesis ($p = 0.040$). Overall, the results confirm the presence of a long-run equilibrium relationship among the variables.

Table 6 Westerlund (2007) bootstrap panel cointegration

Statistics	Value	Z-value	Robust p-value
Gt	-0.902	15.727	0.600
Ga	-0.183	14.198	0.040
Pt	-3.525	15.638	0.000
Pa	-0.328	11.667	0.000

Note: Tests H0: no cointegration. Robust p-values account for cross-sectional dependence with 50 bootstrap replications.
Source: Authors' own calculations

Prior diagnostics confirm cross-sectional dependence, slope heterogeneity, first-difference stationarity, and cointegration, ensuring robust estimation. MMQREG captures distributional heterogeneity, estimating effects at the 0.25, 0.50, 0.75, and 0.90 quantiles of log GDP per capita,

with results reported in Table 7. The coefficients for government consumption and its square reveal a consistent inverted-U relationship, aligning with theoretical predictions (Armeij, 1995). The linear term is positive and significant at the 1% level, ranging from 0.657 at the 0.25 quantile to 0.583 at the 0.90 quantile, indicating that government spending boosts output, particularly in lower-income countries. The squared term is negative and significant at 1%, from -0.121 to -0.099 across quantiles, confirming diminishing returns as government size grows. These findings support the Armeij curve hypothesis that beyond an optimal threshold, government expenditure hampers economic performance. Control variables exhibit positive and significant effects at the 1% level, with capital stock coefficients rising from 1.165 to 1.335, the employment ratio from 0.543 to 0.573, and TFP from 1.846 to 1.918 across quantiles. These align with neoclassical growth models (Solow, 1956; Mankiw et al., 1992), emphasising factor accumulation and productivity as growth drivers. Figure 2 visually complements the MMQREG estimation by plotting the coefficient paths across quantiles with 95% confidence bands. The bands around the coefficients on $\ln gov$ and $\ln gov^2$ remain on the expected side of zero across the quantile range (positive for the linear term and negative for the quadratic term). This pattern supports the presence of an inverted-U relationship and an interior turning point for government consumption.

Table 7 MMQREG estimation results (quantiles 25, 50, 75, 90)

Var.	Location	Scale	Q25 ($\tau=0.25$)	Q50 ($\tau=0.50$)	Q75 ($\tau=0.75$)	Q90 ($\tau=0.90$)
$\ln gov$	0.628*** (0.127)	-0.032 (0.071)	0.657*** (0.153)	0.627*** (0.126)	0.597*** (0.132)	0.583*** (0.146)
$\ln gov^2$	-0.112*** (0.028)	0.010 (0.015)	-0.121*** (0.033)	-0.112*** (0.027)	-0.103*** (0.029)	-0.099*** (0.032)
$\ln stock$	1.232*** (0.043)	0.073*** (0.024)	1.165*** (0.052)	1.234*** (0.043)	1.301*** (0.044)	1.335*** (0.049)
$\ln emp$	0.559*** (0.094)	-0.016 (0.053)	0.573*** (0.113)	0.558*** (0.094)	0.543*** (0.098)	0.536*** (0.108)
$\ln tfp$	1.874*** (0.050)	0.031 (0.028)	1.846*** (0.060)	1.875*** (0.050)	1.904*** (0.052)	1.918*** (0.057)
$_cons$	3.564*** (0.402)	0.122 (0.225)	3.453*** (0.485)	3.567*** (0.401)	3.679*** (0.419)	3.735*** (0.463)
Threshold			15.10%	16.43%	18.14%	19.00%

Note: Coefficients are reported with robust standard errors in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Threshold values are calculated using the formula $\exp(-\beta_1/2\beta_2)$, where β_1 and β_2 are coefficients on the linear and squared log terms of government expenditure.

Source: Authors' own calculations

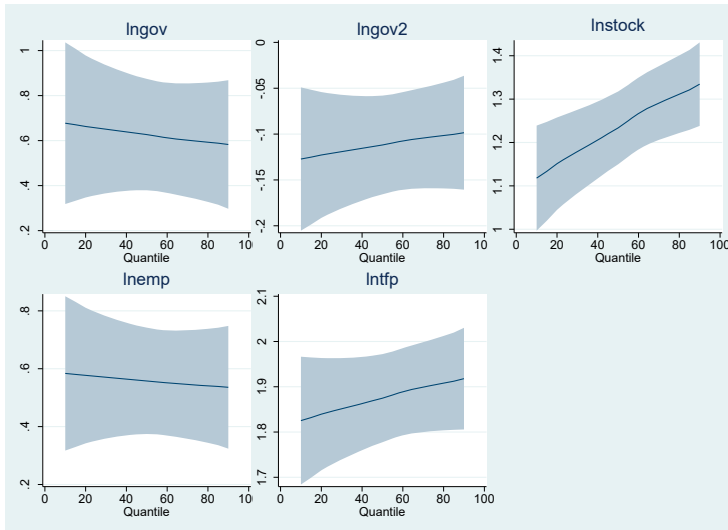
The threshold estimates, calculated as $\exp(-\beta_1/2\beta_2)$, range from 15.10% of GDP at the 0.25 quantile to 19.00% at the 0.90 quantile. This pattern suggests that countries at higher quantiles may tolerate, or even benefit from, relatively larger public sectors before government spending begins to exert negative effects on growth. One possible explanation relates to institutional and administrative capacity: lower-quantile countries, which are likely to have weaker governance and limited fiscal space, may experience inefficiencies or crowding-out effects at lower levels of expenditure (Barro, 1990). In contrast, higher-quantile countries may possess more robust state capacity, better tax systems, and more developed private sectors, allowing them to manage larger budgets without harming economic performance (North, 1990; Bergh & Henrekson, 2011). Additionally, the nature of public goods demanded may shift with development. While lower-income countries may only require basic services, such as infrastructure and security, higher-income economies face demand for more complex and redistributive services, such as education, healthcare, and innovation support. This is consistent with Wagner's Law and Musgrave's stages of public finance, which posit that government expenditure tends to rise with income levels and economic complexity.

Sectoral dynamics may also help explain the upward shift in threshold levels. The estimated coefficients for capital stock and total factor productivity (TFP) increase across quantiles, from 1.165 and 1.846 at the

0.25 quantile to 1.335 and 1.918 at the 0.90 quantile, respectively. This suggests that growth in higher-performing countries is increasingly driven by investment intensity and productivity gains. In these contexts, government spending may be directed toward infrastructure, education, and innovation—areas that reinforce private sector development—thus supporting a higher threshold. In contrast, at the lower end of the distribution (e.g., Q25), labour appears to play a more prominent role in driving growth, as seen in the relatively higher coefficient on the employment-to-population ratio (0.573 at Q25 compared to 0.536 at Q90). These economies are often more labour-intensive and less capitalrich, limiting the growth-enhancing impact of government investment. Additional spending beyond a certain point may produce diminishing returns, especially where institutional weaknesses and limited absorptive capacity restrict effective allocation.

Finally, this upward shift in thresholds may reflect differences in macroeconomic stability, openness, and political economy factors (Rodrik, 1998). Higher-quantile countries often have greater access to credit markets (Reinhart & Rogoff, 2010), more stable institutions, and stronger voter demand for public services (Robinson & Acemoglu, 2012; Meltzer & Richard, 1981), all of which may support a larger optimal government size. While part of the pattern may also stem from the model's sensitivity to changes in coefficients, the consistency across quantiles suggests an underlying economic logic.

Figure 2 Quantile plots



Source: Authors' own calculations

As a robustness check, the model is re-estimated using DOLS and OLS with Driscoll-Kraay standard errors, as reported in Table 8. DOLS accounts for cointegration dynamics, while Driscoll-Kraay corrects for cross-sectional dependence, serial correlation, and heteroskedasticity in the panel. Both estimators deliver the same qualitative pattern as

MMQREG, with a positive coefficient on *Ingov* and a negative coefficient on *Ingov2*. Importantly, the implied optimal government consumption shares fall within the same 15–19 percent range as the MMQREG-based thresholds, indicating that the inverted-U relationship and estimated turning points are robust to the choice of estimator.

Table 8 Robustness check: DOLS vs. Driscoll-Kraay estimations

Variable	DOLS coef. (t-stat)	DOLS p-value	Driscoll-Kraay coef. (t-stat)	Driscoll-Kraay p-value
<i>Ingov</i>	3.33 (34.17)	<0.0001	0.63 (4.55)	0.000
<i>Ingov2</i>	-0.57 (-31.16)	<0.0001	-0.11 (-4.22)	0.000
<i>Instock</i>	0.32 (57.20)	<0.0001	1.23 (22.02)	0.000
<i>Inemp</i>	0.77 (85.19)	<0.0001	0.56 (5.59)	0.000
<i>Intfp</i>	1.12 (102.32)	<0.0001	1.87 (81.53)	0.000
Threshold	18.56%		16.43%	

Note: Threshold values are calculated using the formula $\exp(-\beta_1/2\beta_2)$, where β_1 and β_2 are coefficients on the linear and squared log terms of government expenditure.

Source: Authors' own calculations

Overall, the MMQREG results provide strong evidence in favour of the nonlinear Armey curve hypothesis, revealing that the impact of government size on growth varies across the income distribution. Lower quantiles exhibit lower optimal thresholds, while higher quantiles display greater fiscal tolerance, reflecting differences in structural capacity and growth drivers. These distributional insights, uniquely captured by the quantile-based approach, emphasise the heterogeneity of fiscal-growth dynamics in emerging economies. Robustness checks using DOLS and Driscoll-Kraay estimators confirm the statistical significance and directional consistency of the main coefficients at the mean level. While these average-based estimators do not capture distributional heterogeneity, their alignment with MMQREG's direction of effects strengthens confidence in the overall relationship. The findings suggest that the growthmaximising size of government may vary with a country's level of development, supporting the case for differentiated, context-aware fiscal strategies over universal policy prescriptions.

4. Conclusion

The impact of government expenditures on economic growth is at the centre of fiscal policy debates.

Using a balanced panel of 47 emerging economies from 1991–2019, we estimate a long-run cointegrating relationship between government consumption as a share of GDP and log GDP per capita, controlling for capital intensity, employment, and TFP. Diagnostic tests indicate cross-sectional dependence, slope heterogeneity, and I(1) behaviour, but also strong evidence of cointegration. We therefore apply Machado and Santos Silva's (2019) method of moments quantile regression with country fixed effects to obtain heterogeneous long-run effects across the conditional income distribution.

The results show a statistically robust inverted-U relationship consistent with the Armey curve, with growth-maximising government consumption thresholds rising from about 15% of GDP at lower income quantiles to about 19% at higher quantiles. Panel DOLS and Driscoll-Kraay FE estimates deliver similar nonlinearities at the mean, reinforcing the main conclusions. Taken together, these results reveal that the impact of government expenditures on economic performance varies according to the structural and economic characteristics within countries, thus it is not possible to determine a "one-size-fits-all" optimal ratio.

The differentiated thresholds observed across income groups carry important implications for fiscal

policy design. In lower-income developing economies, where the growth-maximising government size is estimated to be around 15% of GDP, public expenditure should prioritise efficiency-enhancing reforms and be directed toward high-return areas such as basic infrastructure, primary education, and essential health services. These economies commonly face weaker institutional capacity and limited absorptive ability, increasing the likelihood of diminishing returns when government spending expands too rapidly. By contrast, higher-income emerging economies, where the threshold approaches 19%, tend to exhibit stronger administrative capacity, more advanced fiscal systems, and growth dynamics driven increasingly by capital accumulation and total factor productivity. In such contexts, governments may sustain moderately larger levels of public expenditure without incurring efficiency losses, if resources are channelled toward productivity-enhancing sectors. Overall, the findings underscore that optimal fiscal design is inherently context-dependent: policymakers must consider not only the level of government spending but also governance quality, sectoral priorities, and the structural characteristics that determine how public expenditure translates into economic performance.

In methodological terms, the MMQREG framework does not provide strict causal identification, but

it offers a rigorous way to analyse heterogeneity in the government size–growth nexus. The functional form is grounded in the Armey curve and allows for a nonlinear marginal effect of public expenditure on income, while the inclusion of capital stock, employment, and total factor productivity follows standard growth empirics and helps mitigate omitted-variable concerns. By estimating coefficients across quantiles, the model incorporates cross-country differences in structural capacity and development levels, which is consistent with the study’s objective of identifying distributional patterns and policy-relevant thresholds. Accordingly, the results are best interpreted as long-run conditional associations rather than precise causal effects.

A further limitation concerns the level of aggregation in the expenditure data. Reliance on total government consumption obscures sub-component effects such as education, health, or infrastructure. Future research that disaggregates these components could enhance understanding of the Armey curve’s dynamics and clarify which types of spending are most growth-enhancing at different stages of development. In this sense, the present study makes a meaningful contribution to both the theoretical and applied public finance literature and paves the way for the development of more refined and targeted public policies.

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TRUST-EFFECTIVENESS BRIDGE: HOW TEAM COHESION AND SATISFACTION MATTER?

ABSTRACT

Purpose: The primary purpose of this study is to explore the role of team trust in shaping team effectiveness among undergraduate students engaged in collaborative academic projects. Specifically, the study examines how trust within student teams affects their overall satisfaction with the group experience, their sense of cohesion, and ultimately, the quality and success of their group outcomes.

Methodology: The study was conducted within the Organization and Management course, a core subject in the Economics of Entrepreneurship study program. A total of 89 students were divided into 26 teams, each tasked with analyzing a real-world organization and proposing an improved organizational structure.

Results: The analysis revealed a significant positive relationship between team trust and both team satisfaction and team cohesion. In other words, students who reported higher levels of trust in their teammates were also more likely to feel satisfied with the group experience and perceive their teams as cohesive and well-functioning. Furthermore, both team satisfaction and team cohesion were found to be positively linked to team effectiveness, defined as the quality and success of the group's final output.

Conclusion: The study highlights the central importance of trust in building effective student teams and reinforces findings from organizational behavior literature within a real academic setting. When trust is present, team members are more likely to feel engaged, supported, and motivated, which leads to greater collaboration, smoother communication, and ultimately better performance. These insights have practical implications for both educators and managers.

Keywords: Team cohesion, team effectiveness, team satisfaction, team trust

1. Introduction

Teamwork skills are increasingly important in modern business environments that require employees to work and interact with others daily. These skills are among the most highly valued in the labor market, and most organizations claim that a candidate who collaborates well will also perform well in other areas (Crebert et al., 2004; De Prada et al., 2022; Holubčík et al., 2024). As a result, business schools

have increasingly included team projects and case studies in their curricula to build students' teamwork skills (Fittipaldi, 2020; Zeitun et al., 2013).

Moreover, employers expect business schools to prepare students for the labor market by developing an aptitude for teamwork. For several decades, researchers have studied various aspects of teamwork and team effectiveness to help employers maximize their employees' work performance. The

first research on teamwork was conducted by Trist and Bamford (1951), who investigated how teamwork meets an organization's social, psychological, and technological requirements. Today, one of the most famous studies on teamwork was conducted by Loughry et al. (2007), who developed the Comprehensive Assessment of Team Member Effectiveness (CATME), a theory-driven instrument that rigorously measures team member effectiveness.

This paper begins by outlining the research aim and providing a review of the literature on the relationships between team trust, team cohesion, team satisfaction, and team effectiveness. Based on this review, the research hypotheses are developed. Following the theoretical background, the paper presents findings on how team cohesion and team satisfaction mediate the relationship between team trust and team effectiveness, using data collected from students enrolled in the undergraduate study program in Economics of Entrepreneurship. Finally, the paper summarizes the key findings, discusses its limitations, and offers directions for future research.

2. Purpose of research

Previous research on the importance of teamwork and team effectiveness has primarily been conducted in a business environment, with some studies also examining student teamwork in an academic environment (Pikl & Posarić, 2023; Posarić & Pikl, 2024; Zeitun et al., 2013). While these studies have provided valuable insights, they often relied on general or simplified measures of team effectiveness and rarely employed sophisticated and validated instruments such as CATME. The few studies that applied CATME in academic contexts (Pikl & Posarić, 2023; Posarić & Pikl, 2024) demonstrated its value as a rigorous, professional tool for measuring various dimensions of team effectiveness.

Despite the substantial body of literature on team formation, team satisfaction, and team effectiveness, several critical gaps remain that justify further research in this well-explored field. Firstly, there is limited empirical evidence on how trust within student teams influences team effectiveness through specific mediating mechanisms such as team satisfaction and team cohesion. While some researchers have argued that trust is positively linked to perceived team task performance (Costa, 2003), the complex pathways through which trust influences

actual team outcomes in higher education contexts have not been sufficiently explored. Understanding these pathways is crucial for designing learning environments that promote effective collaboration and cultivate essential teamwork skills among students.

Another important contribution of this study lies in its methodological approach. By applying the CATME instrument, rigorously adapted to an academic context, this research provides a more reliable assessment of student team effectiveness than is typically found in previous studies. Many prior studies in the field have relied on ad hoc or single-item measures that do not capture the multifaceted nature of teamwork (Fung, 2014; S. DeOrtentiis et al., 2013). This study addresses systematic methodological criticism by using a comprehensive, validated, and internationally recognized tool. In light of these gaps, the primary purpose of this study is to investigate the mediating roles of team satisfaction and team cohesion in the relationship between team trust and team effectiveness in student teamwork.

By clarifying how trust, satisfaction, and cohesion interact to shape team outcomes, the study aims to expand the theoretical understanding of teamwork dynamics in academic settings. At the same time, the findings should offer practical insights for instructors and course designers into how to build and support more effective, cohesive, and satisfying student teams. In this way, the research contributes to both the scientific literature and the practical advancement of teamwork practices in higher education, ultimately helping to prepare students for the collaborative demands of modern professional environments.

3. Literature review

The variables we will explore in this paper are team trust, team satisfaction, team cohesion, and team effectiveness, as observed in student teamwork within the academic environment. Before analyzing the relationship among these variables, we must first define them. *Team trust* refers to a team member's belief that another member will act in ways that are helpful or at least not harmful (e.g., sharing information), fostering a cooperative environment (Gambetta, 1988). *Team satisfaction* can be defined as how team members feel about events within the project team, including satisfaction with the project

work, team members, and being part of the team (Nguyen et al., 2008). *Team cohesion* can refer to how attractive the team is to its members and the strength of their interpersonal bonds (Cook et al., 1997). Finally, *team effectiveness* is a manager's assessment of team members' performance in completing tasks, achieving goals, empowering one another, sharing information, and maintaining a good working environment (Bourgault et al., 2008).

Gamson (1968) suggested that trust is a crucial factor in employees' attitudes toward their organization. Driscoll (1978) found that organizational trust is most useful in predicting overall satisfaction attitudes. Some authors have investigated the positive relationship between team trust and team satisfaction (Costa, 2003; Costa et al., 2001; Fung, 2014), and some have also explored how these constructs relate to organizational trust and organizational satisfaction (Lin & Guo, 2023; Zhao et al., 2022).

When trust exists within a team, individuals feel free to express themselves genuinely without engaging in impression management or political tactics (Lencioni, 2007). As a result, trust is expected to enhance members' overall satisfaction with being part of the team. This sense of satisfaction plays a vital role in team performance, as it impacts members' confidence, perceived competence, motivation, and contentment with their roles (Robbins & Judge, 2019). Consequently, satisfied team members are more likely to invest greater effort in upcoming assignments. When team members have high trust and are willing to be vulnerable, satisfaction can lead to greater team effectiveness than when trust is lower. Trust has frequently been linked to satisfaction and commitment. For example, Gladstein (1984) identified a significant connection between internal group dynamics—such as open communication—and overall satisfaction. In buyer-seller interactions, Smith and Barclay (1997) demonstrated that trust-related behaviors, such as transparent communication and avoidance of opportunistic actions, contribute to mutual satisfaction between parties. Politics (2006) found that job satisfaction mediates between self-leadership, behavior-focused strategies, and team effectiveness. Similarly, Zeitun et al. (2013) observed a positive relationship between team satisfaction and academic performance in group assignments among American students. Based on these findings, we propose the following hypotheses:

H1: The relationship between team trust and team effectiveness is indirect, such that team satisfaction mediates this relationship.

H1a: Team trust has a direct and positive effect on team satisfaction.

H1b: Team satisfaction has a direct and positive effect on team effectiveness.

Team cohesion relies on making the team's existence matter to each individual (Fine & Holyfield, 1996). Without trust, team members will not be willing to be vulnerable or engage in interdependent actions. Building trust is nearly impossible if team members are not open about their mistakes and weaknesses. A lack of trust hinders the team's ability to become cohesive and engage in productive discussions (Lencioni, 2007). When team members trust each other, they are more likely to see the team as a cohesive unit that helps them achieve their goals. This perception of cohesion reflects the belief that the team can work effectively together to achieve interdependent goals. Team members need to perceive themselves as part of a unified group, as research has shown a positive correlation between cohesion and team effectiveness (Beal et al., 2003; Cai, 2023; Chiochio & Essiembre, 2009; Webber & Donahue, 2001). Accordingly, it is anticipated that trust will have a positive association with cohesion (Fine & Holyfield, 1996), serving as a mediating factor in the connection between team trust and overall team performance.

Higher levels of team cohesion lead to a more effective fulfillment of individual needs while encouraging mutual alignment with the group's goals. A cohesive team environment fosters positive attributes and beneficial outcomes, including heightened awareness of issues, openness to change, stronger motivation, improved morale, enhanced decision-making, and increased creativity (Chidambaram, 1996; Soldz et al., 1993). According to the literature, team cohesion influences project success (Larson & Gobeli, 1989) and team effectiveness in non-project settings (Mcshane & Travaglione, 2003). Cook et al. (1997), Robbins and Judge (2019), and Nelson and Quick (2009) stated that high team cohesion positively impacts productivity, job satisfaction, and growth in non-project teams. Teams with strong cohesion tend to achieve more consistent outcomes because they closely align with established production standards. Furthermore, the act of sharing knowledge serves as a mediating factor

in the relationship between team cohesion and individual performance (van Woerkom & Sanders, 2010). However, it remains unclear whether team cohesion can reliably predict project success, efficiency, and member satisfaction, particularly in contexts constrained by limited time and resources. Considering these results, we pose the following hypotheses:

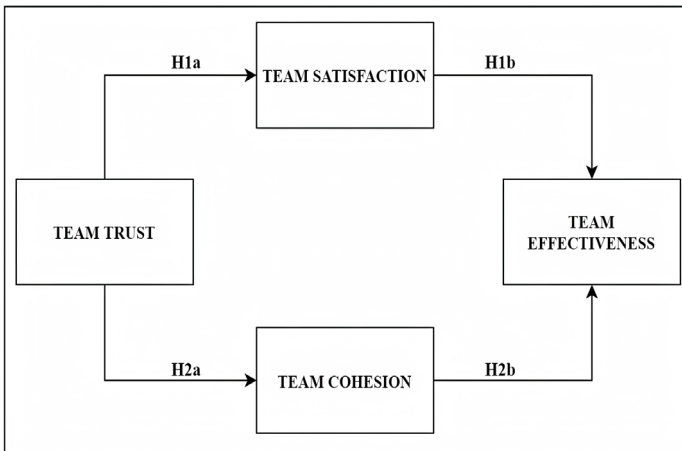
H2: The relationship between team trust and team effectiveness is indirect, such that team cohesion mediates this relationship.

H2a: Team trust has a direct and positive effect on team cohesion.

H2b: Team cohesion has a direct and positive effect on team effectiveness.

Figure 1 shows a conceptual research model.

Figure 1 Conceptual research model



Source: Authors' research

4. Research methods

This study employed a quantitative research design, using an online questionnaire to gather data on team dynamics from undergraduate students participating in a course-based group project. Standardized, previously validated measurement scales were adapted for the team context to assess trust, cohesion, satisfaction, and effectiveness, ensuring reliable, structured data suitable for statistical analysis.

4.1 Data collection, instrument and statistical procedures

A total of 89 undergraduate students enrolled in the Economics of Entrepreneurship study program contributed to data collection in this research. The study was carried out in the second (summer) semester of the 2023–2024 academic year, with 111 students enrolled in the Organization and Management course serving as the sample. The course pre-

pares students to develop organizational and managerial systems for different organizations.

Throughout the course's learning and assessment activities, students were required to analyze a real organization and provide a redesigned organizational structure. The teacher formed the students into teams of about 4; some had 3 or 5. There were 111 students placed in 26 teams. The teacher formed teams using a random-number method. This approach is considered the most effective way to simulate real-world business environments, where individuals often do not have the option to select their team members. The team members selected their team leader among themselves, and the teacher did not influence this decision. Throughout the semester, students worked on these group projects, which culminated in a 15-minute oral presentation and a 5,000- to 7,000-word written report, both delivered at the conclusion of the semester. Teams were expected to work continuously, hold regular meetings, and independently divide tasks.

Additionally, an important requirement for all teams was that every team member had to attend an interview with a manager at a selected organization from real business practice, to collect the data needed to complete the assignment. A total of 89 out of 111 participants completed the questionnaire. The data were gathered in June 2024 using LimeSurvey¹, an online survey tool.

Team trust was assessed with a revised version of the scale originally used by Jarvenpaa, Knoll, and Leidner (1998), adapted to the team context. The measure included six statements for which participants indicated their level of agreement on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The internal consistency of this measure, as indexed by Cronbach's alpha, was 0.64—just below the conventionally accepted cutoff of 0.70 (Jarvenpaa et al., 1998), so we decided to use this variable in our model.

Team cohesion was assessed using an adapted measure developed by Podsakoff and MacKenzie (1994) for use in team settings. The measure also had six statements, each rated on a five-point Likert scale. This scale was reliable, with a Cronbach's alpha of 0.94, above the 0.70 threshold recommended by Nunnally (1978).

Team satisfaction was assessed with a scale initially developed by Gladstein (1984) and modified to the team level for this investigation. This measure consisted of five items rated on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The scale demonstrated acceptable reliability, with a Cronbach's alpha of 0.76 (Nunnally, 1978).

Team effectiveness was measured using a 33-item scale developed by Lau et al. (2014) across five dimensions: (1) contributing to the work of the team, (2) interacting with the team, (3) keeping the team on track, (4) maintaining high standards, and (5) possessing relevant knowledge, skills, and abilities. All items were measured on a five-point Likert scale. Internal consistency was measured for each subscale, and the Cronbach's alpha values of 0.86 for category (1), 0.90 for category (2), 0.89 for category (3), 0.74 for category (4), and 0.81 for category (5) were obtained. They are all within or above the acceptable reliability limit (Nunnally, 1978) psychiatrists, and kindred professionals, in this chapter it will be assumed that the reader is already familiar with fundamental issues relating to behavioral

measurement and, consequently, that there will be no need to discuss low-level principles. Rather, the discussion will center on controversial issues that are of immediate importance to the professional clinician or researcher in the behavioral sciences. Whereas the examples chosen for this chapter to illustrate principles of measurement are particularly applicable to clinical diagnosis, the principles are quite general to empirical science. Because some methods of statistical and mathematical analysis are intimately related to the development and use of measurement methods, critical comments will be made about some prominent approaches to statistical analysis, but details regarding their applications will be left to referenced sources rather than be discussed in detail here. (Any reader who is not already familiar with fundamental principles of psychometric theory and analysis, or would like a refresher course in that regard, might want to consult my book *Psychometric Theory*, 1978..

We tested our hypotheses using regression analysis with Model 4 of the PROCESS macro for SPSS (Hayes, 2018), separately for each mediator.

4.2 Data analysis

Table 1 presents the demographic characteristics of the students who participated in the study and comprised the sample of respondents. Of the total respondents, 73% were female, and 27% were male. The majority of students enrolled in the undergraduate study program in Economics of Entrepreneurship are female. In previous years, there was an even greater disparity between the number of female and male students enrolled in the undergraduate study program in Economics and Entrepreneurship. Furthermore, most respondents (76%) were born between 2004 and 2005, 18% were born between 2002 and 2003, and 6% were born between 2000 and 2001. As for the respondents' roles on the team, 78% were team members, as expected, since only one team member can be the team leader.

Likewise, most teams had 4 team members (71%), and only a small number had 5 (17%) or 3 (12%). In the Organization and Management course, at the beginning of the semester, students are divided into four seminar groups in which they attend lectures. The number of students in each seminar group can vary, resulting in groups with more or fewer teams for team project tasks and affecting the size of each team. Only 11% of respondents reported conflicts during teamwork. This can indicate strong team

¹ www.limesurvey.srce.hr

cohesion. Also, 91% of respondents stated they had rules for working on the team. This is crucial information because defined rules can affect team effectiveness. Finally, 93% of the respondents said they conducted their meetings online. This is also

expected because, following the COVID-19 pandemic, students have been taught to work in an online environment and to use various tools to facilitate online collaboration.

Table 1 Demographic characteristics of the sample

Demographics	Category	Frequency	Percent
Gender	male	24	27%
	female	65	73%
Year	2000–2001	5	6%
	2002–2003	16	18%
	2004–2005	68	76%
Role	team member	69	78%
	team leader	20	22%
Number of team members	3	11	12%
	4	63	71%
	5	15	17%
Conflicts	yes	10	11%
	no	79	89%
Rules	yes	81	91%
	no	8	9%
Meeting place	contact	6	7%
	online	83	93%

Source: Authors' research

Table 2 provides descriptive statistics (minimum, maximum, mean, and standard deviation) for items related to team trust, team satisfaction, team cohesion, and team effectiveness. The lowest mean value for items related to team effectiveness is 3.88, while the highest is 4.91, indicating that respondents rated their team effectiveness highly.

In contrast, team satisfaction showed greater variability. While most items received satisfactory ratings, certain statements, such as “I am very happy to work in this team” (Mean = 3.91) and “The way in which the team worked together was most adequate” (Mean = 3.90), were noticeably lower. Furthermore, the item “The development of teamwork was not adequate” (reverse-coded, Mean = 2.57) suggests that a subset of respondents experienced some dissatisfaction with team processes or collaboration dynamics. These findings point to opportu-

nities for enhancing emotional connectedness and confidence in team interactions.

Measures of team cohesion were generally high, with mean scores ranging from 4.04 to 4.19. The lowest values appeared on reverse-coded items such as “There is no “team spirit” in my group” (Mean = 2.52) and “There is a noticeable lack of confidence among those with whom I work” (Mean = 2.49). Although these low scores actually reflect positive perceptions of team spirit and mutual confidence, the variation suggests that not all team members experience cohesion uniformly.

Regarding team trust, two items had lower mean values (2.52 and 2.49), suggesting that trust may be a relative weakness for some participants.

Table 2 Descriptive statistics of items related to the main constructs

Descriptive Statistics					
Items	N	Minimum	Maximum	Mean	Std. Deviation
EFE1	89	3	5	4.52	0.605
EFE2	89	4	5	4.79	0.412
EFE3	89	3	5	4.57	0.562
EFE4	89	3	5	4.78	0.517
EFE5	89	3	5	4.62	0.554
EFE6	89	3	5	4.58	0.540
EFE7	89	3	5	4.62	0.533
EFE8	89	2	5	4.54	0.708
EFE9	89	2	5	4.69	0.576
EFE10	89	2	5	4.51	0.676
EFE11	89	3	5	4.64	0.506
EFE12	89	2	5	4.24	0.840
EFE13	89	1	5	3.88	1.064
EFE14	89	3	5	4.61	0.650
EFE15	89	1	5	4.24	0.905
EFE16	89	3	5	4.55	0.640
EFE17	89	3	5	4.57	0.705
EFE18	89	3	5	4.58	0.636
EFE19	89	3	5	4.46	0.641
EFE20	89	3	5	4.34	0.722
EFE21	89	2	5	4.36	0.711
EFE22	89	2	5	4.31	0.777
EFE23	89	1	5	4.07	1.009
EFE24	89	3	5	4.43	0.655
EFE25	89	3	5	4.63	0.591
EFE26	89	2	5	4.58	0.704
EFE27	89	2	5	4.57	0.672
EFE28	89	4	5	4.91	0.288
EFE29	89	1	5	4.47	0.755
EFE30	89	2	5	4.42	0.618
EFE31	89	3	5	4.46	0.585
EFE32	89	2	5	4.28	0.754
EFE33	89	1	5	4.18	0.899
SAT1	89	1	5	3.91	1.174
SAT2	89	1	5	4.09	1.018

Descriptive Statistics					
Items	N	Minimum	Maximum	Mean	Std. Deviation
SAT3	89	1	5	3.90	1.077
SAT4	89	1	5	4.17	0.895
SAT5	89	1	5	2.57	1.322
COH1	89	1	5	3.90	0.966
COH2	89	1	5	4.11	1.005
COH3	89	1	5	4.16	0.976
COH4	89	1	5	4.19	0.915
COH5	89	1	5	4.07	1.042
COH6	89	1	5	4.04	1.010
TRUST1	89	1	5	4.06	1.059
TRUST2	89	1	5	4.16	0.976
TRUST3	89	1	5	4.38	0.886
TRUST4	89	1	5	2.52	1.463
TRUST5	89	1	5	2.49	1.399
TRUST6	89	1	5	4.11	0.994

Source: Authors' research

5. Research results and discussion

To test hypotheses, we used regression analysis with Model 4 of the PROCESS MACRO for SPSS (Hayes, 2018). This analysis was conducted twice for each mediator. The results of the first regression analysis showed that team satisfaction mediates the relationship between team trust and team effectiveness. These results are shown in Table 3. The direct effect of team trust on team effectiveness is not significant, but the indirect effect is significant. According to Hair et al. (2022), the results suggest an indirect-only mediation effect, or full mediation in this case. Accordingly, Hypothesis H1 can be accepted. Also, there is a positive relationship between team trust and team satisfaction (p-value < .01), as well as between team satisfaction and team effectiveness (p-value < .10). These results suggest that hypotheses H1a and H1b can be accepted. These results align with previous research on the relationship between team trust and team satisfaction (Costa, 2003; Costa et al., 2001; Fung, 2014). They also align with the proposition by Robbins and Judge (2003) that satisfaction is crucial for team effectiveness. These are valuable findings because this study was the first to conduct research of this type

on a sample of students and can help teachers better understand students' teamwork and team members' satisfaction.

The results of the second regression analysis showed that team cohesion mediates the relationship between team trust and team effectiveness. These results are shown in Table 3. The direct effect of team trust on team effectiveness is not significant, but the indirect effect is significant. According to Hair et al. (2022), the results suggest that we have an indirect-only mediation effect, or full mediation in this case. Accordingly, Hypothesis H2 can be accepted. Also, there is a positive relationship between team trust and team cohesion (p-value < .01) and between team cohesion and team effectiveness (p-value < .05). These results suggest that hypotheses H2a and H2b can be accepted. The results align with previous research (Beal et al., 2003; Chiochio & Essiembre, 2009; Fine & Holyfield, 1996; Webber & Donahue, 2001) and are valuable findings because this study was the first to conduct research of this type on a sample of students, which can help teachers better understand students' teamwork and the relationships between different team members.

Table 3 Results of conditional process mediation analyses without control variables

Model	Direct effect			Indirect effect	Total effect
	(X → Y)	(X → M)	(M → Y)	(X → M → Y)	c
	c'	a	b	a x b*****	
Team Trust → Team Satisfaction → Team Effectiveness	0.3766	0.6579*	0.8790**	0.0210	0.9549
Team Trust → Team Cohesion → Team Effectiveness	0.1273	0.9440***	0.8767****	0.2442	0.9549

Note: * p < .01; ** p < .10; *** P < .01; **** p < .05; ***** 95% bootstrap confidence interval
 Source: Authors' research

The results in Table 4 indicate that when control variables are included, the mediation effects remain consistent with those in the baseline model. In the extended model, the control variables included respondents' gender and their team-member role. For both mediators—team satisfaction and team cohesion—the indirect effects remain significant, confirming full mediation in both pathways, just as in the model without control variables. Interestingly, the indirect effects are even stronger in the extend-

ed model, suggesting that controlling for additional variables strengthens the mediating role of team satisfaction and team cohesion in the relationship between team trust and team effectiveness. The direct effects remain nonsignificant in both models, further supporting the indirect-only mediation. Overall, these findings show that the results are robust and that the inclusion of control variables does not alter the fundamental conclusions drawn from the baseline model.

Table 4 Results of conditional process mediation analyses with control variables

Model	Direct effect			Indirect effect	Total effect
	(X → Y)	(X → M)	(M → Y)	(X → M → Y)	c
	c'	a	b	a x b*****	
Team Trust → Team Satisfaction → Team Effectiveness	0.2423	0.6544*	1.1716***	0.7667	1.0089
Team Trust → Team Cohesion → Team Effectiveness	-0.0267	0.9373***	1.1049**	1.0356	1.0089

Note: * p < .01; ** p < .10; *** P < .01; **** p < .05; ***** 95% bootstrap confidence interval
 Source: Authors' research

5.1 Future agenda

The study was based on a relatively small sample of students from a single course within one faculty. To improve the generalizability of the results, future research should replicate this study with larger, more diverse samples that include students from different study programs, faculties, and universities. Additionally, examining these relationships across various educational levels—such as undergraduate and graduate groups of students—could provide insights into how maturity, prior experience, and academic demands shape team dynamics and performance.

Cultural factors also play a critical role in shaping teamwork behaviors. As norms surrounding trust, cohesion, and satisfaction can vary significantly across cultural contexts, future research should investigate these constructs in international and cross-cultural settings, extending existing literature on global team performance and satisfaction.

The present study collected data at a single point in time. To capture the development and causal relationships of team dynamics, future research would benefit from longitudinal designs. These would enable a more nuanced understanding of how trust, cohesion, and satisfaction evolve throughout a

project and how they affect team effectiveness over time.

While self-reported data provide valuable subjective insights, integrating multiple data sources—such as peer evaluations, teacher assessments, and objective performance metrics—could offer a more comprehensive, triangulated view of team effectiveness and its antecedents. The descriptive statistics indicated lower mean values on certain items related to team trust and satisfaction. Future research should explore which specific dimensions of trust or satisfaction are most challenging for student teams and investigate potential causes, thereby informing more targeted pedagogical interventions.

Given that 93% of teams in this study held their meetings online, future research could examine how virtual versus face-to-face interactions affect the development of trust, cohesion, satisfaction, and overall effectiveness in student teams. This would build on previous comparative studies and reflect evolving modes of academic collaboration.

Furthermore, the high adherence to team rules (91%) and the low incidence of reported conflict (11%) suggest potential areas for deeper investigation. Future work could examine how clearly defined team norms and effective conflict resolution strategies contribute to positive team dynamics and outcomes.

With the rapid proliferation of artificial intelligence (AI) tools in academic settings, future studies should also consider the influence of AI on team processes and effectiveness. Understanding how students use these tools collaboratively can provide critical insights into evolving team practices and technological integration.

Although this study focused on student teams, its findings resonate with research conducted in organizational contexts. Future research could further explore the applicability of these results to professional teams and consider refining the CATME instrument for broader use in industry and other non-academic environments. Ultimately, the insights gained from this study can support educators, researchers, and practitioners in fostering more effective teams. By addressing these suggested directions, future research can build upon the current study's foundation, contributing to a deeper understanding of teamwork development in both educational and professional settings.

5.2 Practical implications

The study found that team trust is positively associated with both team satisfaction and team cohesion, which in turn contribute to team effectiveness. To foster trust from the outset of group work, teachers should create an environment where students feel safe to be authentic and vulnerable without fear of negative repercussions. This psychological safety is crucial for fostering trust and facilitating meaningful collaboration. However, some students reported trust-related issues, indicating a need for targeted pedagogical strategies to address them.

The findings also confirmed that team satisfaction positively influences team effectiveness, acting as a mediator between trust and performance. Higher satisfaction enhances team members' confidence, effort, and engagement, ultimately improving both current and future outcomes. Since some students expressed dissatisfaction with their teamwork experience, teachers should monitor satisfaction levels through feedback, adjust project structures as needed, and introduce activities to enhance the team experience. To further improve performance, teachers should encourage students to see their group as a cohesive unit with shared goals. High cohesion is linked to greater problem awareness, openness to change, increased motivation, and improved morale. Teachers can promote cohesion through teambuilding exercises and by reinforcing the importance of each member's contribution to a group's success.

Understanding the dynamic interplay between trust, satisfaction, cohesion, and effectiveness enables educators to identify and address weaknesses in teamwork. Informed by these insights, teachers can refine project requirements, adjust group sizes, and enhance communication structures to improve overall effectiveness. Designing collaborative tasks that require interdependence can also make trust a functional necessity within teams. While the study did not establish causality, it suggests that clearly defined rules may enhance team effectiveness and cohesion. Teachers can support students in developing effective team norms and constructive conflict-resolution strategies, fostering more stable, productive team dynamics.

Lastly, the study offers practical guidance for evaluating students' satisfaction with team tasks and their assessments of peer collaboration. Such feedback is vital for improving team-based assignments,

which can significantly impact course grades. These insights can help educators refine instructional strategies, optimize future projects, and better prepare students for collaborative work in professional settings. Although the study did not directly compare online and face-to-face teamwork, educators should remain mindful of how virtual environments might affect trust, cohesion, and satisfaction. Integrating effective digital tools and applying best practices for remote collaboration are crucial for fostering successful team dynamics in online learning environments.

6. Conclusion

We investigated the relationship between team trust and team effectiveness among students participating in a team project in the Organization and Management course as part of the undergraduate study program in Economics of Entrepreneurship. We observed this relationship by including two mediating variables: team satisfaction and team cohesion. Research of this type, using the CATME instrument to measure team effectiveness, had not previously been conducted on a sample of students, thus filling a gap in the literature. To a large extent, previous research on teamwork and team effectiveness has been oriented toward a business environment, which has changed in the last decade. The main reason for this is the understanding that teamwork is an important skill that must be perfected already during education.

Our research found that both team satisfaction and team cohesion mediate the relationship between team trust and team effectiveness. Additionally, the results revealed that team trust is positively related to team satisfaction, and team satisfaction is posi-

tively related to team effectiveness. Also, team trust is positively related to team cohesion, and team cohesion is positively related to team effectiveness. The research we conducted confirmed both research questions. These findings align with previous research in a business environment, but they contribute to the literature by examining teamwork and team effectiveness in student teams. Because teamwork is a crucial skill in a business environment, students need to develop these skills during their education. Learning to work in a team as a student can better prepare them to face the challenges of working in a team as a future employee.

This research can help scientists and managers discern which aspects most influence team effectiveness and task performance, and direct their attention to weaker aspects that need improvement. In addition, the results of this research can help teachers determine how satisfied students are with the team task, how students evaluate their team members' teamwork, and how they can improve the team task's success, which is an important part of the final grade in the course. Based on this kind of feedback, teachers can improve team tasks for students, adjust the activities students should complete within the team task framework, and consider ways to enhance team members' satisfaction and team cohesion.

Although this study had various limitations, such as a small sample size (one course at one faculty), self-reported information, and conducting research at a single point in time, it represents an initial attempt to study the impact of team trust on students' performance in team projects using the CATME instrument, with team satisfaction and team cohesion as mediating variables.

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Appendix

Survey items

Variable	Items
Team Effectiveness	Category 1: Contributing to the team's work
	<i>I did a fair share of the team's work.</i>
	<i>I fulfilled my responsibilities to the team.</i>
	<i>I came to team meetings prepared.</i>
	<i>I completed work in a timely manner.</i>
	<i>I did work that was complete and accurate.</i>
	<i>I made important contributions to the team's final product.</i>
	<i>I kept trying when faced with difficult situations.</i>
	<i>I offered to help teammates when it was appropriate.</i>
	Category 2: Interacting with teammates
	<i>I communicate effectively.</i>
	<i>I facilitated effective communication in the team.</i>
	<i>I exchanged information with teammates in a timely manner.</i>
	<i>I provided encouragement to other team members.</i>
	<i>I expressed enthusiasm about working as a team.</i>
	<i>I heard what teammates had to say about issues that affected the team.</i>
	<i>I got team input on important matters before going ahead.</i>
	<i>I accepted feedback about strengths and weaknesses from teammates.</i>
	<i>I used teammates' feedback to improve performance.</i>
	<i>I let other team members help when it was necessary.</i>
	Category 3: Keeping the team on track
	<i>I stayed aware of fellow team members' progress.</i>
	<i>I assessed whether the team was making progress as expected.</i>
	<i>I stayed aware of external factors that influenced team performance.</i>
	<i>I provided constructive feedback to others on the team.</i>
	<i>I motivated others on the team to do their best.</i>
	<i>I made sure that everyone on the team understood important information.</i>
	<i>I helped the team to plan and organize its work.</i>
	Category 4: Expecting quality
	<i>I expected the team to succeed.</i>
<i>I believed that the team could produce high-quality work.</i>	
<i>I cared about the team producing high-quality work.</i>	
<i>I believed that the team should achieve high standards.</i>	

Team Effectiveness	Category 5: Having relevant knowledge, skills, and abilities
	<i>I had the skills and expertise to do excellent work.</i>
	<i>I had the necessary skills and abilities to do a good job.</i>
	<i>I had sufficient knowledge of teammates' roles to step in if necessary.</i>
	<i>I knew how to do the job of other team members.</i>
Team Satisfaction	<i>I am very happy to work in this team.</i>
	<i>I am very satisfied with the decision adopted for this team.</i>
	<i>The way in which the team worked together was most adequate.</i>
	<i>My expectations regarding the positive consequences of team decisions are very positive.</i>
	<i>The development of teamwork was not adequate.</i>
Team Cohesion	<i>There is a great deal of trust among members of my work group.</i>
	<i>Members of my group work well together as a team.</i>
	<i>Members of my work group cooperate well with each other.</i>
	<i>Members of my work group know that they can rely on each other.</i>
	<i>Members of my work group stand up for each other.</i>
	<i>Members of my work group regard each other as friends.</i>
Team Trust	<i>Overall, people in my work group are very trustworthy.</i>
	<i>We are usually considerate of one another's feelings in this work group.</i>
	<i>People in my group are friendly.</i>
	<i>There is no "team spirit" in my group.</i>
	<i>There is a noticeable lack of confidence among those with whom I work.</i>
	<i>We have confidence in one another in this group.</i>

Source: Authors' research

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WERE WINDFALL PROFITS AND THEIR TAX REGULATION IN 2022 A TRIGGER FOR EARNINGS MANAGEMENT? ANALYSIS OF CROATIAN MANUFACTURING COMPANIES

ABSTRACT

Purpose: This research, conducted on a sample of Croatian manufacturing companies, investigates whether windfall profits and their tax regulation in 2022 triggered earnings management.

Methodology: This research uses a company-level difference-in-differences design within the FE panel model for the period 2021–2023. Two interaction variables are designed to capture broader and direct effects of expected political costs. The research model also includes controls for company-level variables to capture the other motives of earnings management.

Results: The occurrence of windfall profits in 2022 did not cause systematic downward earnings management. However, windfall profits in 2022 intensified negative earnings management in the segment of companies that had only negative discretionary accruals. The interaction variable that captures only those companies that were subject to windfall tax regulation in Croatia is negative and statistically significant. This finding confirms that actual exposure to windfall profit regulation is a more pronounced motive for downward earnings management than the mere existence of windfall profits. The control variables exhibit signs that are consistent with theoretical assumptions and previous research.

Conclusion: Research on a sample of Croatian manufacturing companies conditionally confirmed the political cost hypothesis, i.e., only for the companies facing clear and pronounced political costs. However, the observed earnings management practices were not caused only by windfall profits tax regulation but can be linked to the company's indebtedness, profitability, and general level of taxation.

Keywords: Windfall profits, discretionary accruals, earnings management, Croatia

1. Introduction

The start of war in Ukraine in February 2022 led to a sharp rise in prices for all major energy sources. In the second half of 2022, energy prices fell and stabilized at a lower level than the peak prices in mid-2022. The high level of uncertainty associated with the war in Ukraine and the rise in energy costs led to a serious increase in revenue and profits for many companies. Some analyses (Trautvetter, 2024) assume that large companies generated windfall profits of EUR 2,000 billion in 2022, including EUR 310 billion for EU companies. The rise in energy prices had a relatively rapid influence on the prices of many products and services, and the EU faced a record-breaking inflation rate of 9.2% (HICP) in 2022. These developments also gave rise to political discussions and media coverage regarding the introduction of a windfall profits tax in the EU Member States. The EU's response to the energy crisis, windfall corporate profits, and high inflation is the introduction of the "solidarity contribution," aimed at raising funds to support households affected by this crisis. In October 2022, the Council of the EU adopted Regulation (EU) 2022/1854, which introduced a "solidarity contribution" for 2022 and/or 2023.

Article 14 of Council Regulation (EU) No 2022/1854 required EU Member States to levy a "solidarity contribution" on windfall profits (hereinafter "windfall profits tax") from companies operating in the oil, gas, coal, and refining sectors. Alternatively, Member States could adopt equivalent national measures that are similar in terms of the objectives and level of taxation. The tax rate for the windfall tax is at least 33% and is applied to a tax base that is 20% higher than the average taxable profit in the period 2018–2021. A study by Nicolay et al. (2023) estimates that the application of the windfall tax model described above in the EU should result in additional tax revenues of EUR 4.4 billion. The enforcement of windfall taxation in EU countries varies in terms of the scope of sectors affected, the windfall tax rate, the tax base, and the years of application (Enache, 2024). Croatia is among the few EU Member States that has covered all sectors with this tax model. However, its application was restricted to windfall profits in 2022 and only to companies with a turnover of more than EUR 39.82 million in 2022.

According to publicly available data (Litvan, 2024), 179 companies in Croatia were affected by the

windfall tax in 2022 and paid EUR 248 million in total. It should be noted that the Windfall Tax Act was adopted in the Croatian Parliament (Sabor) on December 16, 2022. Considering that the financial year was coming to an end, the possibility of reducing the tax base through real business decisions (i.e., real earnings management), such as investments in fixed assets, an increase in R&D expenditure, or sales shifting, was very limited. According to the official summary data from the FINA database InfoBIZ¹, Croatian companies reported a strong increase in revenue (+26.4%) and revenue per employee (+22.7%) in 2022 compared to 2021. At the same time, financial profitability indicators developed mostly negatively in 2022 compared to the previous year (ROA decreased by 0.6%, the EBITDA margin decreased by 6.3%, and the EBIT margin decreased by 1.0%). Only the ROE indicator rose by 0.4% in 2022. Such poor financial results may be the result of a sharp increase in input prices and/or accounting strategies aimed at minimizing reported accounting profits. In a business environment where windfall profits and their taxation are discussed in the media and in politics, there is a strong incentive to avoid reporting excessive profitability.

Considering the incentives offered by the 2022 business environment, the main objective of this research is to answer the following question: Is earnings management in Croatian manufacturing companies driven by windfall profits and/or related changes in income tax regulation in 2022? Given that the existing literature in the field of earnings management indicates that the level of discretionary accruals is influenced by the number of variables, it is necessary to control for the impact of other influential variables (leverage, size, profitability, etc.). Clarifying the main and secondary research questions contributes to accounting theory and the practical application of accounting knowledge among users of financial statements. This paper contributes to the current body of knowledge on earnings management practices in several ways. Although numerous studies deal with earnings management, recent review articles (Callao et al., 2020; Vagner et al., 2021; Hien, 2024; Gokhale & Pillai, 2024) show that most studies originate from Western countries (USA, UK, Canada, Spain, etc.) and Asian countries (China, Malaysia, Indonesia, South Korea, etc.), while very few studies have been con-

¹ <https://infobiz.fina.hr>

ducted in Eastern and Central European countries. In particular, only two studies (Degiannakis et al., 2019; Pervan et al., 2024) are available for Croatia, which provides an opportunity for additional research and more recent findings. According to the available literature, this is the first study to examine the phenomenon of 2022 windfall profits and the impact of windfall profit taxation in the EU on earnings management. This research focuses on private companies, where the impetus for earnings management differs significantly from that of listed companies. Regarding the research methodology and the measurement of the proxy variable for earnings management, an advance over previous studies is the inclusion of provisions in the total accruals formula, which is generally not the case in previous studies. Such a calculation of total, discretionary, and non-discretionary accruals certainly leads to greater accuracy in measurement and ensures more reliable conclusions. Finally, unlike many studies that focus on only one earnings management factor, this research analyzes the influence of several regressor variables (windfall profits, windfall profits tax regulation, leverage, company size, profitability, and effective income tax) simultaneously.

Empirical findings reveal that the occurrence of windfall profits in 2022 did not cause systematic earnings minimization for companies that reported windfall profits. However, the existence of windfall profits in 2022 amplified downward earnings management in the segment of companies that had only negative discretionary accruals. The interaction variable that identifies only those companies that were actually under Croatian windfall profits tax jurisdiction in 2022 is negative and statistically significant. Such a finding confirms that the actual exposure to windfall profits tax regulation is a more pronounced motive for downward earnings management than the mere existence of windfall profits. Therefore, it can be concluded that the political cost hypothesis can be conditionally accepted, i.e., only for Croatian manufacturing companies faced with direct risk of political costs. The control variables have signs that are consistent with theoretical assumptions and previous research.

The main empirical findings of this study provide useful practical guidelines for various stakeholders. For example, banks and other creditors need to be aware that reported accounting profits might be understated in years with windfall profits if company is faced with credible and pronounced risk of ad-

ditional political costs. Therefore, a more detailed analysis of financial statements is needed, with particular attention paid to discretionary accrual items such as depreciation, write-offs of receivables, inventory write-offs, provisions, etc. Croatian tax administration should assume that companies facing an additional windfall tax burden are likely to use accounting techniques to decrease the accounting earnings. Therefore, tax audits should be stricter for such companies. In years with windfall profits, external auditors should be cautious about increased possibility of earnings management among directly affected companies and check whether the applied accounting methods are in line with accounting standards and general accounting principles.

This paper is divided into five main sections. After the introduction, Section 2 provides a review of relevant research on earnings management with a particular focus on papers dealing with income tax and windfall profits. The third section describes the databases used, the selection of the research samples, and the variables required for the research methodology. The main research results are explained in Section 4, followed by concluding remarks in the final section.

2. Analysis of previous literature

Earnings management in the context of the phenomenon of windfall profits and their taxation can probably be categorized as a “gray” earnings management according to the definition provided by Ronen and Jaari (2008). The “gray” earnings management views the selection of accounting policies/estimates as opportunistic or economically efficient. From this perspective, companies use the flexibility of accounting standards for the personal interests of managers or the interests of the company. Research on the reaction of companies to the introduction of the windfall profits tax and the choice of accounting methods has its theoretical roots in agency theory (Jensen & Meckling, 1976). According to this theory, the company can be perceived as a set of contracts between the company and its stakeholders. Agency theory provided the foundations of positive accounting theory (PAT) developed by Watts and Zimmerman (1986) and related three main hypotheses (political costs, bonus plans, and debt covenant).

In the context of these theories, all company contracts can create incentives to maximize or mini-

mize the reported accounting profits. The incentives for earnings management may be conflicting, as at the same time, the company may wish to report lower accounting profits to the tax authorities, while presenting more favorable accounting figures to creditors. For the purposes of our study, the political cost hypothesis is particularly interesting. According to the political cost hypothesis, companies minimize profits to avoid public and political attention to reduce risks of political costs (taxing windfall profits or enforcing new regulations such as price caps or margin caps). In specific situations, under pressure from consumers and the media, politicians will tend to transfer wealth from companies to the state budget or to consumers and justify such policies with the public interest. Additional regulation or an additional tax burden represents an external pressure on the company's operations, with negative consequences for the company's managers and owners.

Given that the windfall profits tax was introduced in Croatia as a temporary measure (applicable only for 2022), it provided companies with an incentive to shift profits to subsequent years in which this windfall profits tax was not expected to apply. In other words, according to the political cost hypothesis, it is to be expected that companies will implement downward earnings management in the year in which windfall profits occur and are taxed. Numerous studies (Jones, 1991; Cahan, 1997; Makar et al., 1996; Key, 1997; Han & Wang, 1998 – for petroleum refining companies; Chen et al., 2011 – for private companies) confirm such opportunistic behavior of companies that were faced with the risk of additional political costs (Table 1, Section 1). Contrary to such findings, Han and Wang (1998), using a sample of crude oil and natural gas companies, did not find evidence of earnings management related to the 1990 Persian Gulf crisis and the associated windfall profits. Similarly, Beeks (2003) reported no evidence to support the political cost hypothesis for a sample of water and sewerage companies in England and Wales. Chen et al. (2011) rejected the political cost hypothesis for the sample of state-owned companies. In summary, the literature examining windfall profits largely confirms the emergence of downward earnings management in conditions of political and media exposure. However, one part of the findings still indicates that the political cost hypothesis can be completely or partially rejected in specific circumstances that lead to lower political

sensitivity of companies. Such findings emphasize the importance of size, ownership, level of political costs exposure, and institutional context in modeling the relationship between windfall profits and earnings management.

Considering the context of the research on windfall profits in 2022 in Croatia, the focus should be on accruals-oriented earnings management literature. Namely, due to the late adoption of the regulation on windfall profits (December 16, 2022), Croatian companies had very limited opportunities to undertake real business transactions that could reduce reported accounting profits in 2022. Within a very short time window of only 15 days before the end of the business year, companies could only undertake real transactions to a limited extent, and the main mechanism for reducing windfall profits was the use of accounting policies and estimates. More specifically, depreciation/amortization rates, write-offs of receivables/inventories, and provisions for litigation/guarantees could have been increased. Companies could also, to a certain extent, postpone profit recognition and carry it forward to the next year. In accordance with the aforementioned, according to the assumptions of the political cost hypothesis, discretionary accruals in the year of windfall profits and their taxation should be significantly lower than in the subsequent year without such tax burden.

In addition to articles that directly test the political cost hypothesis, it is also useful to explore the closely related literature on corporate behavior in the years around income tax reforms. The articles (Scholes et al., 1992; Sundvik, 2016; Bai et al., 2021; Wali, 2021; Pervan et al., 2024) Table 1, Section 2, analyze the reactions of companies to the income tax reforms that were implemented by lowering the income tax rate, which created incentives for profit shifting to the year with a lower income tax rate. In these situations, companies had the possibility of achieving permanent income tax savings by using earnings management techniques and by minimizing profits in the year preceding the tax reform. Although studies come from very different institutional environments (the U.S., China, Germany, the Netherlands, Sweden, and Croatia), the empirical findings are remarkably similar. Early and recent studies have confirmed that companies behave economically rationally and use earnings management to reduce income tax payments and increase the value of the company.

Table 1 Summary of previous research on political cost hypothesis and income tax reforms

Authors (Year)	Country / Sample	Research context	Methodology	Main findings
Section 1: Literature focused on political cost hypothesis				
Jones, J. (1991)	The U.S., 23 companies from five industries	ITC investigations to obtain relief for companies under profit pressure because of imports	Discretionary accruals; Jones 1991 model	Companies use discretionary accruals to minimize profits during ITC investigations to obtain relief
Cahan, S. F., Chavis, B. M. & Elmendorf, R. G. (1997)	The U.S., 43 chemical industry companies	U.S. Congress debate on new regulation (a new tax for 42 chemical products) for the chemical industry	Discretionary accruals; Jones 1991 model	In the year of Congress debate, chemical companies managed earnings downward
Makar, S. D., Alam, P. & Pearson, M. A. (1996)	The U.S., 144 companies involved in merger transactions under investigation	Mergers were investigated by the U.S. antitrust regulators	Total accruals; regression with GNP as a proxy for the business cycle	Companies under investigation used accruals in the period of economic growth to minimize profits and avoid the attention of antitrust regulators
Key, K. G. (1997)	The U.S., 24 (1989) and 23 (1990) cable TV companies	U.S. Congress debate on new regulation for the cable TV industry because of potential "beyond reasonable profits"	Total accruals; Regression with time dummy	Companies increase negative discretionary accruals during Congressional scrutiny periods
Han, J. C. Y. & Wang, S.-W. (1998)	The U.S., 76 petroleum and natural gas companies	Antitrust investigation risk during the 1990 Persian gulf crisis	Discretionary accruals; Regression with quarter and year dummies	Oil refining companies used discretionary accruals to reduce profits. Crude oil and natural gas companies did not have unusual accruals.
Chen, D., Li, J., Liang, S. & Wang, G. (2011)	China, 232 real estate companies	A government set of policies aimed at stabilizing housing prices and reducing real estate industry profits	Discretionary accruals; Jones 1991 model; Regression with a proxy for political costs	Private companies use earnings management aimed to reduce profitability. Evidence was not confirmed for state-owned companies.
Hsiao, D. F., Hu, Y. & Lin, J. W. (2016)	The U.S., 593 oil and gas companies	2011 Arab Spring political instability and oil price shocks	MLE regressions; discretionary accruals	Political costs increase downward earnings management
Section 2: Literature focused on income tax reforms				
Scholes, M. S., Wilson, G. P. & Wolfson, M. A. (1992)	The U.S., 812 companies from 57 two-digit SIC industries	Income tax reform in the U.S. (1986): reduction of the tax rate from 46% to 34%	Quarterly data; focus on margin deferral and SG&A expenses acceleration	Companies deferred revenue recognition and accelerated expense recognition to shift income
Sundvik, D. (2016)	Sweden, 3,254 private firms	Two income tax reforms (2009 and 2013) in Sweden aimed at lowering the tax rate	Discretionary accruals; Kothari et al. 2005 model; Specific accruals	Firms shift income to lower-tax periods
Bai, M., Song, D. & Li, H. (2021)	China, 639 listed manufacturing companies	Reduction of the income tax rate in China (2007) from 33% to 25%	Current accruals; Regression	Companies under anticipation of income tax reduction use earnings management

Authors (Year)	Country / Sample	Research context	Methodology	Main findings
Wali (2021)	The Netherlands, 1,350 companies and Germany, 1,850 companies	Income tax rate reductions in Germany and the Netherlands	Discretionary accruals; modified Jones 1995 model	Companies use income-decreasing accruals in the year before tax rate cuts
Pervan, I., Jakaša, P. & Pervan, M. (2024)	Croatia, 4,694 (2016 reform) and 4,651 (2020 reform) manufacturing companies	Two income tax reforms (2016 and 2020) in Croatia aimed at lowering tax rate	Earnings distribution analysis, Discretionary accruals; Kothari et al. 2005 model	Both tax reforms triggered a shift of profits to years with lower tax rates

Source: Authors

Although the focus of this research is on the influence of windfall profits and related tax regulation on earnings management, to get a broader picture, it is necessary to unravel other motives such as the payment of regular income taxes and the debt covenant hypothesis. A review of studies examining earnings management in relation to regular income tax payments shows that there are no clear conclusions, as the results are mixed. A study of V4 countries (Hungary, Slovakia, the Czech Republic, and Poland) did not confirm that the income tax variable has influenced the level of discretionary accruals (Callao et al., 2020). SánchezBallesta and Yagüe (2020) report mixed results with regard to tax-driven earnings management. If companies have used accounting techniques to increase their profits in the past, the motives for positive earnings management are more important than the motives for reducing the current income tax payments. In contrast, companies without such historical strategies use accounting methods to reduce income tax payments. A recent study by Delgado et al. (2023) uses neural networks to identify the relationship between earnings management and corporate tax payments. The analysis of a sample of companies from five European countries (Spain, France, Italy, Germany, and the UK) did not confirm the hypothesis that earnings management is used to decrease the income tax burden.

In addition to the political cost hypothesis, the debt covenant hypothesis should also be considered when modeling the determinants of earnings management. According to this hypothesis, companies try to select accounting policies so that the target variables (debttoequity ratio, debt-to-EBITDA ratio, quick ratio, etc.) comply with the conditions set out in existing credit financing agreements.

Numerous studies (DeFond & Jiambalvo, 1994; Lazzem & Jilani, 2018; Palumbo & Rosati, 2022) have examined and mostly confirmed the debt covenant hypothesis. It should be emphasized that the expected direction of earnings management of the debt covenant hypothesis is completely opposite to the political cost hypothesis. In other words, more indebted companies are expected to use accounting techniques to maximize assets and profits. However, some studies (Jha, 2013) have questioned the debt convention hypothesis, as discretionary accruals are inconsistent in the quarter before and the quarter after the breach of the debt financing agreement. Siagian and Handika (2024) report that leverage had a negative impact on the change in accounting policy, which is due to the specific Japanese business environment where banks do not allow earnings management.

3. Data and research variables

The company-level data used for the empirical analysis was retrieved from the Orbis database in May 2025. To avoid the potential problem of cross-industry differences, this research focuses only on the manufacturing industry (NACE Rev. 2 codes from 10 to 32). The data was extracted only for companies that published non-consolidated financial statements and reported an annual turnover of at least EUR 50,000 in the period 2015–2023. The application of these criteria resulted in an initial sample of 4,938 companies. The data obtained from the FINA database InfoBIZ² indicates that the manufacturing sector in Croatia represents one of the most important sectors of the national economy, as it generated 39.9% of export revenues in 2022

² <https://infobiz.fina.hr>

(42.3% in 2023), 23.5% of total revenues (22.3% in 2023), and employed 23.9% of the workforce (23.2% in 2023).

The measurement of discretionary accruals (DACC) first requires a methodology for calculating total accruals (TACC). Based on the available data from the Orbis database, the so-called balance sheet approach was applied. Insight into previous literature (Sundvik, 2016; El Diri, 2018; Kliestik et al., 2021) shows that the balance sheet approach calculates total accruals using the following elements: change in receivables ($\Delta RECE$), change in inventories ($\Delta INVE$), change in payables ($\Delta PAYA$), and depreciation and amortization ($DEPR$). However, it should be noted that such an approach often does not take into account change in provisions ($\Delta PROV$), an item that is subject to considerable discretion. Accordingly, Formula 1 is therefore used to provide a more precise measurement of total accruals:

$$TACC_{it} = \Delta RECE_{it} + \Delta INVE_{it} - \Delta PAYA_{it} - DEPR_{it} - \Delta PROV_{it}. \quad (1)$$

TACC was calculated using cross-sectional data from the manufacturing sector in the “estimation period”. The selection of years for the estimation period in Croatia was somewhat problematic due to two corporate income tax reforms that led to significant discretionary accruals (Pervan, et al., 2024), in 2016 and 2017 (the first reform) and in 2020 and 2021 (the second reform). As discretionary accruals were not expected in the forecast period, the aforementioned years were excluded and only the years 2015, 2018, and 2019 were retained in the estimation dataset.

The coefficients of the earnings management model were estimated by two alternative approaches, the modified Jones model (Dechow et al., 1995), formula 2, and the performance matching model (Kothari et al., 2005), formula 3:

$$\frac{TACC_{it}}{TASS_{it-1}} = \beta_0 + \beta_1 \frac{1}{TASS_{it-1}} + \beta_2 \frac{\Delta REVE_{it} - \Delta RECE_{it}}{TASS_{it-1}} + \beta_3 \frac{PPEQ_{it}}{TASS_{it-1}} \quad (2)$$

$$\frac{TACC_{it}}{TASS_{it-1}} = \beta_0 + \beta_1 \frac{1}{TASS_{it-1}} + \beta_2 \frac{\Delta REVE_{it} - \Delta RECE_{it}}{TASS_{it-1}} + \beta_3 \frac{PPEQ_{it}}{TASS_{it-1}} + \beta_4 ROA_{it}, \quad (3)$$

where TASS stands for total assets, REVE for revenues, RECE for receivables, and PPEQ for the fixed

tangible assets, while ROA represents a ratio between net profit and assets from the same year (t). The estimated beta parameters, derived from the dataset of manufacturing companies, are employed to estimate the non-discretionary component of accruals (NDACC). Finally, the proxy variable for earnings management (discretionary accruals, DACC) is calculated as the difference among actual accruals (AACC) and the non-discretionary component of aggregate accruals (NDACC) in the event period:

$$DACC_{it} = AACC_{it} - NDACC_{it}. \quad (4)$$

Considering the main objective of the research, a company-level Difference-in-Differences (DiD) design with fixed effects is used in the panel model. The DiD approach enables the identification of the effects of the occurrence of windfall profits in 2022 and their taxation on changes in earnings management. The used FE panel with DiD interaction variables explores two sources of variation. Company fixed effects capture time-invariant company characteristics, while year fixed effects capture macroeconomic and other common trends for all companies in the sample. For nuanced results, we decided to use two interaction variables (INTER1_D and INTER2_D). INTER1_D reveals whether companies with 2022 windfall profits adjusted discretionary accruals in 2022 in anticipation of possible political costs (even though the majority of them were not directly affected by the regulation on the windfall profits tax). A negative sign with INTER1_D would indicate profit minimization to avoid the broader aspect of potential political costs (negative publicity in media, regulation of selling price caps, regulation of margins, etc.). On the other hand, the INTER2_D interaction variable isolates the effects of the implemented income tax reform in 2022 and the behavior of that segment of companies faced with the direct effects of the windfall tax regulation. Therefore, the sign with INTER2_D represents the pure causal effect of the windfall tax regulation in Croatia on the practice of earnings management. Since the review of previous research on earnings management has shown that political costs and related tax incentives are neither the only nor the most important drivers of earnings management practices, it is necessary to control for the influence of other competing influential factors presented in Table 2:

Table 2 Research variables

Variable name	Label	Calculation
Discretionary accruals	DACC_K	Kothari et al. (2005)
	DACC_MJ	Dechow et al. (1995)
Interaction dummy 1	INTER1_D	WP2022_D * 2022_D
Interaction dummy 2	INTER2_D	WPTJ2022_D * 2022_D
Dummy variable for 2022	2022_D	Dummy (1 if year = 2022; otherwise 0)
Dummy variable for 2023	2023_D	Dummy (1 if year = 2023; otherwise 0)
Dummy variable for windfall profits in 2022	WP2022_D	Dummy (1 if Income before tax in 2022 > 20% higher than average Income before tax in the period 2018–2021; otherwise 0)
Dummy variable for companies under 2022 windfall profit tax jurisdiction	WPTJ2022_D	Dummy (1 if Revenue in 2022 > EUR 39.82 mil; otherwise 0)
Leverage	LEV	Total Debt _t /Assets _t
Company size	SIZE	Ln (Assets)
Return on Assets	ROA	Net profit _t /Assets _t
Effective income tax rate	EITR	Income tax liability _t /Profit before tax _t

Source: Authors

Given that the study sample consists mainly of private, unlisted companies, motives such as managerial bonuses, income smoothing, and disclosure of private information to investors are not considered relevant in this context. However, the issue of credit financing is of particular importance for private companies, which is why the indebtedness variable is included in the model. In line with similar studies of earnings management, profitability and size variables are included as control variables (Chen et al., 2011; Sundvik, 2016; Assidi et al., 2022; Palumbo & Rosati, 2022; Pervan et al., 2024, etc.). Due to the real risk of reverse causality in the model, some of the independent variables (LEV, ROA and EITR) are used with lag (t-1), while SIZE is used without lagging. The estimated FE panel model has the following form:

$$\begin{aligned}
 DACC_{it} = & \beta_0 + \beta_1 INTER1_D_i + \beta_2 INTER2_D_i \\
 & + \beta_3 LEV_{it} + \beta_4 SIZE_{it-1} + \beta_5 ROA_{it-1} \\
 & + \beta_6 EITR_{it-1} + \beta_7 2022_D + \beta_8 2023_D.
 \end{aligned} \tag{4}$$

4. Empirical findings

Table 3 provides descriptive statistics for all research variables after removal of missing data observations and outliers (two standard deviations above or below the mean). Both proxy variables for earnings management (DACC_K and DACC_MJ) have arithmetic means close to zero, which is in line with the theoretical expectation that positive and negative discretionary accruals cancel out in the long run. The SIZE variable shows significant variation because it includes a rather heterogeneous sample of companies. The average indebtedness (LEV) of the companies in the sample is moderate and amounts to 52.43%. ROA has a high degree of variation and indicates the heterogeneity of observations regarding the business performance. Dummy for windfall profits (WP2022_D) indicates that 24.8% of companies in 2022 reported windfall profits according to the definition from EU and Croatian regulations. However, due to the limited application to large companies in Croatia (WPTJ2022_D), only 0.04% of the companies were subject to windfall profit tax regulation.

Table 3 Descriptive statistics

Variable	N	Mean	Std. Dev.	Min.	Max.
DACC_K _t	15,850	0.011154	0.161713	-0.53242	0.560136
DACC_MJ _t	15,867	0.013498	0.161585	-0.64863	0.576402
LEV _{t-1}	16,568	52.42626	25.91539	-10.657	100
SIZE _t	16,644	6.521029	1.392559	3.295837	9.816543
ROA _{t-1}	16,624	6.919423	8.228259	-19.423	33.522
EITR _{t-1}	16,643	0.112752	0.099476	-0.20556	6.64
2023_D	16,644	0.135845	0.342634	0	1
WP2022_D	16,644	0.247597	0.431629	0	1
WPTJ2022_D	16,644	0.000421	0.020504	0	1

Source: Authors' calculations

Table 4 shows the results of correlation analyses for all variables in the research model. Proxy variables for discretionary accruals (DACC_K and DACC_MJ) are, as expected, highly correlated, which indicates measurement of similar constructs. Correlation analysis reveals that both measures of discretionary accruals are significantly correlated

with almost all independent variables. Since none of the correlations between independent variables exceeds 0.7, multicollinearity does not have a significant impact on the final results from the estimated FE panel regression.

Table 4 Pairwise Pearson correlations among research variables

	DACC_K	DACC_MJ	SIZE _t	LEV _{t-1}	ROA _{t-1}	EITR _{t-1}	2023_D	WP2022_D	WPTJ2022_D
DACC_K _t	1.0000								
DACC_MJ _t	0.9987***	1.0000							
SIZE _t	-0.0682***	-0.0667***	1.0000						
LEV _{t-1}	0.0253***	0.0386***	0.0135*	1.0000					
ROA _{t-1}	-0.0522***	-0.0022	-0.0236***	0.2723***	1.0000				
EITR _{t-1}	-0.0500***	-0.0428***	0.1977***	0.0516***	0.1303***	1.0000			
2023_D	-0.0503***	-0.0418***	0.0450***	-0.0118	0.1580***	0.0236***	1.0000		
WP2022_D	-0.0380***	-0.0375***	0.0134*	0.0070	0.0229**	0.0595***	0.6912***	1.0000	
WPTJ2022_D	-0.0192**	-0.0198**	0.0431***	-0.0173**	-0.0105	0.0062	0.0090	0.0358***	1.0000

Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.10.

Source: Authors' calculations

Given the main objective of this research, the signs and significance of the interaction variables in Table 5 are of particular importance. The empirical findings confirm that the sign of INTER1_D is negative, which is consistent with the hypothesis of profit minimization due to potential broad effects of political costs. However, the first interac-

tion variable is not statistically significant in the baseline DACC models (DACC_K and DACC_MJ), indicating that broad political costs did not have a sufficiently strong or unified effect on the entire sample of windfall profit companies. In contrast, the INTER2_D interaction variable, which captures only those companies that were subject to windfall

tax regulation, is negative and statistically significant in both DACC specifications at the 5% level. This finding confirms that the actual exposure to taxation due to windfall profits is a much stronger motive for downward earnings management than the mere existence of windfall profits. Therefore, it can be concluded that the political cost hypothesis can be accepted, but only for those companies that had a very credible and pronounced risk of political costs, i.e., additional taxation. This finding of

interaction variables is in line with the findings of Han and Wang (1998) and Chen et al. (2011). Han and Wang (1998) found that not all companies in the oil sector are equally exposed to political costs, while Chen et al. (2011) confirmed the political cost hypothesis only for the private real estate companies. Similar to the aforementioned two studies, our findings also confirmed that stronger exposure to political costs is more likely to encourage earnings management practices.

Table 5 FE panel regression results for baseline and signed DACC models

Panel A: DACC; Kothari et al. (2005)			
Variable	DACC_K	DACC_K ⁻	DACC_K ⁺
INTER1_D	-0.0123	-0.0274***	0.0028
INTER2_D	-0.1322**	-0.1350	-0.0682
LEV _{t-1}	0.00138**	-0.00084	0.00067
SIZE _t	0.0350	-0.0435*	0.0479**
ROA _{t-1}	0.00188***	-0.00036	0.00044
EITR _{t-1}	0.1183**	0.1258*	0.1567**
2023_D	-0.0047	-0.0069	0.0026
Constant	-0.3226**	0.2160	-0.2584*
Observations	7,230	3,455	3,775
F value	6.88	3.48	2.63
R² (within)	0.0169	0.0304	0.0194
Panel B: DACC – MJ; Dechow et al. (1995)			
Variable	DACC_MJ	DACC_MJ ⁻	DACC_MJ ⁺
INTER1_D	-0.0101	-0.0269***	0.0058
INTER2_D	-0.1339**	-0.1319	0.0615***
LEV _{t-1}	0.00128**	-0.00091	0.00088
SIZE _t	0.0386*	-0.0417*	0.0505**
ROA _{t-1}	0.00159**	-0.00074	0.00064
EITR _{t-1}	0.1162**	0.1287*	0.1677***
2023_D	-0.0029	-0.0053	0.0052
Constant	-0.3382**	0.2082	-0.2930*
Observations	7,234	3,382	3,852
F value	6.15	3.57	–
R² (within)	0.0146	0.0332	0.0246

Note: FE estimations with firm and year fixed effects. Robust standard errors clustered at the firm level.

*** p < 0.01, ** p < 0.05, * p < 0.10.

Source: Authors' calculations

To gain even deeper insight into the behavior of companies in 2022, the sample was split according to the sign of the DACC variables. Accordingly, additional models (only positive DACC and only negative DACC) were estimated, which revealed asymmetries in the behavior of sampled companies. In both negative DACC specifications ($|DACC_K^-|$ and $|DACC_MJ^-|$), INTER1_D is negative and statistically significant at the 1% level. This finding confirms that the existence of windfall profits in 2022 intensified only downward earnings management, which allows for conditional acceptance of the political cost hypothesis. Conversely, in the segment of companies that had only positive discretionary accruals ($|DACC_K^+|$ and $|DACC_MJ^+|$), INTER1_D is statistically insignificant, indicating that the occurrence of windfall profits in 2022 did not affect the change in upward earnings management. After splitting the sample according to the sign of the DACC variable, INTER2_D is statistically significant and positive only for the $|DACC_MJ^+|$ specification.

The secondary objectives of the research refer to other regressors that, according to theory and earlier empirical evidence, can affect discretionary accruals. In this segment of variables, the debt covenant hypothesis can be analyzed, according to which more indebted companies try to improve financial position and performance in financial statements (Watts & Zimmerman, 1986). The empirical findings from Table 5 confirm the PAT theoretical assumptions because the signs with the LEV variable are positive and statistically significant in both baseline DACC models. Thus, the higher indebtedness of Croatian manufacturing companies caused income-increasing earnings management. This empirical result is in line with findings from similar studies in Croatia (Pervan et al., 2024) and other countries (DeFond & Jiambalvo, 1994; Lazzem & Jilani, 2018; Palumbo & Rosati, 2022). The simultaneous analysis of the political cost hypothesis and the debt covenant hypothesis shows that the findings for the debt covenant hypothesis are more stable and robust through alternative model specifications. Such a finding may suggest that incentives for private contracting are dominant compared to public political cost related motives.

Controlling for the SIZE variable in the baseline DACC models reveals somewhat mixed results because in the DACC_K specification it is positive but statistically insignificant, while in the DACC_MJ

specification, it becomes positive, but only marginally statistically significant (at the 10% level). In the segment of companies with only negative accruals, SIZE only marginally reduces the level of discretionary accruals ($|DACC_K^-|$ and $|DACC_MJ^-|$), while in the segment of companies with only positive accruals ($|DACC_K^+|$ and $|DACC_MJ^+|$), the effect is completely opposite. The lagged ROA variable across both baseline DACC specifications (DACC_K and DACC_MJ) is positive and statistically significant. The observed sign indicates that more profitable companies have larger and more positive discretionary accruals. The finding is in line with previous literature (Dechow et al., 1995; Kothari et al., 2005), which reports that more profitable companies are associated with upward earnings management to meet earnings benchmarks or to signal sustainable performance. After breaking the sample according to the sign of the DACC variable, the profitability measure (ROA) becomes statistically insignificant.

The lagged EITR variable is positive and statistically significant for all six DACC specifications, providing evidence of asymmetric earnings management strategies. A positive sign in both baseline DACC models (DACC_K and DACC_MJ) confirms that companies with a higher tax burden have larger and more positive discretionary accruals. A positive sign in the model with only negative discretionary accruals ($|DACC_K^-|$ and $|DACC_MJ^-|$) indicates that a higher tax burden enhances profit minimization strategies to reduce income tax payments. Conversely, for observations with only positive DACC, a higher EITR results in an increase in reported profits. Such an asymmetric finding for EITR shows that in earnings management practice there is often a trade-off between tax and other motives; sometimes tax motives prevail, while sometimes other motives prevail. Results are comparable with the findings of SánchezBallesta and Yagüe (2020), who also reported similar results with regard to tax-driven earnings management. Namely, they point out that companies, which historically used upward earnings management, have motives that are more pronounced than the motives for decreasing the current income tax burden.

5. Concluding remarks

The war in Ukraine and the sanctions against Russia in 2022 have led to increased uncertainty on

the energy markets and a significant rise in energy prices. EU responded to the energy crisis, windfall corporate profits, and high inflation with a number of different measures, including the windfall profits tax implemented in Croatia and other EU Member States. Such a business environment provides a unique testing ground to examine how companies respond to the increasing possibility of political costs, such as additional profit taxation and selling price restrictions.

By applying the difference-in-differences framework in the FE panel for the period 2021–2023, we came to several very interesting conclusions. This primarily refers to the fact that the occurrence of windfall profits in 2022 did not cause systematic downward earnings management. However, the interaction variable capturing the effect of windfall profits amplified negative earnings management in the segment of companies that had only negative discretionary accruals. The INTER2_D interaction variable that captures only those companies that were subject to windfall profits tax regulation is negative and statistically significant. This finding confirms that the actual exposure to windfall profit taxation is a more pronounced motive for downward earnings management than the mere existence of windfall profits. Therefore, it can be concluded that the political cost hypothesis can be conditionally accepted, i.e., only for companies faced with direct risk of political costs. The control variables have signs that are consistent with theoretical assumptions and previous research. The LEV variable is positive in both baseline models, clearly confirming the debt covenant hypothesis. It should be emphasized that the main empirical findings are stable for both DACC specifications (DACC_K & DACC_MJ), indicating that the results are not sensitive to the choice of constructs for measuring earnings management.

The key findings of this research provide several practical guidelines for the various users of accounting information. Commercial banks and other institutional creditors need to be aware that the reported accounting profits in the years of excessive profitability may be intentionally reduced by the choice of accounting methods/estimates if company is faced with credible and pronounced risk of additional political costs. Consequently, a more detailed analysis of accounting figures is required, with particular attention paid to discretionary accrual items such as depreciation, write-offs

of receivables, write-offs of inventories, provisions, etc. Croatian tax auditors should assume that companies faced with the additional windfall tax burden will probably use accounting methods aimed at reducing the reported accounting profit. Therefore, tax auditors should be stricter for such companies. In the years with windfall profit, external auditors should be particularly careful to prevent accounting manipulations, i.e., the selection of accounting techniques that are not in line with accounting standards and general accounting principles.

Although this research resulted in interesting findings about the impact of windfall profits and related tax regulations on earnings management, several important limitations should be highlighted. First of all, it should be emphasized that the analysis was conducted only for the manufacturing industry in Croatia. Consequently, the number of companies with windfall profits is relatively small, and an even smaller number of companies were subject to windfall profits tax regulation. The sample predominantly included private companies where the incentives for financial reporting strategies are often not identical to those for listed companies. Taking into account all of the above as well as the specific implementation of windfall profits tax regulation in Croatia, the conclusions have limited generalizability. The results could be valid for small open EU economies with a similar institutional and business environment (high book-tax conformity, code law, predominantly private firms, etc.). By contrast, the behavior of listed companies from countries with stronger institutional supervision, better corporate governance practices, and lower book-tax conformity could result in different findings. Another limitation is the research methodology itself, which is limited to total discretionary accruals. The reason for this is the fact that earnings management cannot be measured directly. The total discretionary accruals used in the study are proxy variables, which have certain limitations in terms of measurement reliability. Although we used two measures for discretionary accruals (Dechow et al., 1995 and Kothari et al., 2005 models) for robustness of conclusions, they are not perfect in separating the discretionary and non-discretionary components of accruals. This problem can be particularly pronounced in short data panels in the periods with significant economic turbulence.

Future research should include a larger number of countries to improve the generalizability of the

conclusions. It should consider how institutional (book-tax conformity, rule of law, etc.) and additional company-level factors (audit quality, type of ownership, etc.) shape the influence of windfall profits on earnings management. A longer time coverage of the data would enable the use of a dynamic panel and more reliable knowledge about the practice of earnings management after the tax

reform and the persistence of companies' behavior. Future research could also analyze windfall profits through the prism of real transactions-based earnings management, specific accruals earnings management, or profit distributions. Validating research results using different methodologies can enhance their reliability.

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SECTORAL LENDING AND VALUE ADDED: THE CROATIAN CASE

ABSTRACT

Purpose: The paper deals with the impact of bank loans to corporations and households on gross value added (GVA) in Croatia. The research covers the period from the second quarter of 2016 to the fourth quarter of 2024. The aim of the research is to determine the significance, direction, and strength of the relationship between lending to various economic sectors and households and the development of GVA.

Methodology: This research uses the ARIMAX (Autoregressive Integrated Moving Average with Exogenous Variables) model, which enables quantitative analysis of time series with the simultaneous inclusion of exogenous variables that can affect the dependent variable.

Results: The results show that loans to the manufacturing sector and the accommodation and food sector have the strongest positive impact on GVA, while the trade sector has the largest negative impact. Loans to households have a weaker impact, with housing loans having a positive impact and cash loans having a negative impact on GVA.

Conclusion: The results support the idea that the structural orientation of bank lending policies can have an important impact on economic growth, not only through the volume but also through the allocation. This research provides a basis for the implementation of policies aimed at lending to sectors with high growth potential, while controlling consumer debt. This can support long-term sustainable and structurally sound economic growth. Further research can focus on the components of sectoral GVA to see the financial effects on real values of sectoral productivity growth and eliminate the effects of net prices on GVA growth.

Keywords: Bank loans, corporations, households, gross value added, Croatia

1. Introduction

The role that lending plays in promoting economic growth, particularly in small open economies, i.e. Croatia, has long been controversial. Bank lending plays a vital role in financial intermediation, driving investment and consumption choices, and, in some cases, stimulating the formation of gross value added (GVA). However, an empirical understanding of the contributions of loans to firms and households to real aggregate growth is still limited by differ-

ences in the economic structure and the business cycles (King & Levine, 1993; Levine, 2005). Much of previous research has examined aggregated lending (Beck et al., 2000; Bernanke & Gertler, 1995), ignoring the heterogeneity of sectors. These aggregated data may conceal dissimilarity within the industry, with the most pronounced differences in the case of Croatia, where construction, trade, tourism, and manufacturing contribute to distinct economic processes (World Bank, 2020).

To bridge the gap, this research examines two channels of transmission: a) corporate lending by sector, and b) household lending by loan type, and then measures the effects on GVA. In the period 2016–2024, the share of private sector loans in GDP decreased from 60% to 46%, reflecting reduced financialisation amid rapid GDP growth (Croatian National Bank, 2020; 2025). Total bank loans increased slightly, from €28bn to €40bn, as GDP nearly doubled, prompting speculation about how bank intermediation has underpinned real growth. Given Croatia's recovery from the 2008–2015 downturn, the period provides an interesting setting in which to test the role of sectoral and household lending in GVA dynamics (Ekanayake & Thaver, 2021; Estrada et al., 2015).

Research questions are: a) How do loans to non-financial corporations by sector affect GVA?, b) Do household loans, especially housing and consumer, impact aggregate growth?, c) Do the intensity and direction of the effects differ between corporate and household lending?, and d) Are effects immediate or lagged, as captured by ARIMAX dynamics?

Drawing from theory and prior studies (Demirgüç-Kunt & Maksimovic, 2002; Mian & Sufi, 2014), we hypothesise that:

H1: Loans to non-financial corporations have a statistically significant, positive impact on GVA;

H2: Household loans have differentiated impacts.

In particular, the works of King and Levine (1993), Levine (2005), and Mian and Sufi (2014) provide the key theoretical basis for these hypotheses, emphasising the role of financial development, credit allocation, and household borrowing in shaping economic growth. For the purpose of this study, the hypotheses are considered confirmed if the estimated coefficients are statistically significant at the 5% level ($p < 0.05$).

The research applies ARIMAX models, which incorporate time-series dependence and exogenous effects, as well as absolute and relative effects that are distinguished by means of log-linear and log-log specifications (Enders, 2014; Gujarati & Porter, 2009). By doing so, the study adds to the understanding of the intricate financial–real sector linkage and sector-level asymmetries in credit effects. The findings are also of policy relevance, showing how to steer lending to sectors with high growth multipliers and towards household borrowing that is conducive to sustainable development.

2. Theoretical and conceptual background

The link between bank lending and economic growth has been widely examined in financial development theory. Credit activity is now regarded by empirical evidence as a significant productivity and GVA growth booster, particularly in developing and transition economies. Among the extensive literature, three works are particularly relevant for this study and directly underpin our hypotheses: King and Levine (1993), Levine (2005), and Mian and Sufi (2014). These three works form the theoretical foundation of our hypotheses. As Bernanke and Gertler (1995) suggest, the bank credit channel magnifies the effect of monetary policy, and King and Levine (1993) and Levine (2005) stress the function of the financial system in capital allocation, supervision, and risk management. Other studies have shown that lending promotes investment and growth (Arrfelt et al., 2014; Beck et al., 2000; Bernstein & Barrett, 2011; Charoenwong et al., 2024; Coen & Maritan, 2010; Maritan & Lee, 2017; Sirmon & Hitt, 2009; Zhao et al., 2021; Aghion & Howitt, 2009; Demirgüç-Kunt & Maksimovic, 1998; 2002; Holmström & Tirole, 1997; Ekanayake & Thaver, 2021; Estrada et al., 2015; Ghamati & Mehrara, 2014; Hamdaoui & Márquez, 2024; Idun, 2021; Soedarmono et al., 2016; Xie et al., 2022).

Despite widespread investigation into aggregate lending (Cetorelli, 2012; Hamdaoui & Márquez, 2024; Le et al., 2022; Sant'Anna et al., 2021; Win, 2013; Xie et al., 2022), emerging evidence highlights heterogeneity across sectors. Kalemli-Ozcan et al. (2019) demonstrate that corporate indebtedness reduces investment in times of crisis, whereas Bijsterbosch and Kolasa (2010) highlight the sectoral variation in credit transmission. Mian and Sufi (2014) show that for households, non-purpose loans may enhance short-term consumption but heighten longterm vulnerability. Likewise, the International Monetary Fund (2017) warns that cash loans may engender systemic risk, whereas housing loans encourage investment and multiplier effects in construction.

After the start of QE and then QT, central banks' stance towards monetary policy changed further. A study by Holm-Hadulla and Pool (2025) found that interest rate volatility reduces monetary transmission, while Herbst et al. (2025) find monetary policy to be more influential on bank rates than macroprudential policy. Asriyan et al. (2025) warn that low interest rates could drive away productive

investment, whereas Amado et al. (2025), Daoui (2023), Dlamini and Mashau (2022), Farajnezhad (2022), Idris (2019), James et al. (2013), Radman Peša et al. (2015), Mehar (2022), Moyo and Phiri (2024), Mwangi (2022), Nwagu et al. (2023), Ofoi and Sharma (2021), Rathnayaka et al. (2024), and Sari et al. (2022) highlight the different effects of monetary policy on growth. Schnabel (2025) also points out that the European Central Bank policies reached households faster than the companies indicating the institutional risk and bank caution (Altavilla et al., 2019; Araujo et al., 2019; Blicke & Santos, 2020; Bonfim, 2008; Fraisse & Thesmar, 2019; Gopalakrishnan & Mohapatra, 2020; Harrison et al., 2022; Jing, 2020; Lilienfeld-Toal et al., 2012; Lobo et al., 2020; Qi et al., 2016; Santos & Cincera, 2021; Thapa et al., 2020).

The European Central Bank (2025) survey reveals that lending standards in the euro area vary among member countries. However, empirical research on sectoral lending and GVA is limited in Croatia, where most of the analyses are performed by the CNB in its Macroprudential Diagnostics and Financial Stability reports (Croatian National Bank, 2021; 2022; 2023; 2024a; 2024b; 2024c; 2025). Those list trends like strong growth in cash loans and construction lending. Complementary studies (World Bank, 2020; Filip & Setzer, 2025) connect the institutional quality with GDP growth, stressing asymmetries between regions across Europe (Anthony-Orji et al., 2018; Chinoda & Kapingura, 2023; Dwumfour & Gyamfi, 2020; Haini, 2019; Jiménez & Muñoz, 2022; Miao et al., 2023; Ru & Qamruzzaman, 2022; Udejaja, 2021; Van et al., 2022; Barbero & Rodríguez-Crespo, 2022; Batrancea et al., 2023; d'Agostino & Scarlato, 2013; Razak et al., 2021).

Overall, this paper contributes by applying the ARIMAX methodology to quarterly data, thereby capturing short-term dynamics and providing insights into sectoral asymmetries in Croatia's lending-growth nexus.

3. Data and methodology

This study leverages quarterly data from Q2/2016 to Q4/2024. These sources mainly come from the Central Bureau of Statistics (CBS), which reports gross value added (GVA) by activity, and the Croatian National Bank (CNB), which provides data on loans to non-financial corporations (by sector) and households (housing and consumer loans). Corporate loans to corporations went up from €13.1bn in 2016 to €15.9bn in 2024 (+20%). The analysis initially included seven sectors, manufacturing, electricity and gas, construction, trade, transport and storage, accommodation and food, and real estate, which by end-2024 represented €13.2bn or 83% of all corporate loans. Household lending increased from €15.8bn in 2016 to €24.4bn in 2024 (+54%). By end-2024, housing loans reached €11.9bn (49% of household loans), while cash loans equalled €9.2bn (38%). Household loans, for the most part, were over twice the number of corporate loans.

The research discusses €9.4bn of corporate credit and €21.1bn of household credit, which together account for 76% of private sector credit (€40.3bn in 2024). The dependent variable, GVA, ranged between €8.7bn (Q1/2017) and €19.3bn (Q3/2024), with an average value on a quarter basis being €12.1bn. It was thus better suited for statistical analysis to express all variables in symbolic form.

Table 1 Loans to corporations and households

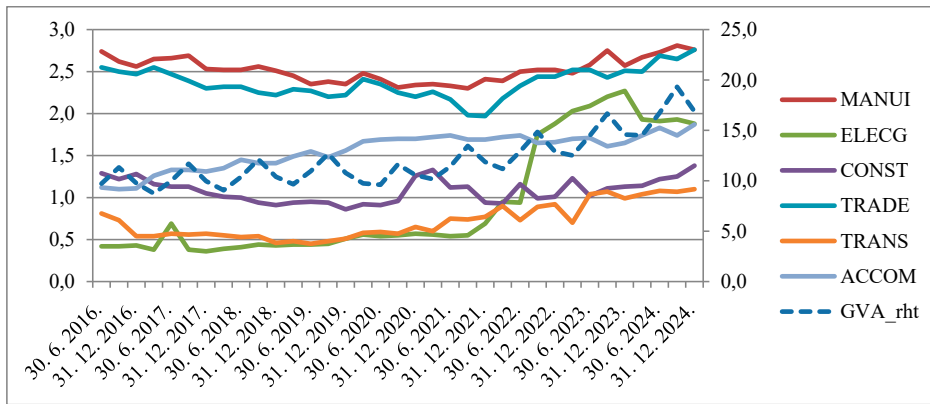
Corporate loans by sector	
Variables	Symbol
Gross value added (<i>dependent variable</i>)	GVA
Manufacturing industry	MANUI
Electricity, gas, steam, and air conditioning supply	ELECG
Wholesale and retail trade	TRADE
Activities of providing accommodation and preparing and serving food	ACCOM
Construction	CONST
Transportation and warehousing	TRANS
Real estate	REALE

Loans to households	
Variables	Symbol
Gross value added (<i>dependent variable</i>)	GVA
Housing loans	HOUSL
Cash non-purpose loans	CASHL

Source: Created by the authors

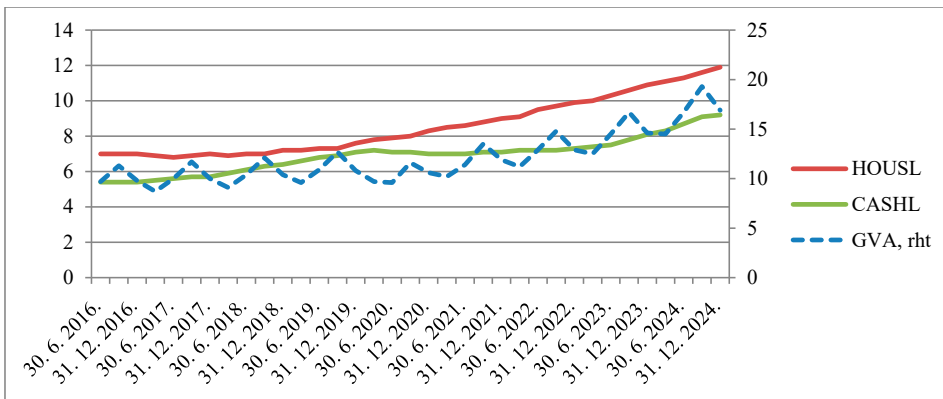
The first step in creating a model is to examine the trends of the variables in the observed period.

Figure 1 Variable trends for loans to corporations and GVA, billion EUR



Source: www.hnb.hr/en/statistics/statistical-data, created by the authors

Figure 2 Variable trends for loans to households and GVA, billion EUR



Source: www.hnb.hr/en/statistics/statistical-data, created by the authors

The analysis showed that construction, transport and warehousing and real estate, all areas of business finance, had no statistically significant impact on GVA in either log-linear or log-log models. At the beginning of the period (Q2/2016), these sectors represented about 30% of the loan volume (€3bn

of €10bn) and their share remained the same up to Q4/2024 (€4bn of €13.2bn). The lack of significance suggests structural inefficiency in capital allocation:

Construction is a cyclical and government-dependent activity. Real estate represents capital accu-

mulation without directly producing output. This reinforces that just volume of loans is not enough to drive economic growth. While these sectors continue to hold almost one-third of corporate loans, there is no evidence that they create value. Thus, lending policy should favour sectors with larger

productive multipliers. The remaining insignificant variables (CONST, TRANS, REALE) were discarded for analysis and the descriptive statistics were prepared for significant variables of corporate and household loans GVA trends.

Table 2 Descriptive statistics for the defined variables

Variable	Corporations			
	Min	Max	Mean	Std_dev
GVA	8.70	19.30	12.09	2.55
MANUI	2.30	2.80	2.53	0.15
ELECG	0.40	2.30	0.94	0.69
TRADE	2.00	2.80	2.37	0.18
ACCOM	1.10	1.90	1.56	
Households				
HOUSL	6.80	11.90	8.54	1.61
CASHL	5.40	9.20	6.93	1.01

Source: Created by the authors

There are 35 observations in the dataset for each variable. Gross value added (GVA) shows the highest variance with a mean of 12.10 and standard deviation of 2.55, a strong fluctuation in the observed time. On the other hand, the manufacturing and trade industry remains the most constant, with only normal standard deviations of 0.15 and 0.18, respectively. The electricity sector has the highest sectoral volatility (std. dev. 0.69; range 1.90), while the accommodation sector shows a relatively low mean (1.56) and moderate variability (std. dev. 0.21), partially demonstrating its seasonal nature. On the household side, housing loans average 8.54 (std. dev. 1.62), indicating sensitivity to real estate market or interest rate changes, while cash loans continue to be the most stable component (mean 6.93; std. dev. 1.01). Generally, GVA presents these ups and downs while cash loans have experienced a stable and consistent trend. A comprehensive ARIMAX (Autoregressive Integrated Moving Average with Exogenous Variables) model is used to investigate such phenomena; it compares the relationship between GVA and bank lending across four dimensions in the economies: manufacturing, electricity supply, trade, and accommodation. The ARIMAX model is suitable because it considers the time-series dependence as well as the effect of the exogenous variables simultaneously. First, it incorporates the strong autocorrelation characteristic of GVA using both AR and MA components (Enders, 2014). Second, lending actions are treated as purely

exogenous variables and they do not encounter simultaneity issues, which occurs in VAR models. Third, log transformation and differencing are used to ensure stationarity, avoiding problems concerning nonlinearity and heteroskedasticity. Finally, two model specifications are applied: a log-linear form, according to which coefficients can be perceived as semi-elasticities, and a log-log form, which yields elasticities (Gujarati & Porter, 2009).

The models can be formally presented as:

a) M1-models for corporations:

a1) log-linear; a2) log-log

$$a1) \log GVA_t(CORP) = \alpha + \sum_{i=1}^p \phi_i \log(GVA_{t-1}) + \sum_{j=1}^q \theta_j \varepsilon_{t-1} + \sum_{k=1}^K \beta_k X_{k,t} + \varepsilon_t$$

$$a2) \Delta \log GVA_t(CORP) = \alpha + \sum_{i=1}^p \phi_i \Delta \log(GVA_{t-1}) + \sum_{j=1}^q \theta_j \varepsilon_{t-1} + \beta_1 \log X_{k,t} \dots + \varepsilon_t$$

b) M2-household models:

b1) log-linear; b2) log-log

$$a1) \log GVA_t(HOUSE) = \alpha + \sum_{i=1}^p \phi_i \log(GVA_{t-1}) + \sum_{k=1}^K \beta_k X_{k,t} + \varepsilon_t$$

$$\text{a2) } \Delta \log \text{GVA}_{t(\text{HOUSE})} = \alpha + \sum_{i=1}^p \phi_i \Delta \log(\text{GVA}_{t-1}) + \beta_1 \Delta \log X_{k,t} \dots +$$

where:

$\log \text{GVA}_t$ – the natural logarithm of gross value added at the moment t

$X_{k,t}$ – exogenous variables – loans to companies by sector and loans to households at the moment t

ϕ_i – coefficient of the autoregressive part of the model (AR)

θ_j – coeff – coefficient of the moving average component (MA)

β_k – regression coefficients of exogenous variables

ε_t – random model error.

The models combine the ability to model the endogenous variable over time with the ability to quantify the impact of external factors, making them suitable for investigating economic dynamics in the context of sectoral credit activity. The log transformed GVA smooths out trends and variability in the main series, which improves the stability of the model. Also, ARIMAX allows for the removal of the autocorrelation effect from the residuals,

which increases the reliability of the estimates of the impact of credit variables. Econometric robustness is achieved because, in addition to the usual stationarity tests (Dickey & Fuller 1979), the model ensures the coherence of the time structures and allows for consistent estimation of the regression coefficients. To ensure the validity of the model, the stationarity of the time series was previously tested using the Augmented Dickey-Fuller (ADF) test. The GVA series was logarithmically transformed and differentiated as necessary to achieve stationarity. Exogenous variables (loans by sector) are not differentiated because it is assumed that short-term changes in the level of loans have an immediate economic impact on GVA, which corresponds to the real transmission channels of credit activity. In conclusion, using the ARIMA structure in the dependent variable component takes into account the internal dynamics of economic activity (e.g., GVA lags and past shocks), thereby increasing the robustness and interpretative value of the model.

4. Results

Both models were estimated using log-linear and log-log specifications. Statistical indicators of model quality show a high level of fit in all variants, with some differences in performance.

Table 3 Model quality statistics

Fit Statistic	Loans to corporations (model M1)		Loans to households (model M2)	
	Log-Linear	Log-Log	Log-Linear	Log-Log
	Mean	Mean	Mean	Mean
Stationary R-sq.	0.895	0.899	0.871	0.822
R-squared	0.904	0.914	0.956	0.943
RMSE	0.887	0.840	0.592	0.665
MAPE	4.628	4.568	2.881	3.653
MaxAPE	17.842	18.325	17.775	17.978
MAE	0.574	0.555	0.337	0.416
MaxAE	2.105	2.071	1.742	1.762
Normalised BIC	0.573	0.463	-0.323	-0.192

Source: Calculated by the authors with the support of IBM SPSS Statistics

In terms of explained variance (R-squared and stationary R-squared), Model 1 has a slightly lower R-squared (0.904–0.914) compared to Model 2

(0.943–0.956), although the explanation is also very high in M1. The stationary R-squared, which shows how well the model tracks fluctuations in station-

ary series, is also slightly higher in M1 (0.895–0.899 versus 0.822–0.871 in M2), suggesting that corporate loans are more strongly associated with quarterly GVA variations. In terms of model precision (prediction errors), Model 2 shows lower prediction error values, especially in the log-linear specification: RMSE: 0.592 (M2) vs. 0.887 (M1), MAE: 0.337 (M2) vs. 0.574 (M1), MAPE: 2.881% (M2) vs. 4.628% (M1). This indicates that Model 2 is more accurate in predicting GVA, which may be more useful for short-term projections and operational applications. The largest absolute errors (MaxAPE and MaxAE) are very similar in both models and both shapes, which means that neither model suffers from serious outliers or unstable episodes in the predictions. Finally, the information criterion

(normalised BIC) of Model 1 shows lower BIC values in the log-log variant, which indicates a better balance between complexity and adaptation. In Model 2, the log-linear specification is more efficient (lower BIC: -0.323), which additionally supports the previous conclusion about its usability for precise estimations with a smaller number of parameters. The results of the estimated ARIMAX (2,0,1) model with logarithmic values of GVA, with untransformed (loglinear) and with logarithmic amounts of sector loans to companies (log-log) are shown in Table 4. The model includes autoregressive components up to the second order (AR(2)), one moving average component (MA(1)), and four exogenous variables in log-linear and log-log specifications.

Table 4 GVA and sector loans to corporations

Model 1_ARIMA (2,0,1)								
Log-linear specification					Estimate	SE	t	Sig.
Dependent	GVA	Log (natural)	Constant		.687	.315	2.180	.038
			AR	Lag 1	.141	.137	1.027	.313
				Lag 2	-.817	.118	-6.922	< .001
			MA	Lag 1	-.456	.216	-2.115	.044
Variables	MANUI	No Transform.	Coefficient	Lag 0	.612	.103	5.924	< .001
	ELECG	No Transform.	Coefficient	Lag 0	.140	.025	5.622	< .001
	TRADE	No Transform.	Coefficient	Lag 0	-.226	.086	-2.624	.014
	ACCOM	No Transform.	Coefficient	Lag 0	.407	.076	5.353	< .001
Log-log specification					Estimate	SE	t	Sig.
Dependent	GVA	Log (natural)	Constant		1.180	.218	5.420	< .001
			AR	Lag 1	.141	.128	1.095	.283
				Lag 2	-.823	.112	-7.334	< .001
			MA	Lag 1	-.567	.192	-2.951	.006
Variables	MANUI	Log (natural)	Coefficient	Lag 0	1.528	.224	6.823	< .001
	ELECG	Log (natural)	Coefficient	Lag 0	.146	.021	6.855	< .001
	TRADE	Log (natural)	Coefficient	Lag 0	-.379	.187	-2.027	.053
	ACCOM	Log (natural)	Coefficient	Lag 0	.553	.097	5.704	< .001

Source: Calculated by the authors with the support of IBM SPSS Statistics

According to the results obtained, it was shown that the M1 model relies on two previous GVA values to predict the current value. In the model, AR(1) = 0.141 (p = 0.313) is not statistically significant, while AR(2) = -0.817 (p < 0.001) is highly significant and shows a strong negative influence of the GVA values from two periods back. In other words, if GVA was high two quarters ago, it has a negative influence today, i.e., there is a reversion to the mean value. This indicates a cyclical reversion where, after the growth

of GVA, there is often a correction in the opposite direction. In the MA (Moving Average) component, lag 1 uses the error (residual) from the previous period to correct the forecast in the current period -0.456 (p = 0.044). At the log-linear specification level, since the dependent variable is log(GVA), and the exogenous variables are loans in billions of euros, the coefficients are interpreted as approximate percentage changes in GVA with a change in loans by 1 billion euros. For example, if loans to the processing

sector increase by 1 billion euros in a quarter, GVA increases by approximately 61.2%, etc. In nature, the coefficients show the elasticity of GDP on lending to individual sectors. Since loans change is expressed in absolute amounts and GVA in log form, these are semi-elasticities. The results imply that the largest marginal contribution to GVA growth is made by loans to the manufacturing industry and tourism, while lending to trade has a negative effect, which may signal saturation or inefficiency in that sector. At the log-log specification level, the dependent variable (GVA) and the independent variables (loans by sector) are transformed by their natural logarithms. This allows the interpretation of the estimated coefficients as elasticity, i.e., how much GVA changes in response to a percentage change in the amount of loans to a particular sector. Specifically, a 1% increase in loans to the manufacturing sector results in an average 1.53% increase in GVA, with high statistical significance ($p < 0.001$), or a 1% increase in loans to the electricity supply sector contributes to a 0.15% increase in GVA, also with high reliability, etc. However, a 1% increase in loans to the trade sector has a negative coefficient (-0.379) and marginal statistical significance ($p \approx 0.053$), which may indicate a glut or inefficient lending in that sector. The results

obtained at both log-linear and log-log specification levels indicate that the effects of lending activity are sector-specific. The manufacturing industry and the accommodation and food sector (tourism) have a significantly positive effect on the growth of GVA, which supports the arguments for targeting credit policy, particularly towards the manufacturing sectors. The negative (and borderline significant) relationship between loans to the trade sector and GVA suggests the need for additional structural analysis of investment efficiency in this segment. In the context of the Croatian economy, which is characterised by pronounced seasonality and reliance on services, the results for the tourism sector further confirm its high multiplicative value. In order to examine the impact of household lending on economic growth, an ARIMA (3,1,0) model was applied. The dependent variable in the model is the logarithm of gross value added (GVA), while the exogenous variables are housing loans and cash non-purpose loans presented in loglinear and log-log specifications. The model is specified with three autoregressive components (AR(3)), order 1 differencing (to ensure stationarity), no moving average (MA), and with exogenous variables without time lag.

Table 5 GVA and household loans

Model 2 _ARIMA (3,1,0)								
Log-linear specification					Estimate	SE	t	Sig.
Dependent	GVA	Natural Log.	Constant		-.015	.017	-.891	.381
			AR	Lag 1	-.774	.133	-5.832	<.001
				Lag 2	-.985	.038	-26.207	<.001
				Lag 3	-.758	.130	-5.826	<.001
			Difference		1			
Variable	HOUSL	No Transform.	Coefficient	Lag 0	.013	.003	4.528	<.001
	CASHL	No Transform.	Coefficient	Lag 0	-.011	.005	-2.213	.036
Log-log specification					Estimate	SE	t	Sig.
Dependent	GVA	Natural Log.	Constant		-.067	.041	-1.614	.118
			AR	Lag 1	-.726	.133	-5.445	<.001
				Lag 2	-.945	.054	-17.546	<.001
				Lag 3	-.728	.130	-5.614	<.001
			Difference		1			
Variable	HOUSL	Natural Log.	Coefficient	Lag 0	.132	.034	3.886	<.001
	CASHL	Natural Log.	Coefficient	Lag 0	-.101	.047	-2.138	.041

Source: Calculated by the authors with the support of IBM SPSS Statistics

According to the results obtained, it turned out that the M2 model relies on AR(3) – the three previ-

ous quarters are used, in I(1) – the first difference of log(GVA) is used (i.e., the change is modelled,

not the level), while MA(0), does not have a “moving average” component. Since the increase in $\log(\text{GVA})$ is modelled (due to the difference I(1)), the model actually says that the change in $\log(\text{GVA})$ in the current quarter depends on the changes in $\log(\text{GVA})$ in the previous 3 quarters. All AR coefficients are negative and significant, which implies that the changes in GVA are reversible, i.e., corrective. In other words, if GVA increased last quarter, the model expects a decrease in the current quarter and vice versa. This is a typical dynamic in economic series, which exhibit seasonality and cyclicity. At the log-linear specification level, the results show that both forms of lending have a statistically significant impact on GVA. An increase in housing loans to households by EUR 1 billion is associated with a growth in GVA of approximately 1.3% ($p < 0.001$), indicating a strong positive effect of housing finance on real economic activity. In contrast, an increase in cash loans by the same amount leads to a decrease in GVA of approximately 1.1% ($p = 0.036$), which may indicate an unfavourable macroeconomic effect of non-purpose (cash) borrowing, especially if it is not directed towards productive investments.

At the log-log specification level, the results indicate that housing loans (HOUSL) have a positive and statistically significant impact on gross value added. The estimated coefficient of 0.132 means that a 1% increase in household loans leads to an increase in GVA of approximately 0.13%, with other factors held constant. However, cash loans (CASHL) have a negative and significant impact, which may indicate an adverse effect of household consumer debt on the productive capacity of the economy or a reduction in disposable income. The application of the ARIMAX(3,1,0) model with log-linear and log-log transformation shows that household loan dynamics have differentiated effects on economic growth: while housing loans stimulate GVA, consumer loans can be counterproductive. These findings may be useful in shaping macroprudential policy and loan regulation.

5. Discussion

The ARIMAX, which is estimated with log-linear and log-log specifications, finds a differentiated relationship between corporate and household lending and the dynamics of gross value added (GVA) in Croatia. Although the main findings are

presented in Tables 4 and 5, the results can also be visualised by comparing actual and predicted GVA values from both models. These visual comparisons (not shown here) confirm that the ARIMAX specifications closely track the observed fluctuations in GVA, with only limited deviations. Such representations provide an intuitive confirmation of the robustness of the statistical estimations. In this regard, three main findings (corporate lending, household lending) are relevant. GVA is strongly, significantly impacted by manufacturing and electricity loans. Manufacturing loans (avg. €2.5bn a quarter) for those years 2016–2024 stagnated at a very low clip (2.5%), pointing to low capacity to absorb and a low willingness of banks to expand credit further. Electricity and gas supply loans (avg. €0.9bn quarterly) grew rapidly (225%), indicating both sectoral growth potential and creditor readiness. These findings offer support for targeted policy measures (taxation relief, guarantees, and development banks) to boost lending in sectors with high multipliers of productivity. Secondly, loans to accommodation and food industry (tourism), are positively associated with GVA. Average quarterly loans stood at €1.56bn, with a combined growth of 55%. Although this validates the centrality of tourism, its seasonal nature and sensitivity to shocks require careful credit allocation and diversification of assets toward sustainable and year-round activities. Thirdly, the trade sector shows a negative coefficient which seems to indicate a bad allocation of credit. This is on average €2.4bn a quarter (11% growth), but additional lending is still not associated with a rise in GVA, and could be reflecting overcapacity, sluggish productivity, or reliance on short-term working capital. It indicates that sectoral investments require further structural scrutiny. Housing loans exert a positive relationship with households, while consumer loans have a negative one. The coefficients for housing and consumer in the log-linear model are 0.013 and -0.011, respectively; log-log models 0.132 and -0.101, respectively. Housing loans (avg. €8.5bn quarterly) provide support to the construction and related sectors, while consumer loans (avg. €7bn quarterly) may increase short-term demand, but can undermine long-term savings and stability. Both categories expanded by 54% from 2016–2024, mirroring banks’ lending policies and household expectations for future income growth. All of these reinforce that sectoral differentiation is an important component of economic performance. Regulatory efforts should focus more on the

sectors with the highest growth multipliers, providing for an even distribution of resources to use in support of efficiency and resilience.

6. Conclusion

This research analysed the impact of bank lending on gross value added (GVA) in Croatia, distinguishing between loans to non-financial corporations and loans to households. By applying the ARIMAX methodology, which incorporates both time dynamics and exogenous shocks, the study was able to capture the differentiated effects of sectoral and household lending on aggregate economic activity. The results show that loans to the manufacturing industry, the energy sector, and accommodation services have a strong and positive impact on GVA, while loans to the trade sector exert a negative effect. Among households, housing loans contribute positively to GVA, whereas cash loans have an adverse impact.

In summary, 45% of all private loans (€18.5bn) favour economic growth, while 30% (€12bn) exert a negative influence, 10% are statistically insignificant, and 15% (€5.9bn) fall outside the scope of this analysis. These results suggest that not only the volume, but also the structure and allocation of lending, matter for economic performance.

From a policy perspective, the findings indicate that the Croatian National Bank (CNB) could strengthen

its credit policy framework by promoting lending to sectors with higher growth multipliers, such as manufacturing, energy, and accommodation. At the same time, stricter monitoring of trade and cash lending is recommended in order to limit potential inefficiencies and reduce systemic risk. A balanced approach could contribute to building a more sustainable and resilient economic structure.

Nevertheless, some limitations must be acknowledged. The analysis is based on aggregate quarterly data, which may mask firm-level heterogeneity and informal credit flows. Moreover, the study focuses on the period 2016–2024, without explicitly accounting for structural breaks. Future research could therefore test the model separately for the pre- and post-COVID periods, explore the long-term efficiency of lending in the trade sector, and examine the interaction of bank lending with institutional quality and consumption patterns.

Overall, this study contributes to the understanding of how sectoral and household lending affects economic growth in Croatia, while offering insights that may help policymakers align credit allocation with sustainable development goals.

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URBAN–RURAL DIFFERENCES IN RETIREMENT PREPAREDNESS: UNPACKING THE PLANNING–RESOURCES PARADOX IN VIETNAM

ABSTRACT

Purpose: Vietnam’s rapid population aging raises pressing questions about household readiness for retirement. This study investigates the extent and sources of rural–urban differences in retirement preparedness, focusing on both behavioral and resource-based dimensions.

Methodology: Using nationally representative data, we analyze two indicators of preparedness: a retirement-planning dedication index and the logarithm of financial assets. Sequential regression models and Blinder–Oaxaca decompositions are employed to separate rural–urban gaps into endowment and coefficient components. Robustness checks include ordered-logit models for planning and an inverse hyperbolic sine wealth-to-income measure for assets.

Results: Urban households hold more financial assets in unconditional comparisons, but this advantage is fully explained by endowment differences and disappears once controls are included. In contrast, rural households exhibit higher planning dedication after accounting for covariates. Decomposition results attribute this rural planning premium primarily to coefficient and interaction effects, suggesting stronger behavioral returns to similar traits in rural settings.

Conclusion: Asset disparities largely reflect compositional differences, while planning gaps stem from behavioral factors. These findings highlight the need for complementary policies that enhance both endowments and behavioral capacities to strengthen retirement preparedness across regions.

Keywords: Financial literacy, rural-urban gaps, retirement planning, Blinder–Oaxaca decomposition, Vietnam

1. Introduction

Population aging poses major challenges to retirement security in developing countries, particularly where public pension systems provide limited coverage and private savings are the dominant source of old-age support. Vietnam illustrates these challenges clearly. The country is aging quickly while

most households remain modest in wealth and financial literacy. Inequality between rural and urban areas continues to persist (Do, 2017; Nguyen & Rozsa, 2019).

A large body of international research has established that financial literacy strongly predicts retirement planning and wealth accumulation

(Lusardi & Mitchell, 2014). Recent research shows that digital financial inclusion via mobile money, internet banking, and online financial tools can shape households' saving, risk-sharing, and asset accumulation, particularly where formal access is limited (Suri & Jack, 2016; Jack & Suri, 2014; De Mel et al., 2018; Suri, 2017; Demirgüç-Kunt et al., 2022). In Vietnam, financial literacy remains low by international standards, with rural households particularly disadvantaged (Morgan & Trinh, 2020). At the same time, urban households enjoy stronger income and asset endowments, broader access to financial services, and better digital infrastructure (Bui & Imai, 2019). On this basis, one would expect urban households to demonstrate superior retirement planning outcomes.

Yet descriptive patterns suggest a paradox. Despite their relative disadvantages in socioeconomic resources, rural households often report similar or even greater levels of retirement-planning dedication compared to urban households. This echoes broader evidence from inequality studies in Vietnam. While resource endowments (e.g., education, income, assets) explain part of rural–urban disparities, differences in how households translate resources into outcomes are equally important (Tran et al., 2024). This raises a critical question: do rural households' planning advantages arise from unmeasured structural conditions, or from greater efficiency in mobilizing modest resources into retirement preparation?

This article addresses that question by analyzing two retirement planning indicators: (1) a planning-dedication index capturing households' behavioral commitment to retirement preparation, and (2) the natural logarithm of financial assets, which represents the stock of resources available for future retirement. Using sequential regression models, we assess how differences in demographics, income, assets, financial inclusion, and digital connectivity explain the observed urban–rural gaps. To move beyond mean differences, we apply the Blinder–Oaxaca decomposition, which partitions gaps into endowment effects (explained by differences in characteristics) and coefficient effects (differences in the returns to those characteristics). This dual-outcome, decomposition-based strategy provides new evidence on how resource advantages and behavioral efficiency interact in shaping retirement preparedness.

Our contribution is threefold. First, we document a planning–resources paradox. Despite fewer re-

sources, rural households exhibit stronger retirement-planning dedication, and this rural advantage is driven primarily by coefficient and interaction effects rather than endowments, a pattern robust to ordered-logit specifications. Second, we extend Vietnamese inequality research, typically centered on income or expenditure, into retirement preparedness by jointly analyzing planning behavior and financial assets. We show that urban households' advantage in financial assets is explained largely by endowment differences (e.g., education, income, and financial inclusion). Third, we deliver policy-relevant guidance by distinguishing the levers behind each gap. Asset disparities call for endowment-enhancing policies (education, financial and digital inclusion), while the planning gap points to improving the translation of existing resources into effective planning through interventions that strengthen behavioral returns to endowments.

The next section provides a brief review of the literature. Section 3 outlines the study's data and methodology. Section 4 presents the main results and discusses their implications. Section 5 concludes and offers policy recommendations and directions for future research.

2. Literature review

2.1 Financial literacy and retirement financial preparation

A substantial body of research documents a strong association between financial knowledge, retirement planning behavior, and long-term wealth accumulation (Marcelin & Sun, 2025). Synthesizing theory and evidence, Lusardi and Mitchell (2014) argue that financial knowledge operates like human capital. It lowers information and transaction costs, improves portfolio choice, and raises lifetime welfare. Across many countries, higher literacy is strongly associated with planning and saving for retirement (Lusardi & Mitchell, 2014). In the United States, individuals with greater literacy are much more likely to plan and to hold retirement wealth, controlling for demographics and income (Lusardi & Mitchell, 2011). Evidence outside advanced economies is consistent with this link but highlights implementation frictions (Hu et al., 2025). Evidence from India and Indonesia suggests that financial education alone has limited effectiveness, and that its impact increases substantially when coupled with access or incentive-based interventions, point-

ing to complementarities between knowledge and financial inclusion (Cole et al., 2011). This knowledge–planning–savings channel underpins our use of both a behavioral outcome (planning dedication) and a resource outcome (log financial assets).

2.2 Financial inclusion and digital channels

Worldwide, urban residents exhibit systematically higher access to formal financial accounts, payment systems, and savings products than their rural counterparts (Klapper et al., 2025). Distance, documentation, and cost barriers are more binding in rural settings (Johnen et al., 2025). Global Findex overviews emphasize these structural frictions and the role of inclusion in poverty reduction and household resilience (Klapper et al., 2018). Digital finance can relax these frictions. For instance, studies of mobile money adoption in Kenya demonstrate reductions in extreme poverty and improved consumption smoothing, highlighting how lowcost digital payment rails facilitate greater saving capacity and informal risk sharing (Suri & Jack, 2016). These findings motivate our focus on inclusion variables (bank account, savings account, cards, internet banking) and digital proxies (internet use, online shopping, apps) as potential mediators of urban–rural gaps in both planning and assets.

2.3 Behavioral frictions and translation from resources to action

Even in the presence of adequate resources and access to financial services, households frequently exhibit undersaving behavior driven by inertia, present bias, and limited attention (Demirgüç-Kunt et al., 2022; De Beckker et al., 2025). For example, the “Save More Tomorrow” program shows that aligning contribution increases with pay raises dramatically boosts participation and contribution rates, demonstrating that small design tweaks can convert intentions into sustained saving (Thaler & Benartzi, 2004). This literature motivates modeling heterogeneity not only in endowments, such as income, education, and account ownership, but also in how effectively different groups translate resources and access into financial planning and asset accumulation, potentially through distinct behavioral or institutional environments (Zhuang & Yang, 2025).

2.4 Urban–rural differences in developing country contexts

Global and Vietnam-focused work documents sizable urban advantages in education, income, and formal access, yet uneven translation into long-term

financial outcomes. Vietnam’s policy priority is to expand financial inclusion precisely to bridge rural gaps. Micro evidence from Vietnam shows that higher financial literacy is associated with retirement-related behaviors and advice-seeking among workers, consistent with patterns observed internationally (Do, 2017; Nguyen & Rosza, 2019). Broader evidence from Vietnam indicates that demographic characteristics, income levels, and digital technology use are associated with higher financial literacy and improved financial behaviors, underscoring the importance of both resources and digital channels (Pham & Le, 2023). These strands support our inclusion of literacy, inclusion, and digital use blocks. They also support our expectation that rural households may sometimes display efficient use of limited resources in planning.

Multiple studies analyze urban–rural economic divides in Vietnam. Bui and Imai (2019) use unconditional quantile regression and decomposition techniques to show that education and remittances reduce inequality but structural differences remain. Similarly, Le & Booth (2014) replicated this finding using the Oaxaca–Blinder decomposition and found that half of the expenditure gap is explained by compositional differences, while the remaining unexplained structural intercept favors urban households.

2.5 Methodological grounding with Blinder–Oaxaca

The Blinder–Oaxaca decomposition partitions mean gaps into endowments (group differences in covariates) and coefficients (differences in returns to those covariates), with an interaction term capturing simultaneous shifts. Originally developed for wage differentials, it is now standard in decomposing group outcome gaps where both composition and structural responses may differ (Blinder, 1973; Jann, 2008). Applying this framework to planning and financial assets allows us to test whether the urban–rural disparity is mostly about resources (education, income, inclusion) or about how those resources translate into behavior and wealth. The Oaxaca–Blinder decomposition is also used to examine disparities within rural Vietnam. Son et al. (2024) show that disparities in characteristics including education, land holdings, and household composition explain much of the income differential between Kinh and non-Kinh groups, whereas the unexplained portion suggests the presence of deeper structural inequality.

Overall, the literature suggests that financial literacy promotes planning and saving, inclusion and digital rails strengthen these links, and behavioral frictions often constrain the conversion of resources into action (Yadav et al., 2025). These facts guide our empirical strategy. Accordingly, we first estimate reduced-form urban–rural gaps. We then add blocks of covariates such as demographics, human capital and income, wealth, financial inclusion, and digital connectivity to track how those gaps attenuate. For robustness, we fit an ordered model for the ordinal planning index and re-estimate using a scale-free outcome (wealth-to-income). Finally, we use the Blinder–Oaxaca decomposition to allocate any remaining gap to differences in endowments versus differences in returns. This structure is directly aligned with the international evidence while tailoring mechanisms to Vietnam's rapid digitalization and evolving inclusion agenda.

3. Data and methodology

3.1 Data collection

The data for this study were obtained from the survey conducted by the Mekong Development Research Institute under the direction of the Asian Development Bank Institute. Data were collected between June and August 2019, using the Viet Nam Household Living Standards Survey (VHLSS) 2018 as the base sample. Two major cities (i.e., Ha Noi and Ho Chi Minh City) were purposely selected, while three additional provinces representing different regions of the country (Bac Ninh in the North, Quang Nam in the Central region, and Dong Thap in the South) were randomly chosen.

Within these areas, enumeration areas from the VHLSS 2018 were randomly selected, and in each enumeration area, approximately 30 households were targeted for interviews. If an original VHLSS household was unavailable, the nearest neighboring household was used as a replacement. In practice, about 50% of the original households could not be traced and were substituted in this way.

Interviews were conducted with the household head, or another member most knowledgeable about household finances, to collect demographic and economic information such as income, debt, and assets. For the sections on fintech adoption and financial literacy, one household member aged 18 or above was randomly selected using dice and household rosters. If the chosen respondent was not available, another adult was randomly selected until one could be interviewed.

Households were classified as rural or urban based on commune-level information. This classification differs from that of Morgan and Trinh (2020), who defined urban households strictly as those residing in Ha Noi or Ho Chi Minh City. Under our approach, households can still be classified as rural if their commune codes indicate so, even when located within major cities. The final sample comprises 1,038 households, with 50.4% residing in rural areas and 49.6% in urban areas.

3.2 Measures

The survey adopts the OECD/INFE questionnaire (OECD, 2018) to measure financial knowledge. The financial knowledge score is based on seven questions covering core concepts such as simple and compound interest, inflation, investment risk, bonds, stocks, and risk diversification. Each correct response is coded as 1, while incorrect responses are coded as 0. The total score ranges from 0 to 7, reflecting the respondent's level of basic financial literacy.

The survey also incorporates indicators of financial inclusion and digital finance use. Respondents were asked whether they hold a bank account, credit card, savings account, or financial investments, and whether they engage in activities such as internet use, online shopping, using financial apps, and internet banking. Additionally, the ability to locate appropriate fintech services was recorded.

Retirement planning is measured by the degree of commitment to achieving long-term financial goals, assessed using a scale from 1 (totally disagree) to 5 (totally agree), based on the question of whether the respondent has set and is trying to achieve long-term financial goals such as retirement planning. The planning-dedication index captures behavioral engagement in retirement preparation. This is responsive to policy, and is naturally modeled on an ordered scale. The log of financial assets represents the stock of resources that finances retirement, improves comparability by reducing skew, and yields coefficients interpretable as percentage effects. Together, these variables separate activation (behavior) from capacity (resources), allowing us to test whether effort translates into accumulation and decompose urban–rural gaps into endowments versus returns.

Finally, the dataset includes a wide range of demographic and socioeconomic characteristics that may influence financial literacy, such as gender, age, marital status, household size, education group, occupation, urban–rural residence, income, financial and physical assets, housing or land, total assets, liabilities, and saving methods.

3.3 Descriptive gap analysis

Table 1 presents two-sample t-tests (and Pearson χ^2 tests for proportions) comparing survey variables between rural and urban respondents. Urban and rural samples are demographically similar: gender and age distributions are nearly identical, household size is slightly smaller in cities, and marriage rates modestly lower. Human capital gaps are substantial—urban residents average 3.2 more years of schooling, are over three times likelier to hold university degrees, and twice as likely to work in finance or business. Economic resources differ sharply: urban income is about 85% higher, and asset disparities are even larg-

er, with urban households holding roughly 2.8 times the total assets, five times the financial assets, and over three times the housing value of rural households. Only physical assets are higher in rural areas, reflecting a more tangible asset mix. Financial access and digital engagement are far greater in urban areas across banking, credit, savings, investments, internet use, and online transactions, though fintech finding ability does not differ significantly. Financial knowledge is also higher among urban respondents. Despite these advantages, the retirement-planning dedication score is statistically similar between urban and rural residents.

Table 1 Descriptive gap analysis

Variable	Urban		Rural		Difference	t-test p-value
	Mean	Std. dev.	Mean	Std. dev.		
male	0.48	0.50	0.49	0.50	-0.01	0.75
female	0.52	0.50	0.51	0.50	0.01	0.75
age	46.87	15.41	46.65	13.41	0.22	0.81
household member number	3.93	1.67	4.11	1.67	-0.18	0.08
married	0.53	0.50	0.60	0.49	-0.06	0.04
financial or business occupation	0.13	0.33	0.06	0.24	0.07	0.00
university education	0.37	0.48	0.10	0.30	0.26	0.00
vocational school education	0.02	0.15	0.03	0.16	0.00	0.72
secondary school education	0.43	0.50	0.52	0.50	-0.09	0.00
primary school education	0.11	0.31	0.25	0.43	-0.14	0.00
no formal education	0.07	0.26	0.10	0.30	-0.03	0.09
year of education	10.91	4.83	7.72	4.33	3.19	0.00
income	208.52	134.83	112.95	91.37	95.56	0.00
financial asset	168.67	598.85	33.29	201.00	135.38	0.00
housing or land	2937.11	3985.79	869.19	2994.73	2067.92	0.00
physical asset	154.41	286.56	246.99	600.94	-92.57	0.01
total asset	2512.37	3941.93	905.70	2704.69	1606.68	0.00
saving methods	1.06	1.25	0.70	0.99	0.36	0.00
bank_account	0.57	0.50	0.26	0.44	0.30	0.00
creditcard	0.40	0.49	0.16	0.37	0.24	0.00
savings account	0.27	0.44	0.11	0.31	0.16	0.00
financial investment	0.03	0.17	0.01	0.09	0.02	0.01
internet user	0.80	0.40	0.42	0.49	0.38	0.00
online shopping	0.43	0.50	0.18	0.38	0.26	0.00
financial apps using	0.09	0.29	0.03	0.18	0.06	0.00
internet banking user	0.28	0.45	0.05	0.22	0.23	0.00
fintech finding ability	0.03	0.16	0.02	0.12	0.01	0.19
financial knowledge	4.77	1.33	4.07	1.39	0.70	0.00
planning_dedication	3.84	1.27	3.95	1.39	-0.11	0.18

Source: Authors' compilation

The results point to a structural urban advantage. Urban households exhibit higher levels of schooling, income, and both liquid and real-estate wealth, alongside markedly greater access to formal and digital financial services. These advantages coincide with higher financial knowledge. This is consistent with the view that exposure and resources may foster literacy. Asset composition also differs by location. Rural households hold more physical assets but fewer financial and housing assets, implying distinct portfolios that may shape saving methods and the relevance of specific financial products. A pronounced digital divide is evident. Large gaps in internet use and fintech adoption are consistent with infrastructural or skills constraints in rural areas. The only exception is the absence of a significant difference in fintech finding ability, indicating a uniformly low capability to navigate fintech services across locations. In sum, the descriptive evidence establishes a paradox. Despite sizeable differences in socioeconomic endowments, financial inclusion, and digital access, rural households

are not less likely to engage in retirement planning and may exhibit marginally greater dedication once they do so.

Given the focus of this research, the baseline multivariate specification will prioritize resourcebased covariates (e.g., education, income, assets, financial inclusion, and digital access) as potential mediators of planning disparities. The initial model regresses each outcome on an urban dummy only. Sequential blocks of covariates are then added to observe attenuation. Finally, the Blinder–Oaxaca decomposition partitions the urban–rural gap into endowment and coefficient components, testing whether rural households' parity in retirement planning is explained by equal effectiveness of fewer resources, or by other unobserved mechanisms.

3.4 Correlation patterns and econometric justification

Table 2 presents Pearson correlations among planning dedication, financial knowledge, ln(financial assets), and a rural indicator.

Table 2 Pearson correlation among main explanatory variables

	Planning dedication	ln Financial asset	Financial knowledge	Rural
Planning dedication	1			
ln Financial asset	0.0613	1		
Financial knowledge	0.0679	0.2345	1	
Rural	0.0547	-0.5038	-0.3396	1

Source: Authors' compilation

Planning dedication is only *weakly* related to resources and literacy: its correlations with ln(financial assets) and financial knowledge are small ($r = 0.061$ and $r = 0.068$, respectively). Likewise, the correlation between planning dedication and rural is positive but very small ($r = 0.055$). These near-zero associations are consistent with the earlier mean comparison showing no statistically significant urban–rural gap in planning dedication. Resources and literacy comove. The log of financial assets and financial knowledge are positively correlated ($r = 0.235$), indicating that households with greater financial wealth tend to score higher on knowledge. Place of residence is strongly linked to resources and knowledge. Rural correlates negatively with ln(financial assets) ($r = -0.504$) and with financial knowledge ($r = -0.340$), reaffirming

the large urban advantages documented in the descriptives.

In sum, the correlation evidence is fully consistent with the earlier descriptive narrative. Urban respondents possess greater resources and literacy, but these do not predict stronger planning dedication. This motivates a modeling strategy that isolates mediating mechanisms and formally tests whether rural households achieve equivalent or greater planning depth despite resource deficits.

3.5 Econometric strategy

Our empirical strategy proceeds in three stages, designed to explain the paradox whereby urban households enjoy substantially greater socioeconomic resources yet do not exhibit stronger retirement-planning dedication. We consider two

outcome variables: (1) the continuous planning-dedication index, and (2) the natural logarithm of financial assets, which captures financial resources available for future retirement.

We begin with parsimonious models in which each outcome is regressed solely on an indicator for urban residence. This establishes the unconditional urban–rural gap and provides a benchmark for assessing the explanatory power of covariates.

To explore mechanisms underlying the gap, we introduce blocks of explanatory variables in a step-wise manner. First, demographic controls such as age, sex, marital status, household size, and occupation type ensure that urban–rural differences are not driven by compositional factors. Next, human capital and income indicators, including years of education, university attainment, household income, and logged income, capture resource endowments that descriptive evidence shows to be higher in urban areas. We then add wealth and assets (e.g., financial assets, housing or land, physical assets, and the asset-range index) to test whether accumulated stock variables explain differences in retirement preparation. Financial inclusion, measured by bank-account ownership, savings accounts, credit cards, internet banking, saving methods, and financial investments, reflects access to the formal financial system where urban advantages are most pronounced. Finally, digital connectivity, encompassing internet use, online shopping, app usage, financial apps, and fintech-finding ability, measures access to technological channels through which planning may occur. By tracing changes in the urban coefficient across specifications, we test whether rural parity or advantage in planning dedication persists after accounting for differential endowments and mediating channels.

After that, several robustness checks will be undertaken. For planning dedication, which is measured on an ordinal 1–5 scale, we re-estimate using an ordered logit model to account for the bounded and ordinal nature of the index. For financial assets, we verify results using alternative normalizations such as wealth-to-income ratios to account for scale effects.

The Blinder–Oaxaca decomposition is applied to formally partition the observed urban–rural gap

into an endowment effect, reflecting differences in mean covariates such as education, assets, or knowledge, and a coefficient effect, capturing differences in the returns to those covariates. This decomposition directly addresses whether rural households' comparable or higher planning dedication reflects compensatory efficiency in resource use or unobserved mechanisms beyond measured endowments.

4. Results and discussions

4.1 Planning dedication

Below we synthesize the multivariate associations with retirement-planning dedication. Results with robust standard errors are reported in Table 3. Across all models, the rural indicator is positive and becomes larger as controls are added ($\beta = 0.215^{**}$ in column 1 to 0.365^{***} in column 5). Thus, once differences in resources and access are held constant, rural respondents report higher planning dedication. In other words, the urban advantage in endowments partly masks a rural advantage in dedication. Turning to resources and knowledge, financial knowledge is a stable, positive correlate of planning dedication ($\beta = 0.148^{***}$ in column 1; 0.080 – 0.112 in columns 2–5), although its size attenuates when resource controls enter. Within resources, accumulated wealth matters more than current cash flow: log total assets are positively associated with dedication (≈ 0.054 – 0.058^{**}), whereas log income is small and insignificant (≈ 0.064 – 0.103 , nonsignificant).

Finally, we consider financial inclusion and digital variables. Most account-ownership and fintech indicators are insignificant once other factors are included. The main exception is online shopping, which is consistently and positively related to planning dedication ($\beta = 0.246^{**}$ in column 3; 0.326^{**} in column 5). Moreover, the interactive term between knowledge and online shopping is negative (-0.144^* , column 4), suggesting that online engagement and knowledge partly substitute. Online shopping is more strongly associated with planning among lower-knowledge respondents, while its incremental association diminishes at higher knowledge levels.

Table 3 Regression results for planning dedication

	(1)	(2)	(3)	(4)	(5)
VARIABLES	planning_ dedication	planning_ dedication	planning_ dedication	planning_ dedication	planning_ dedication
fknowledge	0.148*** (0.0316)	0.0957*** (0.0362)	0.0794** (0.0379)	0.112** (0.0446)	0.0804** (0.0379)
rural	0.215** (0.0842)	0.279** (0.109)	0.304*** (0.113)	0.306*** (0.113)	0.365*** (0.138)
lnincome		0.103 (0.0810)	0.0660 (0.0836)	0.0646 (0.0833)	0.0686 (0.0837)
Intotal_asset		0.0541** (0.0270)	0.0574** (0.0269)	0.0578** (0.0268)	0.0577** (0.0269)
bank_account			0.190 (0.129)	0.177 (0.130)	0.191 (0.129)
creditcard			0.0567 (0.137)	0.0649 (0.138)	0.0557 (0.137)
savings_account			-0.0444 (0.114)	-0.0450 (0.114)	-0.0568 (0.114)
internet_user			-0.114 (0.123)	-0.129 (0.124)	-0.0971 (0.124)
online_shopping			0.246** (0.105)	0.932** (0.379)	0.326** (0.135)
financial_app_using			0.0144 (0.176)	0.0171 (0.174)	0.000530 (0.176)
internet_banking_user			-0.104 (0.142)	-0.0718 (0.142)	-0.122 (0.143)
fknowledge_x_online_ shopping				-0.144* (0.0740)	
rural_x_online_shopping					-0.193 (0.191)
Constant	3.130*** (0.168)	3.086*** (0.429)	3.189*** (0.435)	3.059*** (0.447)	3.128*** (0.447)
Observations	1,038	826	826	826	826
R-squared	0.025	0.040	0.050	0.054	0.051

Note: Robust standard errors in parentheses. Controls for demographics included but not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' compilation

Model fit is modest ($R^2 = 0.025\text{--}0.054$), as is typical for attitudinal indices. Still, the message is clear. Despite sizable shortfalls in resources, financial inclusion, and digital access, rural households ex-

hibit equal or, conditional on observables, greater retirement-planning dedication¹.

1 The ordered logit robustness checks confirm the central findings (to be provided upon request).

The results show that knowledge and assets contribute, but a large part of the variation in dedication remains unexplained. This is consistent with the idea that unobserved motivations or social norms, especially in rural areas, play an important role. Both the linear and ordered logit models point to a rural advantage in planning dedication. This advantage holds across different functional forms and sets of controls. The persistence of the rural coefficient motivates the use of the Blinder–Oaxaca decomposition. This approach separates the observed gap into endowment and coefficient components. It allows us to assess whether rural households achieve greater planning depth because they use fewer resources more efficiently or because of unobserved factors beyond measured endowments.

4.2 Financial resources for retirement

Table 4 reports OLS regressions of the natural logarithm of financial assets on rural residence, financial knowledge, and successive blocks of covariates (robust standard errors).

Column 1 includes financial knowledge and rural. Column 2 adds income, total assets, and demographics. Columns 3 to 5 add financial inclusion and digital variables, with interactions in columns 4 and 5. Model fit improves from $R^2 = 0.071$ in the baseline to $R^2 \approx 0.388$ with the full set of controls.

The rural coefficient is large and negative in the baseline ($-0.876, p < 0.01$). However, once income, total assets, and demographics are included, it becomes small and statistically insignificant (-0.118 in column 2) and remains insignificant thereafter, even turning modestly positive (0.084 – 0.180 in columns 3–5). Hence, the apparent rural shortfall in financial assets is fully accounted for by observed covariates.

Income and total wealth are the dominant correlates. A 1% increase in income is associated with about 0.66–0.79% higher financial assets ($p < 0.01$), and a 1% increase in total assets with about 0.28 to 0.33% higher financial assets ($p < 0.01$). Financial knowledge is strongly positive in the sparse model ($0.221, p < 0.01$), but becomes small and insignificant once resources enter. This suggests that the connection between knowledge and assets operates mainly through income and wealth.

Having a savings account is very strongly associated with higher financial assets (≈ 1.88 – $1.90, p < 0.01$), and being an internet-banking user is also positive (≈ 0.54 – $0.60, p < 0.05$). By contrast, bank-account ownership, credit cards, internet use, online shopping, and financial-app use are not robust predictors once resources are controlled. The two interaction terms (i.e., knowledge \times online shopping and rural \times online shopping) are insignificant.

Table 4 Regression results for financial assets as a retirement source

	(1)	(2)	(3)	(4)	(5)
VARIABLES	lnfin_asset	lnfin_asset	lnfin_asset	lnfin_asset	lnfin_asset
fknowledge	0.221*** (0.0459)	0.0421 (0.0522)	0.0228 (0.0475)	0.0401 (0.0504)	0.0249 (0.0475)
rural	-0.876*** (0.149)	-0.118 (0.168)	0.0838 (0.166)	0.0849 (0.166)	0.180 (0.188)
lnincome		0.790*** (0.108)	0.661*** (0.106)	0.659*** (0.106)	0.665*** (0.106)
lntotal_asset		0.334*** (0.0371)	0.279*** (0.0350)	0.280*** (0.0351)	0.280*** (0.0351)
bank_account			-0.228 (0.227)	-0.234 (0.227)	-0.228 (0.227)
creditcard			-0.0925 (0.246)	-0.0889 (0.246)	-0.0921 (0.246)
savings_account			1.900***	1.902***	1.879***

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Infin_asset	Infin_asset	Infin_asset	Infin_asset	Infin_asset
			(0.224)	(0.225)	(0.227)
internet_user			-0.00422	-0.0126	0.0205
			(0.172)	(0.172)	(0.172)
online_shopping			0.226	0.610	0.367
			(0.199)	(0.612)	(0.261)
financial_app_using			-0.0443	-0.0377	-0.0702
			(0.380)	(0.380)	(0.381)
internet_banking_user			0.576**	0.596**	0.540*
			(0.283)	(0.286)	(0.288)
fknowledge_x_online_shopping				-0.0814	
				(0.126)	
rural_x_online_shopping					-0.314
					(0.331)
Constant	0.963***	-3.504***	-3.074***	-3.140***	-3.165***
	(0.240)	(0.562)	(0.547)	(0.547)	(0.556)
Observations	933	765	765	765	765
R-squared	0.071	0.290	0.387	0.387	0.388

Note: Robust standard errors in parentheses. Controls for demographics included but not shown.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' compilation

The results imply that after conditioning on income, total wealth, and access to formal savings channels, there is no residual rural penalty in financial assets. The location gap observed in bivariate comparisons reflects compositional differences (e.g., income, overall wealth, and formal savings) rather than an independent rural effect².

4.3 Comparison of planning dedication and financial resources

Contrasting the two retirement planning indicators yields a clear divergence. In the planningdedication models, the rural indicator is positive and statistically significant in every specification, indicating higher reported dedication among rural households after adjusting for education, income, total assets, financial inclusion, and digital access. Financial

knowledge remains a meaningful though attenuated correlate of dedication. Online shopping is positively associated, and the negative knowledge \times online-shopping interaction suggests partial substitution. Other inclusion/digital indicators are not robust.

By contrast, in the financial-asset models, the initial rural shortfall is large and significant in the baseline but becomes statistically insignificant once income, total assets, and demographics are included, and remains insignificant after adding financial-inclusion and digital variables, or even turns modestly positive. The wealth-to-income normalization $\ln(W/I)$ leads to the same conclusion. The rural coefficient declines from negative and significant to smaller and indistinguishable from zero in the fully specified models, confirming that any gap is explained by observable endowments. Income and total wealth dominate as predictors of financial assets, and savings-account ownership is strongly positive. Neither financial knowledge nor most digital vari-

2 We re-estimated the financial-preparedness model using the log of the financial-asset-to-income ratio as the dependent variable, normalizing for income scale, and obtained similar results.

ables are robust once resources are held constant. Model-fit patterns reinforce the contrast. Covariates explain only about 2.5–5.4% of the variance in planning dedication but roughly 29–39% for financial assets and about 19–30% for $\ln(W/I)$.

In short, rural households report higher planning dedication, while the apparent deficit in financial assets largely vanishes after accounting for income, overall wealth, and formal savings channels. This motivates the Blinder–Oaxaca decomposition to assess whether observed urban–rural differences arise from endowments or from how endowments translate into planning and asset accumulation.

4.4 Decomposition

4.4.1 Planning dedication

Using the Blinder–Oaxaca decomposition of the planning-dedication index (Table 5), the raw urban–rural difference is small and statistically insignificant (urban – rural = -0.129 , $p = 0.161$). Due to differences in the observed endowments, the explained component is also small and insignificant (0.069 , $p = 0.519$). By contrast, the unexplained component (i.e., differences in coefficients) is negative and marginal (-0.300 , $p = 0.057$). Though only at the 10% level, it suggests that the same characteristics translate into higher planning dedication

among rural households than among otherwise similar urban households. The interaction term is small and insignificant (0.102 , $p = 0.529$).

At the variable level, two patterns stand out. First, given rural returns, urban households’ greater use of internet banking would actually reduce dedication (endowment contribution -0.221 , $p = 0.007$). However, differences in the effects of internet banking and the joint term pull in the opposite direction (coefficient $+0.046$, $p = 0.015$; interaction $+0.253$, $p = 0.006$). Second, higher total assets among urban households modestly widen the urban advantage via endowments ($+0.088$, $p = 0.052$), though coefficient and interaction terms for assets offset this mechanically (-0.388 , $p = 0.251$; -0.060 , $p = 0.258$). Contributions from online shopping, financial knowledge, and bank-account ownership are small and not statistically different from zero.

Taken together, the results indicate that superior endowments do not explain the rural edge in planning dedication. Rather, differences in how characteristics map into dedication play a larger role, albeit with only borderline evidence at the aggregate, unexplained level. In practice, urban households possess stronger structural advantages. Still, these advantages do not translate into planning outcomes as effectively as they do for rural households.

Table 5 Blinder–Oaxaca decomposition of the urban–rural gap in planning dedication

Panel A. Overall decomposition (urban – rural; robust SEs)						
Component	Coefficient	Std. err.	z	p-value		
Urban mean	3.908	0.064	60.77	< 0.001		
Rural mean	4.037	0.065	61.67	< 0.001		
Difference (U – R)	-0.129	0.092	-1.40	0.161		
Explained by endowments	0.069	0.108	0.64	0.519		
Coefficients (unexplained)	-0.300	0.158	-1.90	0.057		
Interaction	0.102	0.163	0.63	0.529		
Panel B. Selected variable-level contributions (contribution to urban – rural gap; robust SEs)						
Variable	Endowments	p	Coefficients	p	Interaction	p
Total assets (log)	0.088	0.052	-0.388	0.251	-0.060	0.258
Internet banking user	-0.221	0.007	0.046	0.015	0.253	0.006
Online shopping	0.141	0.398	0.158	0.339	0.205	0.34
Financial knowledge	0.061	0.139	0.248	0.523	0.04	0.524
Bank account	0.064	0.301	-0.024	0.75	-0.026	0.75

Note: The gap is defined as mean(planning dedication | urban) minus mean(planning dedication | rural); a negative value indicates higher levels of dedication among rural households. Robust standard errors reported.

Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: Authors’ compilation

4.4.2 Financial resources for retirement

The Blinder–Oaxaca decomposition of the urban–rural gap in log financial assets shows a large urban–rural gap of 1.168 log points ($p < 0.001$) (Table 6). This implies urban households hold roughly 3.2 times the financial assets of rural households ($e^{1.168} \approx 3.215$). About three-quarters of this difference is explained by endowments (0.865, $p < 0.001$), with an additional positive interaction (1.026, $p < 0.001$) and a negative coefficient component (-0.722 , $p < 0.001$) that partially offsets the gap.

Composition effects are dominated by income (+0.338*), total assets (+0.267*), and savings-account ownership (+0.156**), which together ac-

count for most of the explained gap. At the returns stage, the income coefficient further widens the gap (+2.191**), while financial-app use narrows it (-0.056^{**}). Interaction terms reinforce these patterns: income (+0.327**), savings-account ownership (+0.242*), and internet use (+0.469*) all add to the urban advantage, whereas financial-app use reduces it (-0.131^{**}). Household size contributes only weakly and mainly through composition (+0.059*).

Overall, the urban lead in financial assets is driven primarily by compositional advantages (i.e., higher income, greater overall wealth, and more formal savings) augmented by differences in how these characteristics translate into asset holdings.

Table 6 Blinder–Oaxaca decomposition of the urban–rural gap in $\ln(\text{financial assets})$

Panel A. Overall decomposition (robust SEs)				
Component	Estimate	Std. err.	z	p-value
Urban mean	2.254	0.147	15.36	< 0.001
Rural mean	1.086	0.093	11.71	< 0.001
Difference (U – R)	1.168	0.174	6.73	< 0.001
Explained by endowments	0.865	0.18	4.8	< 0.001
Coefficients (unexplained)	-0.722	0.186	-3.88	< 0.001
Interaction	1.026	0.229	4.47	< 0.001
Panel B. Selected variable-level contributions to the gap (Urban – Rural)				
Variable	Endowments	Coefficients	Interaction	Note
ln income	+0.338*	+2.191 **	+0.327 **	Income strongly widens the gap via composition and returns.
ln total assets	+0.267*	-0.423	-0.062	Composition widens, returns/interaction offset.
Savings account	+0.156 **	+0.181*	+0.242*	Formal savings strongly widen the gap through all channels.
Internet user	-0.159 **	+0.568*	+0.469*	Rural shortfall in use narrows the gap, but returns and interaction widen it.
Financial-app use	+0.085*	-0.056 **	-0.131 **	Small composition effect; returns/interaction reduce the gap.
Household size	0.059*	-0.166	0.012	Weak, mostly compositional.

Note: The gap is defined as $\text{mean}(\ln(\text{financial assets}) | \text{urban}) - \text{mean}(\ln(\text{financial assets}) | \text{rural})$; a negative value indicates higher $\ln(\text{financial assets})$ among rural households.

Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Share of the gap: Endowments $\approx 74\%$, Coefficients $\approx -62\%$, Interaction $\approx 88\%$ (summing to 100%).

Source: Authors' compilation

4.4.3 Comparative interpretation

Blinder–Oaxaca comparisons point to a sharp divergence across outcomes. For planning dedication, the raw urban–rural difference is small and not significant, and differences in the observed characteristics explain little of the gap. The coefficient component is negative and marginally significant, indicating that the same characteristics tend to be associated with higher dedication in rural areas. Variable-level results show a nuanced role for internet banking. Urban households' greater use would, given rural returns, reduce dedication (negative endowment), while coefficient and interaction terms push in the opposite direction. For financial assets, the urban advantage is large and highly significant, and about three-quarters is explained by endowments. Coefficient differences partly offset the gap overall, although the income coefficient and interaction terms, especially savings accounts and internet use, still add to the urban lead. Taken together, the decompositions show that rural households convert characteristics into planning dedication more effectively. Yet they hold fewer financial assets for retirement planning primarily because they possess fewer asset-enhancing endowments.

5. Conclusion

This study examines an urban–rural paradox: urban households have stronger socio-economic endowments yet do not show greater retirement-planning dedication. Using nationally representative survey data, sequential regressions, and Blinder–Oaxaca decompositions, we analyze a planning-dedication index and log financial assets. We find a large unconditional urban advantage in financial assets, driven mainly by endowments and a positive interaction term (higher income, greater wealth, and more formal savings), partly offset by a negative coefficient component; once these factors are controlled, the rural coefficient becomes statistically insignificant. In contrast, after adjusting for education, income, wealth, financial inclusion, and digital access, rural households exhibit higher planning dedication. For dedication, endowments explain little, while the (negative, marginally significant) coefficient component suggests that the same characteristics translate into greater planning effort in rural areas than in urban areas.

Our findings extend the retirement-planning and financial-inclusion literature. In high-income con-

texts, income, education, formal access, and planning are strongly linked (Ingale & Paluri, 2025), while evidence from developing countries suggests that rural and informal households may plan actively despite limited resources, shaped by informal institutions and local norms (Prasad et al., 2025). Consistent with this, rural households show greater planning dedication after controls, and the Oaxaca decomposition indicates that endowments explain little of the urban–rural gap, whereas the coefficient component is negative and marginally significant. This implies the same characteristics yield more planning dedication in rural areas. For financial assets, endowments dominate: the urban asset advantage is large, with roughly three-quarters explained by higher income, greater wealth, and more formal savings, reinforced by interaction effects (notably savings-account ownership and internet use), while a negative coefficient component partially offsets the gap. The income coefficient contributes positively but only at borderline significance. Overall, the asset gap is primarily compositional rather than preferencedriven (Qian et al., 2024), while rural households appear to translate given characteristics into planning dedication more effectively.

These findings have clear policy implications. The urban–rural financial-asset gap is largely compositional, reflecting higher income, greater wealth, and wider participation in basic savings accounts in cities. Policy should therefore focus on expanding endowments and deepening inclusion: raising earnings, supporting wealth-building, and scaling simple, low-fee accounts that draw households into formal savings. Improving digital rails, such as reliable internet access and easy-to-use banking interfaces, can reinforce these efforts, with the evidence favoring straightforward savings products over complex, feature-heavy apps.

Planning results point to a different lever. After controls, rural households show higher planning dedication, while urban households do not convert stronger resources into stronger planning. In urban areas, low-cost behavioral tools should complement resource provision, including automatic enrollment and escalation in voluntary pension schemes, default saving rules, timely reminders, and goal-based planning interfaces (Nutsbidze & Nutsbidze, 2024). These nudges can be delivered through existing digital touchpoints; for instance, e-commerce engagement is positively associated with planning in our data, even though most fin-

tech indicators are not independently robust. Overall, policy should combine endowment-building and inclusion to narrow the asset gap, especially in rural areas.

While informative, this study has several limitations. First, the rural advantage in planning dedication is driven mainly by coefficient differences that are marginally significant, possibly reflecting unobserved behavioral or institutional factors. Second, the cross-sectional design is descriptive rather than causal, so we cannot assess whether the rural planning advantage persists over time. Finally, external validity is limited because rural–urban institutions, pension systems, and digital infrastructure vary across settings, so replication in other low- and middle-income contexts is needed.

Future research should address several gaps highlighted by our limitations. First, to explain the rural–urban differences in the returns to observed characteristics, studies should incorporate richer measures of preferences and institutions such as social norms, trust, and time preferences, as well as complement survey models with qualitative evidence. Second, longitudinal data are needed to assess whether the rural planning advantage persists over time and to evaluate whether changes in income, wealth, financial inclusion, or digital access translate into subsequent shifts in planning and asset accumulation. Lastly, future work should also mitigate mechanical links between inclusion variables and asset outcomes and replace simple digital-access dummies with indicators of usage intensity and quality.

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THE IMPACT OF ECONOMIC DEVELOPMENT AND INNOVATION POTENTIAL ON ENTREPRENEURIAL ECOSYSTEMS IN THE WESTERN BALKAN AND SCANDINAVIAN COUNTRIES

ABSTRACT

Purpose: Entrepreneurship is a key driver of economic growth and development. This paper examines the interdependence between economic development, innovation, and the growth of entrepreneurial ecosystems in Scandinavian and Western Balkan countries for the year 2024.

Methodology: The study employs standard statistical methods, including correlation analysis, simple and multiple linear regression, followed by a panel data analysis (Fixed and Random Effects models) with a Hausman specification test to validate the robustness of the findings.

Results: Results show that both economic development and innovation positively influence entrepreneurial ecosystems in the cross-sectional analysis. However, panel data analysis indicates that innovation (GII) remains a statistically significant predictor over time, while the effect of GDP per capita becomes less pronounced when innovation is accounted for, suggesting that the relative influence of economic development may be captured through innovation channels in this specific sample. The Random Effects model was validated as the appropriate specification by the Hausman test.

Conclusion: The findings suggest that while economic growth and innovation are jointly linked to ecosystem development, innovation potential shows a more robust statistical association in the observed period. When countries are observed over time, these results should be treated as exploratory, given the specific regional focus and sample size. Policies that strengthen innovation capacity and economic development can effectively foster entrepreneurship, particularly in emerging economies.

Keywords: Entrepreneurial ecosystems, economic development, innovation, Scandinavia, Western Balkans

1. Introduction

The economic growth of countries, especially countries in transition, is related to the development of entrepreneurship. The basic characteristics of entrepreneurs are passion and desire for change, working in conditions of increased uncertainty and risk, willingness to act, creativity, and innovation (Pink, 2011; Ries, 2011). To encourage the development of entrepreneurship, it is necessary to change people's mindsets first. The following limiting factors for startups are commonly discussed: inadequate knowledge, limited access to capital, individual inertia, lack of creativity, and insufficient institutional support, including financial or advisory incentives provided by the state or other organizations (Barringer & Ireland, 2016; Auriol, 2013).

The 21st century is the century of entrepreneurship, bearing in mind that entrepreneurship is the engine of economic growth in countries (Varga, 2021). That is why it is extremely important to encourage the development of entrepreneurship as well as entrepreneurial ecosystems in all countries, especially in countries in transition. Entrepreneurial ecosystems are increasingly attracting attention from theoreticians and practitioners in the field of entrepreneurship and management, as they represent a combination of various actors and environmental factors that influence the development of entrepreneurship within a country or a specific location (Spilling, 1996).

Considering the importance of entrepreneurial ecosystems, it is essential to differentiate the stages of their development across countries. Entrepreneurial ecosystems typically evolve through four phases: the initial phase, the growth phase, the maturity phase, and the diversification/globalization phase (Stam, 2015). Based on this categorization, the Scandinavian countries in the sample fall within the maturity and diversification/globalization stages, or are positioned between these stages, indicating a highly developed entrepreneurial ecosystem. In contrast, the entrepreneurial ecosystems of the Western Balkan countries range from the initial to the growth phase—Albania and Bosnia and Herzegovina are positioned between the initial and growth stages, while Serbia and North Macedonia are in the growth phase (Deutsche Gesellschaft für Internationale Zusammenarbeit, 2021). Consequently, the countries included in this sample represent substantially different levels of entre-

preneurial ecosystem development. This sampling strategy also ensures the inclusion of Western Balkan countries, which belong to the upper-middle-income group, as well as Scandinavian countries, which are classified as high-income economies.

The aim of this paper is to examine the interdependence between economic development, innovation, and the growth of entrepreneurial ecosystems using the example of Scandinavian and Western Balkan countries. To achieve this, the paper first provides a theoretical overview of key concepts related to entrepreneurial ecosystems. Empirically, different analytical procedures are applied depending on the hypothesis. For the first two hypotheses, statistical analysis is conducted using 2024 cross-sectional data, including correlation analysis and simple linear regression. For the third hypothesis, which investigates the joint effect of economic development and innovation on ecosystem performance, both multiple linear regression for 2024 and panel analysis for the period 2020–2024 were conducted, enabling a more comprehensive assessment of their combined and dynamic influence.

The paper is structured as follows. The next section provides an overview of the relevant theoretical background and previous empirical findings related to entrepreneurial ecosystems. The third section presents the research methodology, including the sample, variables, and applied statistical techniques. The fourth section reports the empirical results, followed by a discussion of the findings in relation to the existing literature. Finally, the last section outlines the main conclusions, practical implications, limitations of the study, and directions for future research.

2. Literature review

An entrepreneurial ecosystem is a complex entity that consists of many different actors that cooperate with each other to realize both their own and common interests of the ecosystem (Stam & Van de Ven, 2021). For example, if one considers a startup that begins business in a certain place, an entrepreneur who is the owner of that business should develop cooperative relations with various actors to successfully run their firm. The entrepreneur establishes cooperative relations with suppliers, distributors, as well as customers, to take a position in the market and gain market share. All the above actors play important roles in the entrepreneurial

ecosystem (Raut et al., 2022). Therefore, the entrepreneurial ecosystem consists of many different actors, who play different roles in the ecosystem, as well as environmental factors that interact and thus determine the entrepreneurial success of a region or locality (Spilling, 1996).

There are many definitions of entrepreneurial ecosystems. An entrepreneurial ecosystem is a complex set of economic, social, and institutional factors that interactively influence the creation, finding, and exploitation of entrepreneurial opportunities (Qian, 2012). One of the well-known definitions of entrepreneurial ecosystems is the one that starts from the entrepreneur and sees the entrepreneurial ecosystem as a set of interconnected entrepreneurs, entrepreneurial organizations, institutions, and entrepreneurial processes that formally and informally connect, mediate and manage performance in the local entrepreneurial environment (Mason & Brown, 2014). Since 2018, the definition of entrepreneurial ecosystems has been upgraded with the Ecosystem Quality Composite Index [ESI], which is an indicator of the success of the business of each ecosystem (Global Entrepreneurship Monitor, 2018).

If the entrepreneurial ecosystem is observed in relation to ecosystems in nature, it can be said that the entrepreneurial ecosystem is a sum of biotic components (the individual) and abiotic components (the institutional environment) (Stam & Spigel, 2017; Torres & Godinho, 2022). The biotic component refer to system conditions that are made up of leadership, finances, a network of entrepreneurs, talent, skills, knowledge, support, and others, while the abiotic component, i.e., framework conditions, are made up of the social context or factors that affect the business of the ecosystem (Ivanović-Đukić & Radosavljević, 2020). It is emphasized that entrepreneurial ecosystems can be innovative, fast-growing, and internal ecosystems of company employees (corporate entrepreneurship) (Levi Jakšić et al., 2018). The results of the existence of such an entrepreneurial ecosystem are reflected in the growth of productivity, income, employment, and well-being in an economy. The entrepreneurial ecosystem consists of many different elements, which Isenberg, for clarity, grouped into six domains: culture, politics, finance, human capital, market, and institutional and infrastructural support (Isenberg, 2021). In the past, numerous upgrades were made to Isenberg's initial model of the entrepreneurial

ecosystem, but one should accept the fact that it is not enough to just know the elements of an entrepreneurial ecosystem in order to understand how it works; it is also necessary to understand how the various elements are interconnected and how they function together.

3. Methodology

Bearing in mind the above theoretical considerations, the authors will try to prove the following three hypotheses:

H1: The economic development of a country has a statistically significant impact on the development of its entrepreneurial ecosystem.

H2: The innovative potential of a country has a statistically significant impact on the development of its entrepreneurial ecosystem.

H3: The economic development of a country and its innovative potential together influence the development of its entrepreneurial ecosystem.

In accordance with the defined aim of the research and the hypotheses, appropriate theoretical and empirical research methods were used. For the first two hypotheses, correlation analysis and simple linear regression using 2024 cross-sectional data were applied. For the third hypothesis, which examines the joint influence of economic development and innovation, both multiple linear regression for 2024 and panel analysis covering the period 2020–2024 were employed to capture the combined and dynamic effects on the entrepreneurial ecosystem. The potential for endogeneity in the relationship between innovation and entrepreneurial ecosystems is acknowledged. While the current specification treats innovation potential (GII) and economic development (GDP) as independent variables, it is recognized that a highly developed entrepreneurial ecosystem may reciprocally drive innovation and growth. Given the exploratory nature of this study, the analysis focuses on these structural drivers, while noting this bi-directional causality as a limitation for future research.

3.1 Sample and context of research

As the research sample, the authors selected for the development of entrepreneurial ecosystems of the Western Balkan and Scandinavian countries. The group encompassing Western Balkan countries consists of the following countries: Serbia, North

Macedonia, Montenegro, Bosnia and Herzegovina, and Albania, while the group of Scandinavian countries consists of: Norway, Finland, Denmark, and Sweden. The main reasons for analyzing the entrepreneurial ecosystems of Scandinavian countries and those of the Western Balkans lie in the differences in income levels, cultural mindset, and other contextual factors, such as institutional quality, innovation capacity, governance systems, digital readiness, and societal trust. These differences provide a useful basis for examining how economic development and local environmental factors influence entrepreneurial ecosystems. As highly developed economies, Scandinavian countries have leveraged their global market positions to foster entrepreneurship and create well-established entrepreneurial ecosystems, where support structures play a key role in realizing innovative ideas. Moreover, developed countries like the Scandinavian states serve as an inspiration for entrepreneurs in the Western Balkans (Peráček et al., 2020).

Cultural factors play a crucial role in shaping the entrepreneurial atmosphere and mindset, which is important for creating a stimulating environment for business development. These factors are best defined and measured through Hofstede's index,

which identifies six dimensions of culture: range of power, collectivism vs. individualism, masculine vs. feminine traits (motivation to achieve and succeed), avoidance of uncertainty and risk, long-term vs. short-term orientation, and indulgence (forgiveness, tolerance) (Hofstede & Minkov, 2010).

Table 1 shows two contrasting situations. Scandinavian countries are characterized by a smaller range of power. Instead of authoritative managerial behavior, cooperation between different hierarchical levels is valued, accompanied by informal relations and direct communication. In contrast, the Western Balkan countries exhibit opposite values in terms of these cultural dimensions.

The third column in the table—Motivation for Achievement and Success, formerly referred to as Masculinity and Femininity—reflects the drive of men and women to succeed in business. A typical example is Albania, which scores 80 on this dimension, making it a clearly “masculine” country, whereas Scandinavian countries are generally considered “feminine” according to this indicator. Other Western Balkan countries fall in the middle, gradually moving toward the cultural values characteristic of the Scandinavian countries.

Table 1 Hofstede's index: Country comparison

Country	Power distance	Individualism	Motivation toward Achievements and Success	Uncertainty Avoidance	Long Term Orientation	Indulgence
Sweden	31	71	5	29	53	78
Norway	18	74	16	23	35	70
Denmark	31	69	8	50	35	55
Finland	31	71	5	29	53	78
Serbia	86	25	43	92	52	28
North Macedonia	90	22	45	87	62	35
Albania	90	20	80	70	61	15
Montenegro	88	24	48	90	75	20
Bosnia & Herzegovina	90	22	48	87	70	44

Source: The Culture Factor Group

The data given in the table provide a good basis for the assumption that differences in cultural factors can lead to differences in the understanding of entrepreneurship and the environmental atmosphere

and conditions for the development of entrepreneurship between Scandinavian and Western Balkan countries.

Given the focus on two specific regions—the Western Balkans and Scandinavia—the sample size is constrained to $N = 8$ countries. While this provides a targeted comparative perspective, it limits the inferential power of the statistical tests. Consequently, the findings are presented as exploratory insights into these specific regional dynamics rather than universal confirmations.

3.2 Data and variables

In this research, the Global Innovation Index (GII) and the Global Startup Ecosystem Index (GSEI)

are utilized as primary metrics for innovation and ecosystem quality. Although the GII and the GSEI share certain structural components, such as human capital and infrastructure, they serve distinct analytical purposes. The GII is primarily focused on innovation inputs and outputs, whereas the GSEI targets the operational quality and density of the startup environment. This conceptual distinction justifies their inclusion as separate indicators in the empirical analysis, acknowledging that the observed effects reflect substantive ecosystem dynamics rather than a mere index overlap.

Table 2 Conceptual mapping of GII and GSEI components

Dimension / Component	Global Innovation Index (GII)	Global Startup Ecosystem Index (GSEI)
Primary Focus	National innovation capacity, inputs, and outputs across all sectors.	Operational quality, density, and performance of the startup community.
Human Capital	Education system, R&D researchers, tertiary enrollment, and PISA scales.	Founder quality, availability of tech talent, number of startup events/meetups.
Infrastructure	ICT access, general infrastructure (electricity, logistics), ecological sustainability.	Internet speed, availability of coworking spaces, incubators, and tech hubs.
Market & Finance	Credit availability, investment levels, market diversification, and scale.	Presence of VC funds, number of unicorns, specific startup investment rounds (Seed, Series A).
Institutions	Political stability, regulatory quality, ease of starting a general business.	Specific startup incentives, digital nomad visa regimes, government support for tech.
Knowledge Outputs	Patents, scientific publications, high-tech exports, software spending.	Successful exits (M&A, IPOs), number of active startups, global influence of local startups.

Source: Stam, 2015; StartupBlink, 2024; World Intellectual Property Organization [WIPO], 2024

To address concerns about mechanical correlation between the GII and the GSEI, a conceptual mapping of their components was conducted (Table 2). While both indices share foundational pillars like infrastructure and human capital, the GII captures broad innovation inputs, whereas the GSEI emphasizes the operational outcomes of the startup sector. Statistical diagnostics using Variance Inflation Factors ($VIF = 3.437$) further confirm that the correlation between these indices remains within acceptable limits for multivariate analysis, supporting the conclusion that the GII effect reflects a substantive causal link rather than a mere index construction overlap.

The empirical framework acknowledges potential endogeneity issues, particularly reverse causality, where mature entrepreneurial ecosystems may themselves drive further innovation and GDP growth. While instrumental variables or lagged re-

gressors are common treatments for endogeneity, the limited sample size and time horizon ($T = 5$) of this study necessitate a contemporaneous specification to preserve statistical power. Consequently, the results are presented as exploratory correlations that highlight the structural alignment of these variables rather than unidirectional causal certainties.

3.3 Entrepreneurial ecosystems of the Scandinavian countries

When it comes to the development of entrepreneurial ecosystems in individual Scandinavian countries, the analysis yielded the following results.

Sweden has one of the most developed entrepreneurial ecosystems in the world. In 2024, Sweden was ranked 6th on the StartupBlink list, which represents a drop of one position compared to 2023, when it was ranked 5th. If we look at the European

Union, Sweden ranked 2nd in 2024, the same as in 2023 (StartupBlink, 2024). GDP per capita in Sweden in 2024 amounted to 57,723.2 US dollars (World Bank, 2025a), which classified Sweden as a high-income country. Sweden's GDP for the year 2024 was USD 610,117.79 million (World Bank, 2025b). The World Intellectual Property Organization (WIPO) ranked Sweden second in the world in 2024, indicating that it is a country with high innovation potential (WIPO, 2024). In 2024, Sweden had as many as 12 cities ranked in the top 1,000 cities classified as centers of entrepreneurial ecosystems in the world (StartupBlink, 2024).

According to the same sources, Norway is an innovative country with a developed entrepreneurial ecosystem. In 2024, Norway was ranked 25th on the StartupBlink list, which represents a decline of two positions compared to 2023. Norway was the lowest-ranked Scandinavian country in 2024, ranking 14th in Europe (StartupBlink, 2024). GDP per capita was USD 86,809.7 (World Bank, 2025a), which places both Norway and Sweden in the group of countries with high incomes according to the criteria of the World Bank for the year 2024. Norway's total GDP for the year 2024 was USD 483,727.40 million (World Bank, 2025b). WIPO ranked Norway 21st in the world in 2024, which means that it is a country with great innovation potential (WIPO, 2024). As for the cities ranked in the top 1,000 in 2024, Norway had 8 cities classified as centers of entrepreneurial ecosystems (StartupBlink, 2024).

According to StartupBlink, Denmark was ranked 18th in the world in 2024, marking an increase of one position compared to 2023 (StartupBlink, 2024). GDP per capita was USD 71,851.8, which, just like the previous Scandinavian countries, placed Denmark in the group of countries with high incomes (World Bank, 2025a). Denmark's total GDP was USD 429,457.37 million in 2024 (World Bank, 2025b). According to the Global Innovation Index, Denmark ranked 10th in the world in 2024, placing it, like the previous two countries, among innovative nations (WIPO, 2024). Unlike the previous two Scandinavian countries, in 2024, Denmark had only 6 cities ranked in the top 1,000 in the world in terms of the development of entrepreneurial ecosystems (StartupBlink, 2024).

Finland was ranked 14th in StartupBlink's 2024 ranking, which is a decrease of one position compared to 2023. In the same year, Finland was ranked 8th among the entrepreneurial ecosystems in Eu-

rope (StartupBlink, 2024). Finland's GDP per capita in 2024 was USD 53,188.6, which means that the World Bank criteria were also met in this case, so Finland was classified as a high-income country (World Bank, 2025a). Finland's total GDP in 2024 was USD 299,835.63 million (World Bank, 2025b). It is a country that is extremely prone to innovation, which is confirmed by the ranking on the WIPO list; in 2024, Finland ranked 7th (WIPO, 2024). Finland, like other Scandinavian countries, had multiple cities ranked among the top 1,000. It had as many as 8 cities with entrepreneurial ecosystems ranked among the top 1,000 in the world (StartupBlink, 2024).

3.4 Entrepreneurial ecosystems of the Western Balkan countries

When it comes to the development of entrepreneurial ecosystems in the countries of the Western Balkans, the analysis yielded the following results.

According to StartupBlink data, Serbia ranked 53rd in 2024, with a total score of 3.195, representing a decline of two positions compared to 2023. This decline refers to the decline of all three individual scores: the quantitative, the qualitative, and the business environment score. Serbia, like other Western Balkan countries, is not a member of the European Union, but it is the first among the Western Balkan countries in terms of the development of entrepreneurial ecosystems. As for Europe, Serbia ranked 33rd in 2024, representing a decline of one position compared to 2023 (StartupBlink, 2024). According to the World Bank criteria regarding the level of income, Serbia, like other Western Balkan countries, is among upper-middle-income countries. Accordingly, Serbia's GDP per capita in 2024 was USD 13,523.7 (World Bank, 2025a). Serbia's total GDP in 2024 was USD 89,083.51 million (World Bank, 2025b). Although Serbia is not at the very top of the ranking published by WIPO, its position and score place it among countries with high innovative potential. In 2024, Serbia was in 52nd place in this ranking, with a score of 32.3 out of a maximum of 100 (WIPO, 2024). The centers of entrepreneurial ecosystems in Serbia in 2024 were Belgrade, Novi Sad, and Niš, as in 2023 and 2022. However, in 2021, following the COVID-19 pandemic, Niš was not among the cities with entrepreneurial ecosystems ranked in the top 1,000 in the world. The IT sector in Serbia is a significant driver of economic development in this country and this region, as many entrepreneurs in Serbia develop IT

solutions for foreign companies. The increasingly popular blockchain technology, IT, electronic commerce, and the like are leading sectors in Serbia's entrepreneurship (StartupBlink, 2024).

North Macedonia is the second country in the Western Balkans in terms of the development of entrepreneurial ecosystems. In 2024, North Macedonia ranked 77th on the StartupBlink list, representing a decline of seven positions compared to 2023. As for the ranking in Europe, North Macedonia ranked 40th in 2024 (StartupBlink, 2024). As for economic development in 2024, North Macedonia's GDP per capita was USD 9,310.0, which means that, according to the World Bank criteria, North Macedonia belonged to the group of upper-middle-income countries (World Bank, 2025a). For the year 2024, North Macedonia's GDP amounted to USD 16,685.24 million (World Bank, 2025b). According to the World Intellectual Property Organization, North Macedonia, like Serbia, belongs to the group of countries with potential for entrepreneurial development, based on the Global Innovation Index. According to the ranking of this organization, North Macedonia ranked 58th in 2024, with a total score of 29.9 (WIPO, 2024). As for the centers of entrepreneurial ecosystems in 2024, Skopje was only center in North Macedonia ranked in the top 1,000 in the world according to the total score. Most startups in North Macedonia are in the early development phase, while most entrepreneurs work for global companies in the ICT industry (StartupBlink, 2024).

Albania is a Western Balkan country ranked 72nd on the StartupBlink list in 2024, marking an increase of two positions compared to 2023. As for Europe, Albania ranked 39th in 2024 (StartupBlink, 2024). Albania's GDP per capita in 2024 amounted to USD 10,011.6, placing it among the upper-middle-income countries according to the World Bank criteria (World Bank, 2025a). Albania's total GDP in 2024 was USD 27,177.74 million (World Bank, 2025b). WIPO ranked Albania 84th in 2024, with the Global Innovation Index of 24.5 (WIPO, 2024). Tirana is the only center of entrepreneurial ecosystems in Albania ranked in the top 1,000 in the world in 2024. The Albanian entrepreneurial ecosystem is characterized by a large number of young people with advanced ICT skills who have already participated in projects such as Gjirafa (StartupBlink, 2024).

Montenegro is a small country in the Western Balkans that has great innovation potential, but it is

not ranked on the StartupBlink lists. Montenegro's GDP per capita in 2024 was USD 12,935.5, which ranks it among upper-middle-income countries (World Bank, 2025a). Montenegro's total GDP amounted to USD 8,069.54 million in 2024 (World Bank, 2025b). This means that, relative to population size, Montenegro is the most developed among the observed countries of the Western Balkans. On the other hand, the World Intellectual Property Organization ranked Montenegro 65th in the world in 2024 according to Montenegro's Global Innovation Index score of 28.9 (WIPO, 2024). These indicators show that Montenegro has strong innovative potential and the possibility of developing its economy in a short period of time and transitioning to the group of high-income countries, according to the World Bank criteria.

Bosnia and Herzegovina is the last country in the observed Western Balkan group. In 2024, Bosnia and Herzegovina ranked 96th on the StartupBlink list, marking an improvement of four positions compared to 2023. As for Europe, Bosnia and Herzegovina ranked 44th in 2024, marking an improvement of one position compared to 2023 (StartupBlink, 2024). In 2024, the World Bank ranked Bosnia and Herzegovina among upper-middle-income countries. Bosnia and Herzegovina's GDP per capita in 2024 was USD 8,957.4 (World Bank, 2025a). Bosnia and Herzegovina's total GDP in 2024 was USD 28,343.39 million (World Bank, 2025b). In terms of innovation, the World Intellectual Property Organization ranked Bosnia and Herzegovina 80th, with an overall score of 25.5 (WIPO, 2024). The only city in Bosnia and Herzegovina with an entrepreneurial ecosystem ranked in the top 1,000 in the world is Sarajevo. The main factor contributing to this negative trend is the unstable and unsupportive environment caused by the country's uncertain geopolitical situation (StartupBlink, 2024).

4. Results

The analysis focuses on four countries in the Western Balkans for which all necessary indicators are available: the Republic of Serbia, Albania, North Macedonia, and Bosnia and Herzegovina, as well as four Scandinavian countries: Norway, Denmark, Sweden, and Finland. Due to a lack of data, Montenegro was not included in the further analysis. For the purposes of statistical analysis, secondary data were used (Table 3), which were processed using the SPSS software package. The dependent variable is the total score of the StartupBlink index (Glob-

al Startup Ecosystem Index [GSEI, 2024]), which shows the development of the entrepreneurial ecosystem in each of the analyzed countries. The independent variables are GDP per capita [GDP per

capita] as an indicator of the economic development of a country and the total score of the Global Innovation Index [GII], which shows the innovative potential of each of the analyzed countries.

Table 3 Global Startup Ecosystem Index, GDP per capita in US\$ and Global Innovation Index for observed countries (2024)

Country	Global Startup Ecosystem Index (2024)				GDP per capita in US\$ (2024)	Global Innovation Index (2024)
	World Rank	European Rank	Score	Number of cities		
Sweden	6		27.024	12	57,723.2	64.5
Norway	25		11.694	8	86,809.7	49.1
Denmark	18		15.823	6	71,851.8	57.1
Finland	14		18.147	8	53,188.6	59.4
Serbia	53		3.195	3	13,523.7	32.3
North Macedonia	77		0.850	1	9,310.0	29.9
Albania	72		0.970	1	12,935.5	24.5
Montenegro	-	-	-	-	10,011.6	28.9
Bosnia and Herzegovina	96		0.454	1	8,957.4	25.5

Source: StartupBlink, 2024; World Bank, 2025a; WIPO, 2024

To assess the impact of a country's economic development on the development of its entrepreneurial ecosystem, correlation analysis and simple linear regression will be used. The same statistical methods will be used to assess the impact of a country's innovative potential on the development

of its entrepreneurial ecosystem. The joint impact of economic development and innovative potential on the entrepreneurial ecosystem will be assessed using multiple regression analysis. Prior to this, it will be tested whether the given sample satisfies the assumption of normality (Table 4).

Table 4 Normality tests

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
GSEI	.245	8	.171	.872	8	.159
GDPperCAPITA	.286	8	.053	.835	8	.067
GII	.238	8	.200*	.868	8	.146

^a Lilliefors Significance Correction

* This is a lower bound of the true significance level.

Source: Authors' calculations using SPSS software

Considering the sample size, the Shapiro-Wilk test was used instead of the KolmogorovSmirnov test. Since the significance values for these variables are greater than Sig. > 0.05, it is concluded that the sample is normally distributed.

The next step is correlation analysis. A pronounced correlation between these variables with adequate statistical significance provides the basis for testing the hypotheses using regression analysis methods.

Table 5 Nonparametric correlations

			GSEI	GDPperCAPITA	GII
Spearman's rho	GSEI	Correlation Coefficient	1.000	.786*	.929**
		Sig. (2-tailed)		.021	.001
		N	8	8	8
	GDPperCAPITA	Correlation Coefficient	.786*	1.000	.767*
		Sig. (2-tailed)	.021		.016
		N	8	9	9
	GII	Correlation Coefficient	.929**	.767*	1.000
		Sig. (2-tailed)	.001	.016	
		N	8	9	9

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' calculations using SPSS software

Table 5 shows a strong positive correlation between all observed variables, with statistical significance for each variable. Further analysis involves determining linear regression coefficients for each hypothesis individually.

Spearman's correlation coefficient *rho* shows that there is a strong positive correlation $r = 0.786$ between a country's economic development, expressed by GDP per capita, and the development of

entrepreneurial ecosystems, measured by the Global Startup Ecosystem Index, with statistical significance $\text{Sig.} = 0.021$. The coefficient of determination ($R^2 = 0.6177$) indicates that a country's development economic explains as much as 61.77% of the variance in the development of its entrepreneurial ecosystem. This statistical model is significant at the $\text{Sig.} < 0.05$ level ($F = 8.223$, $\text{Sig.} = 0.029$; Table 6).

Table 6 Linear regression model (Model 1)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	401.962	1	401.962	8.223	.029 ^a
	Residual	293.278	6	48.880		
	Total	695.240	7			

a. Predictors: (Constant), GDPperCAPITA

b. Dependent Variable: GSEI

Coefficients^a

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(1) Constant	.567	4.051		.140	.893
GDPperCAPITA	.000236	.000	.760	2.868	.029

a: Dependent Variable: GSEI

Source: Authors' calculations using SPSS software

To examine the relevance of the regression model for these variables, further analysis is based on the formula:

$$y_i = b_0 + b_1x_1 + \varepsilon_i,$$

where y is the dependent variable (in this case, it is the Global Startup Ecosystem Index), and x is the independent variable (in this case, it is GDP per capita). In this case, the regression model formula is as follows:

$$GSEI = 0.567 + 0.000236 * GDPperCAPITA.$$

The slope coefficient $b_1 = 0.000236$ shows that an increase in GDP per capita by 1 US dollar causes an average increase in the GSEI by 0.000236. The representativeness of this model can be measured

using the coefficient of determination $R^2 = 0.6177$, which indicates that 61.77% of the variance in the GSEI score can be explained by variations in GDP per capita.

As for the second hypothesis, Spearman's ρ coefficient shows an extremely strong correlation between the innovativeness of an economy and the development of entrepreneurial ecosystems ($r = 0.929$; Sig. = 0.001). The coefficient of determination in this case is $R^2 = 0.8630$, which means that a country's propensity for innovation explains as much as 86.30% of the variance in the development of the entrepreneurial ecosystem. This model is statistically significant at the Sig. < 0.05 level ($F = 105.683$, Sig. = 0.00; Table 7).

Table 7 Linear regression model (Model 2)

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	657.889	1	657.889	105.683	.000 ^a
	Residual	37.351	6	6.225		
	Total	695.240	7			
a. Predictors: (Constant), GII b. Dependent Variable: GSEI						

Coefficients^a

Model 2	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(2) Constant	-15.398	2.602		-5.917	.001
GII	.588	.057	.973	10.280	.000
a: Dependent Variable: GSEI					

Source: Authors' calculations using SPSS software

To examine the relevance of the regression model for these variables and in the second model, the following formula is used:

$$y_i = b_0 + b_1x_1 + \varepsilon_i,$$

where y is the dependent variable (in this case, it is the Global Startup Ecosystem Index), and x is the independent variable (in this case, it is the Global Innovation Index). In this case, the regression model formula is as follows:

$$GSEI = -15.398 + 0.588 * GII.$$

The slope coefficient $b_1 = 0.588$ shows that an increase in the Global Innovation Index by one US

dollar causes an average increase in the Global Startup Ecosystem Index by 0.588. The representativeness of this model can be measured using the coefficient of determination $R^2 = 0.8630$, which indicates that 86.30% of the variance of the GSEI score can be explained by variations in the GII.

In the multiple regression model including a country's economic development and innovative potential, the adjusted coefficient of determination is Adj. $R^2 = 0.941$. This indicates that the model explains 94.1% of the variance in the development of the entrepreneurial ecosystem. The regression model is statistically significant at the level of Sig. ≤ 0.05 ($F = 57.218$; Sig. = 0.000; Table 8).

Table 8 Multiple regression model (Model 3)

ANOVA^b

Model 3	Sum of Squares	Df	Mean Square	F	Sig.
(3) Regression	666.135	2	333.068	57.218	.000 ^a
Residual	29.105	5	5.821		
Total	695.240	7			

a. Predictors: (Constant), GDPperCAPITA, GII
b. Dependent Variable: GSEI

Coefficients^a

Model 3		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-17.353	3.005		-5.775	.002		
	GII	.691	.103	1.143	6.737	.001	.291	3.437
	GDPperCAPITA	.00006	.000	-.202	-1.190	.287	.291	3.437

a. Dependent Variable: GSEI

Collinearity Diagnostics^a

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	GII	GDPperCAPITA
1	1	2.770	1.000	.01	.00	.01
	2	.209	3.645	.18	.00	.28
	3	.022	11.336	.81	1.00	.71

a. Dependent Variable: GSEI

Source: Authors' calculations using SPSS software

As shown in the Coefficients section of Table 7, within the multiple regression model only the Global Innovation Index (GII) is statistically significant (Sig = 0.01 < 0.05). Given that this is a multiple regression model, multicollinearity was examined using the Tolerance and VIF values. Since Tolerance > 0.1 and VIF < 10, it can be concluded that the model satisfies the collinearity criteria. Multicollinearity was formally assessed using Variance Inflation Factor (VIF) diagnostics. As presented in Table 8, the VIF values for both innovation potential (GII) and economic development (GDP per capita) are **3.437**. Since these values are well below the conservative threshold of 5 (and the standard limit of 10), it is concluded that multicollinearity does not significantly distort the regression coefficients. This further suggests that the observed loss of statistical significance of GDP per capita in the multivariate

setting is not a statistical artifact of multicollinearity, but rather indicates that its influence is mediated through innovation channels.

To further validate these results, a panel analysis (2020–2024) was conducted using fixed effects (Table 9) and random effects (Table 10) models. Consistent with the SPSS findings, only the GII demonstrated statistical significance in the random effects model (Table 10), while GDP per capita remained insignificant. The Hausman test ($\chi^2 = 4.27$; $p = 0.118$) confirmed that the RE model is the appropriate specification, reinforcing the conclusion that innovative potential is the key factor influencing the entrepreneurial ecosystem (Table 11).

Table 9 Fixed effects (within) regression model

Fixed effects (within) regression Group variable: Country_id			Number of obs = 40 Number of groups = 8			
R-squared: • Within = 0.0798 • Between = 0.7472 • Overall = 0.6334			Obs per group: • min = 5 • avg = 5.0 • max = 5			
corr(u _i , X _b) = -0.6358			F (2,30) = 1.30 Prob > F = 0.2870			
GSEI	Coefficient	Std. err.	t	P > t	[95% conf. interval]	
GDP_PC	.0001678	.0001145	1.46	0.153	-.0000661	.0004016
GII	.3278179	.4248047	0.77	0.446	-.5397491	1.195385
_cons	-12.58676	19.23873	-0.65	0.518	-51.87749	26.70397
sigma_u	5.1319919					
sigma_e	3.6600242					
rho	.66285613 (fraction of variance due to u _i)					
F test that all u _i =0: F (7, 30) = 1.92			Prob > F = 0.1012			

Source: Authors' calculations using STATA software

Table 10 Random effects GLS regression model

Random effects GLS regression Group variable: Country_id			Number of obs = 40 Number of groups = 8			
R-squared: • Within = 0.0035 • Between = 0.9372 • Overall = 0.7746			Obs per group: • min = 5 • avg = 5.0 • max = 5			
corr(u _i , X) = 0 (assumed)			Wald chi ² (2) = 79.34 Prob > chi ² = 0.0000			
GSEI	Coefficients	Std. err.	z	P > z	[95% conf. interval]	
GDP_PC	-.0000337	.000043	-0.78	0.434	-.000118	.0000506
GII	.5483133	.0936845	5.85	0.000	.364695	.7319316
_cons	-14.64832	3.035885	-4.83	0.000	-20.59854	-8.698089
sigma_u	1.4411041					
sigma_e	3.6600242					
rho	.13422351 (fraction of variance due to u _i)					

Source: Authors' calculations using STATA software

Table 11 Hausman FE/RE model

	Coefficients		(b-B)	Sqrt(diag(V _{b-V_B}))
	(b)	(B)		
	FE	RE	Difference	Std. err.
GDP_PC	.0001678	-.0000337	.0002014	.0001061
GII	.3278179	.5483133	-.2204953	.4143456
b = Consistent under H ₀ and H _a ; obtained from xtreg. B = Inconsistent under H _a , efficient under H ₀ ; obtained from xtreg.				
Test of H ₀ : Difference in coefficients not systematic				
chi ² (2) = (b-B)'[(V _{b-V_B}) ⁻¹](b-B) = 4.27 Prob > chi ² = 0.1180				

Source: Authors' calculations using STATA software

The Hausman test suggested the appropriateness of the random effects model; however, the limited power of this test in small samples (N = 8) is acknowledged. Furthermore, time fixed effects were omitted from the final specification to preserve degrees of freedom, though it is recognized that global shocks during the observed period (2020–2024), such as the postpandemic recovery and inflation, may influence the observed dynamics.

Additionally, a Bayesian linear regression was conducted to validate the stability of the coefficients (Table 12). The analysis yielded a posterior mean of **0.582** for the GII, with a 95% credible interval of **[0.421, 0.745]**, confirming that the innovative potential remains a significant and robust predictor. The Bayesian results align with the frequentist OLS estimates, reinforcing the reliability of the findings in an exploratory context.

Table 12 Bayesian linear regression estimates (robustness check)

Likelihood: GSEI ~ regress(xb_GSEI,{sigma2})						
Priors: {GSEI:GII GDP_PC_cons} ~ normal(0,10000) (1) {sigma2} ~ igamma(.01,.01)						
(1) Parameters are elements of the linear form xb_GSEI. Bayesian linear regression Random-walk Metropolis–Hastings sampling			MCMC iterations = 12,500 Burn-in = 2,500 MCMC sample size = 10,000 Number of obs = 40 Acceptance rate = .3861 Efficiency: min = .05375 avg = .07574 max = .1227			
Log marginal likelihood = -142.82917						
	Mean	Std. dev.	MCSe	Median	Equal-tailed [95% cred. interval]	
GSEI						
GII	.5822768	.0824278	.003556	.5804204	.4206201	.7446897
GDP_PC	-.0000517	.0000379	1.6e-06	-.0000505	-.0001282	.0000205
_cons	-15.44989	2.597558	.096671	-15.44672	-20.66569	-10.39068
sigma2	16.58608	4.116725	.117539	15.96389	10.35194	26.46879

Source: Authors' calculations using STATA software

Based on the comprehensive analysis, it can be concluded that there is a strong, statistically significant positive correlation between economic development and entrepreneurial ecosystems. Therefore, *the first hypothesis is confirmed*, which states that *a country's economic development significantly affects the development of its entrepreneurial ecosystem*.

There is also a statistically significant positive correlation between the innovative activity of a country measured by the Global Innovation Index and the score of entrepreneurial ecosystems. Therefore, *the second hypothesis is confirmed*, and it can be concluded that *the innovative activity of the observed countries has a statistically significant impact on the development of their entrepreneurial ecosystems*.

Finally, regarding the third hypothesis, the results indicate that when a country's economic develop-

ment and innovative potential are examined jointly, only the innovative potential (GII) has a statistically significant impact on the Global Startup Ecosystem Index (GSEI). The effect of economic development (GDP per capita) is not statistically significant in either the multiple regression model or the panel analysis. Therefore, Hypothesis 3 is **partially confirmed**: although both variables contribute to the overall model, only innovative potential exhibits a significant individual effect on the development of the entrepreneurial ecosystem.

5. Discussion

The results of the analysis provide important insights into the factors influencing the development of entrepreneurial ecosystems in the selected countries. The study shows that both economic develop-

ment, measured by GDP per capita, and innovative potential, measured by the Global Innovation Index (GII), are strongly correlated with the development of entrepreneurial ecosystems, as reflected by the Global Startup Ecosystem Index (GSEI).

The first model indicates a significant positive relationship between GDP per capita and the GSEI ($r = 0.786$; $\text{Sig.} = 0.021$), with an R^2 of 0.6177. This suggests that a country's economic development explains approximately 61.77% of the variance in its entrepreneurial ecosystem development. This confirms the first hypothesis, emphasizing that higher economic development provides resources and infrastructure that facilitate entrepreneurship. However, the slope coefficient ($b_1 = 0.000236$) indicates that the impact of a one-dollar increase in GDP per capita on the GSEI is relatively small, implying that economic growth alone may not be sufficient to substantially enhance entrepreneurial ecosystems.

The second model shows an even stronger positive correlation between the Global Innovation Index and the GSEI ($r = 0.929$; $\text{Sig.} = 0.001$), with an R^2 of 0.8630. This means that innovative potential explains 86.30% of the variance in entrepreneurial ecosystem development. The slope coefficient ($b_1 = 0.588$) demonstrates that increases in innovation capacity have a much larger effect on entrepreneurial ecosystems compared to equivalent changes in GDP per capita. Consequently, the second hypothesis is confirmed, highlighting that innovation is a critical driver of entrepreneurial ecosystem development in both Western Balkan and Scandinavian countries.

The multiple regression model (Model 3), which combines GDP per capita and the GII, shows an adjusted R^2 of 0.941, indicating that these variables together explain 94.1% of the variance in entrepreneurial ecosystem development. However, only the Global Innovation Index retains statistical significance in the joint model ($\text{Sig.} = 0.001$), while GDP per capita remains nonsignificant ($\text{Sig.} = 0.287$). This finding suggests that, although economic development is correlated with entrepreneurial ecosystem performance in isolation, its effect is largely overshadowed by a country's innovative potential when both factors are considered simultaneously. Therefore, the third hypothesis, which assumed a joint significant impact of both economic development and innovative potential, cannot be fully confirmed. To further verify the robustness of these findings, a panel analysis using both fixed effects (FE) and random effects (RE) models was

conducted for the period 2020–2024. The GSEI was retained as the dependent variable, while GDP per capita and the GII were included as independent variables. The Hausman test indicated that the RE model is consistent ($\chi^2 = 4.27$; $p = 0.118$), and thus RE estimates were used for interpretation. The panel results confirm the findings from the 2024 cross-sectional multiple regression: the GII is a statistically significant predictor of entrepreneurial ecosystem development, while GDP per capita does not show a significant effect. To further verify the stability of these coefficients, a Bayesian linear regression (MCMC with 10,000 iterations) was conducted as a robustness check. The results (Table 12) strongly confirm the frequentist findings, as the innovation potential (GII) yielded a strictly positive posterior mean of 0.582 with a 95% credible interval [0.421, 0.745] that does not contain zero. In contrast, the credible interval for GDP per capita contained zero, reinforcing the conclusion that innovation is the primary driver in this specific context. This longitudinal analysis reinforces the conclusion that innovative potential is the key driver of entrepreneurial ecosystem performance across countries over time, while economic development alone has a limited impact when both factors are considered jointly.

Overall, the analysis emphasizes the dominant role of innovation in shaping entrepreneurial ecosystems. The observed reduction in the statistical significance of GDP per capita in joint models should not be interpreted as irrelevant to ecosystem development. Instead, following the VIF diagnostics ($\text{VIF} = 3.437$), it appears that economic development acts as a foundational requirement, but its influence is largely mediated through innovation channels. In other words, higher GDP per capita provides the resources necessary for innovation, which then directly fuels the entrepreneurial ecosystem. Countries with strong innovative capacities, such as the Scandinavian countries in the sample, tend to have higher GSEI scores, even when GDP per capita is comparable or slightly lower than that of other countries. In contrast, despite varying levels of economic development, Western Balkan countries generally exhibit lower entrepreneurial ecosystem scores due to lower innovation levels. These results underline the importance of policy measures that support innovation, knowledge transfer, and technology adoption to strengthen entrepreneurial ecosystems, particularly in developing economies.

6. Conclusion

The findings of this study suggest that while both economic growth and innovation are jointly linked to ecosystem development, innovation potential shows a more robust statistical association when countries are observed over time. However, the observed reduction in the statistical significance of GDP per capita in the panel setting should not be interpreted as true irrelevance; rather, it suggests that the influence of economic development may be captured through innovation channels in this specific sample. These results provide exploratory insights into the factors shaping entrepreneurial processes in the Western Balkans and Scandinavia.

In addition to the substantive findings, methodological considerations were also considered. Due to the relatively small sample size, the Shapiro–Wilk normality test was applied, as it is more suitable for small samples. To further strengthen the robustness of the results and minimize the risk of violating statistical assumptions, the nonparametric Spearman correlation coefficient was used, ensuring additional reliability of the empirical findings. Furthermore, the inclusion of Bayesian inference (Table 12) provided a modern robustness check that confirmed the stability of the regression coefficients despite the small sample size.

The main contribution of this research lies in its empirical assessment of the relationships between economic development, innovation potential, and the examined indicators, using a combined approach of parametric and nonparametric methods. This provides deeper insight into the factors influencing modern economic processes and lays the groundwork for further research in this field.

Furthermore, the application of panel analysis for the period 2020–2024 reinforces the findings of the cross-sectional multiple regression. By considering the dynamics of economic development and innovative potential across countries over time, the panel results confirm that the Global Innovation Index (GII) remains the dominant factor influencing the development of entrepreneurial ecosystems (GSEI), while GDP per capita does not exhibit a statistically significant effect. This longitudinal perspective strengthens the empirical evidence for the third hypothesis, demonstrating that innovative potential consistently drives entrepreneurial ecosystem development, whereas the direct impact of economic growth appears to be largely mediated by a country's innovation capacity when both factors are considered jointly.

Furthermore, this research contributes to the comparative entrepreneurship literature by applying Stam's (2015) entrepreneurial ecosystem framework to two structurally diverse regions. By positioning the findings relative to innovation-led growth theory, the study clarifies how different ecosystem regimes respond to economic and innovative inputs.

The most important limitations include:

- The small sample size (N=8), which affects statistical power and limits the generalizability of the results, requiring that these findings be treated as exploratory rather than confirmatory. Due to these constraints, advanced resampling methods like Bootstrapping were found to be numerically unstable, leading to the prioritization of Bayesian MCMC and VIF diagnostics to ensure reliability.
- The selection of variables, which does not capture all relevant dimensions of the economic environment.
- Dependence on available datasets, which inherently carry methodological constraints.
- The potential for endogeneity and reverse causality, as highly developed ecosystems may also drive further economic growth and innovation.

Considering these limitations, future studies should:

- Include a larger number of countries and a longer time horizon to obtain more robust and representative findings.
- Integrate a broader set of economic, institutional, and technological indicators, such as human capital metrics, regulatory quality, or innovation infrastructure.
- Apply more advanced econometric techniques, including panel regression models, structural models, or machine learning methods.
- Incorporate qualitative approaches to better understand national specificities and contextual factors.
- Further investigate the conceptual and structural overlap between innovation and ecosystem indices to better isolate their individual causal effects.

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CONSUMER ANIMOSITY AND CROSS-BORDER MARKET DYNAMICS: EVIDENCE FROM BOSNIA AND HERZEGOVINA

ABSTRACT

Purpose: This paper aims to investigate the influence of perceived threat/injustice against Croatia and media exposure to negative content on consumer animosity in Bosnia and Herzegovina, which in turn impacts the intention to boycott/purchase products from Croatia in the context of cross-border markets.

Methodology: Primary data are collected using a cross-sectional survey, and an integrated model incorporating perceived threat/injustice and media exposure to negative content, consumer animosity, and boycott and purchase intentions is validated. CFA is used to test the measurement model, whereas covariance-based SEM is employed to test the relationships. Moderation by pragmatic cross-border mechanisms is tested using factor score regression with robust standard errors.

Results: Perceived threat/injustice and media exposure to negative content are antecedents of consumer animosity. Consumer animosity has a significant positive impact on boycott intention and a negative impact on purchase intention. Cross-border market availability, and travel frequency and stay intensity positively affect purchase intention. Cross-border market availability acts as a moderator that amplifies the negative impact of consumer animosity on purchase intention. The moderating effect of travel frequency and stay intensity, and perceived reciprocal crossborder consumption is not significant.

Conclusion: Structural market exposure has positive effects on purchase intentions, and at the same time, it can have negative consequences for affective resistance in the form of animosity. Therefore, there is a need to develop more nuanced theories of consumer behavior in politically sensitive cross-border settings.

Keywords: Consumer animosity, cross-border market dynamics, intergroup threat, boycott intention, purchase intention, Bosnia and Herzegovina

1. Introduction

Regional conflicts stemming from unresolved political issues also affect the economy. Consumer animosity is a factor for consumers' avoidance of products

from specific nations even when they meet product and price criteria. According to Klein et al. (1998), consumer animosity is an affective response rooted in political, historical, and social conflict, which acts

largely independently of cognitive product evaluations and has a strong influence on both purchase intention and boycott intention (Klein et al., 1998; Ettenson and Klein, 2005; Shoham et al., 2006).

Although many studies indicate that animosity decreases consumer purchase intentions, recent research suggests that this is not always the case. In fact, some research suggests that, even when consumers exhibit animosity toward a country, they may still purchase products from that country, particularly if there is economic interdependence and a high level of product involvement between consumers and a country (Nijssen & Douglas, 2004; Riefler & Diamantopoulos, 2007; Abosag & Farah, 2014; Jiménez & San Martín, 2010). These findings indicate that affective animosity does not always reduce consumer purchase intentions.

Insights from the literature on cross-border consumption and consumer mobility can help address this limitation. Previous literature has shown the effects of pragmatic market conditions, such as the physical availability of products, regular exposure to neighboring markets, and observable consumption patterns, on the behavioral impact of negative affective attitudes. According to the literature, such pragmatic market conditions can mitigate the effects of negative affective attitudes on consumer behavior (Spierings & van der Velde, 2008; Verhoef et al., 2007; Timothy & Butler, 1995). In this case, the national origin of the product will not play a critical role in consumers' minds. Instead, market convenience and accessibility will play a critical role.

Despite such contributions, the field remains theoretically and empirically fragmented. Most research has been biased toward either affective factors (animosity, ethnocentrism) or pragmatic market factors (availability, mobility), with few attempts at integrative research (Klein et al., 1998; Nijssen & Douglas, 2004; Spierings & van der Velde, 2008; Abosag et al., 2012). Social normative dimensions such as perceived reciprocity and normalization of crossborder consumption remain under-theorized and under-researched despite their potential for explaining animosity effects in politically sensitive contexts (Cialdini et al., 1990; Spierings & van der Velde, 2008).

The present research study proposes that the impact of animosity on market behavior is moderated by pragmatic and socially mediated market mechanisms. Specifically, this research aims to examine how (1) the cross-border availability of products

from neighboring countries, (2) the frequency of traveling and length of stay in another country (exposure), and (3) perceived reciprocal cross-border consumption (consumers' perceptions of socially normalized cross-border consumption) condition the impact of animosity on market behavior.

The setting for the study is the Una-Sana Canton (USC), Bosnia and Herzegovina, a region bordering Croatia. The region features a wide range of Croatian products and a high level of cross-border market activity. Historical and political factors may perpetuate negative consumer attitudes toward Croatia. Animosity and consumption would thus be expected to coexist.

The study proposes and tests a holistic model of consumer behavior that integrates cognitive and emotional antecedents of consumer animosity. The study focuses on:

1. The impact of consumer animosity on boycott and purchase intentions;
2. The influence and moderating effect of pragmatic market mechanisms—cross-border market availability (CBMA), travel frequency and stay intensity (TFSI), and perceived reciprocal cross-border consumption (PRCBC).

The study integrates emotional animosity and pragmatic market mechanisms to extend consumer animosity theory and provide a new explanation for why negative consumer attitudes do not always result in market avoidance in border regions and integrated markets.

The remainder of the paper is structured as follows. Section 2 develops the theoretical framework and hypotheses by integrating consumer animosity theory, intergroup threat theory, and cross-border consumption research. Building on this, Section 3 describes the research design, data collection, and measurement instruments implemented to test these hypotheses. Section 4 presents the empirical results, including measurement model assessment, structural relationships, and moderation analyses, which inform the subsequent discussion. Section 5 discusses findings in relation to prior literature and theory, setting the stage for Section 6, which details the theoretical, managerial, and policy implications. Finally, Section 7 concludes by summarizing contributions, noting limitations, and outlining future research directions.

2. Theoretical framework and hypotheses development

2.1 Consumer animosity in international consumer behavior

Consumer animosity is a country-specific affective reaction to political, historical, or economic hostilities between two or more nations. It is typically manifested through a decrease in purchase intentions and an increase in boycott intentions for products made in the hostile nation. Since the pioneering study by Klein et al. (1998), consumer animosity has been conceptualized as an affective construct that is relatively independent of consumers' cognitive judgments of products and has a direct impact on consumer behavior (Klein et al., 1998; Ettenson & Klein, 2005; Shoham et al., 2006).

In the realm of international marketing research, consumer animosity has been theoretically distinguished from related but conceptually different constructs such as consumer ethnocentrism and country-of-origin image (COI). Ethnocentrism has been defined as a normative preference for acquiring domestic products compared to foreign products (Shimp & Sharma, 1987). COI is defined as the beliefs that consumers hold regarding the production capacity and quality of a certain nation (Bilkey & Nes, 1982; Kaynak & Kara, 2002). On the other hand, consumer animosity is defined as a differentiated emotion-driven construct targeting a certain nation, which may lead to reduced probability of purchasing the product from that country, despite the positive cognitive evaluation of the product (Klein et al., 1998).

Previous research has focused on the various aspects of consumer animosity, including war, political, and economic animosity. It has also been acknowledged that accumulated animosity may differ from recent consumer animosity (Hoon et al., 2004; Leonidou et al., 2019). It has also been acknowledged that consumer animosity may be intergenerational in the context of war, implying that individuals who did not experience the war may also display consumer animosity (Volčič, 2007). The significance of consumer animosity, ethnocentrism, and COI has been acknowledged in the Southeastern European region. The research carried out in Bosnia and Herzegovina, Croatia, and Serbia has shown the independent effect of consumer animosity with regards to purchase intentions and boycotts (Brkić et al., 2011; Matić, 2013; Marinković, 2017).

2.2 Perceived injustice, media exposure, and consumer animosity

Intergroup Threat Theory (ITT) is a prominent framework for understanding the development of intergroup antagonism and consumer antagonism. Following the tenets of ITT, prejudice toward out-group members is driven by realistic and symbolic threats posed by out-groups to members from different groups (Stephan & Stephan, 2000; Stephan et al., 2002). Realistic threats involve political, economic, and security risks, whereas symbolic threats involve threats to identity, values, and history.

In international settings and post-conflict societies, emotions of injustice and threat are not solely personal experiences of the individual; rather, they are socially constructed through the political narratives and discourses on intergroup relationships in these settings (Volčič, 2007; Jusić, 2009). In politically stable settings, the media can maintain emotions of injustice through agenda-setting and framing effects (Lecheler & de Vreese, 2019). In accordance with these theoretical assumptions, international marketing research established that perceived injustice and perceived threats are significant cognitive antecedents of CA (Klein et al., 1998; Marinković, 2017). Feelings of injustice and threats against other countries can lead to CA, which can further affect consumer behavior.

Exposure to negative media content can also affect CA. In political communication research, incidental exposure to negative political content can lead to higher emotional responses and affect social norms among people who do not intentionally look for negative political content (Ahmadi & Wohn, 2018; Lecheler & de Vreese, 2019). In other words, media can be considered instruments of affective mobilization that can link political evaluations and consumer behavior.

Based on these considerations, the following research hypotheses are formulated:

H1: Perceived injustice and threat (PT) positively affect consumer animosity (AN).

H2: Media exposure to negative content (ME) positively affects consumer animosity (AN).

2.3 Behavioral outcomes of consumer animosity

Consumer animosity has been found to impact consumer behavior through two closely related but conceptually distinct outcomes: boycott intention

and purchase intention (Sen et al., 2001; Spears & Singh, 2004).

Considerable research has confirmed that animosity has a positive impact on consumer boycott intentions for products from the country of origin, regardless of product quality (Ettenson & Klein, 2005; Klein et al., 1998). In post-conflict settings, such consumer behaviors have been found to serve an expressional function that demonstrates group affiliation, group loyalty, and moral consistency (Brkić et al., 2011; Marinković, 2017).

On the other hand, animosity has been found to negatively impact purchase intentions through increased psychological costs of consumption and through serving as an affective deterrent for market interactions (Riefler & Diamantopoulos, 2007). Although boycott intentions and purchase intentions should not be equated, they are arguably among the most significant behavioral outcomes of consumer animosity.

Accordingly, the following hypotheses are proposed:

H3: Consumer animosity (AN) positively affects boycott intention (BI).

H4: Consumer animosity (AN) negatively affects purchase intention (PI).

2.4 Pragmatic market mechanisms: availability, mobility, and reciprocity

Research on cross-border consumption shows that consumer behavior is not only influenced by affective/normative dispositions but also by pragmatic factors such as product availability and consumer mobility (Timothy & Butler, 1995; Spierings & van der Velde, 2008).

Cross-border market availability (CBMA) refers to the structural presence of neighboring country products in the domestic market, including ease of access and product variety. The higher the CBMA, the lower the constraints to consumption and the higher the normalizing influence on purchasing behavior (Berry et al., 2002; Verhoef et al., 2007).

Travel frequency and stay intensity (TFSI) represent the experiential dimension of cross-border consumption. Frequent physical interactions with the neighboring-country retail environments reduce perceived risk and psychological distance, which, in turn, reduces the importance of national origin

information in consumption decisions (Timothy & Butler, 1995; Verlegh, 2007).

Perceived reciprocal cross-border consumption (PRCBC) refers to the extent to which consumers believe that cross-border consumption is a reciprocal process. Observing neighboring-country consumers consuming products from the domestic market normalizes their own cross-border consumption behavior through descriptive social norms (Cialdini et al., 1990; Spierings & van der Velde, 2008).

Based on these considerations, the following research hypotheses are formulated:

H5: Cross-border market availability (CBMA) positively affects purchase intention (PI).

H6: Travel frequency and stay intensity (TFSI) positively affect purchase intention (PI).

H7: Perceived reciprocal cross-border consumption (PRCBC) positively affects purchase intention (PI).

2.5 Moderating role of pragmatic market mechanisms

Apart from direct market implications, market mechanisms may also affect the nature and strength of the relationship between consumer animosity and actual purchasing behavior. Under conditions of high product availability, high-frequency cross-border movement of people, and the presence of the perception of reciprocal consumption, these factors can restrict, modify, and/or reorient the nature of the relationship between negative affective consumer attitudes and actual purchasing behavior (Verhoef et al., 2007; Spierings & van der Velde, 2008).

Based on the above understanding of market mechanisms, the moderation hypotheses are as follows:

H8a: Cross-border market availability (CBMA) moderates the relationship between consumer animosity (AN) and purchase intention (PI).

H8b: Travel frequency and stay intensity (TFSI) moderate the relationship between consumer animosity (AN) and purchase intention (PI).

H8c: Perceived reciprocal cross-border consumption (PRCBC) moderates the relationship between consumer animosity (AN) and purchase intention (PI).

2.6 Conceptual model overview

The present research study attempts to develop an integrated conceptual model that can account for consumer behavior in a cross-border context, which is highly sensitive in political and historical terms. A key assumption is made in the current research, which is based on the idea that consumer animosity (AN) is not a standalone variable, and its effects on the market are mediated by market configuration and the social normalization of cross-border consumption.

At its core, this conceptual model features consumer animosity (AN), which is conceptualized as a country-specific affective reaction toward the origin of products. Animosity is conceived as a mediating factor through which perceptions of injustice and threats are channeled to influence consumer intentions. In line with Intergroup Threat Theory, animosity is conceived as being driven by perceptions of injustice and threats (PT) and negative media content (ME), which act as antecedents for affective animosity toward a target country:

$$AN = f(PT, ME).$$

At the behavioral level, the model distinguishes between boycott intention (BI) and purchase intention (PI). The former is an engaged and norm-based resistance behavior, whereas the latter is a positive orientation toward buying in the future. Consumer animosity increases BI and decreases PI.

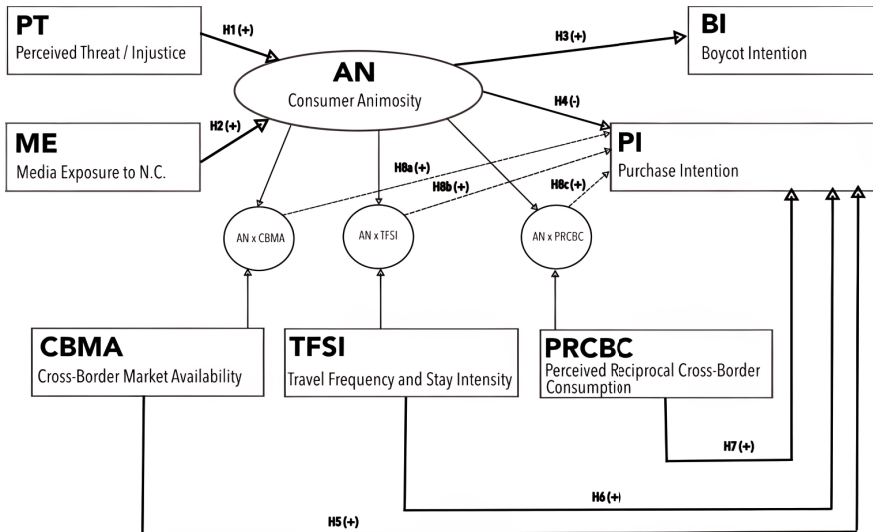
The main contribution of this research is the extension of the traditional animosity concept by including pragmatic market mechanisms that influence consumer purchasing behavior in the cross-border setting. The framework proposes that there are three types of mechanisms that affect cross-border purchasing: cross-border market availability of products from the neighboring country (CBMA), which is structural; travel frequency and stay intensity (TFSI), which is experiential; and perceived reciprocal cross-border consumption behavior (PRCBC), which is social-normative.

These mechanisms have a direct positive effect on PI and modify the effect of animosity on purchase behavior. The mechanisms do not eliminate animosity in cross-border consumption but modify it:

$$PI = f(AN, CBMA, TFSI, PRCBC, AN \times CBMA, AN \times TFSI, AN \times PRCBC).$$

In summary, the model combines affective, cognitive, market structure, and social normative factors that explain the coexistence of negative intergroup attitudes and consumption of products from a country toward which consumers have negative attitudes. The model is suitable for border regions and highly integrated countries where availability and exposure are part of consumers' daily lives.

Figure 1 Conceptual model and hypothesized relationships



Source: Author

3. Method

3.1 Research design and sample

The research design adopted for this study was cross-sectional in nature, using a survey-based approach for testing the integrated model of perceived threat/injustice, exposure to negative political media content, consumer animosity, and behavioral intentions toward products of a neighboring country.

Data were collected for this research between December 2025 and January 2026 in the UnaSana Canton, Bosnia and Herzegovina. The data were collected using a face-to-face intercept survey at the exits of major shopping centers.

The intercept sampling method was used for this research to ensure that the participants were actively engaged in product consumption at the time of data collection. The survey questions used for this research were validated through a two-stage validation process. Initially, a 10-person pretest was conducted for assessing the clarity of the questions, after which minor modifications in the survey questions related to linguistic aspects were undertaken. The results of the 30-person pilot test indicated satisfactory reliability and structure of the questions for this research; therefore, data collection was undertaken. A total of 426 residents of the Una-Sana Canton were included in the final sample for this research. This sample size is well above the minimum sample size required for covariance-based SEM research, including research with latent interaction terms.

3.2 Measurement instruments and construct operationalization

All of the major constructs included in this research, such as consumer animosity (AN), perceived threat/injustice (PT), exposure to negative content in the media (ME), boycott intention (BI), purchase intention (PI), cross-border market availability (CBMA), and perceived reciprocal cross-border consumption (PRCBC), were defined as reflective constructs. The measurement items for each construct were adapted or derived from well-established scales in international marketing, consumer behavior, and political communication research traditions, in accordance with the special relations between Bosnia and Herzegovina and Croatia in terms of politics and economy. The survey was conducted in Bosnian, the native language of the survey participants. All of the constructs in-

cluded in this research were measured using a five-point Likert-type scale with values ranging from 1 (strongly disagree) to 5 (strongly agree).

Travel frequency and stay intensity was conceptualized as a behavioral exposure construct measuring direct experiential exposure of the respondent to the neighboring country. Travel frequency and stay intensity was measured using two ordinal-type items: (1) frequency of traveling to the neighboring country, and (2) an average number of days spent in the neighboring country per year. To ensure equal weights of the two items included in this construct, z-standardization of each item was applied to create a composite index of TFSI.

3.3 Analytical strategy

All the analyses were carried out in the R statistical environment. The analytical process followed a two-stage approach. Prior to confirmatory factor analysis, exploratory factor analysis (EFA) was conducted to examine the dimensionality of the adapted and context-specific measurement scales and to identify potentially problematic items. First, for assessing internal consistency reliability as well as convergent and discriminant validity, a measurement model was estimated using confirmatory factor analysis. After that, a structural model was estimated. Internal consistency reliability was checked using Cronbach's alpha and composite reliability. When the reliability coefficient is above 0.70, it is acceptable (Hair et al., 2019). Convergent validity was checked using standardized factor loadings and average variance extracted. Factor loadings above 0.60 and AVE above 0.50 are considered acceptable (Fornell & Larcker, 1981).

Discriminant validity was assessed based on latent factor correlations obtained from the CFA model. Following conventional guidelines, discriminant validity was considered acceptable when inter-construct correlations remained below the .85 threshold (Henseler et al., 2015).

For model fit, the study employed multiple goodness-of-fit measures. The CFI and TLI should fall above 0.90, and RMSEA and SRMR should fall below 0.08 in order to establish adequate model fit (Hu & Bentler, 1999). The adequacy of the model will be determined on the combined interpretation of these indices.

3.4 Structural model estimation

The structural model was estimated using covariance-based structural equation modeling. Consumer animosity was included as an endogenous

mediator of perceived threat/injustice and media exposure. Boycott intention and purchase intention were included as behavioral consequences of consumer animosity.

Direct effects were examined for: (a) perceived threat/injustice and media exposure on consumer animosity, (b) consumer animosity on boycott intention and purchase intention, and (c) cross-border market availability, travel frequency and stay intensity, and perceived reciprocal cross-border consumption on purchase intention.

Moderation hypotheses were tested using a factor-score regression approach. Latent factor scores were extracted from the validated CFA model and used to compute interaction terms between consumer

animosity and each pragmatic market mechanism (CBMA, TFSI, PRCBC). These interaction terms were then included in regression models predicting purchase intention. The moderation effects were interpreted based on the magnitude, direction, and statistical significance of the interaction terms.

4. Results

4.1 Sample description

This study aims to analyze the data collected from 426 participants. The demographic characteristics of the participants are presented in the section below. Table 1 shows the distribution of the participants by their age and gender.

Table 1 Age category by gender (N = 426)

Age category	Male	Female	Row total
18–24	62 (35.0%)	115 (65.0%)	177 (42.9%)
25–34	30 (46.2%)	35 (53.8%)	65 (15.7%)
35–44	13 (27.7%)	34 (72.3%)	47 (11.4%)
45–54	33 (45.8%)	39 (54.2%)	72 (17.4%)
55+	19 (36.5%)	33 (63.5%)	52 (12.6%)
Total	157 (36.9%)	269 (63.1%)	426 (100%)

Source: Author

Table 2 shows the educational level of the participants. Most of the participants had secondary education, followed by those with a university degree.

Table 2 Education level by gender (N = 426)

Educational level	Male	Female	Row total
Primary school	4 (12.9%)	27 (87.1%)	31 (7.5%)
Secondary school	94 (39.3%)	145 (60.7%)	239 (57.9%)
College (short cycle)	7 (46.7%)	8 (53.3%)	15 (3.6%)
University degree	47 (42.0%)	65 (58.0%)	112 (27.1%)
Master's degree	3 (25.0%)	9 (75.0%)	12 (2.9%)
Doctorate	2 (50.0%)	2 (50.0%)	4 (1.0%)
Total	157 (36.9%)	269 (63.1%)	426 (100%)

Source: Author

Table 3 shows the employment status of the participants. Most of the participants were employed, followed by those who were students.

Table 3 Employment status by gender (N = 426)

Employment status	Male	Female	Row total
Employed	96 (43.0%)	127 (57.0%)	223 (54.0%)
Unemployed	11 (21.2%)	41 (78.8%)	52 (12.6%)
Student	34 (33.3%)	68 (66.7%)	102 (24.7%)
Retired	16 (48.5%)	17 (51.5%)	33 (8.0%)
Other	0 (0.0%)	3 (100.0%)	3 (0.7%)
Total	157 (36.9%)	269 (63.1%)	426 (100%)

Source: Author

In general, the sample shows that there is diversity in the group of active consumers based on their age, educational level, and employment status. This diversity offers a good empirical ground for exploring the ways in which affective, cognitive, and pragmatic factors influence consumer behavior in a politically and historically sensitive cross-border context.

4.2 Measurement model evaluation and scale refinement

Before proceeding with the estimation of the structural model, the psychometric properties of all multi-item constructs were examined via a two-step approach that combined exploratory factor analysis and confirmatory factor analysis. The results of the EFA and CFA are presented in the following paragraphs.

Exploratory Factor Analysis

EFA was performed separately on each latent variable, i.e., PT, ME, AN, BI, PI, CBMA, and PRCBC, to examine their dimensional structure. For the constructs of Perceived Threat/Injustice (PT), Media Exposure (ME), Boycott Intentions (BI), Purchase Intentions (PI), Cross-border Market Availability (CBMA), and Perceived Reciprocal Cross-border Consumption (PRCBC), the results supported the hypothesized one-factor structure. For all these constructs, the items loaded adequately on their respective constructs, and no crossloadings were detected.

For the Consumer Animosity scale, the results of the EFA indicated that two items (AN1 and AN2) exhibited weak psychometric properties, including low factor loadings and communalities, and were therefore excluded prior to the final EFA. The refined five-item scale (AN3–AN7) demonstrated a clear unidimensional structure with moderate to strong factor loadings and an explained variance of 53.8%, indicating satisfactory construct coherence.

Consequently, AN1 and AN2 were excluded from further analysis.

Confirmatory Factor Analysis and measurement model fit

A confirmatory factor analysis (CFA) for the measurement model was performed following the exploratory factor analysis (EFA) procedure. Two measurement models were examined: (a) the entire consumer animosity scale (all seven items, AN1–AN7), and (b) the refined measurement model with items AN1 and AN2 excluded. Model fit comparison indicated that the full AN model (AN1–AN7) fitted the data less adequately (CFI = .894, TLI = .880, RMSEA = .062, SRMR = .059) than the refined AN model (AN3–AN7), which showed excellent fit (CFI = .991, TLI = .990, RMSEA = .049, SRMR = .052). Therefore, the refined measurement model was retained for subsequent analyses. As these items were adapted from the general animosity dimension of Hoffmann et al. (2011), their exclusion indicates that general animosity was not empirically supported in this context.

Reliability and construct validity

Internal consistency reliability was assessed using Cronbach's alpha, ordinal alpha (appropriate for categorical/ordinal indicators), and McDonald's omega. The results indicated acceptable to good reliability across all constructs, with all coefficients exceeding the .70 threshold ($\alpha = .72-.86$; $\alpha_{ord} = .77-.89$; $\omega = .72-.87$). Convergent validity was supported for all constructs, as average variance extracted (AVE) values exceeded the recommended .50 cutoff. Discriminant validity was evaluated based on latent factor correlations from the CFA model. The correlations were moderate and below conventional concern thresholds (e.g., < .85), supporting discriminant validity.

Table 4 CFA loadings and construct reliability and validity indicators

Item	Std. loading	Theoretical grounding
Perceived Threat (PT) $\omega = 0.87$; AVE = 0.62		
PT1 - I believe that the decisions and actions of the Croatian authorities are often unfair toward B&H.	0.781	(Stephan & Stephan, 2000; Stephan et al., 2002)
PT2 - I feel that Croatia often protects its own interests at the expense of B&H.	0.812	
PT3 - B&H is often treated unfairly by Croatia.	0.793	
PT4 - I believe that Croatian policies and actions threaten the identity of B&H.	0.801	
PT5 - Political relations between Croatia and B&H cause me concern or discomfort.	0.748	
Media Exposure (ME) $\omega = 0.86$; AVE = 0.65		
ME1 - I often encounter news or content about political disputes between Croatia and B&H.	0.788	(Lecheler & de Vreese, 2019; Ahmadi & Wohn, 2018)
ME2 - Media content I encounter often portrays relations between Croatia and B&H in a negative tone.	0.823	
ME3 - I often “accidentally” come across negative news about Croatia in relation to B&H, even when I am not actively seeking it.	0.805	
ME4 - While following the media, I am often exposed to repeated negative information about relations between Croatia and B&H.	0.814	
Consumer Animosity (AN) $\omega = 0.86$; AVE = 0.614		
AN1 - I do not hold positive feelings toward Croatia.	removed	(Klein et al., 1998; Shoham et al., 2006; Park & Yoon, 2017; Hoffmann et al., 2011)
AN2 - I feel anger when I think about Croatia’s relationship with B&H.	removed	
AN3 - I believe that Croatia has never fully taken responsibility for its role in events related to B&H during the 1990s.	0.791	
AN4 - Croatia should show greater understanding and responsibility toward B&H due to past political and wartime events.	0.762	
AN5 - I believe that Croatia is not always a fair economic partner to B&H.	0.816	
AN6 - I feel that Croatia often gains economic benefits at the expense of B&H.	0.880	
AN7 - I believe that Croatia has excessive economic influence in B&H.	0.651	
Boycott Intention (BI) $\omega = 0.84$; AVE = 0.63		
BI1 - I intend to avoid purchasing Croatian products whenever possible.	0.826	(Sen et al., 2001)
BI2 - I am willing to consciously boycott Croatian products as a form of disagreement.	0.864	
BI3 - If given a choice, I would choose a product from another country rather than a Croatian product.	0.727	
BI4 - I am willing to recommend to others that they avoid Croatian products.	0.761	
Purchase Intention (PI) $\omega = 0.86$; AVE = 0.73		
PI1 - I am likely to purchase Croatian products in the near future.	0.789	(Spears & Singh, 2004)
PI2 - I intend to purchase Croatian products when the opportunity arises.	0.835	
PI3 - I would consider purchasing Croatian products.	0.931	

Item	Std. loading	Theoretical grounding
Cross-Border Market Availability (CBMA) $\omega = 0.82$; AVE = 0.68		
CBMA1 - Croatian products are widely available in stores in my local area or surroundings.	0.870	(Spierings & van der Velde, 2008; Berry et al., 2002; Reimers & Clulow, 2009; Timothy & Butler, 1995)
CBMA2 - It is easy for me to find Croatian products when purchasing basic groceries or household goods.	0.829	
CBMA3 - In most stores where I shop, there is a wide selection of Croatian brands or labels.	0.764	
Perceived Reciprocal Cross-Border Consumption (PRCBC) $\omega = 0.72$; AVE = 0.54		
PRCBC1 - I often notice consumers from Croatia shopping in B&H.	0.656	(Spierings & van der Velde, 2008; Timothy & Butler, 1995; Cialdini et al., 1990)
PRCBC2 - When I see consumers from Croatia shopping in B&H, I perceive market exchange between the two countries as reciprocal.	0.741	
PRCBC3 - Observing consumers from Croatia shopping in B&H signals to me that purchasing products on both sides of the border is normal.	0.792	

Source: Author

4.3 Structural model results

The hypothesized structural model was estimated using the refined measurement model. Overall model fit was acceptable to good (CFI = .980; TLI = .980; RMSEA = .068; SRMR = .064), supporting the model's suitability for hypothesis testing. As reported in Table 5, perceived threat/injustice (H1) and media exposure to negative content (H2) exerted significant positive effects on consumer animosity. Consumer animosity, in turn, positively predicted boycott in-

tention (H3) and negatively predicted purchase intention (H4). Among the pragmatic market mechanisms, cross-border market availability (H5), travel frequency and stay intensity (H6), and perceived reciprocal cross-border consumption (H7) had significant positive effects on purchase intention. The model explained 60.9% of the variance in consumer animosity, 38.7% in boycott intention, and 39.5% in purchase intention, indicating substantial explanatory power for the key endogenous constructs.

Table 5 Direct effects and hypothesis testing results

Relationship	Std. β	p	Decision
H1: Perceived Threat/Injustice \rightarrow Consumer Animosity	0.570	< .001	Supported
H2: Media Exposure to negative content \rightarrow Consumer Animosity	0.308	< .001	Supported
H3: Consumer Animosity \rightarrow Boycott Intention	0.622	< .001	Supported
H4: Consumer Animosity \rightarrow Purchase Intention	-0.377	< .001	Supported
H5: Cross-border Market Availability (CBMA) \rightarrow Purchase Intention	0.373	< .001	Supported
H6: Travel Frequency and Stay Intensity (TFSI) \rightarrow Purchase Intention	0.217	< .001	Supported
H7: Perceived Reciprocal Cross-border Consumption (PRCBC) \rightarrow Purchase Intention	0.169	< .001	Supported

Source: Author

4.4 Moderation analysis

To examine whether pragmatic cross-border mechanisms condition the relationship between consumer animosity and purchase intention, mod-

eration was tested using a factor-score regression approach. First, latent factor scores for the validated CFA constructs (PT, ME, AN, BI, PI, CBMA, and PRCBC) were extracted using the `lavPredict` func-

tion in lavaan. Travel frequency and stay intensity (TFSI) was included as an observed composite index constructed from standardized indicators.

Prior to estimating interaction effects, the focal predictor (consumer animosity) and all moderators (CBMA, TFSI, and PRCBC) were standardized (z-scored). This procedure allows direct interpretation of coefficients as standardized effects (Std. β), facilitates comparability across predictors, and reduces potential multicollinearity in models with interaction terms. Interaction terms were then computed as products of standardized scores: AN \times CBMA, AN \times TFSI, and AN \times PRCBC.

Purchase intention (latent factor score) was subsequently regressed on the main effects and interaction terms using ordinary least squares (OLS) regression. To ensure robust statistical inference and account for potential heteroskedasticity, heteroskedasticity-consistent standard errors (HC3) were

employed. Multicollinearity diagnostics indicated no concerns (VIFs within acceptable thresholds). Overall, the moderation model explained a substantial proportion of variance in purchase intention ($R^2 = .508$).

The results indicate that the interaction between consumer animosity and cross-border market availability is statistically significant and negative (H8a: Std. $\beta = -0.124$, $p(\text{HC3}) = .002$), suggesting that higher structural availability of neighboring-country products strengthens (intensifies) the negative association between animosity and purchase intention. In contrast, the interaction effects involving travel frequency/stay intensity (H8b) and perceived reciprocal cross-border consumption (H8c) were not statistically significant, indicating that experiential exposure and perceived reciprocity do not meaningfully condition the animosity–purchase relationship in the present sample.

Table 6 Moderation effects on purchase intention

Relationship	Std. β	p (HC3)	Decision
H8a: Consumer Animosity \times Cross-border Market Availability \rightarrow Purchase Intention	-0.124	.002	Supported
H8b: Consumer Animosity \times Travel Frequency and Stay Intensity \rightarrow Purchase Intention	0.015	.743	Not supported
H8c: Consumer Animosity \times Perceived Reciprocal Cross-border Consumption \rightarrow Purchase Intention	0.033	.418	Not supported

Note: p-values are based on heteroskedasticity-consistent standard errors (HC3).

Source: Author

The moderation analysis results show that the dominant boundary condition for the animosity effect is the structural market availability. This means that the relationship between the animosity effect and the consumers is not as straightforward as the models based on the animosity effect suggest, and the impact of the animosity effect on the consumers' purchasing intention is related to the extent of the products' market availability.

5. Discussion

This study contributes to the understanding of consumer animosity by examining its antecedents and behavioral consequences with reference to highly integrated cross-border relations. Perceived threat and perceived injustice, as well as negative media content, are key factors in formation of consumer animosity. According to Intergroup Threat Theory,

consumer animosity is primarily cognitively based, as opposed to an emotional construct. Therefore, it can be argued that the general animosity dimension may not be applicable in highly integrated cross-border relations where perceived threat and perceived injustice are critical.

In terms of its behavioral consequences, consumer animosity has a twofold effect on consumer boycott intention and purchase intention. Animosity increases boycott intention while decreasing purchase intention. Besides animosity, other market mechanisms may affect purchase intention. Market availability of cross-border products, travel frequency, and stay intensity positively affect purchase intention. However, moderation analyses revealed that market availability of cross-border products magnifies the negative effect of animosity on purchase intention. Instead of alleviating hostile

ity-driven consumer resistance, the availability of cross-border products may heighten consumer reluctance toward purchasing cross-border products.

Travel frequency and perceived cross-border consumption do not moderate the animosity–purchase intention relationship. Therefore, it can be argued that while travel frequency and perceived cross-border consumption may positively affect consumption in general, market availability of cross-border products serves as a boundary condition that intensifies consumer animosity-driven reluctance.

6. Implications

6.1 Theoretical implications

The present study makes several notable contributions to the existing body of research concerning consumer animosity and cross-border consumption. First, it extends existing research by demonstrating the twofold effect of consumer animosity, as it not only increases the intention to boycott a product, but also decreases the intention to purchase a product. Second, the research contributes to Intergroup Threat Theory, as it shows that perceived threat and injustice are the most important cognitive factors influencing the occurrence of consumer animosity, while negative media exposure serves as a reinforcement factor. This shows that the occurrence of consumer animosity is socially constructed and cognitively mediated, as opposed to being merely an emotional construct. Most importantly, the research contributes to the existing body of knowledge concerning cross-border consumption, as it shows that market availability of cross-border products and consumer movement have a positive direct effect on the intention to purchase a product, and at the same time, product market availability intensifies the negative effect of consumer animosity on the intention to purchase a product. This shows that the market can act as a facilitator or amplifier of the effect of consumer animosity, depending upon its structural nature.

6.2 Managerial and policy implications

From the managerial standpoint, the findings suggest that the enhancement of product availability in politically sensitive markets should be implemented with caution. Although the enhancement of availability might increase purchase intentions, it might also increase resistance based upon negative

intergroup attitudes among consumers. Therefore, managers in crossborder contexts should implement enhancement of availability with communication interventions targeting perceptions of fairness and historical sensitivities.

From the policy standpoint, the positive direct effect of travel frequency and stay intensity implies that policies facilitating cross-border mobility might encourage pragmatic consumption. Therefore, policies facilitating cross-border mobility might increase resistance based upon everyday interactions without exacerbating animosity-based resistance. However, policymakers should take into account the possibility that enhancing structural market dominance without targeting perceptions might actually exacerbate underlying tensions rather than alleviate them.

7. Conclusion

The current study contributes to the animosity construct by examining the impact of animosity toward a rival country on consumer boycott and purchasing intentions in highly integrated cross-border markets. Based on Intergroup Threat Theory and cross-border consumption literature, an integrated conceptual model is developed that includes cognitive antecedents, media exposure, animosity, behavioral outcomes, and pragmatic market mechanisms. The integrated conceptual model is tested using data collected from consumers in highly integrated cross-border markets.

Key findings of this study are presented as follows. First, perceptions of injustice and threat, accompanied by negative media content, were found to be significant antecedents of animosity, thereby providing support for the cognitive nature of animosity. Second, this study found that animosity has dual effects on consumer behavior, as it was found to increase boycott intentions while decreasing purchasing intentions. This finding provides support for the argument that various forms of consumer behavior need to be considered when examining animosity. Finally, this study found that market mechanisms in cross-border contexts operate in complex ways. Specifically, cross-border market availability, travel frequency/intensity of stay, and perceived cross-border consumption directly influenced purchasing intentions. These findings indicate that pragmatic market mechanisms can indeed be beneficial in cross-border markets characterized by animos-

ity. However, structural market availability was found to uniquely amplify the relationship between animosity and purchasing intention. Therefore, it seems that this particular market mechanism may tap into underlying intergroup tensions.

Collectively, these findings indicate that consumer animosity is a highly context-dependent construct. Market effects arise through the interplay of affective evaluations and everyday experiences of cross-border economic realities. Moreover, these findings contradict the assumption that higher levels of cross-border market integration will result in lower levels of animosity-driven resistance in the marketplace. Instead, it seems that higher levels of cross-border market integration may, in fact, contribute to higher levels of animosity-driven resistance.

Limitations of this study are acknowledged. Specifically, this study is based on a cross-sectional design,

which limits causality. Second, this study is based on a specific cross-border region. Future studies could address these limitations by employing longitudinal designs and examining various product categories and brand origins. Furthermore, various potential moderators of animosity, such as positive intergroup contact, trust, and fairness, may also be considered. Further research may also consider examining how changing media narratives over time may impact market structures and animosity.

This research has also served to demonstrate that animosity must be considered as a phenomenon inextricably linked to the marketplace in which it is expressed. The behavioral effects of animosity are subject to its interplay with attitudes toward a rival country as well as its everyday experience of cross-border economic presence.

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ECONOMIC CRISIS AND PRODUCTION–EXPORT DYNAMICS IN THE AUTOMOTIVE INDUSTRY: A COMPARATIVE PANEL ANALYSIS OF TÜRKIYE AND SELECTED EU COUNTRIES

ABSTRACT

Purpose: Economic crises introduce structural disturbances that disrupt established economic balances within industrial systems, generating diverse responses across countries and sectors. This study examines how crisis conditions affect production–export dynamics in the automotive industry by comparing Türkiye and selected European Union countries over the 2014–2023 period.

Methodology: Using balanced panel data, the empirical relationship between production volume and export turnover is analyzed using fixed- and random-effects models. The Hausman test indicates that the fixed-effects specification is most appropriate, suggesting that countryspecific characteristics play a significant role in shaping production dynamics.

Results: The findings reveal that, while production–export linkages remain statistically significant across countries, the magnitude and persistence of crisis impact vary depending on national production scale, institutional capacity, and structural conditions. The results further indicate that countries with higher production and export volumes experience stronger fluctuations during crisis periods, whereas countries with smaller production bases tend to display more moderate adjustments.

Conclusion: The study provides comparative empirical evidence on how national automotive systems respond to systemic economic disruptions and highlights the importance of structural differences in shaping crisis outcomes across countries.

Keywords: Economic crisis, automotive industry, production–export dynamics, crisis management, Türkiye, European Union

1. Introduction

The liberalization of capital movements and the increasing integration of global financial markets have intensified the frequency, speed, and transmission power of economic crises (Singh, 2003). These crises rarely remain confined to national borders; instead, they spread across countries, sectors, and firms depending on structural characteristics, institutional capacity, and sectoral interdependencies. As a result, economic crises have become systemic phenomena that simultaneously disrupt macroeconomic stability and micro-level business performance (Chatzinikolaou & Kubus, 2025). The business environment in Türkiye, like that of many emerging and developed economies, has repeatedly been exposed to such disruptions, with particularly pronounced effects in capital-intensive, highly interconnected industries.

Among these industries, the automotive sector occupies a strategic position due to its strong backward and forward linkages with manufacturing, employment, exports, and technological innovation. Because automotive production systems rely on complex supply chains, high fixed costs, and international demand conditions, they are especially vulnerable to crisis-induced shocks (Hoeft, 2024). Rapid changes in global competition, demand volatility, financial constraints, and policy uncertainty amplify automotive firms' sensitivity to economic downturns. Crises may emerge from national or international sources, sector-specific dynamics, or firm-level structural weaknesses, and, in many cases, they materialize through the simultaneous interaction of all these factors (Giannoulakis & Sakellaris, 2023). Beyond its macroeconomic significance, the automotive sector also represents an important context for strategic management research. Firms operating in highly integrated global industries must continuously adapt their production structures, supply chains, and export strategies in response to environmental uncertainty and crisis shocks. In this sense, economic crises function not only as macroeconomic disturbances but also as strategic turning points that test firms' adaptive capabilities, resilience, and crisis management strategies.

Economic crises not only affect production and trade volumes; they also have deep social and institutional impacts, increasing unemployment, weakening financial structures, and reducing overall economic welfare (Otker-Robe & Podpiera,

2013). In this context, crises can be conceptualized as periods of heightened uncertainty that disrupt existing equilibrium and force economic actors to operate outside standard managerial and policy frameworks. As emphasized in the literature, a crisis represents a situation that threatens the continuity, values, and functional integrity of economic systems (Booth, 1993; Ritchie, 2004; Boin, 2009). From this perspective, crises can be interpreted as systemic shocks that disrupt the balance among production, finance, and trade, leading to different outcomes across sectors and countries.

The central problem addressed in this study is identifying effective measures that enable firms to manage the transition from temporary financial distress to sustainable recovery during economic crises. In many cases, businesses initially face liquidity constraints and difficulties in meeting short-term obligations; if these challenges are not managed effectively, they may culminate in insolvency or bankruptcy. The automotive sector provides a particularly relevant context for examining this process, as crisis impacts in this sector tend to manifest rapidly and propagate widely through national economies. Therefore, understanding how automotive firms and countries respond to crisis conditions is critical for designing resilient economic and managerial strategies.

From a comparative perspective, crisis responses are rarely uniform. Differences in production scale, export orientation, financial structures, and public policy interventions result in varying crisis effects, even when countries are exposed to the same global shock (Armstrong & Read, 2020). However, recovery processes may display similar dynamics when production and export linkages remain structurally intact. This contrast between diverse crisis impacts and potentially converging recovery patterns underscores the importance of adopting a comparative and system-oriented analytical framework. In this respect, Türkiye and selected European Union countries offer an appropriate empirical setting, as they share strong trade linkages in the automotive industry while differing in institutional capacity, production volume, and crisis management approaches.

From a systems perspective, industrial economies can be interpreted as structures that tend toward balanced interactions among production, trade, and institutional capacity (Andreoni & Chang, 2019). Economic crises disturb this balance by in-

roducing sudden shocks that alter established production and trade dynamics across countries and sectors. The automotive industry, with its complex supply chains and strong production–export linkages, provides an appropriate setting to examine how such systemic disruptions unfold (Solée et al., 2013) and how industrial systems adjust over time. In this sense, analyzing crisis responses in the automotive sector offers a deeper understanding of structural resilience and adaptive capacity in industrial systems. However, empirical evidence comparing production–export dynamics across national automotive systems under crisis conditions remains limited.

The primary aim of this study is to evaluate crisis management responses in the automotive sector during periods of economic instability and identify the strategies that contribute to effective performance under adverse conditions. Specifically, the study compares Türkiye with selected EU countries (Italy, France, Denmark, Estonia, and Poland) by focusing on production levels and export turnover over the 2014–2023 period. These countries were selected to represent different production scales and levels of integration within the European automotive supply chain, allowing comparison between large and smaller automotive systems. This timeframe captures multiple overlapping crisis episodes, including the global economic slowdown following the COVID-19 pandemic and the subsequent energy and geopolitical shocks affecting European markets.

2. Concept of economic crisis

The concept of crisis is generally associated with chaos, turmoil, and depression. In this sense, a crisis can be defined as a situation that causes failure under uncertainty when a threatening risk emerges (Boin, 2009). Similarly, a crisis is also described as a disruption that damages an organization's existing structure and affects the organization (Ritchie, 2004). For institutions and businesses, a crisis is any event that disrupts normal operations, undermines performance, and weakens effectiveness and continuity (Ritchie, 2004). From a systemic perspective, crises may be interpreted as systemic shocks that disrupt established economic balances and generate diverse outcomes across actors, sectors, and countries, even when exposure to the shock is globally shared.

Crises often occur suddenly and create urgent conditions for institutions, organizations, and firms (Phelps, 1986). They can affect systems physically and structurally by creating disruptions that threaten fundamental functions, values, and even survival (Booth, 1993). Wherever crises occur, they may cause sharp contractions in national income and trigger stagnation and depression dynamics. In modern industrial systems, the transmission of crisis impacts can be amplified by interdependence in trade, finance, and supply chains, meaning the same event may produce uneven (asymmetric) sectoral losses and uneven recovery paths across countries (Crespo & Hoyos, 2025).

During crisis processes, problems often begin in the financial structure. Typical forms include currency crises, banking crises, financial crises due to market dysfunction, and external crises triggered by risks originating outside the country (Darican, 2013). An economic crisis, as reflected in serious deterioration of financial markets, may also be described as an economic depression because it produces a downturn without immediate recovery (Erol et al., 2011). In this context, economic crises can be understood as periods in which macro-level instability (e.g., inflation, exchange rate volatility, credit contraction) translates into micro-level distress (e.g., liquidity shortages, demand collapses) (Dhanda 2024), producing feedback loops that deepen losses.

An economic crisis is also defined as the weakening of a country's financial capacity due to reduced opportunities for individuals to meet their needs, rising poverty, and rising consumer prices (Ollivaud & Turner, 2014). It is accompanied by fluctuations above acceptable levels in core economic sectors, including foreign exchange, money markets, and the production of goods and services. Consequently, national economies experience sudden and unexpected disturbances (Gayathri et al., 2024). For an economic problem to be characterized as a crisis, the negative situation should emerge suddenly, create a threat, persist in the short or long run, and produce widespread effects (Aktan & Şen, 2001). Such widespread effects are especially visible in complex industrial ecosystems, including the automotive sector, where shocks propagate through supplier networks, labor markets, financing, and export demand.

In businesses, managerial success becomes especially critical during crisis periods, when classical

management rules often lose their effectiveness (Zamoum & Gorpe, 2018). Therefore, managerial performance depends on analytical thinking and effective communication skills (Wyatt, 2002). Although crises create negative perceptions, it is important to manage them successfully by transforming threats into opportunities. Effective crisis leadership requires remaining calm, acting prudently, and minimizing damage while restoring operational alignment, akin to returning a system to its normal operational state (Woodward, 2025). In some cases, crises may also stimulate transformation and create new opportunities for innovation and organizational renewal (Topçu, 2017). The key is to recognize these opportunities and reduce crisis impacts by guiding employees at the micro level and supporting macro-level stabilization policies (Şendoğdu, 2014). It is also emphasized that shared values help keep a renewed organization together after a crisis (Hurst, 2000). From a strategic management perspective, firms' performance during crisis periods largely depends on their ability to reconfigure resources in response to environmental uncertainty and to adapt to changing conditions. In this context, organizational resilience and adaptive capability are crucial for enabling firms to maintain their competitive position during periods of economic instability. In this context, these arguments are particularly relevant for automotive firms and policymakers seeking to restore balanced production–export dynamics after crisis-driven disruptions. During the COVID-19 shock, EU automotive production experienced major shutdowns and large output losses (European Parliament, 2021). The later European energy-cost shock also intensified cost pressure and competitiveness concerns across the automotive ecosystem (ACEA, 2022). These crisis waves illustrate how a shared shock can create asymmetric impacts across countries and firms, depending on scale, energy exposure, and institutional response capacity—precisely the comparative logic this paper employs.

3. Businesses in difficulty and measures to be taken

Economic crises can push firms into financial distress by compressing demand, tightening credit, increasing input costs, and disrupting supply chains (Yu et al., 2022). However, the effects of a crisis do not appear uniformly: some firms experience rapid liquidity deterioration, while others maintain op-

erational continuity through strategic flexibility (Moridu & Abidin, 2023). Therefore, crisis management can be interpreted as the effort to restore operational and financial stability in cash flow, operations, and stakeholder relations after crisis-induced disruptions (Durugbo & Al-Balushi, 2025). In this section, the indicators of distress and the macro–micro measures that can be taken are discussed.

3.1 Businesses in difficult situations

There are indicators that a business is in a difficult situation, including approaching bankruptcy, losing half of its capital or a substantial portion of assets, consecutive multi-year losses, difficulty paying debts, production stoppages, raw material supply problems, negative responses from credit institutions, and liabilities exceeding assets (Taşpınar Cengiz et al., 2015). These indicators often emerge sequentially, reflecting a deterioration process in which initial liquidity strain can evolve into solvency risk if corrective action is delayed.

Business failures can be economic, financial, or technical. Economic failure can be observed when companies close the period with losses; thus, profitability is a leading indicator of success or failure (Tay Bayramoğlu & Kurban, 2023). Businesses whose profitability exceeds the cost of capital are considered economically successful (Dağlı, 1994). Financial failure may occur even when economic failure is not present, but it can still threaten survival or require major restructuring. Firms may face technical problems such as changes in order frequency and order quantities, and receivable collection failures, which reduce their ability to pay debts; this is described as technical failure and loss of technical liquidity (Uzun, 2005). Scott (1977) describes failure indicators, including economic failure (revenues less than total costs) and company failure (obligations to creditors cannot be fulfilled) (Zenoff & Zwick, 1969). Technical bankruptcy occurs when a firm cannot fulfill obligations on time or fails to pay debts when due (Blum, 1969). When liabilities exceed asset market value, liquidation becomes a key risk.

Certain organizational characteristics can help firms survive and sustain performance over long periods. These include sensitivity to environmental, technological, and political changes, a strong identity and internal commitment, tolerance and controlled diversification, and conservative financing practices that preserve flexibility (de Geus, 1998).

These features function as “resilience capabilities” that strengthen firms’ ability to absorb shocks and recover effectively from crisis conditions (Manfield & Newey, 2018).

3.2 Financial measures to be taken

Precautions against economic crises can be considered at macro and micro levels (Aktan & Şen, 2001). From a systems perspective, macro measures aim to reduce instability and prevent the escalation of shocks, while micro measures aim to stabilize firm-level operations, liquidity, and strategic positioning.

3.2.1. Macro measures

Crises are undesirable and often unexpected periods of financial collapse (Reinhart & Rogoff, 2009). Instead of acting only after crises occur, states should strengthen anticipatory capacity and implement preventive policies (DeLeo, 2015). Because crises disrupt market stability and transfer micro-level cash shortages into broader macro-level instability, states must provide integrated support to businesses, including liquidity relief (Artantaş & Gürsoy, 2023). Support mechanisms may include legal regulations, tax reductions and amnesties, low-interest credit supports, grants, rent and education support, social aids, and other measures that protect both firms and employees.

To take precautions, it is necessary to identify crisis sources and address them directly. Since crises are often linked to macroeconomic instability, ensuring macroeconomic stability is essential (Bicaba et al., 2014). Macroeconomic stability implies harmony among key economic factors and requires policy capability and experience (Türgay & Kenanoğlu, 2023). Political stability and balanced fiscal policy are also critical, as political instability creates uncertainty and encourages short-term policies that can weaken the effectiveness of public investment (Yalçınkaya & Kaya, 2017). During periods of financial crisis, monetary policy should prioritize price stability (Çetin, 2017). In this context, banks and regulators can use tools such as required reserves, interest corridors, liquidity management, and reserve option mechanisms (Eroğlu & Kara, 2017). Discipline in public debt and a rule-based approach (e.g., Maastrichttype targets) can also strengthen credibility. Additionally, the tax system should be reviewed concerning impartiality, simplicity, justice, generality, and efficiency, while avoiding excessive burdens (Bejaković, 2020). Finally, exchange

rate dynamics and interest rate developments should be managed consistently to limit speculative attacks and maintain stability.

3.2.2 Micro measures

At the firm level, crisis measures should address both immediate survival and long-term competitiveness. Dalgıç et al. (2024) show that the “pay as you wish” strategy can be implemented during crisis periods and can influence short-term performance while strengthening brand components in the long term. The strategy is defined as a buyer-determined pricing approach rather than a seller-determined one (Koç & Erdoğan, 2023). Another strategic decision is organizational downsizing (Turan Torun, 2022). Downsizing may prevent major losses, but downsizing alone is insufficient; it must be accompanied by restructuring. Change engineering is a managerial approach used to redesign organizational activities. Downsizing may result from such applications, but implementing downsizing without adequate process analysis may cause irreversible damage in the long run (Hammer & Champy, 1993). Therefore, firms should carefully review their organizational activities and implement necessary changes without panic, aiming for higher quality, lower costs, and greater effectiveness (Sarkar & Osiyevskyy, 2018).

Managers also play a decisive role during crisis periods. They should recognize early warning signals, anticipate crisis-driven negative outcomes, implement actions to minimize damage, learn from past experiences, and prepare for future crises (Demirkaya & Ateşoğlu, 2023). Firms can also maintain their existence by embedding marketing and marketing communication culture across units (Öztekin, 2009) and by preparing crisis call plans, emergency action plans, crisis centers, team structures, and robust communication systems to prevent coordination failures (Çitekci, 2016). Contemporary management approaches such as total quality management and effective leadership have become even more critical in these periods. After major shocks, firms may reduce complexity by divesting, reducing personnel, and simplifying operational structures (Yalçınkaya, 2018). These micro-level measures align with the broader goal of restoring operational balance, e.g., rebuilding alignment among costs, revenues, cash flow, and strategic capacity under crisis conditions (Setyadi et al., 2025).

4. Methodology

Methodologically, the study adopts a descriptive and comparative research design supported by panel data analysis. By examining the relationship between production volume and export turnover, the analysis explores how the production–export relationship behaves across countries during crisis periods. Fixed-effects and random-effects models are employed to capture both within-country and between-country dynamics, while the Hausman test is used to assess the consistency of these specifications. This approach allows for a structured evaluation of how crisis impacts differ across national automotive systems and whether recovery mechanisms follow similar or divergent paths.

By integrating crisis theory, sectoral analysis, and empirical modeling, this study contributes to the literature on economic crisis management in several ways. First, it provides comparative evidence on how automotive production systems respond to systemic shocks in emerging and developed economies. Second, it highlights the role of structural differences in shaping asymmetric crisis outcomes. Finally, it offers policy-relevant insights into how recovery dynamics can be supported through appropriate macro- and micro-level interventions. In

doing so, the study aligns with contemporary discussions of economic resilience and systemic balance amid global uncertainty.

5. Research in the automotive sector – Comparison between Turkey and some European Union countries

This study examines crisis management dynamics in the automotive industry by analyzing total automobile production and export turnover in Türkiye and selected European Union countries (Italy, France, Denmark, Estonia, and Poland) over the 2014–2023 period. The selected timeframe captures multiple overlapping crisis episodes, including the COVID-19 pandemic and subsequent energy- and geopolitics-driven economic shocks that affected global and regional automotive markets. The dataset consists of annual observations. The panel structure was confirmed to be balanced prior to estimation ($n = 6, T = 10, N = 60$).

Table 1 presents summary statistics for automobile production and export turnover in Türkiye and selected European Union countries over the 2014–2023 period.

Table 1 Automobile production and exports in the automotive industry sector

Country	Mean Production (Units)	Std. Dev.	Mean Export Turnover (USD)	Std. Dev.
Türkiye	1,404,200	161,000	10,209,000	1,457,000
Italy	908,869	158,000	15,304,000	2,040,000
France	1,904,485	354,000	21,122,000	2,723,000
Denmark	4,827,887	1,034,000	147,377,000	18,992,000
Estonia	2,647,456	247,000	34,410,000	3,412,000
Poland	592,721	89,000	6,452,000	1,008,000

Source: Created by researchers using data from the Ministry of Commerce, the Turkish Statistical Institute (TURKSTAT), the Automotive Manufacturers Association of Turkey (AMA) (2024), and the International Organization of Motor Vehicle Manufacturers (OICA) (2024)

The dataset consists of annual observations of total automobile production (in units) and total automobile export turnover (in USD), obtained from official national and international sources, including the Ministry of Commerce, TURKSTAT (2024), AMA (2024), and OICA (2024). All variables were examined for consistency across countries and

years, and the panel structure was confirmed to be balanced prior to estimation ($n = 6$ countries, $T = 10$ years, $N = 60$ observations).

To analyze the relationship between production and export performance under crisis conditions, panel data econometric methods were employed.

Panel data analysis allows for controlling for unobserved heterogeneity across countries while capturing both temporal and cross-sectional variation. The following baseline model was estimated:

$$\text{Export_Turnover}_{it} = \alpha + \beta \text{Production_Amount}_{it} + u_{it}$$

where i and t denote countries and time, respectively.

Both fixed-effects (FE) and random-effects (RE) specifications were estimated. The fixed-effects model controls for time-invariant country-specific characteristics, making it particularly suitable for assessing structural asymmetries across national automotive systems. The random-effects model incorporates both within-country and between-country variation. Diagnostic checks for autocorrelation and heteroskedasticity were also conducted to ensure the robustness of the panel estimations. The Hausman test was applied to determine the appropriate specification by testing whether country-specific effects are correlated with the explanatory variable.

The fixed-effects specification allows the analysis to control unobserved, time-invariant country characteristics, which are essential when assessing asymmetric structural responses.

5.1. Results

This section presents the empirical findings obtained from the panel data analysis of automobile production and export turnover in Türkiye and selected European Union countries over the 2014–2023 period. The results are reported in a structured manner, beginning with descriptive statistics that provide an overview of cross-country variation, followed by panel regression estimates and model selection tests. The purpose of this section is to report the statistical outcomes transparently and objectively, without interpretation beyond what is directly supported by the data. Detailed implications and theoretical interpretations of these findings are deferred to the Discussion section.

Table 2 presents descriptive statistics for automobile production and export turnover in Türkiye and selected European Union countries over the 2014–2023 period.

Table 2 Descriptive statistics

Variable	Mean	Median	Std. Dev.
Production Amount (units)	2,019,498	1,477,160	1,491,384
Export Turnover (USD)	39,914,664	18,232,308	70,334,961

Source: Authors, based on research

Descriptive statistics reveal substantial variation in automobile production and export turnover across Türkiye and selected European Union countries over the 2014–2023 period. Mean production and export values are accompanied by relatively large standard deviations, indicating heterogeneity in production scale and export capacity. This dispersion reflects structural differences among countries and suggests that economic crises affect national automotive industries unevenly.

Countries with larger production systems and higher export volumes exhibit greater absolute fluctuations during crisis periods, particularly during the

COVID-19 shock and the subsequent energy-cost crisis. These preliminary findings point to differences in exposure and sensitivity across countries, which are further examined through panel regression analysis.

Table 3 reports the results of the fixed-effects and random-effects panel regression models examining the relationship between automobile production amount and export turnover. In the fixed-effects model, the coefficient on production is positive and statistically significant, indicating that, within countries, increases in production are associated with higher export turnover.

Table 3 Panel data analysis

Variable	Fixed-Effects Model	Random-Effects Model
Production Amount	4.0692 ** (0.016)	6.5020 *** (0.001)
Constant	—	26,784,000 ** (0.008)
R-squared	0.104	0.168
Observations	60	60
Countries	6	6
Years	10	10

Note: p-values in parentheses.

** p < 0.05, *** p < 0.01.

The fixed-effects model controls for country-specific, time-invariant characteristics.

Source: Authors, based on research

The explanatory power of the fixed-effects model is relatively modest, suggesting that production alone does not fully explain export performance during crisis periods. This indicates the presence of additional crisis-related factors—such as demand volatility, cost pressures, and logistical disruptions—that influence export outcomes beyond production capacity.

The random-effects model also yields a positive and statistically significant coefficient for production amount, with a larger estimated magnitude. However, differences between the fixed- and random-effects results necessitate formal model selection.

Table 4 presents the results of the Hausman specification test. The test statistics are statistically significant, leading to rejection of the null hypothesis that the random-effects estimator is consistent. Accordingly, the fixed-effects model is preferred.

Table 4 Hausmann test

Test Statistic	Value
Chi-square	6.484
Degrees of Freedom	1
p-value	0.0109
Preferred Model	Fixed Effects

Source: Authors, based on research

This result indicates that unobserved country-specific characteristics are correlated with production dynamics and export performance. Therefore, these characteristics should be treated as structural rather than random, reinforcing the suitability of the fixed-effects specification for the analysis.

6. Discussion

This section discusses the empirical findings within the broader framework of economic crisis management in industrial sectors. Building on the statistical results presented in the previous section, the discussion interprets how production–export relationships behave under crisis conditions and how these dynamics differ across countries. Particular attention is given to the role of structural characteristics, production scale, and institutional capacity in shaping crisis responses across national automotive systems. The discussion also connects the empirical evidence with broader implications for crisis management at both the macroeconomic and firm levels.

The empirical results indicate that crisis responses in the automotive industry differ across countries. While the relationship between production and export turnover remains positive and statistically significant within countries, the magnitude and persistence of crisis impacts vary across national automotive systems. Economic crises act as systemic shocks that disrupt established production–export relationships and generate different adjustment patterns across countries.

The relatively low explanatory power of production in the fixed-effects model suggests that crisis conditions weaken the otherwise stable linkage between production and exports. This finding implies that additional factors—such as institutional capacity, policy responses, demand volatility, and external cost shocks—play an important role in shaping export outcomes during crisis periods. In other words, production capacity alone cannot fully

explain export performance when economies face significant disruptions.

Cross-country differences in production scale and export dependence play a decisive role in shaping crisis outcomes in the automotive sector. Countries with larger automotive production systems experience stronger absolute contractions during crisis periods, reflecting greater exposure to global demand fluctuations and supply chain disruptions. At the same time, the persistence of a positive production–export relationship suggests that production capacity remains an important determinant of export performance even under adverse economic conditions.

These findings highlight the importance of structural characteristics in determining how national automotive industries respond to crisis conditions. Differences in industrial capacity, supply chain integration, and institutional frameworks influence the extent to which countries can absorb economic shocks and maintain production and export performance. Consequently, countries with stronger production systems and more developed institutional support mechanisms may demonstrate greater resilience during periods of economic instability.

7. Conclusions

Economic crises represent systemic disruptions that affect national economies and industrial sectors through sudden or unexpected shocks. These shocks rarely produce uniform outcomes; instead, they generate different effects depending on countries' structural characteristics, production capacity, export dependence, and institutional resilience. In this context, the automotive sector stands out as one of the most sensitive industries due to its capital-intensive structure, extensive supply chains, and strong integration with global markets. Accordingly, understanding how crises propagate through automotive production systems and how recovery mechanisms function is essential for both policymakers and managers.

Within the conceptual framework of economic crisis, this study emphasizes that crises not only generate negative economic outcomes but also challenge existing equilibria at both the micro and macro levels. From a systemic perspective, crises can be interpreted as shocks that disrupt the balance between production, finance, and trade. The ability to minimize crisis damage and, where possible, trans-

form crisis conditions into opportunities depends largely on effective crisis management, strategic decision-making, and institutional coordination. In this regard, the literature highlights the importance of managerial competence, shared organizational values, and adaptive capacity in sustaining performance during periods of instability (Wyatt, 2002; Topçu, 2017; Şendoğdu, 2014).

The study has also examined businesses in difficulty during crisis periods and the measures that can be taken to address financial distress. The analysis shows that economic, financial, and technical failures often emerge sequentially, reinforcing one another if not addressed on time. Firms that demonstrate environmental sensitivity, conservative financing behavior, strategic flexibility, and strong organizational identity are better positioned to withstand crisis pressures (de Geus, 1998). At the macro level, policy instruments aimed at ensuring macroeconomic stability, maintaining price stability, supporting liquidity, and strengthening institutional credibility play a critical role in limiting the depth and duration of crisis impacts (Aktan & Şen, 2001; Eroğlu & Kara, 2017). At the micro level, restructuring, adaptive pricing strategies, effective leadership, and crisis preparedness emerge as key mechanisms for restoring operational balance.

Empirically, the study has analyzed automobile production and export turnover data for Türkiye and selected European Union countries—Italy, France, Denmark, Estonia, and Poland—over the 2014–2023 period. This period captures multiple overlapping crisis episodes, including the COVID-19 pandemic and subsequent energy- and geopolitics-driven economic shocks. The descriptive statistics reveal substantial cross-country variability in both production and export performance, indicating heterogeneous structural conditions across national automotive systems.

The panel data analysis provides further insight into these dynamics. The fixed-effects model demonstrates a statistically significant relationship between production volume and export turnover, indicating that within countries, production increases are associated with higher export performance. However, the model's relatively low explanatory power suggests that production alone cannot fully account for export outcomes under crisis conditions. This finding implies that crisis periods introduce additional distortions such as demand volatility, cost pressures, and logistical disruptions

that weaken otherwise stable production–export linkages.

The random-effects model yields a stronger estimate of the relationship, but the Hausman test indicates that the fixed-effects specification is more appropriate. This result confirms that country-specific characteristics are correlated with production dynamics and should be treated as structural rather than random. In other words, the same global shock does not translate into identical outcomes; instead, national automotive systems respond differently depending on scale, institutional capacity, and crisis management effectiveness.

The comparative analysis further shows that countries with higher production and export volumes experienced sharper absolute declines during crisis periods, whereas countries with lower production levels exhibited more moderate contractions. This pattern suggests that greater integration into global value chains may amplify exposure to systemic shocks. At the same time, the persistence of a positive production–export linkage implies that recovery processes may follow similar patterns once production capacity stabilizes and export channels normalize.

Overall, the findings of this study contribute to the literature on economic crisis management by demonstrating how crisis shocks affect automotive industries differently across countries and by high-

lighting the conditions under which production–export dynamics remain resilient during recovery periods. For policymakers, the results underline the importance of proactive macroeconomic stabilization policies and sector-specific support measures that reduce vulnerability to external shocks. For managers, the findings emphasize the need for strategic flexibility, crisis preparedness, and organizational resilience in maintaining performance under adverse conditions. Beyond its economic implications, this study offers key insights into strategic management. The asymmetric crisis responses observed between Türkiye and European Union economies demonstrate that their institutional and structural contexts shape the strategic flexibility and resilience of automotive firms. Economic crises thus act not only as macroeconomic shocks but also as strategic inflection points that reveal firms' adaptive capacities. Diversifying export markets, implementing flexible production systems, and building resilient supply chains are critical for mitigating the impacts of crises. Furthermore, crisis management strategies should be tailored to each country's specific institutional capacities and production scales. Future research may extend this analysis by incorporating additional explanatory variables, such as energy costs, exchange rate volatility, and firm-level data, to explore further the mechanisms through which structural differences influence crisis dynamics in industrial systems.

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PRELIMINARY COMMUNICATION

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Financial nihilism and the phenomenon of memecoins



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FINANCIAL NIHILISM AND THE PHENOMENON OF MEMECOINS

ABSTRACT

Purpose: To introduce a conceptual framework of financial nihilism and demonstrate how memecoins embody it, while proposing measurable macro- and micro-level proxies that can track its emergence.

Methodology: Conceptual synthesis and desk research are paired with an empirical illustration: daily data for the 20 largest memecoins active ≥ 1 year (Dec/2013 – Oct/2025) against Bitcoin. We report distribution diagnostics and correlations, and assemble a proxy basket from FRED (money supply, housing prices/affordability, consumer credit, real wages, consumer sentiment, a real 1-year rate, and a personal saving rate; 2020–2025).

Results: Memecoin returns exhibit extreme volatility, positive skew and fat tails, with medians near zero and infrequent, outsized upside bursts. Major memecoins co-move tightly with Bitcoin, while smaller tokens decouple idiosyncratically. Dogecoin dominates capitalization, yet issuance velocity and failure rates point to pervasive turnover. The macro backdrop (elevated liquidity, housing inflation, rising household debt, stagnant real compensation, depressed sentiment, and a shift from near-zero to positive real short rates alongside subdued saving) creates conditions favoring short-horizon, attention-driven speculation.

Conclusion: Memecoins operate less as value-based investments and more as cultural-financial performances, making them useful proxies of a broader turn toward financial nihilism. Tracking the proposed proxy basket alongside memecoin activity can help policymakers and regulators anticipate retail risk-on/off waves and calibrate macroprudential, literacy, and consumer-protection responses.

Keywords: Financial nihilism, memecoins, proxy variables, speculative assets

1. Introduction

Zero as a number and the concept of “nothing” (lat. nihil) have been controversial ever since people started contemplating reality (Dhar, 2012; Bhattacharyya, 2021; Mumford, 2021; Riviere, 2025). “Nihilism” in its modern philosophical sense was coined by German philosopher F. H. Jacobi in 1799 (Livieri, 2020). In the political context, it de-

notes the rejection of fundamental social and political structures. It has spread particularly after Nietzsche, who used it to describe the disintegration of traditional morality in Western society (Britanica, 2025).

After two world wars, the subsequent Cold War, and countless large-scale crises, a form of *nihilism* has been interwoven into almost every part of mod-

ern society; finance is certainly one of them. The term “financial nihilism” in the present day is most frequently used in the sense described by Kofinas (2019): it is “an investment philosophy that treats the objects of speculation as though they were inherently or intrinsically worthless.” From this, we describe financial nihilism as a skeptical or cynical attitude towards the value and meaning of financial assets and norms, reflecting a deep distrust that financial assets, systems, or institutions possess any inherent value, fairness, or rationality. It emerges from the perception that decadent society (along with its markets) no longer rewards productivity, prudence, or fundamental analysis, but instead operates as a performative arena where value is dictated by popularity, speculation, and collective delusion.

Within the context of this paper, we define memecoins as crypto-assets inspired by internet memes, viral trends, or humorous cultural phenomena, typically lacking underlying utility or technological purpose, with value primarily driven by community hype, social media momentum, and celebrity endorsements. The nihilistic postmodern zeitgeist is particularly evident in memecoin speculation, where absurdity, humor, and chaos replace traditional valuation and logic, and where participants knowingly embrace risk while financing objects they themselves regard as preposterous.

The primary purpose of this paper is to describe the emergence of financial nihilism as a novel concept, and the occurrence of memecoins as one representation of it. The secondary purpose is to detect and identify reliable metrics that could function as measurable proxies of financial nihilism and the memecoin market.

The phenomenon of crypto-assets, which was born from profound disappointment with traditional financial systems¹, and memecoins as a crypto offspring, pose the paradox of value: can assets with no intrinsic utility garner significant market attention? Are there objective metrics which could substantiate the narrative of financial nihilism as described here?

The hypothesis of this paper states that, although they have no meaningful value and may ultimately prove be just a passing trend, memecoins are an expression of financial nihilism, an indicator of wider changes in societal values and perspectives. Al-

though trivial and banal on the surface, they should not be ignored, but rather observed with the aim of understanding them better as signals of possible structural changes.

These topics are extremely important because if financial nihilism emerges, it can spread everywhere and needs to be challenged right from the start. Nihilism erodes trust in economic institutions, undermines the incentives for productive investment, and replaces long-term value creation with short-term speculation, irony, and existential detachment from financial norms. Traditional finance is built on assumptions of rationality, institutional trust, and a long-term perspective. Financial nihilism breaks these assumptions, revealing the psychological and cultural consequences of decades of crisis, rising inequality, and (perceived) systemic manipulation. When people no longer believe that effort, hard work, or fundamental analysis matter, or when memecoins replace conventional investment assets, and ironic slogans² replace legitimate investment logic, this could indicate not just a behavioral shift, but deeper philosophical and generational breaks. This could severely destabilize not just markets, but the social contract that underpins them. Therefore, even if the size of the memecoin market is trivial in comparison to the long-established financial markets, they should not be overlooked and lightly disregarded, as they may represent a manifestation of an important trend.

The rest of this paper is structured as follows. The literature review evaluates previous research important for understanding financial nihilism and memecoins. The methodology and data section outlines the methods and data used for the quantitative examination of financial nihilism. The results and discussion section presents the empirical findings and situates them within the broader research context. Finally, the conclusion summarizes the key insights and implications.

2. Literature review

The literature on nihilism is abundant; however, “to the best of our knowledge, academic papers on “financial nihilism are almost non-existent. EBSCO Business Source Complete (with EconLit), Google Scholar, JSTOR, Scopus, and Web of Science (WoS – all subset databases) were searched in May–October 2025 for the phrase “financial nihilism”.

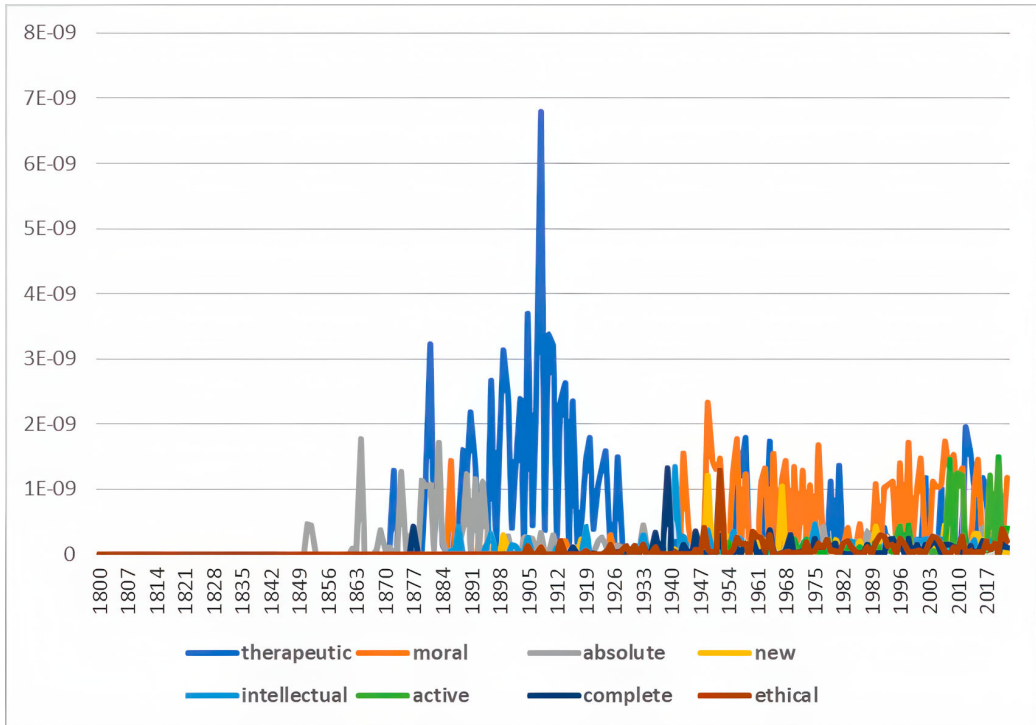
1 Bitcoin’s genesis block refers to the use of public resources to bail out private companies.

2 E.g. “stonks only go up”; “to the moon” (Anton et al., 2024).

EBSCO provided one result (Das, 2011). JSTOR has no entries regarding financial nihilism. Google Scholar provided 30 results, most of them citing work presented in this paper, with some exceptions (De Collibus, 2024; DuPont et al., 2024). Scopus yielded one result: a book chapter that referenced previous work (Clarke, 2024). WoS returned two results (Romano, 2012; Tkachenko & Pototskyi, 2013). Recently, Sajter (2026) has offered a structured review of how nihilism has been defined, debated, and challenged across major schools of economic thought, coupled with a bibliometric analysis (using Dimensions.ai, Scopus and Web of Science) mapping the term's diffusion, co-occurrence patterns, and thematic clusters in the business and economics literature.

Given that the academic literature is scarce at best, the entire corpus of English language corpus of books from 1800 to 2020 was examined, as indexed by Google Books and presented by Ngram Viewer, searching for phrases containing "nihilism". The most frequently occurring phrases include *moral, active, therapeutic, absolute, ethical, intellectual*, and *complete nihilism*. The percentages in the Google Ngram Viewer represent the frequency of a word or phrase (an "ngram") as a proportion of all words in the corpus for a given year (Graph 1). The peak was in 1908 with "therapeutic nihilism". "Financial nihilism" as a phrase, as well as the term "memecoins", do appear in the literature, but are so rare that they cannot be displayed, which indicates their novelty and originality.

Graph 1 Google Ngram results for phrases containing 'nihilism' in the English language corpus, 1800–2020

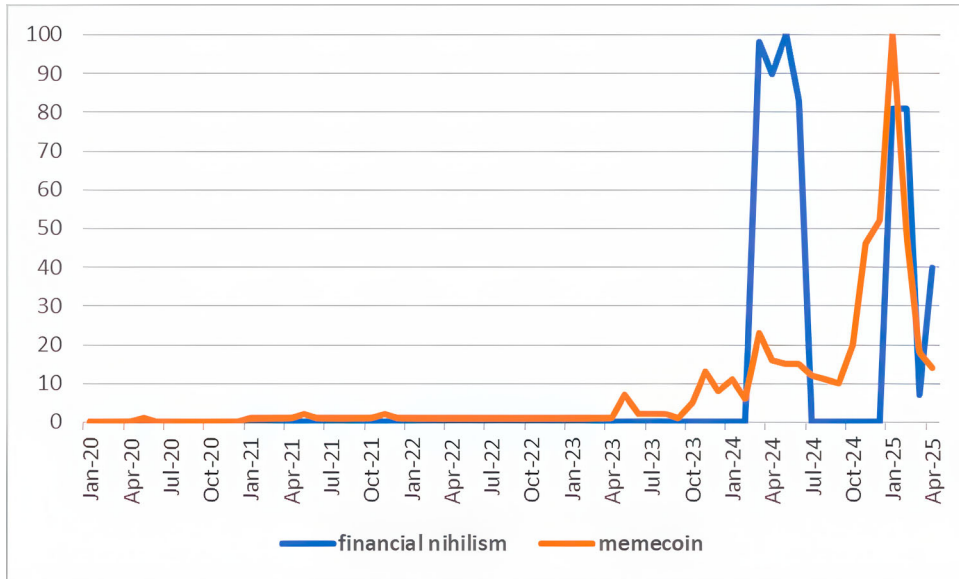


Source: Authors, data from Google Books (2025)

"Memecoins" and "financial nihilism" have been trending web search terms in recent years. It can be observed from Google Trends data that prior to

March 2024 there was no web search history for the phrase "financial nihilism", while the term "memecoin" first appeared in search queries in July 2013.

Graph 2 Worldwide Google search trends for ‘financial nihilism’ and ‘memecoin,’ January 2020–April 2025



Source: Authors, data from Google Trends (2025)

Although academic literature is scarce, financial nihilism is not a completely new concept, as some papers touch upon it. They are presented here in chronological order.

A century and a half ago, Smith (1883) addressed the figure of the “financial nihilist” as part of a broader critique of radical economic reform movements. He portrays financial nihilists as extreme, destructive figures aligned with a broader revolutionary current, including communists, socialists, and anarchists, who seek not reform but the total dismantling of existing institutions, including private property, established morality, and social order. Smith uses “financial nihilist” as a rhetorical tool to condemn radical reformers who propose abolishing private property and capitalism without offering a coherent, realistic alternative, and whose ideas, he believes, would lead to social and economic chaos rather than justice.

McKenna and Zannoni (2000) argue from a Post-Keynesian perspective that uncertainty, particularly non-ergodicity³, is a fundamental feature of

economic reality, especially evident in investment decisions. They emphasize that investment decisions involve non-ergodic uncertainty, indicating that the future cannot be probabilistically estimated with historical data. This aligns with the philosophical foundation of financial nihilism, where valuation lacks objective certainty. They argue that uncertainty does not eliminate rationality. Instead, rationality under uncertainty involves creating institutions to manage and mitigate insecurity. In the context of financial nihilism, one might interpret memecoins as informal “institutions” that develop spontaneously, as communities face inherent uncertainty, embracing absurdity as a response to an unpredictable financial system. Instead of concluding that uncertainty leads to nihilism, the authors state that uncertainty incentivizes the creation of protective institutions, social safety nets, and preventive mechanisms (e.g., bankruptcy laws, central banks, regulatory frameworks). Financial nihilism, on the other hand, might arise when such institutions fail or are perceived to be ineffective, leading market participants to act in ways which are not in line with traditional notions of rationality. While McKenna and Zannoni reject nihilism as a logical outcome, their detailed analysis of the implications of uncertainty helps to explain why financial ni-

³ The inability to reliably predict future events using past data—that is, knowing how something behaved in the past or in similar circumstances does not reliably indicate what will happen in the future.

hilism might occur when institutions fail or when market participants stop believing in conventional economic rationality, and instead participate in speculative financial behavior, such as buying (and creating) memecoins.

The section “Financial Nihilism” by Das (2011, pp. 321–335) is strongly connected to the memecoin phenomenon by presenting the loss of meaning and moral grounding in modern financial markets, which is a core characteristic of financial nihilism. Das describes a world in which money is not tied to the creation of value but instead ends up being a goal on its own, used to speculate and present status. Memecoins perform similarly: they are often created as jokes or social comments, but are treated as tradable assets. They are bought and sold not because they reflect underlying economic fundamentals, but because of the pleasure of participating in a certain moment and the pursuit of profit regardless of any belief. Das outlines how finance enters into everyday life, converting identity, success, and even suffering into commodities. Memecoin culture reflects this, where individuals insert themselves into financial narratives (e.g., “retiring on Dogecoin”) and view market participation as a form of performance. The purpose of memecoin trading is not to seek its fundamental value (as it is evidently non-existent) but to signal cultural belonging, nihilistic revolt, and an acceptance of speculative chaos. This is at the same time a critique of, and escape from, a financial system perceived as irreparably rigged, meaningless, or disconnected from reality. Financial nihilism is portrayed by Das as the exploitation of systems and people for gain, without concern for consequences. This characteristic is reflected in the intentional absurdity and recklessness of memecoin speculation. Markets become playgrounds of irony and detachment, where losing is part of the joke and moral responsibility is disregarded. Das’s narrative ends with the perception that the system has collapsed, with people participating in finance not because they believe in its purpose, but because it is the only thing left to do (since hard work does not matter). Memecoin traders often exhibit this postmodern disillusionment, treating markets as casinos in which meaning does not exist, yet the “game” continues. By emphasizing detachment from fundamentals, financialization, cynicism, moral decline, and the collapse of belief in long-term stability, Das provides the philosophical and cultural background within which the memecoin phenomenon can be interpreted. Examined through the perspective of Das, memecoins are not an anomaly, but a logical and

inevitable expression of late-stage, decadent finance, where value is replaced by virality.

Talavera (2014) examines the notion of financial nihilism through the framework of a “genealogy of speculation”. He argues that contemporary financial capitalism, characterized by speculative practices, separates economic actions from underlying ethical and substantial value systems. This separation is parallel with financial nihilism, where financial speculation itself becomes self-referential and disconnected from real economic value, leading to a crisis of meaning and legitimacy in economic systems. Talavera critically addresses how speculative finance advances nihilistic attitudes by prioritizing profit over ethical considerations or meaningful human goals.

Gendron et al. (2022) highlight the challenge to traditional financial expertise by alternative forms facilitated by digitalization, indicating a shift in financial knowledge dissemination and power structures. This study contributes to understanding speculative practices by showing how alternative expertise incorporates traditional elements, influencing market dynamics. It also illustrates how bottom-up movements can create populist economics, impacting financial markets and challenging established institutions. As such, it links financial nihilism to contemporary capitalism through retail investors’ resentment and the disruption of traditional market rules.

Considering memecoins, Philander (2023) describes meme asset gambling as speculation disconnected from traditional measures of value, involving collective behavior and overconfidence. This is closely related to financial nihilism. He implies that financial markets increasingly look like gambling environments, requiring regulatory standards and financial literacy programs. His study contributes to theoretical understanding by linking speculative practices to gambling behaviors, highlighting the need for frameworks that integrate financial speculation with the psychological understanding of risk-taking.

By showing how memecoins reflect an emotional and often parodic attitude toward financial participation, Anton et al. (2024) add further support to the interpretation of financial nihilism presented in this paper. Their analysis of blockchain ecosystems as media environments filled with symbolic engagement emphasizes the argument that memecoins

function less as rational investments and more as cultural performances. Adding to this conceptual and cultural framing, Conlon and Corbet (2025) provide econometric evidence that memecoin proliferation contributes to heightened systemic risk, irrational contagion, and ethically ambiguous market behavior. In addition, Galati and Perdichizzi (2025) demonstrate how symbolic and affective drivers (rather than fundamentals) can reorganize value flows, further hiding the distinction between speculation and collective narratives. Lee and Ryu (2025) argue that memecoin dynamics demonstrate a broader shift toward symbolic extraction in digital finance, where virality and narratives replace fundamental valuation as drivers of speculative behavior. Together, Long et al. (2025) and Wang et al. (2025) show how memecoins derive legitimacy and market traction through the interaction of affective language, visual symbolism, and community-driven narratives, revealing a logic of valuation rooted less in fundamentals than in participatory performance.

In his forthcoming book, Samman (2026) argues that recent trends in digital finance repeat the dilemmas of nihilism, giving rise to a lucrative new culture of financial nihilism. Samman links sentiments of nihilism to the logic of global finance, essentially claiming that all historical moods of nihilism now circulate within the financial system.

While prior research has provided insights pointing toward financial nihilism, the conceptual framework is still lacking. Therefore, a systematic analysis of potential reasoning is evaluated. The underlying methodology is explained in the following paragraphs.

3. Methodology and data

This paper presents a theoretical and conceptual framework for financial nihilism and seeks to identify its measurable proxies through desk research and a literature review. In order to achieve this, memecoin prices are analyzed to illustrate the emergence of financial nihilism due to the following factors:

By design, memecoins typically have no underlying project or cash flow. A token might be launched in minutes with a funny name and image, purely as a vehicle for speculation. This radical lack of fundamentals takes the greater fool theory to its extreme. Memecoin traders fully internalize this: they bet on momentum, popularity, and narrative alone—a consciously nihilistic stance on value.

Memecoins are notorious for explosive rises and crashes within days or even hours. Traders often know this will happen, yet they still play the game, hoping to time it correctly. This reflects a form of fatalistic risk-taking, an acknowledgment that everything is essentially gambling.

Memecoin culture thrives on internet humor, irony, and community-driven narratives. By bonding over the idea that the financial system is a joke, memecoin enthusiasts both express their cynicism and momentarily surpass it through the perception of collective fun.

To empirically support the analysis, daily price data for the 20 largest memecoins (by market capitalization) that have operated for at least one year were collected from CoinMarketCap.com in mid-October 2025, covering the period from Dec/2013 to Oct/2025. Since most functioning memecoins (at the time of data collection) were launched relatively recently, they have shorter historical records. Furthermore, only memecoins that had been active for at least one year were selected in order to exclude those experiencing temporary hype at the time of data collection.

Clearly, this sample is encumbered with survivorship bias, as industry reports state that approx. 97% of memecoins disappeared after their introduction, and that the average lifespan of a memecoin is one year (ChainPlay, 2024b). However, since it was not feasible to obtain data for memecoins that had disappeared (collapsed or faded away), the sample was analyzed with this caveat in mind. As the most influential force of crypto-economics and the dominant driver, Bitcoin price was also observed in parallel with the selected memecoins. Bitcoin data were obtained from Investing.com. It should also be noted that memecoins are treated as signals or proxies rather than comprehensive representations of contemporary finance, and that generalizations should be performed accordingly.

The underlying logic of financial nihilism is substantiated using time-series variables that elucidate the economic background of the memecoin phenomenon. The selected time-series data presented in Table 1 were obtained from the Federal Reserve Bank of St. Louis (FRED, 2025) that, taken together, could serve as proxies for the mindset described by financial nihilism. It covers monthly level data from 01/01/2020 to 01/08/2025.

The empirical analysis relies on U.S. macroeconomic data (FRED), and macro proxies reflect U.S. economic conditions. Therefore, conclusions about financial nihilism should be interpreted primar-

ily within a U.S.-influenced context. However, in a highly-interconnected and globalized world it is believed that fundamental insights could be applicable elsewhere.

Table 1 Variables selected from FRED as proxies for financial nihilism

Time series (FRED code)	Variable name	What it measures (proxy for)	Rationale for inclusion
M2 Money Stock (M2SL)	<i>money</i>	Broad U.S. money supply including cash, checking and savings deposits, and retail money-market funds	Rapid increases reflect extraordinary monetary expansion. Excess liquidity can fuel speculative manias and make traditional valuation anchors seem irrelevant.
Housing Inventory: Median Listing Price per Square Feet (MEDLISPRIPERSQUFEEUS)	<i>house1</i>	Housing affordability	Rapidly rising listing prices per square foot reflect deteriorating housing affordability. When property prices soar relative to wages, more households feel locked out of traditional wealth-building via homeownership. This can feed frustration and encourage speculative behavior in riskier assets, making housing affordability a useful component in an index capturing the conditions underlying financial nihilism.
S&P/Case-Shiller U.S. National Home Price Index (CSUSHPINSA)	<i>house2</i>	Composite home price index for the U.S. housing market. Provides a broad measure of housing price appreciation	A variable complementary to housing affordability. Asset inflation increasingly prices out younger buyers and drives them toward unconventional investments.
Consumer Credit Outstanding (TOTALSL)	<i>debt</i>	Total consumer debt held by households (revolving + nonrevolving) - captures the overall level of household credit exposure	Higher values indicate greater reliance on debt and potential strain on disposable income, which encourages gambling behavior.
Real Compensation Per Hour, Business Sector (RCPHBS); quarterly data interpolated to monthly frequency	<i>wage</i>	Real (inflation-adjusted) hourly compensation in the U.S. business sector	Lower or stagnant wages can devolve financial optimism into nihilism.
University of Michigan Consumer Sentiment Index (UMCSENT)	<i>feel</i>	Survey of consumers' attitudes toward personal finances and the economy	Persistent pessimism reflects distrust in the economic system.
1-Year Real Interest Rate (REAINTRATREARAT1YE)	<i>yield (%)</i>	Real yield that investors face; true purchasing-power return on risk-free assets over the next year	Extremely low or negative real rates destroy the opportunity cost of holding risky assets and encourage "search for yield" speculation.
Personal Saving Rate (PSAVERT)	<i>save (%)</i>	Savings as a percentage of disposable income	A falling savings rate (sometimes negative) signals that households are spending or speculating rather than building long-term buffers.

Source: Authors

Except for *yield* and *save* (which are in percentages), variables *money*, *house1*, *house2*, *debt*, *wage* and *feel* were standardized to the index value of 100

on the starting date (01/01/2020) in order to obtain comparability.

4. Results and discussion

The selected sample of the 20 largest memecoins by market capitalization, which had been active (were

in fluctuation) for at least one year at the date of data collection is shown in Table 2.

Table 2 Market capitalization of the memecoin sample (Oct/2025)

No.	Memecoin	Market Cap (USD bn)	Sample share
1	Dogecoin	30.30	66.1%
2	Shiba inu	6.01	13.1%
3	Pepe	3.01	20.8%
4	Bonk	1.22	
5	SPX6900	0.96	
6	FLOKI	0.76	
7	dogwifhat	0.54	
8	Fartcoin	0.37	
9	ApeCoin	0.31	
10	Toshi	0.30	
11	Cheems	0.28	
12	Brett	0.27	
13	AICompanions	0.23	
14	Snek	0.22	
15	MogCoin	0.19	
16	Dog (Bitcoin)	0.19	
17	Turbo	0.18	
18	BabyDogeCoin	0.18	
19	catinadogsworld	0.17	
20	Popcat (SOL)	0.15	
TOTAL		45.84	100%

Source: Authors, data from CoinMarketCap (2025)

Even though the market size of the largest memecoins is not trivial, at approximately USD 46 billion, market capitalization of Bitcoin at the same time was approximately 50 times greater, at approxi-

mately USD 2.28 trillion, which clearly shows the significantly larger scale of the dominant global crypto-asset.

Table 3 Descriptive statistics of daily returns for Bitcoin and sampled memecoins, Dec/2013–Oct/2025

No.	Asset	Obs.	Sample length (in years)	Mean	Trimmed mean (5%)	Median	Min.	Max.	Std. Dev.
0	Bitcoin	4315	11.8	0.24%	0.16%	0.09%	-57.21%	336.84%	6.74%
1	Dogecoin	4315	11.8	0.46%	-0.04%	-0.15%	-44.07%	355.49%	9.58%
2	Shiba inu	1906	5.2	4.46%	0.07%	0.00%	-71.57%	5852.38%	135.62%
3	Pepe	920	2.5	5.73%	0.18%	-0.12%	-32.80%	3974.87%	131.79%
4	Bonk	1025	2.8	1.03%	0.09%	-0.48%	-39.63%	193.72%	12.67%
5	SPX6900	795	2.2	2.30%	0.99%	-0.27%	-37.35%	324.26%	18.93%
6	FLOKI	1563	4.3	19.05%	-0.13%	-0.48%	-99.62%	28850.00%	729.80%
7	dogwifhat	700	1.9	2.87%	0.56%	-0.39%	-70.64%	678.37%	30.46%
8	Fartcoin	366	1.0	2.67%	1.10%	-0.16%	-42.69%	225.19%	19.73%
9	ApeCoin	1312	3.6	-0.05%	-0.11%	0.01%	-37.31%	70.13%	6.15%
10	Toshi	807	2.2	10.27%	-0.11%	-1.37%	-98.79%	7280.12%	256.72%
11	Popcat(SOL)	678	1.9	3.55%	0.75%	-0.54%	-47.98%	714.24%	37.38%
12	Cheems	387	1.1	1.32%	0.67%	0.09%	-35.99%	73.28%	10.08%
13	Brett	601	1.6	1.41%	0.22%	-0.77%	-28.83%	217.08%	14.30%
14	AICompanions	405	1.1	1.32%	0.07%	-0.93%	-29.90%	89.65%	13.41%
15	Snek	898	2.5	0.84%	0.50%	-0.34%	-48.20%	79.74%	9.64%
16	MogCoin	823	2.3	1.35%	0.37%	-0.25%	-55.50%	123.36%	14.09%
17	Dog (Bitcoin)	541	1.5	0.20%	-0.21%	-0.74%	-22.73%	37.82%	8.62%
18	Turbo	903	2.5	1.56%	-0.17%	-0.95%	-47.24%	431.17%	21.54%
19	BabyDogeCoin	1486	4.1	0.24%	-0.18%	-0.36%	-28.76%	75.31%	7.06%
20	catinadogsworld	572	1.6	0.59%	-0.19%	-0.47%	-26.37%	96.96%	10.90%

Source: Authors

Table 3 shows a market characterized by extreme dispersion and short, uneven histories. While Bitcoin's average daily return is modest with relatively lower dispersion, many memecoins combine brief sample lengths (often under 3 years) with much larger variability and occasional outsized jumps; e.g., several tokens exhibit negative medians despite positive means, consistent with infrequent “pump” episodes amid generally poor days, whereas cases

like FLOKI post extraordinary maximum alongside triple-digit standard deviations, and newer entrants such as Pepe or Dogwifhat display similarly turbulent profiles over short windows. Taken together, these patterns show that memecoins operate less as vehicles of steady value accumulation and more as arenas for episodic speculation in which participation and narrative momentum outweigh (non-existing) fundamentals.

Table 4 Distributional characteristics of the selected crypto-asset returns

No.	Asset	Coef. Var.	Skewness	Kurtosis	Jarque-Bera ($p = 0.00$)
0	Bitcoin	2,758.55	30.31	1,476.62	392,000,000
1	Dogecoin	2,096.95	15.84	510.90	47,000,228
2	Shiba inu	3,041.26	42.17	1,817.40	261,000,000
3	Pepe	2,300.86	29.80	898.06	30,717,049
4	Bonk	1,228.29	7.00	91.75	364,356
5	SPX6900	824.51	6.81	105.71	371,611
6	FLOKI	3,831.29	39.52	1,562.30	158,000,000
7	dogwifhat	1,060.93	16.40	349.94	3,552,005
8	Fartcoin	738.44	4.85	46.87	33,993
9	ApeCoin	-12,853.49	1.47	20.34	22,908
10	Toshi	2,500.33	28.25	800.85	21,406,387
11	Popcat(SOL)	1,053.96	13.88	238.93	1,610,616
12	Cheems	766.40	1.85	10.55	1,962
13	Brett	1,015.27	6.92	90.64	207,043
14	AICompanions	1,016.40	2.40	10.12	2,065
15	Snek	1,142.96	0.99	9.33	3,363
16	MogCoin	1,046.91	2.17	12.48	5,918
17	Dog (Bitcoin)	4,410.96	0.87	1.92	147
18	Turbo	1,379.45	12.43	218.25	1,795,516
19	BabyDogeCoin	2,905.27	2.67	21.26	29,537
20	catinadogsworld	1,835.67	3.24	22.19	12,512

Source: Authors

Table 4 indicates that return distributions across the sample are profoundly non-normal. Coefficients of variation are in the thousands for key names, accompanied by pronounced positive skew (often above 10) and extreme kurtosis (hundreds to > 1.500), with the Jarque–Bera test rejecting normal-

ity at $p = 0$ for all series. Bearing in mind that the sample is survivorship biased, these fat-tailed and right-skewed distributions formalize that meme-asset payoffs are dominated by rare, outsized upside bursts amid long stretches of modest or negative average returns.

Table 5 Correlation matrix of daily returns among major memecoins

ASSETS	BTC	Doge	Shiba inu	Pepe
BTC	1.00			
Dogecoin	0.78	1.00		
Shiba inu	0.67	0.73	1.00	
Pepe	0.66	0.68	0.75	1.00
Bonk	0.61	0.62	0.70	0.71
SPX6900	0.57	0.54	0.61	0.59
FLOKI	0.63	0.65	0.81	0.80
dogwifhat	0.61	0.66	0.72	0.80
Fartcoin	0.27	0.26	0.23	0.27
ApeCoin	0.53	0.55	0.62	0.59
Toshi	0.27	0.29	0.26	0.29
Popcat(SOL)	0.59	0.60	0.67	0.69
Cheems	0.30	0.30	0.37	0.34
Brett	0.68	0.70	0.76	0.78
AICompanions	0.13	0.08*	0.09*	0.11
Snek	0.62	0.56	0.66	0.55
MogCoin	0.63	0.57	0.64	0.75
Dog (Bitcoin)	0.41	0.42	0.40	0.40
Turbo	0.54	0.50	0.65	0.64
BabyDogeCoin	0.44	0.47	0.60	0.67
catinadogsworld	0.64	0.68	0.66	0.66

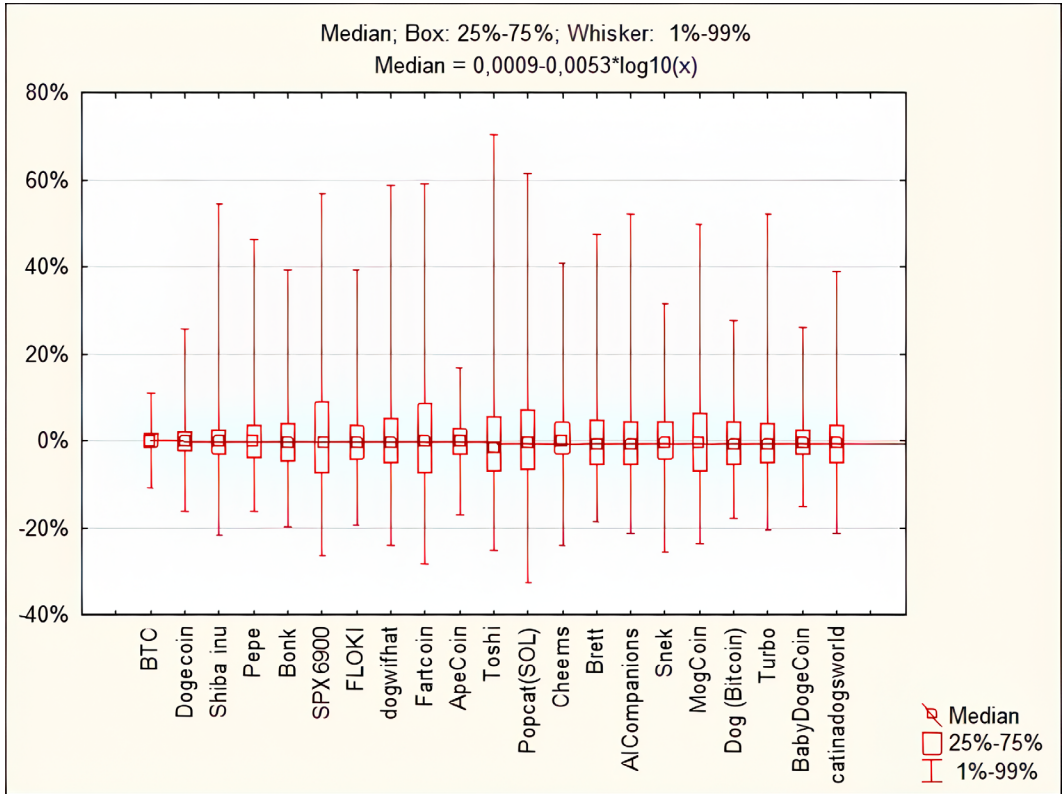
* Insignificant at $p < .05$; all other results are significant

Source: Authors

Most pairs co-move strongly with Bitcoin and with each other (e.g., BTC–Doge 0.78, BTC–Shiba 0.67, BTC–Pepe 0.66), and several bigger memecoins form a tightly linked cluster (Shiba–FLOKI 0.81, Pepe–FLOKI 0.80, Dogwifhat–Pepe 0.80). At the same time, a second tier exhibits only moderate co-movement, which suggests idiosyncratic narratives and/or thin liquidity. The correlation matrix (Table

5) implies that shared liquidity cycles create market-wide “risk-on/off” waves, but with meaningful heterogeneity: large memecoins are synchronized with the crypto market factor, whereas smaller or niche tokens decouple more often, reducing diversification benefits within the meme segment and concentrating drawdown risk during common shocks.

Graph 3 Distribution of daily returns: Box-and-Whisker for Bitcoin and major memecoins (Full Sample)

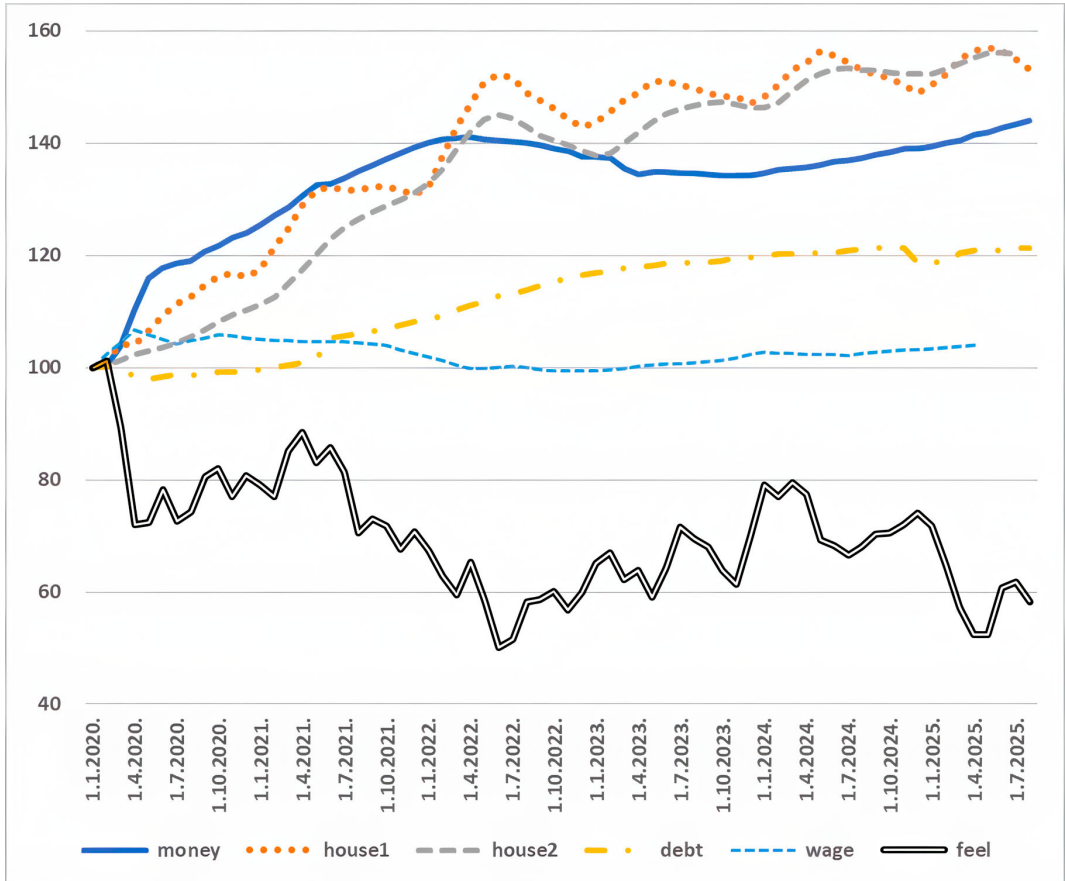


Source: Authors

The box-and-whisker plots (Graph 3) show medians clustered near zero, but much wider interquartile ranges and longer whiskers for most memecoins than for Bitcoin, with frequent asymmetric outliers (especially on the upside), indicating irregular bursts rather than steady drift. Several large names (e.g., Doge, Shiba Inu) display fat upper tails along-

side sizable downside extremes, while newer coins exhibit even more dispersed boxes with sparse but violent jumps, consistent with episodic attention waves rather than continuous price formation. This implies that location and scale summaries (means, standard deviations) understate risk because dispersion is driven by tail events.

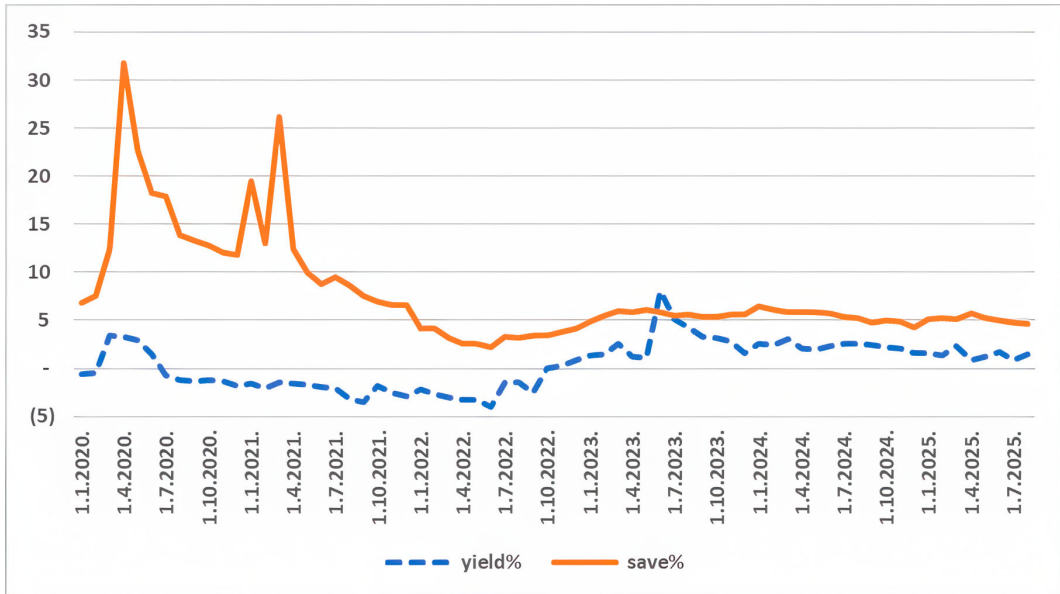
Graph 4 Socioeconomic proxies underpinning memecoin activity, 2020–2025 (indexed to 100 in Jan-2020)



Source: Authors, data from FRED (2025)

The macro backdrop in Graph 4 shows a combination that is unusually favorable to speculative retail cycles: liquidity (*money*) remains elevated relative to its pre-2020 baseline, housing indicators (*house1*: median listing price per sq. ft.; *house2*: Case-Shiller index) outpace stagnant compensation (*wage*), and household credit (*debt*) expands, while consumer sentiment (*feel*) spends long stretches below its starting level. These co-movements depict

abundant money, rising asset and housing costs, a squeeze on purchasing power, greater reliance on credit, and a persistently wary mood, i.e., conditions under which short-horizon, attention-driven speculation in meme assets becomes more attractive than conventional saving or long-horizon investing.

Graph 5 Real risk-free yield and personal saving dynamics, 2020–2025 (monthly, %)

Source: Authors, data from FRED (2025)

The contrast of the real 1-year risk-free rate and the personal saving rate highlights two distinct phases over 2020–2025. First, in the period 2020–2022, real short-term yields were near or below zero, while savings spiked briefly and then fell back. This environment lowered the opportunity cost of risk-taking and left a temporary stock of cash available for speculative participation. Second, from 2023 onward, real yields turned positive as policy tightened, yet the saving rate remained subdued and volatile, rather than reverting durably to pre-2020 condition. This asymmetric adjustment (higher real financing costs without a proportionate rebuilding of household buffers) helps explain why nihilistic trading could persist: households faced diminished incentives (and capacity) to accumulate precautionary savings, keeping short-term speculation attractive.

5. Discussion

One memecoin—Doge—strongly dominates, accounting for two-thirds of total memecoin market capitalization. However, it is important to note that

market capitalization is not the best indicator of the importance of memecoins in observing financial nihilism, as there were more than 13 million individual memecoins issued in 2025 only (Lagrou, 2025). Over 10,000 memecoins are launched every day at the pump.fun, the main global memecoin hub, but cca 95% of them disappear within the same day (ChainPlay, 2024a). Furthermore, at the same hub, 98% of memecoins do not survive beyond 3 months (ChainPlay, 2024a). This turnover clearly shows that the memecoin phenomenon is better captured by issuance velocity, birth–death (hazard) rates, and short-horizon trading churn than by market capitalization. In other words, the market's significance lies less in a few large, surviving tokens and more in the investment stance, where participation and thrill-seeking routinely outweigh fundamentals.

These statistics reveal a noticeable dual structure within the memecoin ecosystem. On the one hand, a small number of established tokens are traded in high-liquidity markets and denominated in millions of dollars. On the other hand, a vast underclass of short-lived tokens is created and destroyed at prices amounting to fractions of a cent. This two-tier sys-

tem reflects a broader fragmentation of financial meaning: between a symbolic layer where value persists through recognition and market capitalization, and a “disposable” layer where tokens function as momentary cultural gestures and/or speculative jokes. This disparity emphasizes how memecoin markets embody the illusion of wealth and the reality of uselessness, reinforcing the notion of financial nihilism as a situation in which participation, rather than long-term value, becomes the primary purpose.

When observed together with the macro proxies (Graphs 4 and 5), micro-evidence (Tables 3–5) suggests a market organized by liquidity and attention cycles rather than fundamentals. Fat-tailed return shapes coexist with a strong common factor (tight co-movement of bigger memecoins with Bitcoin) and occasional diversification in the long tail. This configuration implies that risk concentrates in “risk-on/off” episodes, while eccentric stories of smaller coins mostly fade out at the market level. The memecoin market could function as a proxy barometer of household mood and liquidity conditions, because when safe returns are irrelevant or liquidity is low, speculation rises up quickly and then withdraws just as fast, intensifying fragility through correlated shocks. However, it should be clearly stated that visual co-movements do not imply causality, and that further testing is needed.

6. Conclusion

This paper attempts to articulate a coherent concept of financial nihilism and show how the contemporary surge of memecoins makes that concept empirically measurable. The paper moves financial nihilism from a purely philosophical or abstract idea into a concept that could be measured, observed, or analyzed empirically through data, by looking at memecoin prices, volatility, or macro proxies like liquidity, real wages, or consumer sentiment.

The motivation is straightforward: if parts of modern finance have shifted from valuing fundamentals to performing participation, then measures to describe that shift are needed. Accordingly, we build a theoretical and conceptual framework, supported by desk research and a literature review, and illustrate it with market data on major memecoins (benchmarked to Bitcoin), and a set of proxies (money, housing costs/affordability, household credit, real wages and sentiment, and the real short-

rate/personal saving) that capture the background conditions under which short-horizon speculation becomes attractive.

The main findings exhibit that memecoins display a two-tier market structure: a small core of liquid, dollar-denominated names alongside a vast periphery of short-lived, sub-cent tokens/coins. Return distributions are profoundly non-normal: fat-tailed and positively skewed payoffs dominated by rare, outsized upside bursts amid long stretches of modest or negative average returns. Larger memecoins co-move tightly with Bitcoin, while smaller tokens decouple individually. Risk clusters in synchronized risk-on/off waves, with only occasional diversification in the long tail.

These findings align with the macro background characterized by higher liquidity relative to the period before the 2020s, wages behind housing costs, expanding household credit, depressed consumer sentiment, and post-2023 regime of positive real short rates without a corresponding reconstruction of household savings. Such conditions lower the usefulness of patient saving and make speculation comparatively appealing, helping explain why participation in nihilistic trading can persist.

Viewed through this perspective, “memecoin economics” is less about discounting cash flows and more about cultural-financial performance under weakened belief in institutions and fundamentals. Financial nihilism is not just disbelief, it may be the conviction that the system is broken. Participation and narrative recognition may substitute for intrinsic worth, and markets could be interpreted as casinos.

There are several implications of these findings. For digital finance, memecoin activity can serve as an indicator of household mood, offering early signals of retail risk-on phases. For regulators and policymakers, preparedness for shocks can improve with disclosure standards at launch, targeted consumer-protection, and financial literacy programs. At a broader level, if performative speculation and ironic participation are becoming normal, the legitimacy of institutions and the future orientation of finance are in jeopardy. These are questions of utmost importance that extend beyond microstructure into the political economy of trust.

This paper has its limitations and shortcomings. The analysis is primarily conceptual and English-language oriented, and the memecoin sample is

necessarily affected by survivorship bias because failed tokens leave insufficient data. The macro-level analysis is broad, exploratory, illustrative, and largely based on inspection of trends, and further formal statistical testing should be performed. These caveats do not overturn the findings, but they constrain validity and call for a more detailed analysis.

Future researchers could operationalize the proxy basket into a reproducible index and test its time-series relation to memecoin activity. Furthermore, one might link wallet-level flows and social-media attention to price bursts, in order to clarify the micro-channels of risk-on propagation.

In sum, the purpose of the paper was to name and measure an important drift in contemporary finance. Empirically, we showed that memecoin markets are organized by liquidity-and-attention cycles, exhibit a two-tier structure and fat-tailed payoffs, and co-move around a dominant crypto asset. Conceptually, we argued that these features are intelligible as manifestations of financial nihilism. If that diagnosis is correct, then memecoins are not a sideshow but a sensitive gauge of our financial culture, one that warrants careful monitoring by scholars, investors, firms, and governments alike.

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