Scientific Annals of Economics and Business

Alexandru Ioan Cuza University of Iasi

Volume 71 (LXXI), Issue 4, 2024

Editura Universității „Alexandru Ioan Cuza” din Iaşi
2024

Scientific Annals of Economics and Business (continues *Analele ştiinţifice ale Universităţii „Al.I. Cuza" din Iaşi. Ştiinţe economice / Scientific Annals of the Alexandru Ioan Cuza University of Iasi. Economic Sciences*)
Founded in 1954
ISSN–L 2501-1960; ISSN (Print) 2501-1960; ISSN (Online) 2501-3165
Publisher: Editura Universităţii „Alexandru Ioan Cuza" din Iaşi (http://www.editura.uaic.ro/)
Frequency: Four issues a year (March, June, September and December)

Indexed and Abstracted:
Clarivate Analytics Web of Science – Emerging Sources Citation Index, Scopus, EBSCO, EconLit (The American Economic Association's electronic bibliography), Directory of Open Access Journals (DOAJ), Research Papers in Economics (RePEc), ERIH PLUS, Central and Eastern European Online Library (CEEOL), Cabell's Directories, Scirus, IndexCopernicus, Online Catalogue of the ZBW - German National Library of Economics (ECONIS), Electronic Journals Library, The Knowledge Base Social Sciences in Eastern Europe, Scientific Commons, The ZDB, Intute: Social Science (SOSIG - Social Science Information Gateway), New Jour, GESIS SocioGuide, Genamics Journalseek, Catalogo Italiano dei Periodici (ACNP), Google Scholar, ResearchGate.

Journal metrics:
Clarivate Analytics - Journal Citation Reports 2023: Impact Factor: 0.9 (JIF quartile: Q3); 5 Year Impact Factor 0.8; JCI: 0.27; AIS: 0.105
Scopus: Quartile Q3; CiteScore 2023: 1.4; Scimago Journal Rank (SJR) 2023: 0.203; SNIP 2023: 0.542; CiteScore Tracker 2024: 1.6

Archiving:
All of SAEB's content is archived in **Portico** (https://www.portico.org/), which provides permanent archiving for electronic scholarly journals.

Contact
Alexandru Ioan Cuza University of Iasi
Faculty of Economics and Business Administration
Bd. Carol I no. 22, Iasi, 700505, Romania
Tel.: +40232201433, +40232201435, Fax: +40232217000
Email: saeb@uaic.ro, Website: http://saeb.feaa.uaic.ro

Table of contents

The Multidimensional Nature of CSR: The Role of the CEO Socio-Demographic Profile 449
Mariem Bouzguenda, Anis Jarboui

Technological Disruption, Ease of Doing Business, and Manufacturing Resilience: A Study of Competitiveness and Efficiency in Developing Countries 473
Dwi Budi Santoso, Ferry Prasetyia, Trinh Thi Chung, Axellina Muara Setyanti, Nayaka Artha Wicesa, Al Muizzudin Fazaalloh

Insights and Influencers: A Decade of Social Media Marketing Research Revealed Through Bibliometrics 497
Ahmad Khraiwish, Ahmed H. Alsharif

Impact of Innovation and Trade Participation on Economic Growth Among Selected African Countries 519
Victor Ushahemba Ijirshar, Isa Jibrin Okpe, Jerome Terhemba Andohol

Analysis of Public Debt in the Context of Crises Generated by Socio-Economic Events. Case Study: European Union Countries 547
Alin Vasile Străchinaru

Re-investigation of Financial Development on Income Inequality: An Empirical Analysis for G-20 Emerging Economies 583
Asiye Öznur Ümit, Sinem Eyüboğlu

Network Effects on Platform Markets. Revisiting the Theoretical Literature 605
Isabel Soares, Manuel Nieto-Mengotti

The Determinants of Firm Value: A Panel Data Approach on the S&P 500 Companies 625
Alexandra Ioana Vintilă

Income-Based Economic Determinants of Life Expectancy in Four Groups of Countries Classified by their Levels of Income 641
Ismael M. Abdulrahman, Sarah Ahmed Chawsheen

Scientific Annals of Economics and Business
71 (4), 2024, 449-472
DOI: 10.47743/saeb-2024-0025

The Multidimensional Nature of CSR: The Role of the CEO Socio-Demographic Profile

Mariem Bouzguenda*, Anis Jarboui**

Abstract: It is important to find out why corporations commit to socially responsible activities. Prior research have predominantly applied a uniform perception of corporate social responsibility CSR without paying particular attention to separate CSR activities. This outlook is surprising because firms meet social responsibility expectations through a unique CSR in spite of the stakeholder divergence. For addressing the limitation of these perspectives, this study develops the divergent dimensions of CSR (environment, governance and social). Afterwards, we look into the interdependencies between the different socio-demographic factors specific to the CEO (age, tenure; gender, and education level), accounting for the divergence in the CSR dimensions. Based on a sample of companies listed on the STOXX 600 index throughout the period ranging from 2018 to 2022, the results confirm that age, tenure and education level of the CEO are positively affect the CSR in governance dimension and social dimension. Nevertheless, the gender variable is negatively correlated with their dimensions.

Keywords: socio-demographic factors; multidimensional nature of CSR; the Upper Echelons Theory; the Stakeholder Theory and STOXX 600.

JEL classification: G32; O16; M14.

* University of Economic Science and Management of Sfax, Tunisia; e-mail: *mariembouzguenda@hotmail.fr* (corresponding author).
** University of Economic Science and Management of Sfax, Tunisia; e-mail: *anisjarboui@yahoo.fr*.

Article history: Received 25 June 2024 | Accepted 28 November 2024 | Published online 17 December 2024

To cite this article: Bouzguenda, M., Jarboui, A. (2024). The multidimensional nature of CSR: The role of the CEO socio-demographic profile. *Scientific Annals of Economics and Business*, 71(4), 449-472. https://doi.org/10.47743/saeb-2024-0025.

1. INTRODUCTION

The last decades have witnessed an increasing development in the concept of corporate social responsibility (CSR) (Moisescu, 2017; Kumar *et al.*, 2019; Awawdeh *et al.*, 2022; Ho *et al.*, 2022; Sadiq *et al.*, 2022; Bhaskar *et al.*, 2023; Choi *et al.*, 2023; Nguyen *et al.*, 2024; Shahzadi *et al.*, 2024). The CSR plays a fundamental role, having evolved and encompassed an increasingly broad perspective (Catalão-Lopes *et al.*, 2023; Kim *et al.*, 2023). It has emerged as a strategic tool reflecting a competitive edge among firms (Bhaskar *et al.*, 2023). As a result, the success of companies depends on implementing CSR activities in their business models, guaranteeing a better financial performance (Khediri, 2021). The CSR is a major concern for many firms due to the diversification of stakeholders and the growth of their expectations, leading to a diversification of CSR activities (Liang *et al.*, 2024). Thus, most organizations have been endeavoring to find a balance satisfying all stakeholders. Hence, CEOs are responsible for all decisions about the choice of CSR activities (Schwoy *et al.*, 2023; Wang, 2023). According to Waldman *et al.* (2006), the main decision-maker in the corporation is the CEO who is responsible for setting the company's CSR strategy. The CEO has the ability to influence the CSR strategies and practices because he/she has an important and privileged position in the firm (Waldman and Siegel, 2008; Cassells and Lewis, 2011; Amor-Esteban *et al.*, 2019; Birindelli *et al.*, 2019; Zhou *et al.*, 2021; Bhaskar *et al.*, 2023). Much research has documented the extent to which CSR decisions depend on CEO characteristics such as demographic composition, experience, and personal values (Manner, 2010; McCarthy *et al.*, 2017; Liu *et al.*, 2019; Schwoy *et al.*, 2023). However, recent research has hardly ever investigated the socio-demographic factors of the CEO in relation to different CSR activities. This is particularly surprising for the CSR which is a corporate policy involving a contract and social engagement with multiple stakeholders (Lee *et al.*, 2013; Huang *et al.*, 2020; Chen *et al.*, 2022; Choi *et al.*, 2023). For these reasons, our basic argument in our study is that the CSR is multidimensional. Therefore, it is necessary to deal with the dimensions individually in order to better understand the relationships between the CEO personal values and each category of CSR (Choi *et al.*, 2023). This approach bridges the gap between the studies of Petrenko *et al.* (2016) and Kim *et al.* (2018). These studies focus only on the CSR as a whole without addressing the heterogeneity of its dimensions. Our research is based on the distinction between the CSR categories, which is similar to that of Hillman and Keim (2001) pointing out that engaging in the social dimension is not necessarily the same as that of environment. We should be attentive when using only one aggregate measure for the CSR (Wood, 1991; Jamali and Sidani, 2008). Hence, we present a more comprehensive assessment of the relationship between socio-demographic factors while distinguishing between each of the CSR dimensions. In this context, we aim to give proof of the impact of CEO socio-demographic factors (age, tenure, gender and education) on the CSR on the one hand, and on each CSR dimension on the other hand.

The remainder of this article is structured as follows. Section 2 deals with the literature review. Section 3 is about the hypothesis development. Section 4 analyzes the methodology. Section 5 presents the empirical results and discussion. Section 6 concludes, and Section 7 sets out the limitations and prospective.

2. LITERATURE REVIEW

The concept of "doing well by doing good" dates back to the 1930s when corporate social concerns began to gain ground in the European countries (Berle, 1931). Contemporary research began in the 1950s (Bowen, 1953). Since the 1980s, the CSR has gained importance in the corporate organizational process, coinciding with the development of the Stakeholder Theory of the firm. However, only recently that research has been able to provide a more comprehensive overview of this strategic tactic (Aguinis and Glavas, 2012; Bhaskar *et al.*, 2023). The CSR is defined as activities at the corporate level when the firm appears to promote some social goods, beyond the interests of the company and what is required by law (McWilliams and Siegel, 2001). Today, the CSR is very important in the corporate strategy (Camacho Ibanez and Fernandez, 2018; Lal *et al.*, 2022; Kim *et al.*, 2023; Rahman *et al.*, 2024) which usually helps address several issues such as business ethics, environmental protection, consumer protection, and anti-corruption in corporate practices (Nguyen *et al.*, 2024; Rahman *et al.*, 2024). These actions are voluntary, helping companies gain legitimacy (Du and Vieira, 2012; Lee *et al.*, 2018), improve the corporate image (Kim and Ham, 2016), build the customer loyalty (Kim *et al.*, 2014; Moisescu, 2017; Catalão-Lopes *et al.*, 2023) and enhance the financial performance (Park and Lee, 2009). For these reasons, a growing number of corporations are increasing their investments in CSR activities (Chen and Hung, 2021). Therefore, it is worth finding out the company's motives for engaging in any CSR dimension. Given the resources devoted to the CSR, it is important to understand the motives for the CSR engagement (Huang *et al.*, 2020; Chen *et al.*, 2022). There are two main leads that attempt to explain the use of the CSR. The first one is often referred to as stakeholder maximization, which suggests that CEOs practice the CSR to maintain better relationships with other stakeholders such as suppliers, bankers and employees who then reward the company (Deng *et al.*, 2013; López-Concepción *et al.*, 2022). According to this lead, the CSR is considered as strategic. The second lead addresses the background of the CSR. In fact, it suggests that CEOs engage in socially-responsible activities at the expense of shareholders, possibly for their own benefit (Pagano and Volpin, 2005; Surroca and Tribó, 2008). More recently, the CSR has taken into account all leads and views in order to consider all stakeholders in the following categories: environment, governance, and social (McCarthy *et al.*, 2017). Indeed, the motivation for the CSR does not always have to be monetary (Chen *et al.*, 2022)). Specifically, non-financial factors such as the socio-demographic ones of the company's CEO could also influence the CSR (Tang *et al.*, 2015; Velte, 2020). The leading argument of Hambrick and Mason (1984) Upper Echelons Theory states that the experiences, values and personalities of CEOs affect the strategic choices of a firm. Several studies, such as the one conducted by Carpenter and Sanders (2004), have examined the relationship between the CEO characteristics and organizational outcomes (Chen et al., 2022; Choi et al., 2023). In other words, the CEO acts in a significant way on the CSR process (Wang, 2023). Therefore, the diversification of individual characteristics of CEOs provides a strong and clear explanation in the variation of CSR activities (Hambrick and Mason, 1984; Donaldson and Fafaliou, 2003; Huang *et al.*, 2020). Accordingly, this research pays particular attention to a fundamental argument stating that the CEO socio-demographic characteristics are used as proxies for the purpose of accounting for the variation in CSR dimensions.

3. HYPOTHESIS DEVELOPMENT

The CEO characteristics have been the subject of several recent studies on CSR (Chen *et al.*, 2019; Yuan *et al.*, 2019; Bhaskar *et al.*, 2023; Schwoy *et al.*, 2023). This area of research is based on the arguments of the Upper Echelons Theory (Hambrick and Mason, 1984) stating that the CEO personal values are likely to influence the strategic decisions of the firm. The literature on CSR has provided a substantial empirical validation of the CEO influence on socially responsible decisions (Wernicke *et al.*, 2022; Schwoy *et al.*, 2023). In addition to extrinsic economic incentives (Flammer *et al.*, 2019), the existing literature on CSR dealing with CEO influence has mainly focused on their intrinsic characteristics.

- **The CEO age**

Previous studies have set out many useful insights for practitioners and academics of the CEO age effect on the CSR. According to Child (1974), younger CEOs who would like to build a talent reputation are more willing to take risks in order to engage in CSR activities. In fact, CSR activities are a long-term investment, so young CEOs will be highly motivated to engage in these projects (Kish-Gephart *et al.*, 2019). Moreover, younger CEOs seem to have stronger physical and mental perseverance than their older colleagues. Therefore, they are more flexible to innovative ideas and behavioral changes (Hambrick and Mason, 1984; Elsaid and Ursel, 2012). These efforts are manifested in the investment in projects highly related to development (Choi *et al.*, 2023). Fabrizi *et al.* (2014) and Saridakis *et al.* (2020) state that young CEOs are well judged by the market concerning their abilities to achieve financial and strategic goals. For Li *et al.* (2020), a young CEO tends to follow new information, and take bold actions to show that he/she has an excellent capability of interpreting information about investment opportunities. However, an older CEO is more cautious when getting new information. In this framework, our first hypothesis is formulated as follows:

Hypothesis 1: A young CEO has a positive effect on the CSR, and on its categories.

- **The CEO tenure**

A CEO tenure presents a defining characteristic in the CSR research (Choi *et al.*, 2023). It reflects the CEO ability based on firm-specific experiences (Slaughter *et al.*, 2007; Luo *et al.*, 2014) and flexibility in the managerial paradigm (Henderson *et al.*, 2006; McClelland *et al.*, 2012) that are necessary to manage diverse stakeholder interests. A well-recent line of research highlights the changes in a CEO behaviour over the course of his or her tenure (Choi *et al.*, 2023). Initially, CEOs are very sensitive to their external environment, and are relatively more likely to adapt to it. For example, the likelihood of implementing a strategic change is greater for CEOs with shorter tenures (Wiersema and Bantel, 1992). 0ver time, CEOs have become more stable (Miller, 1991), and are more willing to ignore external pressures (Lewis, 2014). They also tend to conform and retain the strategies of peer firms (Finkelstein and Hambrick, 1990). Thus, externally-related activities such as the CSR should decrease the CEO tenure increases (Marquis and Lee, 2013; Chen *et al.*, 2019; Saridakis *et al.*, 2020). Consistent with this argument, Pan *et al.* (2016) report that a much bigger investment is decided at the beginning of the CEO tenure. Chen *et al.* (2019) announce that since the CSR brings about long-run benefits for firms, CEOs are more spurred on to engage in CSR activities at the beginning of their tenures. Based on the arguments above, we stipulate our second hypothesis as follows:

Hypothesis 2: A long CEO tenure has a negative effect on the CSR, and on its categories.

- **The CEO gender**

Based on previous studies during the last decades, it has been proved that female CEOs show stronger ethics views and positive attitudes towards the CSR than male CEOs (Harjoto and Rossi, 2019). Related studies (Metz and Tharenou, 2001) suggest that women possess valuable skills essential for coping with unstable environments. Chu *et al.* (2022) declare the importance placed by women more than men on the issues of the sustainable development and corporate environmental and social responsibilities may be in a perfect harmony with their skills and the psychological state (resolving conflicts, adapting to change, motivating and inspiring others, while relieving the stress of subordinates and reduces the probability of turnover). Thus, women are more trained and rational than men to invest in decisions related to the CSR and different activities (Furlotti *et al.*, 2019; Wernicke *et al.*, 2022; Choi *et al.*, 2023; Liang *et al.*, 2024). In the same vein, we postulate the third hypothesis as follows:

Hypothesis 3: The female CEO has a positive effect on the CSR, and on its categories.

- **The CEO level**

Several studies examine the direct relationship between the CEO education level and CSR. Smith and Gray (2001) evince that the CEOs with a higher education level have a global vision of management, making them more sensitive to the expectations of different stakeholders and social issues, and more aware of the importance and significance of the CSR disclosure (Malik *et al.*, 2020). Schaper (2002) and Gadenne *et al.* (2009) state that a higher level of education would be associated with a more developed level of sensitivity to CSR issues. CSR activities are diverse, and require a great deal of research and development, and innovation, which in turn need CEOs who are generally associated with new technologies, and tend to have a greater cognitive density to assimilate these different CSR activities. Following prior studies (Hambrick and Mason, 1984; Herrmann and Datta, 2002) CEOs with a high level of education are better strategic decision-makers as they have acquired diverse knowledge and values. Following this literature, we propose our fourth hypothesis as follows:

Hypothesis 4: The CEO education level has a positive impact on the CSR, and on its categories.

4. METHODOLOGY

4.1 Sampling and data collection

Our research is carried out on a sample of European companies listed on the STOXX 600 index. The study covers a period of 5 years between 2018 and 2022. For the selection of our sample, we have excluded financial firms because they do not have the same characteristics as non-financial ones. We have also excluded firms with missing data. Table no. 1 summarizes the descriptive of the sample. The final sample covers 367 firms, corresponding to 1835 firm-year observations. We use the DataStream database for all corporate financial information. The CSR data is obtained from Thomson Reuters- Asset 4. The Data on CEOs is collected manually from annual reports. We have used STATA software, version 13, with the aim of processing the statistical data of our sample. The corporations in our sample belong to 9 sectors and 17 countries. The sample used for the analysis of Corporate Social Responsibility (CSR) practices primarily consists of companies located in economically and financially developed countries. These countries include Austria, Belgium,

Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Luxembourg, Norway, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, where CSR regulations are generally stricter and the resources allocated to these practices are more abundant.

Table no. 1 – Sample descriptive

Panel A: the selection steps of the final sample

Description	Number of companies
Initial sample	600
(-) Financial companies	138
(-) Companies with missing data	95
(=) Final sample	**367**

Panel B: Distribution of the sample by sector

Sectors	N	%
Oil and gas	16	4.4%
Basic materials	25	6.8%
Industries	74	20.2%
Consumer goods	58	15.8%
Health Care	29	7.9%
Consumer Services	56	15.3%
Telecommunications	24	6.5%
Utilities	33	8.9%
Technologies	52	14.2%
Total	367	100%

4.2 Measures

4.2.1 Measures of dependent variables

In this research, we rely on data from the Asset 4 to measuring the CSR as well as its dimensions. The CSR variable is expressed as a percentage, between 0 and 100, with a higher score indicating a better CSR performance.

- **Environmental Dimension of CSR**

The environmental dimension of Corporate Social Responsibility refers to the actions and policies companies implement to minimize their negative impact on the environment. This includes initiatives aimed at protecting and preserving natural resources, reducing greenhouse gas emissions, effectively managing waste, and promoting sustainable practices throughout their value chain. By rigorously measuring the environmental CSR, companies can not only reduce their negative impact but also benefit from sustainable growth opportunities and enhanced reputation among stakeholders (Adeneye *et al.*, 2023; Ma *et al.*, 2023; Nataprawira and Ulpah, 2023).

- **Governance Dimension of CSR**

The governance dimension of CSR plays a pivotal role in ensuring that companies operate with integrity, accountability, and transparency. By implementing robust governance practices, companies can cultivate an ethical culture, effectively manage risks, and establish enduring relationships with stakeholders. This not only enhances their reputation but also contributes to long-term success and sustainability (Adeneye *et al.*, 2023; Ma *et al.*, 2023; Nataprawira and Ulpah, 2023).

The governance dimension of CSR, as assessed by Asset 4, involves a thorough assessment of how companies manage and govern themselves to uphold ethical standards, accountability, and transparency. This evaluation not only helps mitigate risks but also fosters trust among stakeholders, thereby supporting sustainable business practices and long-term value creation.

- **Social dimension of CSR**

The social dimension of Corporate Social Responsibility (CSR) encompasses the initiatives and practices that companies undertake to address and improve their impact on society. This dimension focuses on how businesses contribute positively to the well-being of their employees, communities, and broader society. By addressing social issues and investing in community and employee welfare, companies can enhance their reputation, strengthen relationships with stakeholders, and contribute positively to sustainable development goals (Adeneye *et al.*, 2023; Ma *et al.*, 2023; Nataprawira and Ulpah, 2023).

The social dimension of CSR as evaluated by Asset4 encompasses a comprehensive assessment of how companies address and manage their impact on society. It underscores the importance of businesses making meaningful contributions to society while driving long-term value creation and sustainability.

4.2.2 Measures of independent variables

- The CEO age (CEO AGE): In our research, we opt for the natural log of the CEO age as a measure of this variable in line with the work of Fabrizi *et al.* (2014); Muttakin *et al.* (2018) and Belot and Serve (2018).
- The CEO tenure (CEO TENURE): the CEO tenure is measured by counting the number of years since the appointment of a CEO in the company. In other words, it is the number of years the CEO has held the position (Chen *et al.*, 2019; Ahn *et al.*, 2020).
- The CEO gender (CEO GENDER): We use a binary variable equal to 1 if the CEO is male, and 0 otherwise (Manner, 2010; Marquis and Lee, 2013).
- The CEO education level (CEO LEVEL): It is a dichotomous variable equal to 1 if the CEO has an MBA (Master Business Administration), and 0 otherwise (Aier *et al.*, 2005; Kouaib and Jarboui, 2016).

4.2.3 Measures of control variables

- The CSR strategy (STRA): According to Asset4, the aggregate strategy score measures a company's commitment to and effectiveness in creating a comprehensive vision and strategy integrating financial and non-financial aspects. For Shaukat *et al.* (2016), CSR strategy denotes the firm's overall strategic plan for executing and optimizing its

accountability responsibilities against itself, stakeholders, and the socio-environmental actors (Shaukat *et al.*, 2016; Yuan *et al.*, 2019; Chandrakant and Rajesh, 2023).

- The firm profitability (ROA): The firm profitability is calculated as profit before extraordinary items, based on the book value of total assets at the beginning of the year. We expect a positive relationship between the firm profitability and CSR (Waddock and Graves, 1997; Tang *et al.*, 2015).
- The firm size (SIZE): This variable is equal to the natural log of the book value of total assets at the beginning of the year. We expect a positive relationship between the firm size and CSR (McWilliams and Siegel, 2001).
- The firm age (AGE): The firm age is computed from the year of foundation to the year of observation in our study (Muttakin *et al.*, 2018).
- Leverage (DEBT): Several studies suggest that leverage is a fundamental factor influencing the CSR engagement (Jiao, 2010; Giroud and Mueller, 2017). Leverage is related to total debt, calculated based on the book value of total assets at the beginning of the year. We expect a negative relationship between the leverage and CSR (Waddock and Graves, 1997; Jiao, 2010).

Table no. 2 – Variable definitions and measures

Variables	Definitions	Unit of measure	Data source	Authors
Dependent variables				
Overall CSR	The CSR score is an aggregate score based on much information.	ESG Scores	Asset 4	Hillman and Keim (2001); Jiao (2010); Baron *et al.* (2011); Jo and Harjoto (2012) ; Ahn *et al.* (2020); Chouaibi *et al.* (2021); Adeneye *et al.* (2023); Ma *et al.* (2023); Nataprawira and Ulpah (2023).
Environment	The CSR environment score weighs a corporation's liability towards the thorough living and non-living ecosystem. It shows the ability of a company to use the best management actions with a view not to taking environmental risks and in order to keep the natural system safe.	ESG Scores	Asset 4	
Governance	It is a score evaluating a firm's engagement and efficacy in keeping track of the best actions in the corporate governance.	ESG Scores	Asset 4	
Social	This score assesses a firm's efficiency in making the employee satisfied through providing a secure workplace, and equal and promotion opportunities.	ESG Scores	Asset 4	
Independent variables				
CEO AGE	It is the log of the CEO age.	logarithmic scale	Annual Report	Fabrizi *et al.* (2014); Muttakin *et al.* (2018); Belot and Serve (2018).
CEO TENURE	It is the number of years the CEO has held his/her position.	Years	Annual Report	Khan *et al.* (2021); Yin *et al.* (2024).
CEO GENDER	It is a dichotomous variable that equals 1 when the CEO is male	Dummy	Annual Report	Manner (2010); Marquis and Lee (2013);

Variables	Definitions	Unit of measure	Data source	Authors
	and 0 otherwise.			McCarthy *et al.* (2017).
CEO LEVEL	It is a dichotomous variable that equals 1 if the CEO has an MBA, and 0 otherwise.	Dummy	Annual Report	Aier *et al.* (2005); Kouaib and Jarboui (2016).
Control variables				
STRA	The CSR strategy score reflects the company's evidence of practice in exercising and communicating CSR and its dimensions in its decision-making process on a daily basis.	ESG Scores	Asset 4	Shaukat *et al.* (2016); Hussain and Moriarty (2018); Ahn *et al.* (2020).
ROA	It is the company performance as measured by the ratio of operating income to total assets.	Percentage (%)	Datastrem	Tang *et al.* (2015)
FIRM SIZE	It is the firm size as measured by the natural logarithm of total assets.	logarithmic scale	Datastream	Cabagnols and Le Bas (2008); Lopes (2018).
FIRM AGE	It is the natural log of the number of years since the foundation of a company.	logarithmic scale	Datastream	Tang *et al.* (2015).
DEBT	The debt ratio is equal to total debt/total assets	Percentage (%)	Datastream	Jiao (2010); Giroud and Mueller (2017).

4.3 Research methodology

Econometrically, we will estimate panel regression models allowing us to assess the relationship between the socio-demographic factors of CEOs and the CSR and its dimensions. The models are as follows:

- Overall CSR = $\beta 0+\beta 1$ (AGE CEO) + $\beta 2$(TENURE CEO) + $\beta 3$ (GENDER CEO) + $\beta 4$(LEVEL CEO) + $\beta 5$(STRA) + $\beta 6$(ROA) + $\beta 7$(SIZE FIRM) + $\beta 8$(AGE FIRM) + $\beta 9$(DEBT) + Ɛit **(Model 1)**
- Environment = $\beta 0+\beta 1$ (AGE CEO) + $\beta 2$(TENURE CEO) + $\beta 3$ (GENDER CEO) + $\beta 4$(LEVEL CEO) + $\beta 5$(STRA) + $\beta 6$(ROA) + $\beta 7$(SIZE FIRM) + $\beta 8$(AGE FIRM) + $\beta 9$(DEBT) + Ɛit **(Model 1.1)**
- Social = $\beta 0+\beta 1$ (AGE CEO) + $\beta 2$(TENURE CEO) + $\beta 3$ (GENDER CEO) + $\beta 4$(LEVEL CEO) + $\beta 5$(STRA) + $\beta 6$(ROA) + $\beta 7$(SIZE FIRM) + $\beta 8$(AGE FIRM) + $\beta 9$(DEBT) + Ɛit **(Model 1.2)**
- Governance = $\beta 0+\beta 1$ (AGE CEO) + $\beta 2$(TENURE CEO) + $\beta 3$ (GENDER CEO) + $\beta 4$(LEVEL CEO) + $\beta 5$(STRA) + $\beta 6$(ROA) + $\beta 7$(SIZE FIRM) + $\beta 8$(AGE FIRM) + $\beta 9$(DEBT) + Ɛit **(Model 1.3)**

The dependent variable represents the overall CSR score (Overall CSR) and each of its dimensions (environment, social and governance).

The independent variables are the CEO socio-demographic, which are as follows:

CEO AGE: it is the age of the CEO. CEO TENURE: it is the number of years the CEO has held the position.

CEO GENDER: it is a dichotomous variable indicating 1 when the CEO is male, and 0 otherwise.

CEO LEVEL: it is the level of education of the CEO.

STRA: it is the CSR strategy score.

ROA: it is the performance of the company.

SIZE: it is the size of the company.

AGE: it is the age of the company. DEBT: it is the debt ratio.

β0: it is a constant. β1, β2, β3, β4, β5, β6, β7, β8 and β9: they are parameters of the model to be estimated.

εit: it is the residual of the regression.

5. THE EMPIRICAL RESULTS AND DISCUSSION

5.1 Result of univariate analysis

5.1.1 Descriptive statistics

Panel A from Table no. 3 displays the mean of the overall CSR score and CSR dimensions for the between 2018 and 2022. We notice that the average of the overall CSR is 64.62%, and the dimensions of, environment, governance and social have an average of 44.53, 56.25and 78.89, respectively. The overall CSR varies between a minimum of 10.43 and a maximum of 95.3 with a standard deviation of 14.9. The score of the CSR dimensions varies between a minimum of zero and a maximum of 99%.

Panel B from Table no. 3 evinces that the mean of the CEO age is 58 years, and the minimum (maximum) is 34 years (89). The CEO tenure variable shows a mean of 8.25 and a standard deviation of 5.89. Regarding the control variables, we find that the CSR strategy shows a mean of 57.25, a minimum of 0, and a maximum of 99.45.The companies in the sample are profitable with a ROA mean of 7.61%. The average firm size is equal to 11184058.79. The average firm age in the sample, which has been measured by the logarithm of number of years since its inception is 46 years , while the minimum firm age in the sample is 1.56 years, and the maximum firm age is 497 years. Finally, the debt variable represents a mean equal to 23.34. The minimum and maximum vary between 0 and 92.74. The descriptive statistics of dichotomous variables reported in Panel C of Table no. 3 highlight that 82.62% of the CEOs in our sample are men, while 17.38% are women. Finally, the education level variable shows that 77.92% of the CEOs in our sample have an MBA degree.

Table no. 3 – Descriptive statistics

Panel A: Descriptive statistics of dependent variables								
Variables	**Category**	**Model**	**N**	**Mean**	**Standard deviation**	**Min**	**Max**	**Median**
Dependent variable								
CSR	Overall	Model 1	1835	64,62	14,90	10,43	95,3	**66,41**
	Environment	Model 1.1	1835	44,53	32,72	0	99,77	**50,00**
	Governance	Model 1.2	1835	56,25	27,55	0	99,87	**57,97**
	Social	Model 1.3	1835	78,89	19,64	0	99,84	**84,43**

Panel B: Descriptive statistics for continuous variables						
Variables	**N**	**Mean**	**Standard deviation**	**Min**	**Max**	**Median**
CEO AGE	1835	4,06	0,13	3,52	4,49	**4,06**
CEO TENURE	1835	8,25	5,89	0	42	**7**
Control variables						
STRA	1835	57,25	28,69	0	99,45	**64,99**
ROA	1835	7,61	7,99	-24,54	69,32	**6**
SIZE	1835	16,23	1,54	10,32	19,87	**84,36**
AGE	1835	3,83	0,93	0,45	6,21	**3,79**
DEBT	1835	23,34	16,58	0	92,74	22,77

Panel C: Descriptive statistics for dichotomous variables			
Variables	**Modalities**	**Frequencies**	**Percentage**
CEO GENDER	1	1516	**82,62**
	0	319	**17,38**
CEO LEVEL	1	1426	**77,92**
	0	**409**	**22,28**

5.1.2 Correlation analysis

The correlation matrices, as depicted in Table no. 4, prove to illustrate the correlation coefficients as prevailing among the independent variables. This table allows us to note that there is no regression correlation exceeding 0.7. The limit set by Kervin (1992) and Haouas *et al.* (2024) between our explanatory variables, means that there is no severe multicollinearity problem. The variance inflation factor (VIF) is also reported to assess the severity of multicollinearity.

Table no. 4 – Spearman correlation matrix

	CEO AGE	**CEO TENURE**	**CEO GENDER**	**CEO LEVEL**	**STRATEGY**	**ROA**	**FIRM SIZE**	**FIRM AGE**	**DEBT**
CEO AGE	**1,0000**								
CEO TENURE	0,0512 (0,0284)	**1,0000**							
CEO GENDER	0,0905 (0,0001)	0,0577 (0,0136)	**1,0000**						
CEO LEVEL	0,1251 (0,0000)	0,1022 (0,0001)	0,0819 (0,0004)	**1,0000**					
STRATEGY	0,0987 (0,0000)	-0,0420 (0,0723)	0,0260 (0,2652)	0,0253 (0,2795)	**1,0000**				
ROA	-0,0875 (0,0002)	-0,0420 (0,0723)	0,0445 (0,0568)	-0,0664 (0,0045)	-0,0808 (0,0005)	**1,0000**			
FIRM SIZE	0,1722 (0,0000)	-0,0095 (0,6855)	-0,0641 (0,0060)	0,0290 (0,2153)	0,4013 (0,0000)	-0,3056 (0,0000)	**1,0000**		
AGE FIRM	0,0108 (0,6814)	-0,0691 (0, 0031)	-0,0104 (0,6566)	-0,0106 (0,6496)	0,0728 (0,0018)	0,0598 (0,0105)	0,1013 (0,0000)	**1,0000**	
DEBT	0,0320 (0,1705)	0,0307 (0,1883)	-0,0182 (0,4373)	0,0375 (0,1086)	0,1058 (0,0000)	-0,1944 (0,0000)	0,1860 (0,0000)	-0,1695 (0,0000)	**1,0000**

Table no. 5 evince that all VIFs are below the standard threshold of 10-cutoff point, as set by Greene (2008). This leads us to proceed to the regression analysis with the absence of a serious problem of multicollinearity between our independent variables.

Table no. 5 – VIF collinearity

Variables		VIF
FIRM SIZE	1,33	**0,749**
STRA	1,21	**0,827**
DEBT	1,11	**0,900**
ROA	1,10	**0,908**
FIRM AGE	1,08	**0,930**
CEO AGE	1,08	**0,930**
CEO TENURE	1,04	**0,965**
CEO LEVEL	1,03	**0,968**
CEO GENDER	1,02	**0,976**
VIF Mean	**1,11**	

5.2 Result of the multivariate analysis

Panel data include two different indices: one index for firms and the other one for time. The two are often indicated by the index i and t, respectively. It is really interesting to identify the effects associated with them. The index i varies from one firm to another, but the index t does not vary over time. This effect may be fixed or random. In addition to the question of individual effects, the issue of correlation and that of heteroscedasticity are raised in the context of panel data.

5.2.1 Test for the presence of individual effects

The sample of our study consists of 367 European companies listed on the STOXX 600 index. These firms have been observed throughout the period ranging from 2018 to 2022 This leads us to estimate the regression models on panel data. The first test to be carried out is the test for the presence of individual effects in order to check whether there are individual effects in our data.

The null hypothesis means the absence of individual effects (H0: yes = 0) in the following regression: Yit = ã + Xitâ + ui + eit.

H0: absence of individual effects.

H1: Presence of individual effects.

If the null hypothesis is rejected, individual effects must be included in the models.

In Table no. 6, the probability of the Fisher test is equal to 0.0000 for the seven models in our research, so it is significant at the 1% level. Therefore, we can come to the inference of the presence of individual effects, and we accept hypothesis H1.

5.2.2 Hausman specification test

The Hausmann test (1978) makes it possible to distinguish fixed effects from random effects. This test compares the variance-covariance matrix of two estimators:

W= (âf-âa)'var (âf -âa) -1(âf-âa)
H0: Random effects statistical model.
H1: Fixed effects statistical model.

Table no. 7 summarizes the results of this test. The Hausman test result shows a value of (0.0000) which is less than 5%. We note that the probability of the chi2 test is significant at the 1% level for all our research models. This allows us to reject the null hypothesis, and favor a fixed effect model for our regression.

5.2.3 Heteroscedasticity test

In addition to the issue of individual effects, the issue of heteroscedasticity in the context of panel data is raised. Touching the homoscedasticity hypothesis, we need to check whether the error variance of each individual is constant for any individual i. Yet, heteroscedasticity is detected when the error variance is not constant. That being the case, to detect heteroscedasticity, we use the Breusch-Pagan test. Statistically, if F-Fisher is significant, we note the presence of heteroscedasticity. The results are presented in the Table no. 6.

Table no. 8, the result of the Breusch-Pagan test provides evidence that the probability is lower than the threshold of five, which leads us to accept hypothesis 1, and to reject the null hypothesis. This confirms the absence of a heteroscedasticity problem. We infer that our regression models substantiate that the result of the test for the presence of individual effects justifies the use of panel data econometrics, and that the chi-square statistic of the Hausman test yields a p-value below the 5% threshold, which leads us to choose the fixed effect model and not the random one. Thus, we also find out that our research models give proof of the presence of an error heteroscedasticity problem. In summary, and after testing the hypotheses for the application of the regression, we can deduce that the regressions will be estimated by the FGLS (Feasible General Least Squares) method.

Table no. 6 – Testing for the presence of individual effects

	Model (1)	**Model (1.1)**	**Model (1.2)**	**Model (1.3)**
Fisher	**2010.14**	**2448.55**	**1396.91**	**2098,90**
Test	(0,0000)***	(0,0000)***	(0,0000)***	(0,0000)***

Table no. 7 – Hausman test

	Model (1)	**Model(1.1**	**Model (1.2)**	**Model (1.3)**
Hausman	**123,32**	**31,28**	**61,22**	**36,48**
Test	(0,0000)***	(0,0001)**	(0,0000)***	(0,0000)***

Table no. 8 – Breuch-Pagan test

	Model (1)	**Model (1.2)**	**Model (1.2)**	**Model (1.3)**
Breusch	**175,16**	**385,73**	**279,73**	**124,60**
Pagan Test	(0,0000)***	(0,0000)**	(0,0000)***	(0,0000)***

5.3 Regression results

Table no. 9 shows a positive and statistically significant association between the CEO age and the CSR as a whole, and, between the CEO age and each of all dimensions (environment, social and governance). Our result also aligns with the studies by Petrenko *et al.* (2016) and Malik *et al.* (2020) who postulate that younger CEOs are more likely to engage in CSR activities. Moreover, we notice that the CEO tenure positively and significantly acts at 1% on two dimensions, which are governance and social. Chen *et al.* (2019) argue that CEOs have a greater incentive to engage in CSR activities at the beginning of their tenures, as CSR creates long-term benefits for firms. In similar works, Bhaskar *et al.* (2023) finds a positive significant association between CEO tenure and CSR. Regarding the CEO gender in our sample of companies, our empirical result shows that this variable is statistically and negatively correlated with governance and social dimensions at the 1% level.

The last variable (CEO LEVEL) evinces a positive and significant relationship with the three dimensions (environment, governance and social), which is in line with the contributions of Huang (2013) and Malik *et al.* (2020). Our finding partially confirm our hypotheses proposed in the previous literature (Oh *et al.*, 2016; Khan *et al.*, 2021; Choi *et al.*, 2023).

Respecting the control variables, we notice that the CSR strategy is positively and significantly related to all our dependent variables at the 1% level. According to Shaukat *et al.* (2016) following the firms with effective and comprehensive CSR, strategies achieve superior corporate environmental and social performance. The association between the return on assets (ROA) and the CSR shows mixed results. In fact, there is a significant negative relationship in model 1.1 (environment) and model 1.2 (governance), which is in accordance with some studies, namely McWilliams and Siegel (2001) and Di Giuli and Kostovetsky (2014). Nonetheless, the outcomes of model 1(overall CSR) advance a positive and significant effect at the 1% threshold. This is consistent with Deng *et al.* (2013), Erhemjamts *et al.* (2013), Wu and Shen (2013). These authors document that the higher the profitability of firms is, the higher their propensity to engage in CSR activities is. In this sense, Brammer and Millington (2008) announce, following a high ROA, that firms divert and redirect short- term financial objectives towards socially-responsible objectives. As regards the size and age of the company, we substantiate a positive and significant relationship with the CSR. This confirms the studies of Cabagnols and Le Bas (2008) and Poussing (2018). They predict that the CSR varies according to the firm size, which means that small firms provide a low interest in CSR indicators compared to large ones (Schwoy *et al.*, 2023; Wijaya *et al.*, 2024). In addition, young firms will more easily accept the issues that are related to the CSR compared to older ones (Cabagnols and Le Bas, 2008). The relationship between leverage and CSR is negative. This is consistent with the previous studies by McWilliams and Siegel (2001); Ghoul *et al.* (2017); Jo and Harjoto (2012). For instance, research shows that a high CSR is associated with a lower cost of equity (Ghoul *et al.*, 2017), a lower cost of debt (Goss and Roberts, 2009), an easier access to credit (Cheng *et al.*, 2014), a lower risk of stock market crashes (Kim *et al.*, 2014), and a better access to political connections (Lin, 2024). We have concluded that larger and older firms that pursue a CSR strategy practically invest in all dimensions of the CSR because they have high incentives to avoid regulations, to reduce potential political costs and to protect their brand image (Saridakis *et al.*, 2020; Chandrakant and Rajesh, 2023).

Table no. 9 – Regression of the impact of socio-demographic factors on the CSR

The variables	Model 1		Model (1.1)		Model (1.2)		Model (1.3)	
	Z	p-value	Z	p-value	z	p-value	z	p-value
The independent variables								
CEO AGE	4,08	0,000***	7,37	0,000***	2,13	0,033**	6,50	0,000***
CEO TENURE	1,89	0,059**	-0,64	0,647	1,74	0,081**	5,01	0,000***
CEO GENDER	1,76	0,079**	3,74	0,000***	-2,84	0,004***	-2,94	0,003***
CEO LEVEL	0,55	0,584	5,61	0,000***	2,47	0,014**	4,90	0,000***
Control variables								
STRA	12,90	0,000***	18,04	0,000***	19,15	0,000***	24,16	0,000***
ROA	4,50	0,000***	-2,94	0,003***	6,70	0,000***	-0,27	0,787
FIRM SIZE	15,67	0,000***	22,03	0,000***	25,46	0,000***	9,56	0,000***
FIRM AGE	4,44	0,000***	6,47	0,000***	10,46	0,000***	7,44	0,000***
DEBT	-2,53	0,011**	-6	0,000***	-6,13	0,000***	-2,39	0,017**
R-square	0.9915		0.9758		0.9597		0.9945	
Prob>F	0,0000		0,0000		0,0000		0,0000	
Wald Chi2	2386.68		2844.47		2518.72		1402.07	
Prob> chi2	0,0000		0,0000		0,0000		0,0000	

Notes: ***, **and *are the significance at the 1%, 5% and 10% threshold, respectively. The dependent variable is represented by the corporate social responsibility and its dimensions. The explanatory variables are defined as follows: AGE: it is the logarithm of the CEO age; TENURE: it is measured by the number of years the CEO has held the position; GENDER: it is a dichotomous variable that takes the value 1 if the CEO is male, and 0 otherwise; LEVEL: it is a dichotomous variable that takes the value '1' if the CEO has an MBA, and 0 otherwise. The control variables are defined as follows: STRA: it is the CSR strategy score; ROA: it is the ratio of the operating income to total assets; SIZE: it is the logarithm of total assets; AGE: it is the number of years the firm has been in existence since inception; DEBT: it is the ratio of total debts to total assets. εi: it is the error term.

6. CONCLUSION

After dealing with the dimensions of the CSR individually, our objective is to find out to what extent the socio-demographic factors of the CEO play an important role in the overall CSR as well as in each of its dimensions. This study aims to theoretically and empirically examine the relationship between the socio- demographic factors of the CEO and CSR while addressing the multidimensionality of CSR (Liang *et al.*, 2024; Nguyen *et al.*, 2024). Among the socio-demographic factors, we look into some quantitative (age and tenure of the CEO) and qualitative (gender and education level of the CEO) characteristics to find out their impact on the CSR and on its categories. Based on a sample of 367 companies, we conclude that young male CEOs with short tenures and MBAs are less likely to invest in governance and social dimensions of CSR compared to their female counterparts. The environmental dimension is worth highlighting, but their results vary widely from one model to another. At the end of our research, we infer that the European firms are increasingly aware of the importance of CSR indicators. Although the main objective of corporations is to make profits, they can at the same time contribute to socially responsible objectives, by integrating CSR activities into their management instruments and activities. This is in line with the arguments of the Upper Echelons Theory, which argues that the personality characteristics of CEOs

influence the strategic decisions of a firm (Hambrick and Mason, 1984). Unlike previous research, which primarily approaches the CSR engagement with a uniform conceptualization or by focusing on the overall CSR, this study contributes to the literature by following Hillman and Keim (2001) approach while individually distinguishing between each of the dimensions of CSR (Mohy-ud-Din and Raza, 2023). Drawing on established dimensions of the CSR (environment, governance and social) from the existing literature, this study identifies and empirically validates a completely heterogeneous set of CSR-related activities. Moreover, previous research measuring the CSR as a whole has serious limitations because in reality, firms deal with several types of stakeholders that deserve to be treated differently (Saridakis *et al.*, 2020; Choi *et al.*, 2023). Thus, our study offers a broader theoretical and empirical conception of the CSR engagement, and distinguishes between its dimensions.

This article presents diverse managerial implications. To start with, it provides a clear roadmap for managers on the different categories of CSR. More specifically, owing to a variety of CSR activities and the increasing demands of stakeholder expectations (Choi *et al.*, 2023; Shahzadi *et al.*, 2024), CEOs may end up prioritizing specific dimensions of CSR that are appropriate to their personal and corporate characteristics. Therefore, CEOs must be aware that it is not only enough to commit to CSR, but also they must choose the activities appropriate for them. Secondly, the results of our study help companies had better align their CEO selection with the CSR direction. In fact, the CEO selection requires considerable resources and effort, as does the CSR implementation. These two elements are critical to the effectiveness and sustainability of the corporation. Therefore, the firm should be conscious of the prominence of socio-demographic factors of the CEO in the CSR decision-making. This study offers guidance for selecting CEOs with a more comprehensive understanding of CSR-related activity choices. Companies can also better align staff appointments with their socially responsible actions. This can contribute to the achievement of the company's mission and goals to meet the requirements of all stakeholders. Eventually, there has been no consensus on the best structure of the CSR, so CEOs must pay particular attention to showing their responsibility since each dimension of CSR could target one aspect of the socially responsible action.

7. LIMITATIONS AND PROSPECTS

Like any research study, the current study has its own limitations. Although this paper lists socio-demographic features of CEOs and company characteristics, there are other psychological and behavioral factors and biases of CEOs that can affect the commitment to CSR and the choice of these activities. For example, the CEO narcissism largely affects the CSR as well as its dimensions (Chatterjee and Hambrick, 2011). Similarly, the CEO remuneration, ownership and duality clearly influence the investments of CSR dimensions (Muttakin *et al.*, 2018; Withisuphakorn and Jiraporn, 2019; Li *et al.*, 2020). Finally, a CEO having environmental experience with different stakeholders (Walls and Berrone, 2017), and having managerial capabilities (Yuan *et al.*, 2019) can also act on CSR decisions.

There are also other corporate factors like board characteristics including size, diversity and independence (Muttakin *et al.*, 2018; Zou *et al.*, 2018) can affect the choice of CSR dimensions. Hence, future research could incorporate this set of characteristics that gives rise to new results. We have limited our study to a few dimensions of CSR, but they are commonly used. Thus, future research could investigate new information to use other dimensions of CSR

(human right, product, employee...). The CSR research focuses on adopting corporate governance practices that are consistent with organizational efforts to limit the remuneration of CEOs and board executives, transparency and disclosure (Awawdeh *et al.*, 2022; Ho *et al.*, 2022; Sadiq *et al.*, 2022). In this case, future research could further look into the relationship between socio- demographic factors and CSR activities via incorporating the role of governance as a moderating factor.

References

Adeneye, Y. B., Kammoun, I., & Ab Wahab, S. N. A. (2023). Capital structure and speed of adjustment: the impact of environmental, social and governance (ESG) performance. *Sustainability Accounting, Management and Policy Journal, 14*(5), 945-977. http://dx.doi.org/10.1108/SAMPJ-01-2022-0060

Aguinis, H., & Glavas, A. (2012). What we know and don't know about corporate social responsibility: A review and research agenda. *Journal of Management, 38*(4), 932-968. http://dx.doi.org/10.1177/0149206311436079

Ahn, J., Wong, M. L., & Kwon, J. (2020). Different role of hotel CSR activities in the formation of customers' brand loyalty. *International Journal of Quality and Service Sciences, 12*(3), 337-353. http://dx.doi.org/10.1108/IJQSS-02-2020-0028

Aier, J. K., Comprix, J., Gunlock, M. T., & Lee, D. (2005). The financial expertise of CFOs and accounting restatements. *Accounting Horizons, 19*(3), 123-135. http://dx.doi.org/10.2308/acch.2005.19.3.123

Amor-Esteban, V., Galindo-Villardón, M. P., García-Sánchez, I. M., & David, F. (2019). An extension of the industrial corporate social responsibility practices index: New information for stakeholder engagement under a multivariate approach. *Corporate Social Responsibility and Environmental Management, 26*(1), 127-140. http://dx.doi.org/10.1002/csr.1665

Awawdeh, A. E., Ananzeh, M., El-khateeb, A. I., & Aljumah, A. (2022). Role of green financing and corporate social responsibility (CSR) in technological innovation and corporate environmental performance: A COVID-19 perspective. *China Finance Review International, 12*(2), 297-316. http://dx.doi.org/10.1108/CFRI-03-2021-0048

Baron, D. P., Agus Harjoto, M., & Jo, H. (2011). The economics and politics of corporate social performance. *Business and Politics, 13*(2), 1-46. http://dx.doi.org/10.2202/1469-3569.1374

Belot, F., & Serve, S. (2018). Earnings quality in private SMEs: Do CEO demographics matter? *Journal of Small Business Management, 56*(1), 323-344. http://dx.doi.org/10.1111/jsbm.12375

Berle, A. A. (1931). Corporate powers as powers in trust. *Harvard Law Review, 44*(7), 1049-1074 http://dx.doi.org/10.2307/1331341

Bhaskar, R., Li, P., Bansal, S., & Kumar, S. (2023). A new insight on CEO characteristics and corporate social responsibility (CSR): A meta-analytical review. *International Review of Financial Analysis, 89*, 102815. http://dx.doi.org/10.1016/j.irfa.2023.102815

Birindelli, G., Iannuzzi, A. P., & Savioli, M. (2019). The impact of women leaders on environmental performance: Evidence on gender diversity in banks. *Corporate Social Responsibility and Environmental Management, 26*(6), 1485-1499. http://dx.doi.org/10.1002/csr.1762

Bowen, H. R. (1953). Graduate education in economics. *The American Economic Review, 43*(4), iv-223.

Brammer, S., & Millington, A. (2008). Does it pay to be different? An analysis of the relationship between corporate social and financial performance. *Strategic Management Journal, 29*(12), 1325-1343. http://dx.doi.org/10.1002/smj.714

Cabagnols, A., & Le Bas, C. (2008). Les déterminants du comportement de Responsabilité sociale de l'entreprise. Une analyse économétrique à partir de nouvelles données d'enquête. *Économies et sociétés, 10*(1), 175-202.

Camacho Ibanez, J., & Fernandez, J. L. (2018). Competitiveness and CSR in SME: Results from a Study in the Madrid Region. *Management Dynamics in the Knowledge Economy, 6*(1), 105–116.

Carpenter, M. A., & Sanders, W. G. (2004). The effects of top management team pay and firm internationalization on MNC performance. *Journal of Management, 30*(4), 509-528. http://dx.doi.org/10.1016/j.jm.2004.02.001

Cassells, S., & Lewis, K. (2011). SMEs and environmental responsibility: Do actions reflect attitudes? *Corporate Social Responsibility and Environmental Management, 18*(3), 186-199. http://dx.doi.org/10.1002/csr.269

Catalão-Lopes, M., Pina, J. P., & Costa, A. (2023). Pretending to be Socially Responsible? The Role of Consumers' Rewarding Behaviour. *Scientific Annals of Economics and Business, 70*(2), 163-183. http://dx.doi.org/10.47743/saeb-2023-0024

Chandrakant, R., & Rajesh, R. (2023). Social sustainability, corporate governance, and sustainability performances: An empirical study of the effects. *Journal of Ambient Intelligence and Humanized Computing, 14*(7), 9131-9143. http://dx.doi.org/10.1007/s12652-022-04417-4

Chatterjee, A., & Hambrick, D. C. (2011). Executive Personality, Capability Cues, and Risk Taking: How Narcissistic CEOs React to Their Successes and Stumbles. *Administrative Science Quarterly - ADMIN SCI QUART, 56*(2), 202-237. http://dx.doi.org/10.1177/0001839211427534

Chen, F., Huang, Z. X., Wang, F., & Xie, Z. (2022). Can corporate social responsibility disclosure alleviate asset price volatility? Evidence from China. *Economic Modelling, 116*, 105985. http://dx.doi.org/10.1016/j.econmod.2022.105985

Chen, R. C., & Hung, S. W. (2021). Exploring the impact of corporate social responsibility on real earning management and discretionary accruals. *Corporate Social Responsibility and Environmental Management, 28*(1), 333-351. http://dx.doi.org/10.1002/csr.2052

Chen, W. T., Zhou, G. S., & Zhu, X. K. (2019). CEO tenure and corporate social responsibility performance. *Journal of Business Research, 95*, 292-302. http://dx.doi.org/10.1016/j.jbusres.2018.08.018

Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management Journal, 35*(1), 1-23. http://dx.doi.org/10.1002/smj.2131

Child, J. (1974). Managerial and organizational factors associated with company performance part I. *Journal of Management Studies, 11*(3), 175-189. http://dx.doi.org/10.1111/j.1467-6486.1974.tb00693.x

Choi, D., Shin, H., & Kim, K. (2023). CEO's childhood experience of natural disaster and CSR activities. *Journal of Business Ethics, 188*, 281–306. http://dx.doi.org/10.1007/s10551-022-05319-3

Chouaibi, Y., Rossi, M., & Zouari, G. (2021). The effect of corporate social responsibility and the executive compensation on implicit cost of equity: Evidence from French ESG data. *Sustainability, 13*(20), 1-17. http://dx.doi.org/10.3390/su132011510

Chu, B., Handel, B., Kolstad, J., & Malmendier, U. (2022). *Gender Differences in Non-Promotable Tasks: The Case of Clinical Note-Taking*.

Deng, X., Kang, J. K., & Low, B. S. (2013). Corporate social responsibility and stakeholder value maximization: Evidence from mergers. *Journal of Financial Economics, 110*(1), 87-109. http://dx.doi.org/10.1016/j.jfineco.2013.04.014

Di Giuli, A., & Kostovetsky, L. (2014). Are red or blue companies more likely to go green? Politics and corporate social responsibility. *Journal of Financial Economics, 111*(1), 158-180. http://dx.doi.org/10.1016/j.jfineco.2013.10.002

Donaldson, J., & Fafaliou, I. (2003). Business ethics, corporate social responsibility and corporate governance: a review and summary critique. *European Research Studies Journal, 0*(1-2), 97-118.

Du, S., & Vieira, E. T. (2012). Striving for legitimacy through corporate social responsibility: Insights from oil companies. *Journal of Business Ethics, 110*(4), 413-427. http://dx.doi.org/10.1007/s10551-012-1490-4

Elsaid, E., & Ursel, N. D. (2012). Age, CEO succession, and risk taking. *Accounting and Finance Research, 1*(2), 77-86. http://dx.doi.org/10.5430/afr.v1n2p77

Erhemjamts, O., Li, Q., & Venkateswaran, A. (2013). Corporate social responsibility and its impact on firms' investment policy, organizational structure, and performance. *Journal of Business Ethics, 118*(2), 395-412. http://dx.doi.org/10.1007/s10551-012-1594-x

Fabrizi, M., Mallin, C., & Michelon, G. (2014). The role of CEO's personal incentives in driving corporate social responsibility. *Journal of Business Ethics, 124*(2), 311-326. http://dx.doi.org/10.1007/s10551-013-1864-2

Finkelstein, S., & Hambrick, D. C. (1990). Top-management-team tenure and organizational outcomes: The moderating role of managerial discretion. *Administrative Science Quarterly, 35*(3), 484-503. http://dx.doi.org/10.2307/2393314

Flammer, C., Hong, B., & Minor, D. (2019). Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes. *Strategic Management Journal, 40*(7), 1097-1122. http://dx.doi.org/10.1002/smj.3018

Furlotti, K., Mazza, T., Tibiletti, V., & Triani, S. (2019). Women in top positions on boards of directors: Gender policies disclosed in Italian sustainability reporting. *Corporate Social Responsibility and Environmental Management, 26*(1), 57-70. http://dx.doi.org/10.1002/csr.1657

Gadenne, D. L., Kennedy, J., & McKeiver, C. (2009). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics, 84*(1), 45-63. http://dx.doi.org/10.1007/s10551-008-9672-9

Ghoul, S. E., Guedhami, O., & Kim, Y. (2017). Country-level institutions, firm value, and the role of corporate social responsibility initiatives. *Journal of International Business Studies, 48*(3), 360-385. http://dx.doi.org/10.1057/jibs.2016.4

Giroud, X., & Mueller, H. (2017). Firm Leverage, Consumer Demand, and Employment Losses during the Great Recession. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.2896892

Goss, A., & Roberts, G. (2009). The Impact of Corporate Social Responsibility on the Cost of Bank Loans. *Journal of Banking & Finance, 35*, 1794-1810. http://dx.doi.org/10.1016/j.jbankfin.2010.12.002

Greene, W. H. (2008). *Econometric analysis* (6TH ed.). Upper Saddle River, NJ: Prentice Hall.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review, 9*(2), 193-206. http://dx.doi.org/10.2307/258434

Haouas, A., Ochi, A., & Labidi, M. A. (2024). Sources of Algeria's economic growth, 1979–2019: Augmented growth accounting framework and growth regression method. *Regional Science Policy & Practice, 16*(3), 1-19. http://dx.doi.org/10.1111/rsp3.12448

Harjoto, M. A., & Rossi, F. (2019). Religiosity, female directors, and corporate social responsibility for Italian listed companies. *Journal of Business Research, 95*, 338-346. http://dx.doi.org/10.1016/j.jbusres.2018.08.013

Henderson, A. D., Miller, D., & Hambrick, D. C. (2006). How quickly do CEOs become obsolete? Industry dynamism, CEO tenure, and company performance. *Strategic Management Journal, 27*(5), 447-460. http://dx.doi.org/10.1002/smj.524

Herrmann, P., & Datta, D. K. (2002). CEO successor characteristics and the choice of foreign market entry mode: An empirical study. *Journal of International Business Studies, 33*(3), 551-569. http://dx.doi.org/10.1057/palgrave.jibs.8491031

Hillman, A. J., & Keim, G. D. (2001). Shareholder value, stakeholder management, and social issues: What's the bottom line? *Strategic Management Journal, 22*(2), 125-139. http://dx.doi.org/10.1002/1097-0266(200101)22:2<125::AID-SMJ150>3.0.CO;2-H

Ho, J. C., Chen, T. H., & Wu, J. J. (2022). Are corporate social responsibility reports informative? Evidence from textual analysis of banks in China. *China Finance Review International, 12*(1), 101-120. http://dx.doi.org/10.1108/CFRI-04-2021-0081

Huang, K., Sim, N., & Zhao, H. (2020). Corporate social responsibility, corporate financial performance and the confounding effects of economic fluctuations: A meta-analysis. *International Review of Financial Analysis, 70*, 101504. http://dx.doi.org/10.1016/j.irfa.2020.101504

Huang, S. K. (2013). The impact of CEO characteristics on corporate sustainable development. *Corporate Social Responsibility and Environmental Management, 20*(4), 234-244. http://dx.doi.org/10.1002/csr.1295

Hussain, W., & Moriarty, J. (2018). Accountable to whom? Rethinking the role of corporations in political CSR. *Journal of Business Ethics, 149*(3), 519-534. http://dx.doi.org/10.1007/s10551-016-3027-8

Jamali, D., & Sidani, Y. (2008). Classical vs. modern managerial CSR perspectives: Insights from Lebanese context and cross-cultural implications. *Business and Society Review, 113*(3), 329-346. http://dx.doi.org/10.1111/j.1467-8594.2008.00323.x

Jiao, Y. (2010). Stakeholder welfare and firm value. *Journal of Banking & Finance, 34*(10), 2549-2561. http://dx.doi.org/10.1016/j.jbankfin.2010.04.013

Jo, H., & Harjoto, M. A. (2012). The causal effect of corporate governance on corporate social responsibility. *Journal of Business Ethics, 106*(1), 53-72. http://dx.doi.org/10.1007/s10551-011-1052-1

Kervin, J. B. (1992). *Methods for business*. New Haven, CT: Yale University Press.

Khan, T. M., Bai, G., Fareed, Z., Quresh, S., Khalid, Z., & Khan, W. A. (2021). CEO tenure, CEO compensation, corporate social and environmental performance in China: The moderating role of coastal and non-coastal areas. *Frontiers in Psychology, 11*, 574062. http://dx.doi.org/10.3389/fpsyg.2020.574062

Khediri, K. B. (2021). CSR and investment efficiency in Western European countries. *Corporate Social Responsibility and Environmental Management, 28*(6), 1769-1784. http://dx.doi.org/10.1002/csr.2151

Kim, E., & Ham, S. (2016). Restaurants' disclosure of nutritional information as a corporate social responsibility initiative: Customers' attitudinal and behavioral responses. *International Journal of Hospitality Management, 55*, 96-106. http://dx.doi.org/10.1016/j.ijhm.2016.02.002

Kim, J., Ju, J., & Kim, J. (2023). The effects of consideration of future consequences and CSR fit in stigmatized industries: Perceived CSR motives as mediators. *Public Relations Review, 49*(1), 102294. http://dx.doi.org/10.1016/j.pubrev.2023.102294

Kim, J. K., Overton, H., Hull, K., & Choi, M. (2018). Examining public perceptions of CSR in sport. *Corporate Communications, 23*, 629-647. http://dx.doi.org/10.1108/CCIJ-05-2018-0060

Kim, Y., Li, H., & Li, S. (2014). Corporate social responsibility and stock price crash risk. *Journal of Banking & Finance, 43*, 1-13. http://dx.doi.org/10.1016/j.jbankfin.2014.02.013

Kish-Gephart, J. J., Treviño, L. K., Chen, A., & Tilton, J. (2019). Behavioral Business Ethics: The Journey from Foundations to Future *Business Ethics* (Vol. 3, pp. 3-34). Leeds: Emerald Publishing Limited. http://dx.doi.org/10.1108/S2514-175920190000003001

Kouaib, A., & Jarboui, A. (2016). The moderating effect of CEO profile on the link between cutting R&D expenditures and targeting to meet/beat earnings benchmarks. *The Journal of High Technology Management Research, 27*(2), 140-160. http://dx.doi.org/10.1016/j.hitech.2016.10.005

Kumar, D., Goyal, P., & Kumar, V. (2019). Prioritizing CSR barriers in the Indian service industry: A fuzzy AHP approach. *Scientific Annals of Economics and Business, 66*(2), 213-233. http://dx.doi.org/10.47743/saeb-2019-0009

Lal, M., Kumar, R. B., Kumar, A., Saud, H. S., & Rai, V. K. (2022). Corporate social responsibility, accounting, and auditing: A retrospective review. *International Journal of Accounting, Business and Finance, 1*(2), 48-74. http://dx.doi.org/10.55429/ijabf.v1i2.65

Lee, E. M., Park, S. Y., & Lee, H. J. (2013). Employee perception of CSR activities: Its antecedents and consequences. *Journal of Business Research, 66*(10), 1716-1724. http://dx.doi.org/10.1016/j.jbusres.2012.11.008

Lee, Y. J., Yoon, H. J., & O'Donnell, N. H. (2018). The effects of information cues on perceived legitimacy of companies that promote corporate social responsibility initiatives on social networking sites. *Journal of Business Research, 83*, 202-214. http://dx.doi.org/10.1016/j.jbusres.2017.09.039

Lewis, F. D. (2014). *Rumi-past and present, east and west: The life, teachings, and poetry of Jalâl Al-Din Rumi*: Simon and Schuster.

Li, H., Hang, Y., Shah, S. G. M., Akram, A., & Ozturk, I. (2020). Demonstrating the impact of cognitive CEO on firms' performance and CSR activity. *Frontiers in Psychology, 11*, 278. http://dx.doi.org/10.3389/fpsyg.2020.00278

Liang, J., Jain, A., Newman, A., Mount, M. P., & Kim, J. (2024). Motivated to be socially responsible? CEO regulatory focus, firm performance, and corporate social responsibility. *Journal of Business Research, 176*, 114578. http://dx.doi.org/10.1016/j.jbusres.2024.114578

Lin, W. L. (2024). The role of corporate social responsibility and corporate social irresponsibility in shaping corporate reputation: An analysis of competitive action and innovation strategies. *Corporate Social Responsibility and Environmental Management, 31*(2), 1451-1468. http://dx.doi.org/10.1002/csr.2640

Liu, M. T., Liu, Y., Mo, Z., Zhao, Z., & Zhu, Z. (2019). How CSR influences customer behavioural loyalty in the Chinese hotel industry. *Asia Pacific Journal of Marketing and Logistics, 32*(1), 1-22. http://dx.doi.org/10.1108/APJML-04-2018-0160

Lopes, A. P. (2018). Audit quality and earnings management: Evidence from Portugal. *Athens Journal of Business & Economics, 4*(2), 179-192.

López-Concepción, A., Gil-Lacruz, A. I., & Saz-Gil, I. (2022). Stakeholder engagement, Csr development and Sdgs compliance: A systematic review from 2015 to 2021. *Corporate Social Responsibility and Environmental Management, 29*(1), 19-31. http://dx.doi.org/10.1002/csr.2170

Luo, X., Kanuri, V. K., & Andrews, M. (2014). How does CEO tenure matter? The mediating role of firm-employee and firm-customer relationships. *Strategic Management Journal, 35*(4), 492-511. http://dx.doi.org/10.1002/smj.2112

Ma, Y. M., Deng, Z., Teng, Y., Yang, Z., & Zheng, X. V. (2023). Firms' multi-sided platform construction efforts and ESG performance: An information processing theory perspective. *Industrial Marketing Management, 115*, 455-469. http://dx.doi.org/10.1016/j.indmarman.2023.10.018

Malik, F., Wang, F., Naseem, M. A., Ikram, A., & Ali, S. (2020). Determinants of corporate social responsibility related to CEO attributes: An empirical study. *SAGE Open, 10*(1), 1-12. http://dx.doi.org/10.1177/2158244019899093

Manner, M. H. (2010). The impact of CEO characteristics on corporate social performance. *Journal of Business Ethics, 93*(S1), 53-72. http://dx.doi.org/10.1007/s10551-010-0626-7

Marquis, C., & Lee, M. (2013). Who is governing whom? Executives, governance, and the structure of generosity in large US firms. *Strategic Management Journal, 34*(4), 483-497. http://dx.doi.org/10.1002/smj.2028

McCarthy, S., Oliver, B., & Song, S. (2017). Corporate social responsibility and CEO confidence. *Journal of Banking & Finance, 75*, 280-291. http://dx.doi.org/10.1016/j.jbankfin.2016.11.024

McClelland, P. L., Barker, V. L., & Oh, W. Y. (2012). CEO career horizon and tenure: Future performance implications under different contingencies. *Journal of Business Research, 65*(9), 1387-1393. http://dx.doi.org/10.1016/j.jbusres.2011.09.003

McWilliams, A., & Siegel, D. (2001). Corporate social responsibility: A theory of the firm perspective. *Academy of Management Review, 26*(1), 117-127. http://dx.doi.org/10.2307/259398

Metz, I., & Tharenou, P. (2001). Women's career advancement: The relative contribution of human and social capital. *Group & Organization Management, 26*(3), 312-342. http://dx.doi.org/10.1177/1059601101263005

Miller, D. (1991). Stale in the saddle: CEO tenure and the match between organization and environment. *Management Science, 37*(1), 34-52. http://dx.doi.org/10.1287/mnsc.37.1.34

Mohy-ud-Din, K., & Raza, S. A. (2023). Role of board indexes on corporate social responsibility (CSR) and shareholders' wealth. *Journal of Cleaner Production, 400*, 136521. http://dx.doi.org/10.1016/j.jclepro.2023.136521

Moisescu, O.-I. (2017). From CSR to customer loyalty: An empirical investigation in the retail banking industry of a developing country. *Scientific Annals of Economics and Business, 64*(3), 307-323. http://dx.doi.org/10.1515/saeb-2017-0020

Muttakin, M. B., Khan, A., & Mihret, D. G. (2018). The effect of board capital and CEO power on corporate social responsibility disclosures. *Journal of Business Ethics, 150*(1), 41-56. http://dx.doi.org/10.1007/s10551-016-3105-y

Nataprawira, A., & Ulpah, M. (2023). The Effect of Esg and Earnings Management on Dividend Policy of Listed Firm in Indonesia. *Jurnal Scientia 12*(01), 445-455. http://dx.doi.org/10.58471/scientia.v12i01.1132

Nguyen, V. M., Chien, P. T., & Ha, K. D. (2024). What drives construction SMEs on CSR implementation during economic uncertainty? *Journal of Cleaner Production, 449*(5), 141664. http://dx.doi.org/10.1016/j.jclepro.2024.141664

Oh, W. Y., Chang, Y. K., & Cheng, Z. (2016). When CEO career horizon problems matter for corporate social responsibility: The moderating roles of industry-level discretion and blockholder ownership. *Journal of Business Ethics, 133*(2), 279-291. http://dx.doi.org/10.1007/s10551-014-2397-z

Pagano, M., & Volpin, P. F. (2005). The political economy of corporate governance. *The American Economic Review, 95*(4), 1005-1030. http://dx.doi.org/10.1257/0002828054825646

Pan, Y., Wang, T. Y., & Weisbach, M. S. (2016). CEO investment cycles. *Review of Financial Studies, 29*(11), 2955-2999. http://dx.doi.org/10.1093/rfs/hhw033

Park, S. Y., & Lee, S. (2009). Financial rewards for social responsibility: A mixed picture for restaurant companies. *Cornell Hospitality Quarterly, 50*(2), 168-179. http://dx.doi.org/10.1177/1938965509331814

Petrenko, O. V., Aime, F., Ridge, J., & Hill, A. (2016). Corporate social responsibility or CEO narcissism? CSR motivations and organizational performance. *Strategic Management Journal, 37*(2), 262-279. http://dx.doi.org/10.1002/smj.2348

Poussing, N. (2018). Does corporate social responsibility encourage sustainable innovation adoption? Empirical evidence from Luxembourg. *Corporate Social Responsibility and Environmental Management, 26*(3), 681-689. http://dx.doi.org/10.1002/csr.1712

Rahman, M. H., Tanchangya, T., Rahman, J., Aktar, M. A., & Majumder, S. C. (2024). Corporate social responsibility and green financing behavior in Bangladesh: Towards sustainable tourism. *Innovation and Green Development, 3*(3), 1-14. http://dx.doi.org/10.1016/j.igd.2024.100133

Sadiq, M., Nonthapot, S., Mohamad, S., Chee Keong, O., Ehsanullah, S., & Iqbal, N. (2022). Does green finance matter for sustainable entrepreneurship and environmental corporate social responsibility during COVID-19? *China Finance Review International, 12*(2), 317-333. http://dx.doi.org/10.1108/CFRI-02-2021-0038

Saridakis, C., Angelidou, S., & Woodside, A. G. (2020). What type of CSR engagement suits my firm best? Evidence from an abductively-derived typology. *Journal of Business Research, 108*, 174-187. http://dx.doi.org/10.1016/j.jbusres.2019.11.032

Schaper, M. (2002). The challenge of environmental responsibility and sustainable development: Implications for SME and entrepreneurship academics. *Radical Changes in the World: Will SMEs Soar or Crash?*, 541-553.

Schwoy, S., Dutzi, A., Corten, M., & Steijvers, T. (2023). Staging or real commitment? CEO reputation management as a moderator of the influence of firm size on corporate social responsibility performance and controversies. *Journal of Cleaner Production, 410*, 137325. http://dx.doi.org/10.1016/j.jclepro.2023.137325

Shahzadi, G., John, A., Qadeer, F., Jia, F., & Yan, J. (2024). CSR beyond symbolism: The importance of substantive attributions for employee CSR engagement. *Journal of Cleaner Production, 436*, 140440. http://dx.doi.org/10.1016/j.jclepro.2023.140440

Shaukat, A., Qiu, Y., & Trojanowski, G. (2016). Board attributes, corporate social responsibility strategy, and corporate environmental and social performance. *Journal of Business Ethics, 135*(3), 569-585. http://dx.doi.org/10.1007/s10551-014-2460-9

Slaughter, S. A., Ang, S., & Fong Boh, W. (2007). Firm-specific human capital and compensation organizational tenure profiles: An archival analysis of salary data for it. *Human Resource Management, 46*(3), 373-394. http://dx.doi.org/10.1002/hrm.20169

Smith, P., & Gray, B. (2001). Reassessing the concept of emotional labour in student nurse education: Role of link lecturers and mentors in a time of change. *Nurse Education Today, 21*(3), 230-237. http://dx.doi.org/10.1054/nedt.2001.0541

Surroca, J., & Tribó, J. A. (2008). Managerial entrenchment and corporate social performance. *Journal of Business Finance & Accounting, 35*(5-6), 748-789. http://dx.doi.org/10.1111/j.1468-5957.2008.02090.x

Tang, L., Gallagher, C. C., & Bie, B. (2015). Corporate social responsibility communication through corporate websites: A comparison of leading corporations in the United States and China. *International Journal of Business Communication, 52*(2), 205-227. http://dx.doi.org/10.1177/2329488414525443

Velte, P. (2020). Do CEO incentives and characteristics influence corporate social responsibility (CSR) and vice versa? A literature review. *Social Responsibility Journal, 16*(8), 1293-1323. http://dx.doi.org/10.1108/SRJ-04-2019-0145

Waddock, S. A., & Graves, S. B. (1997). Quality of management and quality of stakeholder relations: Are they identical? *Business & Society, 36*(3), 250-279. http://dx.doi.org/10.1177/000765039703600303

Waldman, D. A., & Siegel, D. (2008). Defining the socially responsible leader. *The Leadership Quarterly, 19*(1), 117-131. http://dx.doi.org/10.1016/j.leaqua.2007.12.008

Waldman, D. A., Sully de Luque, M., Washburn, N., House, R. J., Adetoun, B., Barrasa, A., . . . Wilderom, C. P. M. (2006). Cultural and leadership predictors of corporate social responsibility values of top management: a GLOBE study of 15 countries. *Journal of International Business Studies, 37*(6), 823-837. http://dx.doi.org/10.1057/palgrave.jibs.8400230

Walls, J. L., & Berrone, P. (2017). The power of one to make a difference: How informal and formal CEO power affect environmental sustainability. *Journal of Business Ethics, 145*(2), 293-308. http://dx.doi.org/10.1007/s10551-015-2902-z

Wang, P. (2023). Corporate social responsibility and corporate innovation–The moderating role of CEO social capital. *Finance Research Letters, 55*(Part A), 103863. http://dx.doi.org/10.1016/j.frl.2023.103863

Wernicke, G., Sajko, M., & Boone, C. (2022). How much influence do CEOs have on company actions and outcomes? The example of corporate social responsibility. *Academy of Management Discoveries, 8*(1), 36-55. http://dx.doi.org/10.5465/amd.2019.0074

Wiersema, M. F., & Bantel, K. A. (1992). Top management team demographics and corporate strategic change. *Academy of Management Journal, 35*(1), 91-121. http://dx.doi.org/10.2307/256474

Wijaya, L. I., Sugiarto, L. S., & Sutejo, B. S. (2024). Social responsibility and firm value: The moderating role of firm size. *Jurnal Manajemen Maranatha, 23*(2), 175-184. http://dx.doi.org/10.28932/jmm.v23i2.8596

Withisuphakorn, P., & Jiraporn, P. (2019). Deciphering the motives behind corporate social responsibility (CSR) using managerial ownership: Evidence from heteroskedastic identification. *Applied Economics Letters, 26*(12), 963-970. http://dx.doi.org/10.1080/13504851.2018.1524973

Wood, D. J. (1991). Social issues in management: Theory and research in corporate social performance. *Journal of Management, 17*(2), 383-406. http://dx.doi.org/10.1177/014920639101700206

Wu, M. W., & Shen, C. H. (2013). Corporate social responsibility in the banking industry: Motives and financial performance. *Journal of Banking & Finance, 37*(9), 3529-3547. http://dx.doi.org/10.1016/j.jbankfin.2013.04.023

Yin, J., Li, J., & Ma, J. (2024). The effects of CEO awards on corporate social responsibility focus. *Journal of Business Ethics, 190*(4), 897-916. http://dx.doi.org/10.1007/s10551-023-05411-2

Yuan, Y., Tian, G., Lu, L. Y., & Yu, Y. (2019). CEO ability and corporate social responsibility. *Journal of Business Ethics, 157*(2), 391-411. http://dx.doi.org/10.1007/s10551-017-3622-3

Zhou, G., Sun, Y., Luo, S., & Liao, J. (2021). Corporate social responsibility and bank financial performance in China: The moderating role of green credit. *Energy Economics, 97*, 1-10. http://dx.doi.org/10.1016/j.eneco.2021.105190

Zou, Z., Wu, Y., Zhu, Q., & Yang, S. (2018). Do female executives prioritize corporate social responsibility? *Emerging Markets Finance and Trade, 54*(13), 2965-2981. http://dx.doi.org/10.1080/1540496X.2018.1453355

Scientific Annals of Economics and Business
71 (4), 2024, 473-496
DOI: 10.47743/saeb-2024-0016

Technological Disruption, Ease of Doing Business, and Manufacturing Resilience: A Study of Competitiveness and Efficiency in Developing Countries

Dwi Budi Santoso[*], Ferry Prasetyia[**], Trinh Thi Chung[***], Axellina Muara Setyanti[§], Nayaka Artha Wicesa[°], Al Muizzudin Fazaalloh[††]

Abstract: This research aimed to analyze the determinants of efficiency and competitiveness in the manufacturing sector, encompassing GDP per capita, ease of doing business, technology, and several variables indicative of governance quality, such as corruption control and government effectiveness. Competitiveness in this study is measured using the concept of Revealed Comparative Advantages (RCA) introduced by Balassa (1965) employing Panel Corrected Standard Error (PCSE) estimation technique. Simultaneously, manufacturing efficiency is gauged utilizing the Data Envelopment Analysis (DEA) method, a nonparametric approach applied to compute the efficiency of a group of decision-making units (DMU). The findings reveal that GDP per capita, Technology, Government Governance Index, and Nominal Exchange Rate significantly and positively influence RCA. Conversely, Ease of Doing Business is found to exert a significant negative impact on RCA. Furthermore, the DEA efficiency scores indicate values of 1 for several African countries, including the Democratic Republic of Congo, Eswatini, and Burundi, and also find high efficiency in certain Asian countries such as China, Thailand, Malaysia, and Indonesia. Efficient allocation of capital (Gross Fixed Capital Formation) and labor (Labor Force in the Industrial Sector) optimizes output (Manufacturing Share of GDP). This study holds implications for enhancing the driving factors of competitiveness and optimizing efficiency in the manufacturing sector across developing countries worldwide.

Keywords: manufacturing sector; competitiveness; technology; ease of doing business; developing countries.

JEL classification: L60; C33; O14.

[*] Universitas Brawijaya, Indonesia; e-mail: *dbudi@ub.ac.id* (corresponding author).
[**] Universitas Brawijaya, Indonesia; e-mail: *ferry.p@ub.ac.id*.
[***] FPT University, Vietnam; e-mail: *chungnt109@gmail.com*.
[§] Universitas Brawijaya, Indonesia; e-mail: *axellinamuara@ub.ac.id*.
[°] Universitas Brawijaya, Indonesia; e-mail: *nayakaarthawicesa@ub.ac.id*.
[††] Universitas Brawijaya, Indonesia; e-mail: *almuiz.wang@ub.ac.id*.

Article history: Received 8 January 2024 | Accepted 15 April 2024 | Published online 23 September 2024

To cite this article: Santoso, D. B., Prasetyia, F., Chung, T. T., Setyanti, A. M., Wicesa, N. A., Fazaalloh, A. M. (2024). Technological Disruption, Ease of Doing Business, and Manufacturing Resilience: A Study of Competitiveness and Efficiency in Developing Countries. *Scientific Annals of Economics and Business*, 71(4), 473-496. https://doi.org/10.47743/saeb-2024-0016.

1. INTRODUCTION

The manufacturing sector plays a crucial role in the economic development of a country. In developing nations, the growth of the manufacturing sector often serves as a primary indicator of economic progress and structural transformation (Mijiyawa, 2017; Haraguchi *et al.*, 2019). With the increasing forces of globalization and economic integration, developing countries are increasingly focusing on the development of the manufacturing sector to achieve sustainable economic growth. Research and development activities within manufacturing enterprises have become vital sources for technological advancement in the global economy (Shen *et al.*, 2007). Therefore, manufacturing stands as a key driver for innovation and technology diffusion. Additionally, manufacturing offers spillover advantages to other economic sectors (Tsai & Wang, 2004; Min *et al.*, 2019).

The evolution of manufacturing in the era of Artificial Intelligence (AI) has significantly transformed production methods and factory operations. By harnessing AI, manufacturing can optimize efficiency, enhance product quality, and reduce production costs. AI enables the development of more sophisticated and flexible automation systems. Industrial robotics equipped with AI can perform tasks requiring high precision, such as product assembly or material processing. They can also learn and adapt to changing production environments. In modern manufacturing, AI can optimize supply chain management by analyzing data from various sources, including suppliers, transportation, and inventory, to provide more accurate predictions of customer demand, reduce delivery times, and prevent stock shortages.

The development of the industrial sector in developing countries has been a focal point in recent decades. For instance, in Asia, a region experiencing rapid economic growth, several developing and emerging nations show potential for manufacturing sector development. Industrial development in Asia has been underway since the end of World War II, with Japan emerging as a global manufacturing powerhouse in the decades following the war, followed by other Asian nations such as South Korea, Taiwan, and Malaysia (Şengör *et al.*, 2023). Certain Latin American countries, such as Brazil (Andreoni & Tregenna, 2020; Contador *et al.*, 2020) and Mexico (Mosk, 2022), have also witnessed significant advancements in the industrial sector. They have engaged in manufacturing, including automotive, technology, and consumer products. Furthermore, regional and national initiatives have been undertaken to drive industrial growth in Africa, such as the African Continental Free Trade Area (AfCFTA), aiming to create a single market for goods and services across the continent, and government initiatives like "Made in Africa" to boost local production (Onwuka Onyinye & Udegbunam Kingsley, 2019; Apiko *et al.*, 2020). These countries, along with other developing nations, have successfully leveraged comparative advantages, such as competitive labor costs, technical expertise availability, and expansive markets, to develop robust manufacturing industries.

Rodrik (2006) argues that sustainable growth requires a dynamic industrial base. Hence, the concept of "industrialization logic" (Nixson, 1990) is introduced, explaining why many developing countries adopt strategies for rapid industrialization. Typically commencing with industries employing relatively simple technology and having the potential for labor-intensive absorption (Felipe & Estrada, 2008). The growth of the manufacturing sector in developing countries can have positive economic, social, and environmental impacts (Abdul-Rashid *et al.*, 2017). Firstly, a strong manufacturing sector

can create new employment opportunities and reduce unemployment rates (Kapoor, 2015; Machado *et al.*, 2020). Secondly, a developing manufacturing sector contributes to the increase in national income and exports (Noviriani *et al.*, 2023), thereby enhancing economic stability and trade balances. Thirdly, an innovation and technology-oriented manufacturing sector can drive productivity improvement and the country's competitiveness in the global market (Sutantio *et al.*, 2023). Lastly, an environmentally sustainable manufacturing sector can promote sustainable growth.

In Lewis' model, the economy of a developing country consists of two sectors: the traditional agricultural sector with surplus rural population characterized by zero marginal labor productivity, and the highly productive and modern urban industrial sector to which labor is gradually shifted from the agricultural sector (Lee, 1995). The basic idea of this theory is that industrial development occurs through the unlimited transfer of cheap labor to the modern sector. Therefore, in a situation of surplus labor, labor-using technologies should be employed for industrialization. Competitiveness and manufacturing efficiency become integral factors in driving growth and economic progress in developing countries. High competitiveness can propel a country's export growth. By becoming more efficient and competitive in the manufacturing sector, a country can enhance its production and exports, contributing to economic growth.

Hence, this research aims to conduct a comprehensive analysis of the factors driving competitiveness in the manufacturing sector in developing countries worldwide. The study will analyze factors influencing manufacturing sector competitiveness, such as GDP per capita, ease of doing business, technology, and several variables reflecting governance quality, such as corruption control and government effectiveness. Competitiveness in this research will employ the concept of Revealed Comparative Advantages (RCA) introduced by Balassa (1965). In addition to GDP per capita, this study will also use the squared term of GDP per capita to observe the possibility of U-shaped phenomena or deindustrialization in developing countries in Asia. Furthermore, this research will identify the level of technical efficiency and whether there are differences in manufacturing efficiency among developing countries.

2. LITERATURE REVIEW

The manufacturing sector assumes various crucial roles in the economy of a nation by significantly contributing to economic growth and employment generation. Within the framework of economic growth, the manufacturing sector is often regarded as a primary driver of innovation and productivity. The production of manufactured goods adds value through the utilization of advanced technology and enhanced efficiency in production processes. Furthermore, the sustainability of long-term economic growth is frequently contingent upon a nation's capacity to maintain a robust manufacturing sector capable of producing high-value goods and products for both domestic and global markets.

The theoretical foundation supporting the importance of the manufacturing sector is rooted in economic development theories, particularly within the concept of economic structuralization. This theory underscores the significance of economic diversification through the development of the manufacturing sector as a means to enhance competitiveness and economic resilience. Economic scholars such as Paul Krugman (Fujita & Thisse, 2009) also endorse this perspective, emphasizing the importance of the manufacturing sector in

improving productivity and creating spillover effects that stimulate overall economic growth. Spillover effects refer to the positive impacts generated by activities or innovations in one economic sector on other sectors. In the context of the manufacturing sector, spillover effects are closely associated with the idea that investments or innovations in manufacturing goods production can stimulate broader economic growth and enhance overall productivity. Several spillover effects in the manufacturing sector include:

a) Improved Productivity: Investments in technology and innovation in the manufacturing sector can lead to increased productivity. When a company or sector achieves higher productivity levels, it can trigger enhanced efficiency in the supply chain and accelerate economic growth, not only in developed countries, as stated in the findings of Hulten and Schwab (2000), but also in developing countries, as evidenced by the research of Khanna and Sharma (2021) indicating that high-tech manufacturing firms are more productive than low-tech counterparts.

b) Job Creation: The development of the manufacturing sector often directly and indirectly creates jobs. Involving a large workforce in the production process and supply chain leads to spillover effects in the form of job creation in related sectors such as logistics, distribution, and other supporting services. Lu *et al.* (2022) referred to this as human-centric manufacturing, believing that in the evolution map of manufacturing in the era of industry 5.0 through 5C, Coexistence, Cooperation and Collaboration to future Compassion, and Coevolution, a reliable human-machine coevolution relationship will be produced.

c) Innovation and Technology: As an innovation hub, the manufacturing sector creates spillover effects by generating new technologies and best practices. These innovations can spread to other sectors, enhancing overall economic competitiveness and driving growth in areas such as research and development (Xu *et al.*, 2019; Gomes *et al.*, 2022).

Optimizing the spillover effects of the manufacturing sector can be a key strategy for the progress of developing countries. Developing nations need to increase investment in research and development, especially in the manufacturing sector. By stimulating innovation and the development of new technologies, there will be opportunities to create spillover effects that enhance productivity and competitiveness throughout the economy. Training and education focusing on skills required in the manufacturing sector can enhance the quality of the workforce. Skilled human resources can maximize the benefits of spillover effects by effectively implementing new technology and innovations in the production process. Additionally, the development of robust infrastructure, such as reliable transportation and energy networks, can help improve connectivity and efficiency in the manufacturing supply chain. Good infrastructure facilitates the movement of raw materials and finished products, supports the growth of the manufacturing sector, and creates spillover opportunities in related sectors. Furthermore, creating a business-friendly environment, including conducive investment policies, tax incentives, and clear regulations, can encourage the growth of the manufacturing sector. Legal certainty and consistent policies are also crucial for attracting investment and ensuring the sustainability of spillover effects from the manufacturing sector.

There are several empirical microeconomic studies on the development of the manufacturing sector and economic growth that can serve as references. The first study by Bigsten *et al.* (2004) examines the impact of exports on the performance of African manufacturing firms (Fafchamps *et al.*, 2008). The second paper utilizes a cross-country empirical approach to identify factors contributing to economic growth in the South Asian region (Maroof *et al.*, 2019). The third paper investigates the factors limiting the success of

African manufacturing firms and their ability to sustain in export markets (Söderbom & Teal, 2003; Söderbom *et al.*, 2006). Subsequently, the fourth paper examines the factors influencing the performance of African manufacturing firms (Biggs & Srivastava, 1996; Söderbom & Teal, 2004).

In contrast to micro studies, macro empirical studies on the factors influencing the development of manufacturing, especially in developing countries in Asia, are relatively scarce. One notable study is by Leon-Gonzalez and Vinayagathasan (2015). The aim of this research is to examine the determinants of economic growth in developing countries in Asia using Bayesian model averaging (BMA) based on data from 27 Asian developing countries from 1980 to 2009. Based on empirical evidence regarding growth determinants, the economic investment ratio is positively related to growth, while government consumption expenditure and trade conditions are negatively related. Leon-Gonzalez and Vinayagathasan (2015) also find evidence of a nonlinear relationship between inflation and economic growth, indicating that inflation hinders economic growth when it exceeds 5.43% but does not affect growth below that level.

Another macro indicator is the influence of the exchange rate on economic growth in the manufacturing sector. A study conducted by Hendro *et al.* (2020) explains the relationship between the Rupiah exchange rate and the economy. This research shows that the Rupiah exchange rate has a significant positive influence on stock prices, while interest rates have a significant negative influence. Strengthening the Rupiah exchange rate indicates an improved economic condition, making stock investments profitable. However, an increase in interest rates can increase the burden on companies to meet obligations or debts to banks, potentially lowering company profits and ultimately reducing stock prices. Inflation does not have a significant influence on stock performance. This study has some limitations, such as being conducted only in Indonesia and analyzing data within a relatively short time period. Nevertheless, the authors emphasize that further research is necessary, involving other countries and extending the time period to understand long-term economic conditions. Future research also needs to compare stable and unstable conditions to determine factors sensitive to stock returns. Dollar and Kraay (2004) and Baldwin and Robert-Nicoud (2014) explain that economic openness through trade liberalization and globalization has played a crucial role in stimulating specific manufacturing growth in developing Asian countries. Highlighting the positive effects of trade reforms, such as tariff reductions and non-tariff barriers, in enhancing competitiveness, promoting exports, and attracting FDI. Access to international markets and participation in global value chains have provided opportunities for technology transfer and increased manufacturing industry.

In their research on technology, Wiboonchutikula *et al.* (2016) investigated the spillover effects of technology on upstream, downstream, and horizontal industries on domestic manufacturing firms in Thailand, utilizing firm-level data observed through total factor productivity (TFP) and estimating stochastic production frontiers to ascertain firm-level technical efficiency. The findings revealed no discernible impact of technology spillovers from Foreign Direct Investment (FDI) in horizontal industries on TFP or the technical efficiency of domestic firms. In a similar vein, Singh (2016) obtained contrasting results. Singh (2016) explored the relationship between technology spillovers and productivity among a group of manufacturing firms in India during the period 2001-2012. Technology spillover impact was defined as the function of technology adoption (R&D and technical knowledge) and technology diffusion (imports and exports). Two productivity

measures, namely total factor productivity (TFP) and labor productivity, were employed in the analysis. The research findings indicated that firms engaged in technology adoption tended to be more productive than others based on TFP. Regarding labor productivity, firms involved in both technology adoption and diffusion through imports exhibited higher productivity compared to others. This confirms that manufacturing firms in India represent the learning-from-importing phenomenon due to their generally labor-intensive production processes. The findings also indicated a weak relationship between technology diffusion through exports and TFP but a strong association between labor productivity, technology diffusion through imports, and R&D.

Moreover, beyond the aforementioned factors, institutional elements, including government policies, regulations, and the business environment, shape the prospects of manufacturing sector growth significantly. Research by Acemoglu and Johnson (2005) indicates that countries with effective governance, transparent and efficient governance structures, well-defined property rights, and supportive business regulations attract investments and foster manufacturing growth. Effective institutions can facilitate industrial clustering, encourage entrepreneurship, and provide a conducive environment for manufacturing development (World Bank, 2019). Morris and Aziz (2011) underscore the importance of ease of doing business in attracting investors and expediting the structural transformation of a country's economy. This study explores the concept of ease of doing business, which generally refers to the business regulatory environment and factors influencing the formation, operation, and growth of businesses in a country. The study covers indicators such as government regulations, governance effectiveness, contract enforcement, property rights protection, access to credit, tax systems, and other aspects affecting the ease with which businesses can operate and thrive.

In the case of several countries, ease of doing business has proven to be a factor capable of enhancing macroeconomic performance, such as economic growth. Ani (2015) research on 29 Asian countries concluded that Singapore exhibited the best regulatory performance, achieving the highest ease of doing business scores in five indicators: Starting a Business, Registering Property, Protecting Investors, Trading Across Borders, and Enforcing Contracts. Conversely, China demonstrated the highest economic growth. Variations in ease of doing business were explained by the handling of construction permits, obtaining credit, property registration, and trading across borders. Handling construction permits and obtaining credit had negative effects on Gross Domestic Product (GDP), while property registration and international trade had positive effects. International trade was found to have a significant impact on GDP among selected Asian countries. This study provides further insight into key factors influencing ease of doing business and economic growth in the region. In conclusion, efficient regulations and ease of engaging in international business can make a significant positive contribution to a country's economic growth.

Another crucial aspect is corruption control, which significantly influences economic growth. Khan (1998) studied the role of patron-client networks in facilitating or perpetuating corruption in Asia. Corruption refers to the misuse or abuse of power for personal gain, often involving bribery, embezzlement, nepotism, or other unethical behaviors. Corruption tends to be rampant in the early stages of capitalist development when capitalists have little legitimacy, and states face an excess of rights and resources. However, the economic consequences of corruption vary significantly across Asian countries. According to this research, the type of patron-client network in which developer corruption occurs is related to

their economic performance. The types of rights exchanged through corruption, as well as the conditions of these exchanges, are determined by the type of patron-client network. This study compares patron-client networks in India, Malaysia, Thailand, and South Korea. Such examinations help explain why corruption accompanies rapid growth in some countries, while in others, corruption results in significant transfers.

Apart from focusing on economic issues, the availability and quality of human resources and structural transformation are also crucial for manufacturing growth. Psacharopoulos and Patrinos (2018) and Nguyen and Nguyen (2019) show that skilled and educated labor produces higher productivity, innovation, and technological progress in the manufacturing sector. Investments in education, vocational training programs, and research and development (R&D) activities have proven to have positive impacts on manufacturing growth in developing countries. Technological advancements and Artificial Intelligence have significant potential in the structural transformation of a country or region.

3. DATA AND METHODOLOGY

3.1 Data

In this empirical study, we consider the secondary data is sourced from the World Bank from 2001 - 2021. The object of this research is 73 developing countries in the world, so the number of observations is 1533. Table no. 1 presents the descriptive statistics on the data used in this study.

Table no. 1 – Descriptive statistics of the data

Variables	Mean	Max	Min	St. Dev
Revealed Comparative Advantage (RCA)				
• 73 Countries	0.3149546	0.9052595	-0.023759	0.2429658
• Africa	0.2310800	0.7822757	-0.023759	0.2168141
• America	0.2730070	0.7440690	0.0175952	0.2045908
• Asia	0.4597916	0.9052595	0.0361010	0.2653739
• Europe	0.3462467	0.5396400	0.0713590	0.1759124
GDP per Capita				
• 73 Countries	3351	9357	202	2586
• Africa	2198	8048	202	2154
• America	5193	9357	1589	2610
• Asia	3504	9011	681	2651
• Europe	4161	6180	2508	1411
Technology				
• 73 Countries	0.9593520	10.02182	-7.712805	2.038854
• Africa	0.3541032	10.02182	-7.712805	2.702101
• America	0.5426009	1.611167	-0.8012477	0.679793
• Asia	1.9648650	3.825119	-0.421419	1.054400
• Europe	1.6090540	3.548967	-1.438686	1.662957
Ease of Doing Business				
• 73 Countries	52.46370	80.10372	-14.35744	16.75705
• Africa	53.22347	77.49374	24.64672	14.13370

Variables	Mean	Max	Min	St. Dev
• America	59.90378	69.29637	42.67968	8.589313
• Asia	50.44499	80.10372	-14.35744	22.41028
• Europe	37.00349	57.56866	20.843330	12.48589
Governance Index				
• 73 Countries	-0.479201	0.7547524	-1.622806	0.451715
• Africa	-.5515212	0.7547524	-1.622806	0.551959
• America	-.3219694	0.5970802	-0.631891	0.332270
• Asia	-.5091987	0.3399206	-1.025248	0.383565
• Europe	-.3936341	0.0636524	-0.814372	0.305850
Nominal Exchange Rate				
• 73 Countries	1235.078	19504.61	0.83324	3564.616
• Africa	513.5727	2562.554	1.77749	659.6081
• America	568.8689	5359.488	1.00000	1476.246
• Asia	3122.217	19504.61	1.10851	6184.27
• Europe	23.38871	109.4732	0.833247	42.62334

Analysis of the manufacturing sector in developing countries has high urgency considering the significant impact it can have on economic growth, job creation and poverty alleviation. The manufacturing sector often becomes the backbone of the economies of developing countries because of its potential to increase added value, transfer technology and diversify the economy. By examining the manufacturing sector, researchers can identify key factors that influence competitiveness and innovation in this industry, help formulate policies that support sustainable growth, and address challenges such as dependence on the agricultural sector and economic inequality. Of the 136 developing countries in the world, 73 developing countries were obtained as research samples, with details of 31 developing countries from the African continent, 15 developing countries from the American continent, 21 developing countries from the Asian continent, and 6 developing countries from the European continent. The selection of the 73 countries was based on the availability of data for each variable in order to obtain balanced data between countries and over time (Balanced Panel Data).

3.2. Methodology

This research uses a quantitative approach with econometric modeling. The author carried out empirical testing on the data obtained, then explained the estimation results accompanied by arguments and justification to answer the research objectives stated previously. The method used in this research is Instrument Variable Panel Data Regression and Data Envelopment Analysis (DEA). There are 2 models that will be estimated in this research. First, the manufacturing industry competitiveness model will be estimated using the Panel Data Regression method with the Panel Corrected Standard Error (PCSE) estimation technique. The estimation technique was chosen to overcome the problems of autocorrelation and heteroscedasticity. Second, the manufacturing industry efficiency model will be estimated using the Data Envelopment Analysis (DEA) method. The operational definitions of variables in the Manufacturing Industry Competitiveness Model can be seen in Table no. 2. The Panel Data Regression model is following.

$$RCA_{it} = \beta_0 + \beta_1 GDP\_Cap_{it} + \beta_2 GDP\_Cap^2_{it} + \beta_3 TFP_{it} + \beta_4 EODB_{it} + \beta_5 GI_{it} + \beta_6 NER_{it} + e_{it} \quad (1)$$

Table no. 2 – Definition of Variables in the Competitiveness Model of the Manufacturing Industry

Variables	Symbol	Definition	Source
Revealed Comparative Advantage	RCA	The performance of a country's manufacturing exports on the export performance of the manufacturing of developing countries in the world. RCA is calculated using the following formula: $$RCA = \frac{XM_i/TX_i}{XMA/TXA}$$ where: XM = State manufacturing export I to the world TX = total country exports I to the world XMA = manufacturing exports of developing countries throughout the world TXA = Total Exports of Developing Countries throughout the World	World Bank (World Development Indicators/WDI)
Per capita GDP	GDP_Cap	The average income of the population in a country. GDP per capita is a gross domestic product divided by the population	World Bank (WDI)
Square of Per capita GDP	GDP_Cap^2	The square value of GDP per capita	World Bank (WDI)
Technology	TFP	Measure the efficiency and level of utilization of input in the production process. TFP is measured using Solow Residual Gy – C * Gk – (1-C) * Gl Where: Gy = Growth Rate of Aggregate Output GK = Growth Rate of Aggregate Capital GL = Growth Rate of Aggregate Labor C = Capital Share	World Bank (WDI)
Ease of Doing Business	EODB	Measuring how the ease of doing business measured in the Ease of Doing Business Index. The score is shown on a scale of 0 to 100, where 0 shows the worst and 100 regulatory performance shows the best regulatory performance	World Bank (WDI)

Variables	Symbol	Definition	Source
Governance Index	GI	Is a governance index for the six dimensions of governance: (1) the effectiveness of government; (2) corruption control; (3) political stability; (4) regulatory quality; (5) rule of law; (6) Democracy and Accountability	World Bank
Nominal Exchange Rate	NER	Relative price of the currency of two countries, namely against the United States	World Bank (WDI)

In this study, the governance index (GI) is an index formed from 6 dimensions namely (1) the effectiveness of government; (2) corruption control; (3) political stability; (4) regulatory quality; (5) rule of law; (6) Democracy and accountability. In this study we calculated the governance index by the average of the six dimensions as carried out by Easterly and Levine (2002); Al-Marhubi (2004); Bjørnskov (2006).

Furthermore, data envelopment analysis (DEA), is one of the nonparametric methods used to calculate the efficiency of a group of decision grafting units (DMU). The DEA method measures efficiency using several output variables and predetermined input variables. DEA calculates the relative efficiency of a group of DMU using linear programming techniques. Efficiency estimation results are used to compare efficiency between DMU, but these results cannot be used to compare with other DMU that are not estimated together. Two common models that are often used in DEA are CCR and BCC. CCR was developed in 1978 and is an abbreviation of the name of the inventor of this model, namely Chanes, Cooper, and Rhodes. CCR has the assumption that the increase from input will make the output more equal. The second model is BCC, the assumption of this model is VRS (Variable Return to Scale), which states that the increase in input will not make the output more equal. This model assumes that DMU has not operated at maximum value. This study will use the DEA method with OUPUT -oriented BCC models. This model was chosen because the comparison of input and output increases was not the same (VRS) and the amount of output increased every year. Assuming that there is n DMU ($DMUj$, j = 1,2, ..., n) which uses input as much as m (xi, i = 1,2, ..., m) to produce output as much as s (yr, r = 1.2 , ..., s) then an output -oriented conventional BCC model can be written, namely:

$$Min \sum_{i=1}^{m} w_i x_{ij} + \mu_0$$

$$s.t. \sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} w_i x_{ij} + \mu_0 \geq 0 \quad j = 1,2,\dots,n$$

$$\sum_{r=1}^{s} \mu_r y_{rj} = 1$$

$$\mu_0 \; bebas$$

$$w_i \geq \varepsilon, \quad i = 1,2,\dots,m$$
$$\mu_r \geq \varepsilon, \quad r = 1,2,\dots,s$$

Furthermore, the output is measured using Share of Manufacturing to PDB (SM) that is percentage of manufacturing industry production value on gross domestic product, while the input consists of Labor in Industrial Sector (LIS) showing the percentage of labor in the industrial sector to the total workforce and Gross fixed capital formation (GCF) measuring the expenditures for the addition of fixed economic assets plus net changes at the inventory level, measured in the percentage of GDP.

4. EMPIRICAL RESULTS

4.1 The Determinant of the Competitiveness of the Manufacturing Sector

Analysis of Determinant Performance of Competitiveness of the Manufacturing Sector is very relevant in the context of international globalization and competition. Developing countries are often involved in the global market, and the competitiveness of their manufacturing sector can be the main determinant of their success in competing with other countries. By understanding the factors that influence competitiveness, countries can identify their strengths and weaknesses in the global market (Garcia Pires, 2012). This analysis helps design policies that support the expansion of international trade, increasing competitiveness, and better integration in the global value chain.

Analysis of determinants of the competitiveness of the competitiveness of the manufacturing sector also has an impact on the efforts of economic diversification and national resilience. Developing countries that are too dependent on certain sectors or commodities are at risk of facing significant economic challenges. With a focus on the manufacturing sector, analysis can help countries plan policies to reduce the risk of economic instability that may arise from fluctuations in commodity prices or global market changes. Economic diversification through the development of a strong manufacturing sector can increase economic resilience and reduce vulnerability to global economic turmoil (Tonuchi & Onyebuchi, 2019).

Table no. 3 – Panel Data Regression Estimation Results (PCSE)

Variabel Dependen: Revealed Comparative Advantage (RCA)						
Independent Variables	Fixed Effect Model (FEM_		Generalized Least Square (GLS)		**Panel Corrected Standard Error (PCSE)**	
	Coeff	Prob	Coeff	Prob	**Coeff**	**Prob**
Per capita GDP	0.000011**	0.015	0.0000174**	0.014	**0.0000174*** **	**0.000**
Square of per Capita GDP	-1.20e-09***	0.000	-1.31e-09**	0.036	**-1.31e-09*** **	**0.000**
Technology	-0.0001281	0.713	0.001499	0.108	**0.001499***	**0.071**
Wase of Doing Business	-0.0001443	0.396	-0.001037***	0.000	**-0.001037*** **	**0.000**
Governance Index	-0.031742**	0.043	0.140228***	0.000	**0.140228*** **	**0.000**
Nominal Exchange Rate	6.37e-06***	0.000	3.84e-06**	0.020	**3.84e-06*** **	**0.000**
Constant	.2863839***	0.000	0.398267***	0.000	**0.398267*** **	**0.000**
Prob (F-Stat)	0.0000		0.0000		**0.0000**	

Note: Signicant Level ***1%, **5%, *10%

Based on the regression estimation of panel data with Panel-Corrected Standard Errors (PCSE), it is found that all independent variables have a significant impact on the competitiveness performance (RCA) at α=1%, except for the Technology variable, which is significant at α=10%. Per Capita GDP, Technology, Government Governance Index, and Nominal Exchange Rate have a significant positive influence on RCA, while Ease of Doing Business is found to have a significant negative impact on RCA.

The Impact of Per Capita GDP on RCA

The positive impact of Per Capita GDP on competitiveness performance (RCA) reflects the close relationship between a country's economic standard of living and its ability to compete in the international market. The increase in Per Capita GDP is often associated with sustainable economic growth, which can drive investment in technology, enhance production efficiency, and diversify the economy. As an indicator of societal well-being, a high Per Capita GDP creates conditions conducive to the development of the manufacturing sector and competitiveness in the global market (Fagerberg *et al.*, 2007). The economic convergence theory supports the idea that countries with low Per Capita GDP tend to grow faster than those with high Per Capita GDP, thus enhancing their relative competitiveness (Varblane & Vahter, 2005).

The increase in Per Capita GDP can also be linked to enhanced production capacity and improved product quality. Countries with a high Per Capita GDP tend to have greater access to capital, technology, and high-quality human resources. This can drive the development of high technology, innovation, and efforts to improve the quality of manufacturing products (Ahmad & Schreyer, 2016). In this context, the beta convergence theory suggests that countries with low expenditure levels will more rapidly adopt and adapt to high technology, thereby enhancing the competitiveness of their manufacturing sector. Per Capita GDP can also be considered a general indicator of a country's economic development. As prosperity levels rise, governments and businesses can focus more on developing sectors with high competitiveness potential, including the manufacturing sector. Higher income allows for further investment in research and development, infrastructure, and education, all of which can strengthen competitiveness in manufacturing production and exports. Furthermore, the relationship between Per Capita GDP and RCA can be reciprocal causality. Improved competitiveness in the manufacturing sector can significantly contribute to economic growth and societal well-being, creating a positive feedback loop that reinforces both variables. Conversely, an increase in Per Capita GDP can also create better conditions for investment in the manufacturing sector, which, in turn, can enhance a country's competitiveness in the global market (Nababan, 2019).

The Impact of Technology on RCA

The positive impact of the Technology variable on competitiveness performance (RCA) reflects the crucial role of technology in enhancing innovation and efficiency in the manufacturing sector. Technology serves not only as a tool to improve productivity but also as a primary driver of innovation in production processes and the development of new products (Moldabekova *et al.*, 2021). Endogenous growth theory suggests that investment in research and technological development can create an environment conducive to long-term growth, thereby enhancing the competitiveness of the manufacturing sector (Howitt, 2010). The positive influence of technology on RCA can also be associated with the adoption of

high technology in the production process. Countries capable of adopting and integrating high technology into their manufacturing sector can experience significant improvements in production efficiency, product quality, and portfolio diversification. The catch-up theory proposes that developing countries can overcome their lag by adopting technology developed by advanced countries, leading to increased competitiveness in the manufacturing sector (Miao *et al.*, 2018; Saghafi *et al.*, 2021).

Besides that, it can also be seen as an indicator of enhancing a country's global competitive ability in the international market. Technology plays a central role in improving a country's competitiveness in facing global competition. By applying high technology, the manufacturing sector can produce goods with better quality, more cost-efficient production, and environmentally friendly processes, all of which can provide a competitive advantage in the international market. The significance of technology in enhancing the competitiveness of the manufacturing sector can also be viewed as a step toward sustainable competitiveness. Technology contributes to minimizing environmental impact, improving resource efficiency, and creating innovative solutions for sustainability challenges. Thus, the positive impact of Technology on RCA reflects an awareness of the importance of sustainable aspects in achieving sustainable competitiveness in the global market.

The Impact of Ease of Doing Business on RCA

The negative impact of Ease of Doing Business on competitiveness performance (RCA) can be elucidated by the limitations in measuring ease of doing business that may not encompass key elements supporting innovation. Some ease of doing business indicators may overly focus on regulatory and administrative aspects without sufficiently emphasizing factors that drive innovation in the manufacturing sector. For instance, indicators overly concentrated on licensing and administrative aspects may not fully reflect a country's ability to create an innovative environment in the manufacturing sector. This impact may also indicate that countries with low ease of doing business may face constraints in infrastructure development and effective management (Morano *et al.*, 2023). Factors such as complex regulations and high bureaucracy can hinder investments in infrastructure and diminish project management quality. This can negatively impact the competitiveness of the manufacturing sector, as its success is often associated with the availability of adequate infrastructure and efficient management (Hurtado, 2018).

The negative impact of Ease of Doing Business on RCA may also reflect structural challenges faced by informal economies in some countries. If business regulations and procedures are overly complicated, informal sectors may become more dominant, while the formal manufacturing sector may struggle to compete. Economic dualism theory suggests that dualism between formal and informal sectors can create barriers to the development of the formal manufacturing sector. Additionally, this impact may also be related to social and labor aspects. If stringent business regulations make it difficult for companies to recruit and retain qualified labor, it can reduce the competitiveness of the manufacturing sector. Moreover, uncertainty in business regulations can create uncertainty in investment and growth planning, hindering competitiveness in the global market.

The Impact of Governance on RCA

The positive impact of the Governance Index on competitiveness performance (RCA) reflects the crucial role of governance in creating a conducive business environment for the

growth of the manufacturing sector. Agency theory emphasizes the significance of effective governance in bridging the relationship between the private and public sectors. Good governance can formulate policies supporting investment, reduce bureaucracy, and provide legal certainty, all contributing to enhanced competitiveness in the manufacturing sector. The improvement in the competitiveness of the manufacturing sector can be linked to the government's ability to manage resources efficiently and control corruption. Effective governance can allocate resources effectively, ensure fairness in business competition, and shape regulations that support innovation. Corporate governance theory is also relevant here, as good government governance can motivate companies to improve performance and transparency, thereby enhancing their competitiveness.

Good governance can foster trust among market participants, both domestic and international. This trust is crucial for encouraging foreign direct investment and domestic investment in the manufacturing sector. Agency theory suggests that when governance has a transparent and accountable structure, market participants are more likely to invest, triggering the growth of the manufacturing sector and enhancing competitiveness in the global market. Good governance can also facilitate innovation and the development of institutions supporting the growth of the manufacturing sector. A responsive government to the needs of the private sector, capable of creating policies supporting research and development, as well as the implementation of innovation in the manufacturing sector, provides a significant boost to competitiveness. Institutional political economy theory underscores the importance of effective institutions in promoting economic development and innovation. Overall, the positive influence of the Governance Index on RCA illustrates how crucial good governance is in shaping an environment that supports and enhances the competitiveness of the manufacturing sector in the economies of developing countries.

The Impact of Exchange Rate on RCA

The positive impact of Exchange Rate on competitiveness performance (RCA) can be explained by the relationship between the national currency exchange rate and a country's export capacity. Expectations theory posits that a strengthening exchange rate can incentivize exporters, as they will receive more foreign currency for each unit of product sold. With a favorable exchange rate, manufactured products from that country become more affordable to international consumers, enhancing competitiveness in the export market. A positive exchange rate can also affect production costs. National currency appreciation can reduce the costs of importing raw materials and components, thereby lowering production costs for manufacturing companies. This helps improve the competitiveness of local products, both in the domestic and international markets. Purchasing power parity theory provides a basis for understanding how changes in the exchange rate can influence production costs and, consequently, the competitiveness of manufactured products.

An increase in the exchange rate can also open doors for foreign direct investment (FDI), which can have a positive impact on the competitiveness of the manufacturing sector. As per the principles of foreign direct investment, a favorable exchange rate can attract the interest of foreign investors to invest their capital in the manufacturing sector. FDI brings new technology, efficient management, and access to global markets, all of which can enhance competitiveness and innovation in the manufacturing sector. A favorable exchange rate can also facilitate the expansion of export markets for manufactured products. Pricing

theory in international trade indicates that with a higher exchange rate, companies can set lower prices for their products in international markets without sacrificing profits. This can help improve the competitiveness of manufactured products in export markets, increasing market share and the contribution of the manufacturing sector to national export performance.

4.2 Analysis of Technical Efficiency in the Manufacturing Sector

Analysis of technical efficiency in the manufacturing sector in developing countries has a large relevance in measurement of productivity and identification of the potential for increasing efficiency. Through methods such as data envelopment analysis (DEA), it can be known the extent to which the input used in the production process can be converted into optimal output. The results of this analysis can provide an overview of the extent to which the company or manufacturing sector as a whole operates at the maximum level of efficiency. Identification of factors that limit efficiency can help the government and industry players take appropriate action to increase productivity.

Table no. 4 – Estimation Results of Envelopment Analysis (DEA)

DMU	Score	Rank	Benchmark (Lambda)
Congo, Dem. Rep.	1.000	1	Congo, Dem. Rep.(1)
Eswatini	1.000	1	Eswatini(1)
Burundi	1.000	1	Burundi(1)
Mozambique	0.964	4	Burundi(0.894838);Eswatini(0.105162)
China	0.960	5	Eswatini(1)
Madagascar	0.924	6	Burundi(0.646476);Congo, Dem. Rep.(0.221462);Eswatini(0.132062)
Thailand	0.883	7	Eswatini(1)
Cote d'Ivoire	0.812	8	Burundi(0.694581);Eswatini(0.305419)
Cambodia	0.794	9	Congo, Dem. Rep.(0.772717);Eswatini(0.227283)
Malaysia	0.775	10	Eswatini(1)
Indonesia	0.766	11	Eswatini(1)
Benin	0.764	12	Congo, Dem. Rep.(0.760142);Eswatini(0.239858)
Philippines	0.741	13	Congo, Dem. Rep.(0.184731);Eswatini(0.815269)
Belarus	0.740	14	Eswatini(1)
Cameroon	0.693	15	Burundi(0.388391);Congo, Dem. Rep.(0.144988);Eswatini(0.466621)
Bangladesh	0.685	16	Congo, Dem. Rep.(0.635501);Eswatini(0.364499)
Lesotho	0.685	17	Congo, Dem. Rep.(0.476279);Eswatini(0.523721)
Pakistan	0.679	18	Congo, Dem. Rep.(0.777354);Eswatini(0.222646)
Kyrgyz Republic	0.593	19	Congo, Dem. Rep.(0.57052);Eswatini(0.42948)
Egypt, Arab Rep.	0.580	20	Congo, Dem. Rep.(0.276664);Eswatini(0.723336)
Guatemala	0.577	21	Congo, Dem. Rep.(0.034575);Eswatini(0.965425)
Honduras	0.575	22	Congo, Dem. Rep.(0.093765);Eswatini(0.906235)
Sri Lanka	0.575	23	Eswatini(1)
India	0.545	24	Congo, Dem. Rep.(0.207826);Eswatini(0.792174)
Vietnam	0.513	25	Congo, Dem. Rep.(0.01243);Eswatini(0.98757)
Dominican Republic	0.509	26	Eswatini(1)
El Salvador	0.508	27	Eswatini(1)
Argentina	0.507	28	Eswatini(1)

DMU	Score	Rank	Benchmark (Lambda)
Senegal	0.502	29	Congo, Dem. Rep.(0.474982);Eswatini(0.525018)
Turkey	0.502	30	Eswatini(1)
Lao PDR	0.501	31	Burundi(0.599361);Eswatini(0.400639)
Mexico	0.494	32	Eswatini(1)
Tunisia	0.492	33	Eswatini(1)
Morocco	0.489	34	Eswatini(1)
Kenya	0.481	35	Congo, Dem. Rep.(0.662209);Eswatini(0.337791)
Uganda	0.477	36	Burundi(0.58972);Congo, Dem. Rep.(0.155619);Eswatini(0.254661)
Mauritius	0.476	37	Eswatini(1)
Ukraine	0.474	38	Eswatini(1)
Peru	0.465	39	Eswatini(1)
Burkina Faso	0.460	40	Congo, Dem. Rep.(0.8666);Eswatini(0.1334)
Nicaragua	0.455	41	Congo, Dem. Rep.(0.132083);Eswatini(0.867917)
Costa Rica	0.450	42	Eswatini(1)
Tanzania	0.444	43	Burundi(0.741861);Eswatini(0.258139)
Nigeria	0.433	44	Burundi(0.302305);Eswatini(0.697695)
Rwanda	0.431	45	Burundi(0.752958);Congo, Dem. Rep.(0.078507);Eswatini(0.168535)
South Africa	0.430	46	Eswatini(1)
Bhutan	0.427	47	Burundi(0.621627);Eswatini(0.378373)
Iran, Islamic Rep.	0.423	48	Eswatini(1)
Bolivia	0.413	49	Congo, Dem. Rep.(0.34688);Eswatini(0.65312)
Ecuador	0.409	50	Eswatini(1)
Togo	0.399	51	Congo, Dem. Rep.(0.860822);Eswatini(0.139178)
Colombia	0.399	52	Eswatini(1)
Nepal	0.391	53	Burundi(0.580534);Congo, Dem. Rep.(0.139655);Eswatini(0.279811)
Brazil	0.383	54	Eswatini(1)
Moldova	0.371	55	Eswatini(1)
Niger	0.370	56	Burundi(0.562514);Congo, Dem. Rep.(0.278807);Eswatini(0.158679)
Namibia	0.370	57	Eswatini(1)
Kazakhstan	0.364	58	Eswatini(1)
Paraguay	0.351	59	Eswatini(1)
Armenia	0.340	60	Eswatini(1)
Bosnia and Herzegovina	0.314	61	Eswatini(1)
Belize	0.294	62	Eswatini(1)
Lebanon	0.250	63	Eswatini(1)
Sudan	0.232	64	Congo, Dem. Rep.(0.494355);Eswatini(0.505645)
Comoros	0.227	65	Congo, Dem. Rep.(0.62538);Eswatini(0.37462)
Albania	0.191	66	Eswatini(1)
Montenegro	0.189	67	Eswatini(1)
Azerbaijan	0.179	68	Burundi(0.069354);Eswatini(0.930646)
Botswana	0.174	69	Eswatini(1)
Congo, Rep.	0.144	70	Eswatini(1)
Gabon	0.143	71	Burundi(0.133639);Eswatini(0.866361)
Algeria	0.114	72	Eswatini(1)

Based on the DEA estimation results, it was found that there are three efficient countries: Burundi, the Democratic Republic of the Congo, and Eswatini. When capital input (Gross Fixed Capital Formation) and labor input (Labor in the Industrial Sector) can be allocated efficiently, it optimizes the output (Share of Manufacturing in GDP). In this context, efficiency refers to a country's ability to maximize the manufacturing sector's output relative to the inputs used. Firstly, Burundi, the Democratic Republic of the Congo, and Eswatini can be considered as countries that successfully manage their capital and labor optimally for the manufacturing sector. This could be attributed to policies supporting investment in capital formation and workforce development in the industrial sector. This capability can strengthen the manufacturing sector as a key driver in their economies.

Secondly, high efficiency may reflect positive factors such as political stability, supportive investment policies, and good access to natural resources or markets. Success in efficiently allocating inputs can significantly contribute to economic growth and the sustainability of the manufacturing sector, which, in turn, can impact the economic well-being of the country.

The efficiency analysis results indicate that some developing countries in Africa have achieved efficiency in their manufacturing sectors, despite facing various challenges on the continent. For example, the Democratic Republic of the Congo has substantial natural resource potential, including minerals like copper, cobalt, and gold. The manufacturing sector related to mineral processing could make a significant contribution to the economy and create opportunities for technical efficiency. However, challenges may include sustainable resource management and environmental security. If the manufacturing sector in the DRC is primarily related to the processing of extractive raw materials, technical efficiency can be reflected in the country's ability to extract added value from its natural resources. Diversifying the manufacturing sector into higher-value activities in the value chain can enhance efficiency. The success of the manufacturing sector is also related to the availability and quality of the workforce. Training and education programs to enhance workforce skills can play a crucial role in technical efficiency. Furthermore, Eswatini, formerly known as Swaziland, is a landlocked country in southern Africa bordered by South Africa and Mozambique. Eswatini has a relatively small economy and depends on specific sectors. Agriculture, especially subsistence farming and livestock, remains an essential part of the economy and employs a significant portion of the rural population. The manufacturing sector, particularly in sugar, textiles, and agricultural processing, also plays a crucial role in Eswatini's economy. The sugar industry, including sugarcane processing, is a key sector and a major contributor to export income. Moreover, efforts to diversify the economy continue to reduce dependence on specific sectors. Burundi is a small landlocked country in Central Africa, bordered by Rwanda, Tanzania, and the Democratic Republic of the Congo. In this context, the manufacturing sector may have a significant impact on the country's economy. The relatively small size of the economy may allow the government and industry players to focus more on supporting the development of the manufacturing sector.

Eswatini is the only absolute monarchy in Africa, where the king holds significant political power. This factor can influence economic policies and national development, playing a role in investment and economic growth. Although some sectors are developing, Eswatini faces economic challenges, including high unemployment rates, a lack of economic diversification, and income distribution inequality. Efforts to address these challenges involve structural reforms and government initiatives to encourage foreign

investment and the development of potential sectors, such as the manufacturing sector. In its development, it is known that the Eswatini government is working to develop infrastructure to support economic growth. This includes investments in transportation, energy, and telecommunications sectors to improve connectivity and economic competitiveness.

In addition to the three African countries mentioned above, several Asian countries such as China, Thailand, Malaysia, Cambodia, and the Philippines have also demonstrated high levels of technical efficiency in their manufacturing sectors, with DEA scores above 0.75. Many successful Asian countries have integrated themselves into global supply chains, leveraging international partnerships to optimize specialization and production efficiency. This provides access to global markets and cutting-edge technology. These countries tend to make significant investments in technology research and development and promote innovation in the manufacturing sector. The adoption of advanced technology and innovation in the production process can enhance efficiency and productivity. Additionally, good infrastructure, including quality transportation and telecommunication networks, supports the efficiency of distribution and supply chains in the manufacturing sector. Good accessibility to ports and export markets also contributes to this efficiency. Furthermore, this research also examines how developing countries position themselves in the mapping of labor input and PMTB, and DEA scores, thus illustrating how these countries leverage inputs to achieve technical efficiency in the manufacturing sector.

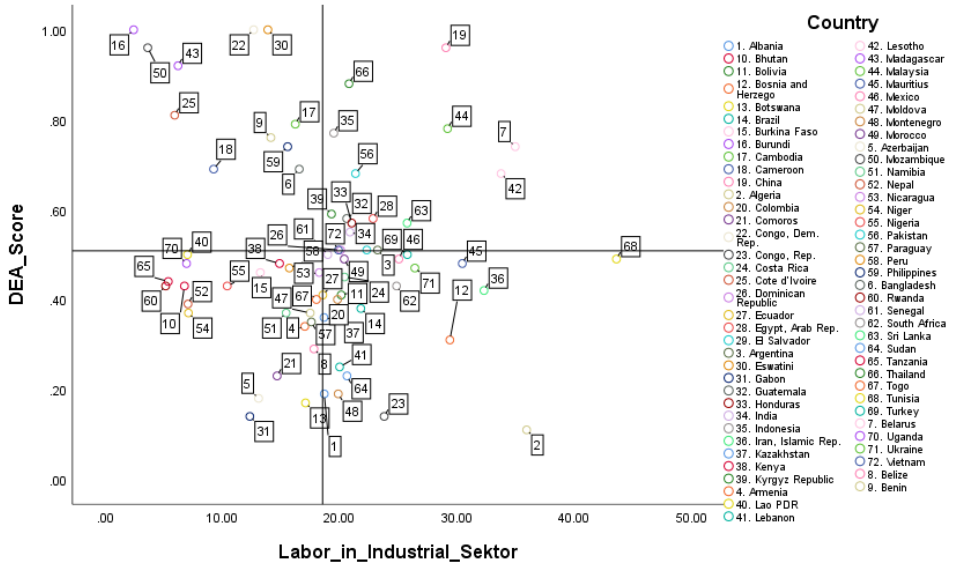


Figure no. 1 – Mapping of labor input inputs in the industrial sector and DEA scores

Information:

Quadrant I (upper right): high industrial sector labor, high efficiency
Quadrant II (Upper Left): Low Labor Industrial Sector, High Efficiency
Quadrant III (Lower Left): Low Manpower Industrial Sector, Low Efficiency
Quadrant II (Lower Right): High Industrial Sector Labor, Low Efficiency

From Figure no. 1 it can be seen that developing countries are scattered in four quadrants, describing the variation in the comparison of labor input with its efficiency achievements shown by DEA scores, but found the number of countries that are more dominating in the quadrant of low DEA scores (quadrant III and IV). It is known that several countries in quadrant III (Low Industrial Sector Labor, Low Efficiency) include Gabon (Code 31), Azerbaijan (Code 5), Nepal (Code 52), and Niger (Code 54). Furthermore, some identified countries are in quadrant IV (high industrial sector labor, low efficiency), including Algeria (Code 2), Bosnia and Herzego (Code 12), and Iran (Code 36). The existence of some developing countries that experience low efficiency in the manufacturing sector despite having a high input number of labor in the industrial sector can be explained with several factors, such as lack of skills and low productivity. Although the number of workers may be high, lack of skills and appropriate training can result in low efficiency. Low labor skills can hamper the ability to utilize input effectively. In addition, the inability to adopt the latest technology and lack of innovation in the production process can cause low efficiency. These countries may be left behind in terms of technology and innovation, which can reduce the productivity of the manufacturing sector.

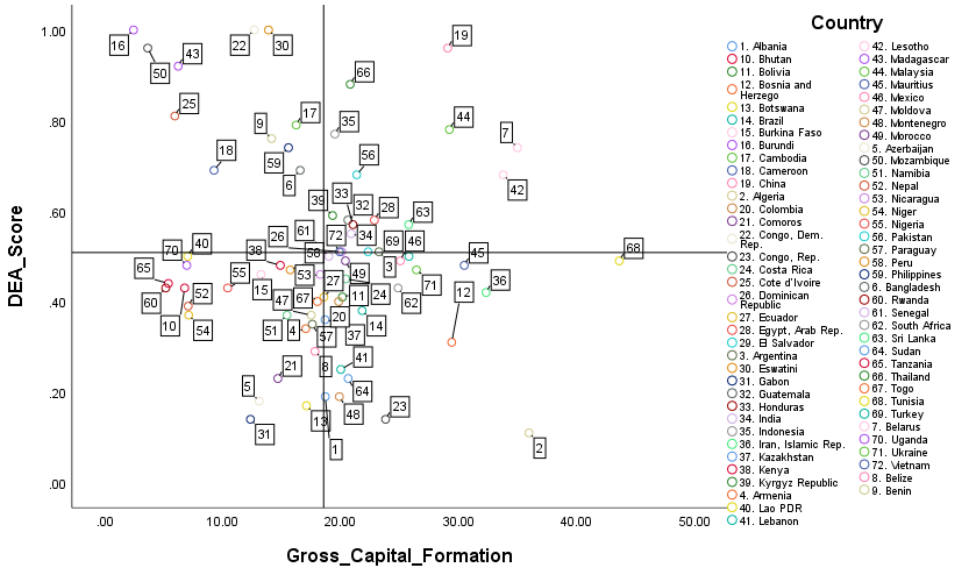


Figure no. 2 – Mapping input Gross Capital Formation and DEA Score

Information:

Quadrant I (upper right): high PMTB, high efficiency
Quadrant II (upper left): low PMTB, high efficiency
Quadrant III (lower left): low PMTB, low efficiency
Quadrant II (lower right): high PMTB, low efficiency

In addition to mapping labor input in the industrial sector, a similar mapping was conducted for Gross Fixed Capital Formation (GFCF) input compared to DEA score achievements, indicating levels of technical efficiency in Figure no. 2. The figure reveals a consistent pattern of diverse variability among countries, with more nations located in the

low-efficiency quadrants (Quadrants III and IV) than in the high-efficiency ones (Quadrants I and II). Some countries demonstrating high efficiency (Quadrant I) include Burundi (Code 16) and Mozambique (Code 50), while those in Quadrant II include China (Code 19) and Thailand (66). Conversely, countries exhibiting low efficiency, such as Azerbaijan (Code 5), Nepal (Code 52), and Niger (Code 54), are found in Quadrant III, and those in Quadrant IV include Algeria (Code 2) and Bosnia and Herzegovina (Code 12). The presence of developing countries with low efficiency in the manufacturing sector, despite high Gross Fixed Capital Formation (GFCF) inputs, may be attributed to investment quality factors. Low efficiency in the manufacturing sector, despite high GFCF, can be influenced by poor investment quality. If investments are not appropriately directed or do not support technology, innovation, and productivity, their impact on efficiency may be limited. Additionally, ineffective management in handling investments can lead to suboptimal fund allocation. The planning, execution, and oversight of investments need enhancement to ensure the efficient utilization of GFCF in creating added value for the industrial sector in developing countries.

5. CONCLUSION, LIMITATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

Per capita GDP, Technology, Government Governance Index, and Nominal Exchange Rate significantly and positively influence RCA, while Ease of Doing Business is found to have a significant negative impact on RCA. The Democratic Republic of the Congo, Eswatini, and Burundi are identified as having technical efficiency in their manufacturing sectors, as indicated by DEA scores of 1. This study also reveals notable efficiency in certain Asian countries, such as China, Thailand, Malaysia, and Indonesia. Efficient allocation of inputs, including Gross Fixed Capital Formation and Industrial Labor, optimizes the output share of manufacturing relative to GDP. In mapping the labor input in the industrial sector and Gross Fixed Capital Formation (GFCF) input against the technical efficiency (DEA scores) of developing countries, a prevalent trend emerges, with more nations situated in the low-efficiency quadrants (Quadrants III and IV) compared to the high-efficiency ones (Quadrants I and II). This depiction underscores the persistent challenges of inefficiency in the manufacturing sector across many developing countries.

While this study provides valuable insights into the factors influencing Revealed Comparative Advantage (RCA) and identifies countries with technical efficiency in their manufacturing sectors, there are certain limitations to be acknowledged. Firstly, the analysis is based on cross-sectional data, limiting our ability to establish causation and observe changes over time. Secondly, the study relies on available data, and the quality and reliability of this data may vary across countries. Additionally, the findings may be influenced by external factors not considered in this study. Furthermore, the efficiency analysis, while informative, does not delve into the specific mechanisms contributing to inefficiencies within the manufacturing sectors of developing countries. Future research endeavors should address these limitations to enhance the comprehensiveness and robustness of our understanding of manufacturing sector dynamics in the context of developing economies.

References

Abdul-Rashid, S. H., Sakundarini, N., Raja Ghazilla, R. A., & Thurasamy, R. (2017). The impact of sustainable manufacturing practices on sustainability performance: Empirical evidence from Malaysia. *International Journal of Operations & Production Management, 37*(2), 182-204. http://dx.doi.org/10.1108/IJOPM-04-2015-0223

Acemoglu, D., & Johnson, S. (2005). Unbundling Institutions. *Journal of Political Economy, 113*(5), 949-995.

Ahmad, N., & Schreyer, P. (2016). Are GDP and productivity measures up to the challenges of the digital economy? *International Productivity Monitor, 30*, 4-27.

Al-Marhubi, F. (2004). The Determinants of Governance: A Cross-Country Analysis. *Contemporary Economic Policy, 22*(3), 394-406. http://dx.doi.org/https://doi.org/10.1093/cep/byh029

Andreoni, A., & Tregenna, F. (2020). Escaping the middle-income technology trap: A comparative analysis of industrial policies in China, Brazil and South Africa. *Structural Change and Economic Dynamics, 54*, 324-340. http://dx.doi.org/10.1016/j.strueco.2020.05.008

Ani, T. G. (2015). Effect of Ease of Doing Business to Economic Growth among Selected Countries in Asia. *Asia Pacific Journal of Multidisciplinary Research, 3*(5), 139-145.

Apiko, P., Woolfrey, S., & Byiers, B. (2020). *The promise of the African Continental Free Trade Area (AfCFTA)*. (287).

Balassa, B. (1965). Trade liberalisation and 'revealed' comparative advantage. *Manchester School, 33*(2), 99-123. http://dx.doi.org/10.1111/j.1467-9957.1965.tb00050.x

Baldwin, R., & Robert-Nicoud, F. (2014). Trade-in-Goods and Trade-in-Tasks: An Integrating Framework. *Journal of International Economics, 92*(1), 51-62. http://dx.doi.org/10.1016/j.jinteco.2013.10.002

Biggs, T., & Srivastava, P. (1996). *Structural aspects of manufacturing in sub-Saharan Africa: findings from a seven country enterprise survey* (Vol. 346): World Bank Publications.

Bigsten, A., Collier, P., Dercon, S., Fafchamps, M., Gauthier, B., Willem Gunning, J., & Zeufack, A. (2004). Do African manufacturing firms learn from exporting? *The Journal of Development Studies, 40*(3), 115-141. http://dx.doi.org/10.1080/0022038042000213229

Bjørnskov, C. (2006). The multiple facets of social capital. *European Journal of Political Economy, 22*, 22-40.

Contador, J. C., Satyro, W. C., Contador, J. L., & Spinola, M. D. M. (2020). Flexibility in the Brazilian industry 4.0: Challenges and opportunities. *Global Journal of Flexible Systems Managment, 21*(Suppl 1), 15-31. http://dx.doi.org/10.1007/s40171-020-00240-y

Dollar, D., & Kraay, A. (2004). Trade, Growth, and Poverty. *Economic Journal (London), 114*(493), F22-F49. http://dx.doi.org/10.1111/j.0013-0133.2004.00186.x

Easterly, W., & Levine, R. (2002). Tropics, Germs, and Crops: How Endowments Influence Economic Development. *NBER Working Paper, 9106*.

Fafchamps, M., El Hamine, S., & Zeufack, A. (2008). Learning to export: Evidence from Moroccan manufacturing. *Journal of African Economies, 17*(2), 305-355. http://dx.doi.org/10.1093/jae/ejm008

Fagerberg, J., Srholec, M., & Knell, M. (2007). The competitiveness of nations: Why some countries prosper while others fall behind. *World Development, 35*(10), 1595-1620. http://dx.doi.org/10.1016/j.worlddev.2007.01.004

Felipe, J., & Estrada, G. (2008). Benchmarking developing Asia's manufacturing sector. *International Journal of Development Issues, 7*(2), 97-119. http://dx.doi.org/10.1108/14468950810909097

Fujita, M., & Thisse, J. F. (2009). New economic geography: An appraisal on the occasion of Paul Krugman's 2008 Nobel Prize in Economic Sciences. *Regional Science and Urban Economics, 39*(2), 109-119. http://dx.doi.org/10.1016/j.regsciurbeco.2008.11.003

Garcia Pires, A. J. (2012). International trade and competitiveness. *Economic Theory, 50*(3), 727-763. http://dx.doi.org/10.1007/s00199-010-0586-2

Gomes, G., Seman, L. O., & De Montreuil Carmona, L. J. (2022). Industry does matter: Analysing innovation, firm performance and organisational learning heterogeneities on Brazilian manufacturing sectors. *Structural Change and Economic Dynamics, 63*, 544-555. http://dx.doi.org/10.1016/j.strueco.2022.08.001

Haraguchi, N., Martorano, B., Sanfilippo, M., & Shingal, A. (2019). Manufacturing growth accelerations in developing countries. *Review of Development Economics, 23*(4), 1696-1724. http://dx.doi.org/10.1111/rode.12621

Hendro, W., Utomo Humam Santosa, S., & Tri, W. (2020). The effect of Indonesian Rupiah exchange rates, inflation, and interest rates on the stock performance of manufacturing companies in Indonesia. *Eurasia: Economics & Business, 1*(31), 52-59. http://dx.doi.org/10.18551/econeurasia.2020-01

Howitt, P. (2010). Endogenous growth theory *Economic growth* (pp. 68-73). Durlauf, S.N.

Blume, L.E.: Palgrave Macmillan UK.

Hulten, C., & Schwab, R. M. (2000). *Does infrastructure investment increase the productivity of manufacturing industry in the US? Econometrics and The Cost of Capital*: MIT Press.

Hurtado, J. M. (2018). Country patterns and effects on the ease of doing business and competitiveness: A global study. *International Journal of Competitiveness, 1*(3), 206-220. http://dx.doi.org/10.1504/IJC.2018.091478

Kapoor, R. (2015). Creating jobs in India's organised manufacturing sector. *The Indian Journal of Labour Economics : the Quarterly Journal of the Indian Society of Labour Economics, 58*(3), 349-375. http://dx.doi.org/10.1007/s41027-016-0032-5

Khan, M. H. (1998). Patron—Client Networks and the economic effects of corruption in Asia. *European Journal of Development Research, 10*, 15-39. http://dx.doi.org/10.1080/09578819808426700

Khanna, R., & Sharma, C. (2021). Do technological investments promote manufacturing productivity? A firm-level analysis for India. *Economic Modelling, 105*, 105672. http://dx.doi.org/10.1016/j.econmod.2021.105672

Lee, J. (1995). Comparative advantage in manufacturing as a determinant of industrialization: The Korean case. *World Development, 23*(7), 1195-1214. http://dx.doi.org/10.1016/0305-750X(95)00039-F

Leon-Gonzalez, R., & Vinayagathasan, T. (2015). Robust determinants of growth in Asian developing economies: A Bayesian panel data model averaging approach. *Journal of Asian Economics, 36*, 34-46. http://dx.doi.org/10.1016/j.asieco.2014.12.001

Lu, Y., Zheng, H., Chand, S., Xia, W., Liu, Z., Xu, X., . . . Bao, J. (2022). Outlook on human-centric manufacturing towards Industry 5.0. *Journal of Manufacturing Systems, 62*, 612-627. http://dx.doi.org/10.1016/j.jmsy.2022.02.001

Machado, C. G., Winroth, M. P., & Ribeiro da Silva, E. H. D. (2020). Sustainable manufacturing in Industry 4.0: An emerging research agenda. *International Journal of Production Research, 58*(5), 1462-1484. http://dx.doi.org/10.1080/00207543.2019.1652777

Maroof, Z., Hussain, S., Jawad, M., & Naz, M. (2019). Determinants of industrial development: Panel analysis of South Asian economies. *Quality & Quantity, 53*, 1391-1419. http://dx.doi.org/10.1007/s11135-018-0820-8

Miao, Y., Song, J., Lee, K., & Jin, C. (2018). Technological catch-up by east Asian firms: Trends, issues, and future research agenda. *Asia Pacific Journal of Management, 35*, 639-669. http://dx.doi.org/10.1007/s10490-018-9566-z

Mijiyawa, A. G. (2017). Drivers of structural transformation: The case of the manufacturing sector in Africa. *World Development, 99*, 141-159. http://dx.doi.org/10.1016/j.worlddev.2017.07.007

Min, Y. K., Lee, S. G., & Aoshima, Y. (2019). A comparative study on industrial spillover effects among Korea, China, the USA, Germany and Japan. *Industrial Management & Data Systems, 119*(3), 454-472. http://dx.doi.org/10.1108/IMDS-05-2018-0215

Moldabekova, A., Philipp, R., Satybaldin, A. A., & Prause, G. (2021). Technological readiness and innovation as drivers for logistics 4.0. *Journal of Asian Finance Economics and Business, 8*(1), 145-156. http://dx.doi.org/10.13106/jafeb.2021.vol8.no1.145

Morano, R. S., Jacomossi, R. R., Barrichello, A., & Feldmann, P. R. (2023). The Interdependence Between Ease of Doing Business, Innovation, and Competitiveness of Nations. *BAR - Brazilian Administration Review, 20*(2), 1-14. http://dx.doi.org/10.1590/1807-7692bar2023220103

Morris, R., & Aziz, A. (2011). Ease of doing business and FDI inflow to Sub-Saharan Africa and Asian countries. *Cross Cultural Management: An International Journal, 18*(4), 400-411. http://dx.doi.org/10.1108/13527601111179483

Mosk, S. A. (2022). *Industrial revolution in Mexico*: Univ of California Press.

Nababan, T. S. (2019). Development Analysis of Global Competitiveness Index of ASEAN-7 Countries and Its Relationship on Gross Domestic Product. *Integrated Journal of Business and Economics, 3*(1), 1-14. http://dx.doi.org/10.33019/ijbe.v3i1.108

Nguyen, H. V., & Nguyen, C. H. (2019). Education and Economic Growth: A Comparative Study of East Asia and Latin America. *Journal of Comparative Asian Development, 18*(3), 261-284.

Nixson, F. I. (1990). Industrialization and structural change in developing countries. *Journal of International Development, 2*(3), 310-333. http://dx.doi.org/10.1002/jid.3380020302

Noviriani, E., Mukaromah, L., & Zurmansyah, E. (2023). Studi Literatur Industrialisasi Dalam Perekonomian Indonesia. *Jurnal Ekuilnomi, 5*(1), 109-115. http://dx.doi.org/10.36985/5jk1cw14

Onwuka Onyinye, N., & Udegbunam Kingsley, C. (2019). The African continental free trade area : prospects and challenges. *Conflict Trends, 2019*(3), 3-10. http://dx.doi.org/10.10520/EJC-1c4f9d05e1

Psacharopoulos, G., & Patrinos, H. A. (2018). Returns to investment in education: a decennial review of the global literature. *Education Economics, 26*(5), 445-458. http://dx.doi.org/10.1080/09645292.2018.1484426

Rodrik, D. (2006). Industrial development: stylized facts and policies *Harvard University* (pp. 1-33). Cambridge: John F. Kennedy School of Government.

Saghafi, F., Mohaghar, A., & Kashiha, M. (2021). Developing a catch-up model of technology: A grounded theory approach. *Journal of Science and Technology Policy Management, 12*(4), 627-650. http://dx.doi.org/10.1108/JSTPM-07-2019-0068

Shen, J., Dunn, D., & Shen, Y. (2007). Challenges facing U.S. manufacturing and strategies. *Journal of Industrial Technology 23*(2), 2-10.

Singh, A. (2016). Do Technology Spillovers Accelerate Performance of Firms? Unravelling a Puzzle from Indian Manufacturing Industry. *Annals of the University Dunarea de Jos of Galati, 22*(3), 108-120.

Söderbom, M., & Teal, F. (2003). Are manufacturing exports the key to economic success in Africa? *Journal of African Economies, 12*(1), 1-29. http://dx.doi.org/10.1093/jae/12.1.1

Söderbom, M., & Teal, F. (2004). Size and efficiency in African manufacturing firms: Evidence from firm-level panel data. *Journal of Development Economics, 73*(1), 369-394. http://dx.doi.org/10.1016/j.jdeveco.2003.02.005

Söderbom, M., Teal, F., & Harding, A. (2006). The determinants of survival among African manufacturing firms. *Economic Development and Cultural Change, 54*(3), 533-555. http://dx.doi.org/10.1086/500030

Sutantio, R. A., Andini, D. P., Chairina, R. L., & Komariyah, S. (2023). Agro-Industry-Based Agricultural Development Strategy: The Concept of Sustainable Development Goals (SDGs). *Jurnal Ilmiah Inovasi, 23*(1), 84-91. http://dx.doi.org/10.25047/jii.v23i1.3803

Şengör, A. C., Alexeeva, N. N., Owen, L., de Beaufort, L. F., Spencer, J. E., Ryabchikov, A. M., . . . Pannell, C. W. (2023). Asia. *Encyclopedia Britannica*. Retrieved from https://www.britannica.com/place/Asia

Tonuchi, J. E., & Onyebuchi, N. A. (2019). Economic diversification in Nigeria: The role of agriculture and manufacturing sector. *International Journal of Research in Electronics and Computer Engineering, 7*(3), 916-919.

Tsai, K. H., & Wang, J. C. (2004). R&D productivity and the spillover effects of high-tech industry on the traditional manufacturing sector: The case of Taiwan. *World Economy, 27*(10), 1555-1570. http://dx.doi.org/10.1111/j.1467-9701.2004.00666.x

Varblane, U., & Vahter, P. (2005). An Analysis of the Economic Convergence Process in the Transition Countries. *SSRN Electronic Journal*(37-2005). http://dx.doi.org/10.2139/ssrn.757204

Wiboonchutikula, P., Phucharoen, C., & Pruektanakul, N. (2016). Spillover effects of foreign direct investment on domestic manufacturing firms in Thailand. *The Singapore Economic Review, 61*(02), 1640028. http://dx.doi.org/10.1142/S0217590816400282

World Bank. (2019). *Doing Business 2019: Training for Reform*: World Bank.

Xu, J., Shang, Y., Yu, W., & Liu, F. (2019). Intellectual capital, technological innovation and firm performance: Evidence from China's manufacturing sector. *Sustainability, 11*(19), 5328. http://dx.doi.org/10.3390/su11195328

Scientific Annals of Economics and Business
71 (4), 2024, 497-518
DOI: 10.47743/saeb-2024-0023

Insights and Influencers: A Decade of Social Media Marketing Research Revealed Through Bibliometrics

Ahmad Khraiwish*, Ahmed H. Alsharif **

Abstract: Social media marketing employs channels like Twitter, Facebook, Instagram, and YouTube for purposes such as advertising, customer interaction, sales, and fostering connections with the target audience. A notable gap in prior research within the Scopus database prompted this investigation, employing a bibliometric analysis focused on "(social media marketing OR social media strategy OR social media management OR social media platforms OR social media trends or social media contest OR social media analytics)." Adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, we scrutinized relevant articles on Scopus from 2013 to November 2023, revealing insights from 1,198 articles. The review findings demonstrate that the number of articles devoted to the study of social media and social media marketing has increased exponentially in recent years. More importantly, the research identifies some of the most influential studies in this area. The paper discusses trends and highlights the challenges related to social media platforms and marketing. To the authors' knowledge, this represents the first study to review the literature from leading journals on social media platforms in marketing using bibliometric techniques. Furthermore, lays the foundation for future research, guiding scholars to less-explored areas and fostering potential collaborations, thereby enhancing the depth of understanding in this domain.

Keywords: social media; platforms; marketing; bibliometric analysis; Scopus database.

JEL classification: M30; M31; M39; O3.

* Marketing Department, Faculty of Business, Applied Science Private University (ASU), Jordan; e-mail: *A.khraiwish@asu.edu.jo*.
** Graduate School of Business, University of Science Malaysia (USM), Penang, Malaysia; e-mail: *ahmedalsharif07@gmail.com; alsharif@usm.my* (corresponding author).

Article history: Received 14 December 2023 | Accepted 14 July 2024 | Published online 15 December 2024

To cite this article: Khraiwish, A., Alsharif, A. H. (2024). Insights and Influencers: A Decade of Social Media Marketing Research Revealed Through Bibliometrics. *Scientific Annals of Economics and Business*, 71(4), 497-518. https://doi.org/10.47743/saeb-2024-0023.

1. INTRODUCTION

The convergence of digital platforms and marketing strategies has given birth to a dynamic paradigm termed "digital marketing" encompassing various components, including social media marketing (Wymbs, 2011; Key, 2017; Faruk *et al.*, 2021; Madan and Rosca, 2022). This paradigm signifies a revolutionary shift in how businesses promote and engage with their target audiences, capitalizing on digital channels' extensive outreach and interactive potential (Wymbs, 2011; Wang, 2021; Madan and Rosca, 2022). Social media marketing has become an essential component of modern marketing strategies, offering a platform for businesses to engage with their target audience and promote their products and services (Sharma and Verma, 2018). The success factors and best practices of social media marketing have been extensively explored, providing valuable insights into its multi-dimensional and multi-criteria framework (Jami Pour *et al.*, 2021). Furthermore, the adoption of social media marketing by small and medium enterprises (SMEs) has been influenced by various factors, shedding light on the significance of this marketing approach for businesses of all sizes (Dahnil *et al.*, 2014). Additionally, large global organizations have assessed the strategic adoption of social media, emphasizing its role as a crucial channel for advertising and marketing communications (Zhang and Mao, 2016).

Social media marketing involves using various social networks and platforms such as Twitter, Facebook, Instagram, and YouTube for advertising, customer interaction, sales, and building relationships with the target market (Jami Pour *et al.*, 2021). The popularity of digital platforms has led to a significant increase in social media users, with estimates reaching 447.9 million users by the end of 2023, highlighting the extensive reach of social media (Fresneda and Chandrashekaran, 2021). Social media marketing encompasses using social media platforms for marketing, sales, public relations, and customer service delivery (Bilgin, 2018). It has been emphasized that social media marketing activities are significant for branding actions, contributing to brand awareness, image, and loyalty (Li *et al.*, 2021). Despite the vast opportunities social media offers to companies, there is no clear definition or comprehensive framework to guide the integration of social media with marketing strategies (Al-Gasawneh *et al.*, 2023).

Furthermore, social media has been widely used for marketing to facilitate communication between manufacturers, marketers, and consumers (Emini and Zeqiri, 2021). The impact of social media marketing on brand awareness, purchase intention, and brand loyalty has been investigated, highlighting its relevance in influencing consumer behavior and perceptions (Sadli *et al.*, 2022; Sumague and Briones, 2022). Additionally, social media marketing has positively impacted customer perceptions and engagement, contributing to brand loyalty and image building (Muchardie *et al.*, 2016). Social media marketing has emerged as a powerful tool for businesses, enabling communication, brand promotion, and influencing consumer behavior.

Consumer attitudes toward social media and targeted advertising have been studied extensively, highlighting the impact of social media marketing on purchase intention and consumer behavior (Golob *et al.*, 2022; Sianturi *et al.*, 2022). Moreover, the utilization of social media as a marketing strategy for SMEs has been explored, emphasizing its role in enhancing the performance of millennial SMEs (Widyaningrum, 2016; Himelboim *et al.*, 2017). The influence of the family environment, entrepreneurial orientation, and the use of

social media marketing on the performance of SMEs has been investigated, underscoring the interconnectedness of these factors in driving business success (Himelboim *et al.*, 2017).

The development of digital marketing strategies and service quality using social media has been recognized as integral to the digital economy, emphasizing the inseparable nature of social media from an organization's integrated marketing strategy (Koesharijadi *et al.*, 2022). Furthermore, the role of social media influencers in promoting and reviewing products has been acknowledged, indicating the growing significance of influencer marketing within social media marketing (Stubb *et al.*, 2019; Sun, 2021). The impact of e-marketing and social media marketing on e-commerce shopping decisions has been studied, demonstrating the pivotal role of these strategies in shaping consumer behavior and purchase decisions (Priansa and Suryawardani, 2020). These interconnected concepts underscore the evolutionary trajectory of contemporary marketing, necessitating adept maneuvering of digital pathways to realize organizational goals within an increasingly interconnected global context.

Aware of the growing interest in social media marketing, several studies analyzing scientific production on "social media marketing" research have already been published (Goldie *et al.*, 2014; Noor *et al.*, 2020; Chaudhari and Pawar, 2021). However, no previous research was performed to map the "(social media marketing OR social media strategy OR social media management OR social media platforms OR social media trends or social media contest OR social media analytics)" production in the Scopus (SC) database. Hence, this investigation deviates from other literature reviews that focus on global academic research trends in the relevant field from 2013 to November 2023, specifically utilizing the SC database. The aim is to address a gap in scientific literature, aspiring to provide a thorough bibliometric analysis encompassing the most prolific countries, academic institutions, authors, and journals. Additionally, the study seeks to identify articles with the highest citation numbers, analyze the co-citation network of authors and papers, and determine hot keywords along with their occurrences. The primary contributions and objectives of this bibliometric analysis can be succinctly outlined as follows:

1) To identify the annual growth trends in scientific publications and citations within the "social media" research.

2) To assess the overall performance of the field by pinpointing prominent countries, academic institutions, journals, and authors contributing to social media literature.

3) To identify key themes and keywords that recurrently emerge in social media research, shedding light on the most prevalent topics within the field.

4) To highlight the most-cited review articles, offering valuable insights for future studies and research directions in the social media domain.

The structure of this research is as follows: Section 2 outlines the methodology employed in this study. Section 3 is concerned with findings and discussions. Section 4 provides concise and comprehensive conclusions. Finally, Section 5 presents the study's limitations and potential future directions.

2. METHODS

The study aims to provide a systematic and bibliometric literature review and a visualized overview of the existing articles (Alsharif *et al.*, 2022b; Yao *et al.*, 2022). This study followed the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol of Page *et al.* (2021) to assess and study the

literature, which corresponds with the objectives of this study. Employing a bibliometric analysis approach, the study aimed to uncover and examine global research trends within the "(social media marketing OR social media strategy OR social media management OR social media platforms OR social media trends or social media contest OR social media analytics)" research. This comprehensive investigation encompassed the analysis of various facets, including the most productive countries, academic institutions, journals, authors, highly cited articles, and keyword occurrences, all serving as critical indicators for assessing the progress in scholarly publications within this domain.

The fundamental aim of this study was to offer a comprehensive insight into the ongoing trends in pertinent research, addressing gaps present in the current body of literature. In pursuit of this objective, four specific research questions were formulated, strategically guiding the analysis structure and aiming to attain a profound understanding of the existing scientific research within the examined domain. These research questions were meticulously crafted to illuminate crucial areas of interest, contributing to the advancement of knowledge in the relevant field, outlined as follows:

1) Is there an annual growth in scientific publications in the field, and if so, what is its magnitude?

2) Which countries, academic institutions, journals, and authors stand out prominently in the field?

3) What are the most notable keywords found in the selected articles?

4) Which articles receive the highest number of citations in the field?

Endeavoring to answer the research questions, the current study starts by extracting articles from the Scopus database in November 2023. This study has followed the instruction of Donthu *et al.* (2021); Alsharif *et al.* (2023e) to present a thorough bibliometric analysis detecting and listing "the prominent countries, institutions, journals, and authors"; later on, a brief description of each analyzed parameter is provided. In addition, this study followed the instructions of Ahmed (2022); Alsharif *et al.* (2023b) to systematically review the relevant articles. The VOSviewer software was utilized to create visualization maps, which simplifies bibliometric research across various fields (Koseoglu *et al.*, 2016; Alsharif *et al.*, 2020b; Palácios *et al.*, 2021; Pilelienė *et al.*, 2022). VOSviewer has been used in several studies such as neuromarketing (Sánchez-Fernández *et al.*, 2021; Alsharif and Pilelienė, 2023; Alsharif *et al.*, 2023c; Alsharif *et al.*, 2023e) that use neuroscience tools to study consumer behavior (Alsharif *et al.*, 2020a; Alsharif *et al.*, 2022a; Alsharif *et al.*, 2023d), digital marketing (Zhang *et al.*, 2017; Faruk *et al.*, 2021; Krishen *et al.*, 2021), social media marketing (Goldie *et al.*, 2014; Noor *et al.*, 2020; Chaudhari and Pawar, 2021; Joshi *et al.*, 2023), E-marketing (Gao *et al.*, 2021), and mobile marketing (Hussain and Aziz, 2022) to gain a comprehensive understanding of the development of using neuroimaging tools in this field.

The following query was applied to the title, abstract, and keywords: "TITLE-ABS-KEY (social AND media AND marketing OR social AND media AND strategy OR social AND media AND management OR social AND media AND platforms OR social AND media AND trends OR social AND media AND contest OR social AND media AND analytics) AND (LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2023)) AND (LIMIT-TO (OA, "all")) AND

(LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (PUBSTAGE, "final"))".

In November 2023, data was meticulously collected from the Scopus database for this rigorous study. The primary focus was on articles and reviews focusing on "(social media marketing OR social media strategy OR social media management OR social media platforms OR social media trends or social media contest OR social media analytics)" research. This study specifically targeted articles published between 2013 and November 2023, as there has been a noticeable surge in the number of publications related to these domains within this time frame. Additionally, the selection process was constrained to English articles, given the widespread use of the English language in academic publishing (e.g., Spanish (11 articles), Russian (9), Portuguese (5), Croatian (1), Ukrainian (1), Hungarian (1), German (1) were excluded). The objective of this study was to gather an extensive collection of articles to explore and highlight the global academic trends in the relevant research. Figure no. 1 visually depicts the systematic selection process employed in this study.

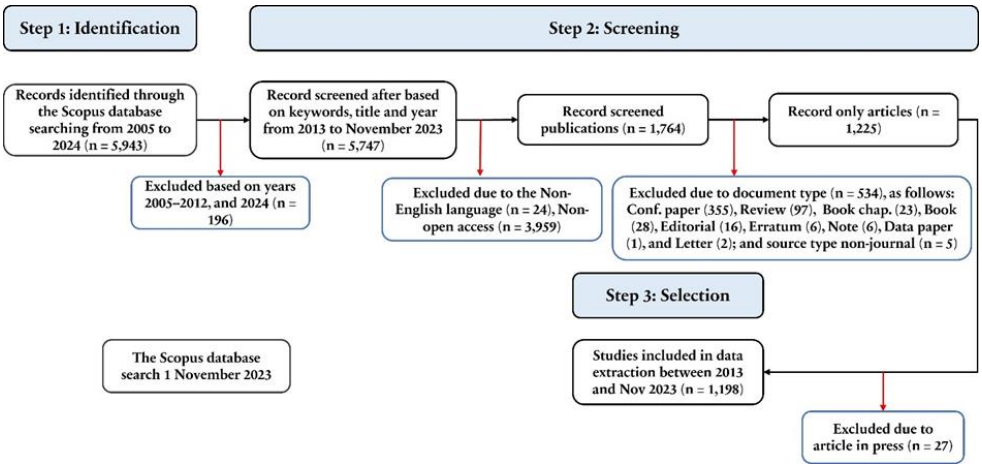


Figure no. 1 – An overview of the literature review and flow chart of selecting articles process
Source: own elaboration

3. RESULTS AND DISCUSSIONS

The examination of the methodology resulted in the identification of 1,198 scholarly journal articles pertaining to themes such as "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics." The analysis underscored a significant proliferation in scholarly publications, with more than 60% of the total articles (798 documents) being disseminated in the past four years, spanning from 2020 to November 2023. Figure no. 2 provides a graphical representation of annual and cumulative publications and annual citations from 2013 to November 2023. The escalating interest among academics in this research domain has precipitated an upswing in both scholarly publications and scholarly attention to social media marketing research.

Figure no. 2 – The annual publications and citations between 2013 and November 2023
Source: own elaboration

3.1 A bibliometric analysis

3.1.1 Contributions of countries and institutions

The analysis conducted in this study reveals that countries exhibit a significant presence, with a minimum of 20 articles. The data presented in Table no. 1 provides a comprehensive overview of the findings, demonstrating that the combined contributions of the U.S.A, the U.K, and India contributed more than 50% (700 articles) of the total publications since 2013. The U.S.A is the most prominent country, producing a remarkable total of 366 articles, with the highest-cited documents (7851 citations). "Purdue University" has published 17 articles with 170 citations, whereas the "Indian Institute of Technology Delhi" published the highest-cited articles (10 articles and 914 citations). Although Canada has published 81 articles with 1839 citations, an institute, the "University of Toronto," emerged as the leading academic institution, contributing 18 documents that have received 262 citations. Finally, with 20 published articles, Hong Kong is positioned at the lower end among the most prominent countries, and its notable academic institution, the "The Hong Kong Polytechnic University," has contributed five articles to the body of research.

Table no. 1 – The top prominent countries with a minimum of 20 articles.

#	Country	TPs	TCs	The prominent institution	TPi	TCi
1	U.S.A	366	7851	Purdue University	17	170
2	U.K	212	6553	University of Oxford	15	237
3	India	122	2079	Indian Institute of Technology Delhi	10	914
4	Australia	119	2652	The University of Sydney	16	431
5	China	82	1702	Tsinghua University	8	142
6	Canada	81	1839	University of Toronto	18	262

#	Country	TPs	TCs	The prominent institution	TPi	TCi
7	Germany	59	1587	Fraunhofer Institute for Intelligent Analysis and Information Systems	5	147
8	Italy	50	1062	Politecnico di Milano	8	149
9	K.S.A	47	719	King Abdulaziz University	13	343
10	Spain	47	786	Universidad Complutense de Madrid	8	80
11	Malaysia	40	849	Universiti Teknologi MARA	10	11
12	Netherlands	34	1161	Universiteit van Amsterdam	6	345
13	Greece	28	333	Lonian University	5	113
14	Switzerland	28	500	ETH Zürich	4	70
15	France	26	565	Centre National de la Recherche Scientifique	4	25
16	South Korea	25	540	Sungkyunkwan University	4	133
17	Sweden	23	706	The Ratio Institute	8	349
18	Pakistan	22	381	Quaid-i-Azam University	4	53
19	Indonesia	21	354	Bina Nusantara University	4	10
20	U.A.E	21	677	Zayed University	7	321
21	Finland	20	258	Tampere University	8	85
22	Hong Kong	20	580	The Hong Kong Polytechnic University	5	30

Note: TPs: total publication, TCs: total citations, Tpi: total publication by the institute, Tci: total citations of the institute

Source: own elaboration

Table no. 2 illustrates the most cited articles published by institutes. For example, "Indian Institute of Technology Delhi" published the most cited article, "Measuring social media influencer index- insights from Facebook, Twitter and Instagram," with 262 TCmci. This is followed by an article titled "A Big Data Analytics Method for Tourist Behaviour Analysis," with 251 TCmci, published by Zayed University. Finally, Universiti Teknologi MARA published the least cited paper in the list with three TCmci, a paper titled "Visualization of job availability based on text analytics localization approach."

Table no. 2 – The top most cited paper published by institutions.

The prominent institution	Title of the most cited paper published by an institution	Year	TCmci
Purdue University	"VisOHC: Designing Visual Analytics for Online Health Communities"	2016	29
University of Oxford	"Live Streamers on Twitch.tv as Social Media Influencers: Chances and Challenges for Strategic Communication"	2019	54
Indian Institute of Technology Delhi	"Measuring social media influencer index- insights from Facebook, Twitter and Instagram"	2019	262
The University of Sydney	"Use of social media in urology: Data from the American Urological Association (AUA)"	2014	122
Tsinghua University	"A research framework for pharmacovigilance in health social media: Identification and evaluation of patient adverse drug event reports"	2015	48
University of Toronto	"Data sharing practices of medicines related apps and the mobile ecosystem: Traffic, content, and network analysis"	2019	95
Fraunhofer Institute for Intelligent Analysis and Information Systems	"Supporting Story Synthesis: Bridging the Gap between Visual Analytics and Storytelling"	2020	50
Politecnico di Milano	"Understanding panic buying during COVID-19: A text analytics approach"	2021	43

Note: TCmci: total citations of the most-cited institute paper

King Abdulaziz University	"Artificial intelligence technologies and related urban planning and development concepts: How are they perceived and utilized in Australia?"	2020	81
Universidad Complutense de Madrid	"Daily market news sentiment and stock prices"	2019	35
Universiti Teknologi MARA	"Visualization of job availability based on text analytics localization approach"	2019	3
Universiteit van Amsterdam	"Scraping the social?: Issues in live social research"	2013	172
Lonian University	"Text mining in big data analytics"	2020	107
ETH Zürich	"Crowdbreaks: Tracking health trends using public social media data and crowdsourcing"	2019	33
Centre National de la Recherche Scientifique	"Acquiring, Analyzing and Interpreting Knowledge Data for Sustainable Engineering Education: An Experimental Study Using YouTube"	2022	16
Sungkyunkwan University	"The effects of visual congruence on increasing consumers' brand engagement: An empirical investigation of influencer marketing on Instagram using deep-learning algorithms for automatic image classification"	2020	79
The Ratio Institute	"The sharing economy in social media: Analyzing tensions between market and non-market logics"	2017	113
Quaid-i-Azam University	"Towards Deep Learning Prospects: Insights for Social Media Analytics"	2019	32
Bina Nusantara University	"Personality Prediction Based on Text Analytics Using Bidirectional Encoder Representations from Transformers from English Twitter Dataset"	2021	4
Zayed University	"A Big Data Analytics Method for Tourist Behaviour Analysis"	2017	251
Tampere University	"JeSuisCharlie: Towards a multi-method study of hybrid media events"	2016	42
The Hong Kong Polytechnic University	"Social media mining under the COVID-19 context: Progress, challenges, and opportunities"	2022	16

Source: own elaboration

3.1.2 Contributions of journals

Table no. 3 provides a comprehensive overview of the principal scholarly journals that have made substantial contributions to the realms of "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics" research. Among these journals, "IEEE Access" and "Journal of Medical Internet Research" are the most influential journals in the field, publishing 34 articles each and amassing 920 and 915 TCs, respectively. "Information" journal has published the least articles, with ten articles and 41 TCs.

In addition, the "Journal of Big Data," with 15.1 CS, has published the highest-cited article titled "Uncertainty in big data analytics: survey, opportunities, and challenges," totaling 245 TCmcJ. Followed by "IEEE Access," with 8.9 CS, and the second-highest-cited paper, "CityPulse: Large Scale Data Analytics Framework for Smart Cities," totaling 177 TCmcj. In addition, the "IEEE Transactions on Visualization and Computer Graphics" journal, with 9.4 CS, produced the third-highest-cited article, "Personal visualization and personal visual analytics," which occupied 172 cTCmcj. At the end, "Information" journal published the least cited article, titled "Digital memory in the post-witness era: How holocaust museums use social media as new memory ecologies," with 15 TCmcj.

Table no. 3 – The productive journals with 15 publications at least.

#	Journal	TPs	TCs	CS 23	Title of the most cited document published by a journal	TCmcj
1	IEEE Access	34	920	8.9	"CityPulse: Large Scale Data Analytics Framework for Smart Cities"	177
2	Journal of Medical Internet Research	34	915	13.5	"Conversations and medical news frames on twitter: Infodemiological study on COVID-19 in South Korea"	162
3	Plos One	23	501	5.8	"Spatial and social media data analytics of housing prices in Shenzhen, China"	78
4	Sustainability	21	255	6.2	"Identifying tourist places of interest based on digital imprints: Towards a sustainable smart City"	78
5	Big Data and Society	16	457	10.1	"Known or knowing publics? Social media data mining and the question of public agency"	98
6	International Journal of Environmental Research and Public Health	16	166	6.6	"Covid-19: Detecting government pandemic measures and public concerns from twitter Arabic data using distributed machine learning"	48
7	International Journal of Advanced Computer Science and Applications	15	74	2.1	"Arabic Tweets Sentiment Analysis about Online Learning during COVID-19 in Saudi Arabia"	19
8	JMIR Formative Research	15	45	2.5	"Nursing Perspectives on the Impacts of COVID-19: Social Media Content Analysis"	16
9	Social Network Analysis and Mining	14	243	4.8	"Customer segmentation using online platforms: isolating behavioral and demographic segments for persona creation via aggregated user data"	84
10	IEEE Transactions on Visualization and Computer Graphics	12	376	9.4	"Personal visualization and personal visual analytics"	172
11	Journal of Big Data	12	488	15.1	"Uncertainty in big data analytics: survey, opportunities, and challenges"	245
12	Social Media and Society	10	478	8.1	"Classifying Twitter Topic-Networks Using Social Network Analysis"	160
13	Applied Sciences	10	106	4.7	"Sehaa: A big data analytics tool for healthcare symptoms and diseases detection using twitter, apache spark, and machine learning"	65
14	Electronics	10	60	4.7	"Fake news data exploration and analytics"	28
15	Information	10	41	6.0	"Digital memory in the post-witness era: How holocaust museums use social media as new memory ecologies"	15

Note: CS23; CiteScore in 2023, TCmcj: total citations of the most-cited journal paper
Source: own elaboration

3.1.3 Contributions of authors

Table no. 4 provides an exhaustive examination of the most prolific contributors in the realms of "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media

analytics" research. The criteria for this scrutiny involved identifying highly productive authors producing a minimum of five articles for inclusion.

Yigitcanlar, T., affiliated with the Queensland University of Technology, Australia, emerges as the most prolific author, having authored 11 articles with a total of 429 TCs. On the other end of the productivity spectrum, Sykora, M., associated with Loughborough University, the U.K, stands as the least productive author, contributing five articles and accumulating 76 TCs. Dwivedi, Y.K., from Swansea University, the U.K, is identified as the most impactful author, with a total citation count of 620 TCs.

Furthermore, three selected authors, namely Dwivedi, Y.K., Wang, X., and Sykora, M., are affiliated with distinct the U.K. institutions, collectively producing 18 articles with a cumulative total of 1024 TCs. Two authors affiliated with Australian institutes, Yigitcanlar, T. (Queensland University of Technology), Slabbert, A.D. (Cape Peninsula University of Technology), and Vu, H.Q. (Deakin University), have jointly contributed 16 articles, amassing 738 TCs. Similarly, two authors associated with Swedish institutions, Laurell, C. (Einride, Stockholm), and Sandström, C. (Jönköping International Business School), have collaborated on 15 articles, accumulating 758 TCs.

In summation, authors affiliated with the U.K institutions are identified as the most influential, followed closely by authors affiliated with Swedish institutions.

Table no. 4 – The most productive authors with a minimum of five articles

#	Author's name	SC ID	TPs	TCs	Affiliation	Country
1	Yigitcanlar, T.	6505536041	11	429	Queensland University of Technology	Australia
2	Laurell, C.	56148137600	9	420	Einride, Stockholm	Sweden
3	Dwivedi, Y.K.	35239818900	8	680	Swansea University	U.K.
4	Kankanamge, N.	57207298965	8	365	University of Moratuwa	Sri Lanka
5	Mehmood, R.	25643246000	7	282	HITEC University	Pakistan
6	Bir, C.	57195335359	6	55	Oklahoma State University	U.S.A.
7	Kar, A.K.	55911169300	6	615	Indian Institute of Technology Delhi	India
8	Sandström, C.	35118164800	6	338	Jönköping International Business School	Sweden
9	Vu, H.Q.	36081495000	5	309	Deakin University	Australia
10	Wang, X.	55736800500	5	268	University of Birmingham	U.K.
11	Andrienko, G.	6603717488	5	147	Fraunhofer Institute for Intelligent Analysis and Information Systems	Germany
12	Katib, I.	26534538800	5	182	King Abdulaziz University	K.S.A.
13	Sykora, M.	15061787500	5	76	Loughborough University	U.K.

Note: SC; Scopus

Source: own elaboration

3.1.4 Keywords occurrences network

In bibliometric analysis, keyword occurrences are a crucial quantitative metric, providing insights into the strength of associations between paired keywords (Alsharif *et al.*, 2023c). A higher frequency of occurrence signifies a stronger connection between keywords. This analytical approach facilitates a comprehensive understanding of the article's content (Alsharif *et al.*, 2020a). The strength of linkage between keywords reflects their frequency within the article, while the overall number of links represents the total occurrences of keywords throughout the article.

In this study, an exhaustive examination of co-occurring author keywords was conducted using the widely employed VOSviewer software for bibliometric analysis (Alsharif *et al.*, 2020b; Alsharif *et al.*, 2023a). To construct the keyword co-occurrence network, we applied preprocessing and adjustments to the original keywords when necessary, amalgamating similar terms such as "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics." Following data refinement procedures, we established the threshold for keyword co-occurrence at a minimum of five occurrences and a maximum of 400 lines in VOSviewer, generating a visualization of the co-occurrence network content. As depicted in Figure no. 3, the analysis revealed nine clusters, with 131 nodes appearing in the network. Each node in the visualization represents a keyword, and the size of the node is proportional to the frequency of the keyword in the reviewed literature; larger nodes denote a higher occurrence frequency of keyword co-occurrence. Keywords that commonly co-occur are positioned in close proximity in the network, resulting in the arrangement of all authors' keywords into nine clusters with varying levels of significance. Cluster 1 (34 items), Cluster 2 (25 items), Cluster 3 (20 items), Cluster 4 (12 items), Cluster 5 (12 items), Cluster 6 (10 items), Cluster 7 (8 items), Cluster 8 (5 items), Cluster 9 (5 items).

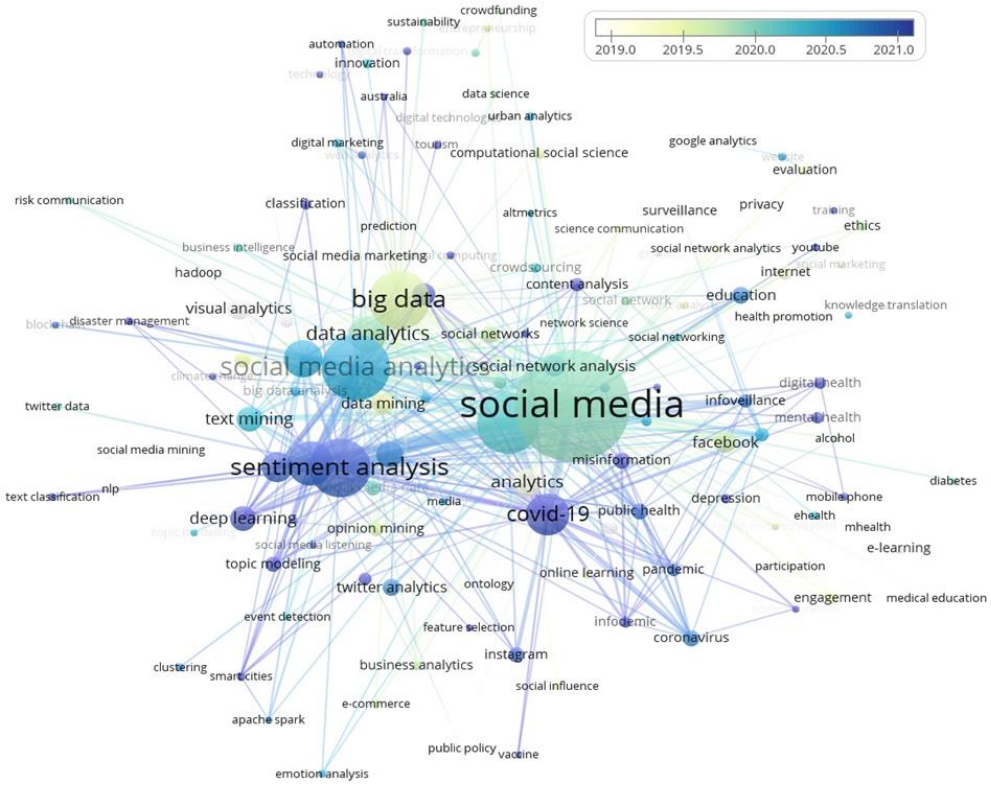


Figure no. 3 – Map of authors' keywords with five occurrences at least
Source: own elaboration

Table no. 5 – The Co-word author analysis with a minimum of three co-words

Word	Co-word analysis	Number of co-words
Social	*Cluster 1:* Social media, social marketing, social network analytics, social networking *Cluster 2:* Computational social science, social media analytics, social media marketing *Cluster 3:* Social media analysis, social media data, social media listening, social media mining *Cluster 4:* Social networks *Cluster 6:* Social computing, social network, social network analysis *Cluster 8:* social influence	16
Analytics	*Cluster 1:* Google analytics, social network analytics *Cluster 2:* Social media analytics, urban analytics, web analytics *Cluster 3:* Big data analytics, predictive analytics *Cluster 5:* Text analytics, visual analytics *Cluster 6:* Learning analytics *Cluster 7:* Business analytics, twitter analytics *Cluster 8:* Analytics *Cluster 9:* Data analytics	14
Media	*Cluster 1:* Social media *Cluster 2:* Social media analytics, social media marketing *Cluster 3:* social media analysis, social media data, social media listening, social media mining *Cluster 9:* Media	8
Analysis	*Cluster 1:* Text analysis *Cluster 3:* Big data analysis, social media analysis *Cluster 5:* Sentiment analysis *Cluster 6:* Network analysis, social network analysis *Cluster 8:* Content analysis, emotion analysis	8
Social Media	*Cluster 1:* Social media *Cluster 2:* Social media analytics, social media marketing *Cluster 3:* social media analysis, social media data, social mediat listening, social media mining	7
Digital	*Cluster 1:* Digital health *Cluster 2:* Digital marketing, digital technologies, digital transformation	4
Platform	*Cluster 1:* YouTube, Facebook, *Cluster 8:* Instagram *Cluster 6:* Twitter	4
Marketing	*Cluster 1:* Social marketing *Cluster 2:* Digital marketing, social media marketing	3

Source: own elaboration

3.1.5 Citations Analysis

The citation analysis plays a crucial role in understanding global academic trends within specific fields (Alsharif *et al.*, 2022c), such as "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics" research, as it offers the most impactful articles in the field. This information is important for future researchers who are seeking to identify influential documents. In this study, we selected and analyzed 1,198 articles in the relevant field. We specifically focused on identifying the most cited articles, with a minimum

of 150 TCs. It can classify Table no. 6 into three clusters, as follows: Cluster (1) three articles with more than 300 citations; Cluster (2) five articles with citations between 200-300; and Cluster (3) fourteen articles with citations between 150-200.

As tabulated in Table no. 6, the article's titled "Social media analytics – Challenges in topic discovery, data collection, and data preparation" is the most cited article, with 463 citations, published in "International Journal of Information Management" and written by Stieglitz *et al.* (2018). on the opposite side of spectrum, "A survey of text mining in social media: Facebook and Twitter perspectives" is the least cited article in the list, with 151 citations, published in "Advances in Science, Technology and Engineering Systems" journal and written by Salloum *et al.* (2017).

Table no. 6 – The top cited document with a minimum of 151 citations

#	Title of paper	TCs	Journal	Reference
	Cluster 1			
1	"Social media analytics – Challenges in topic discovery, data collection, and data preparation"	463	International Journal of Information Management	(Stieglitz *et al.*, 2018)
2	"Virality prediction and community structure in social networks"	414	Scientific Reports	(Weng *et al.*, 2013)
3	"Social media analytics: a survey of techniques, tools and platforms"	379	AI and Society	(Batrinca and Treleaven, 2015)
	Cluster 2			
4	"COVID-19 infodemic: More retweets for science-based information on coronavirus than for false information"	266	International Sociology	(Pulido *et al.*, 2020)
5	"Measuring social media influencer index-insights from facebook, Twitter and Instagram"	262	Journal of retailing and consumer services	(Arora *et al.*, 2019)
6	"Tutorial: Big data analytics: Concepts, technologies, and applications"	255	Communications of the Association for Information Systems	(Watson, 2014)
7	"A Big Data Analytics Method for Tourist Behaviour Analysis"	251	Information and Management	(Miah *et al.*, 2017)
8	"Uncertainty in big data analytics: survey, opportunities, and challenges"	245	Journal of Big Data	(Hariri *et al.*, 2019)
	Cluster 3			
9	"Big data emerging technology: Insights into innovative environment for online learning resources"	184	International Journal of Emerging Technologies in Learning	(Huda *et al.*, 2018)
10	"Constructing a Data-Driven Society: China's Social Credit System as a State Surveillance Infrastructure"	183	Policy and Internet	(Liang *et al.*, 2018)
11	"CityPulse: Large Scale Data Analytics Framework for Smart Cities"	177	IEEE Access	(Puiu *et al.*, 2016)
12	"Social media data analytics to improve supply chain management in food industries"	176	Transportation Research Part E: Logistics and Transportation Review	(Singh *et al.*, 2018)
13	"Personal visualization and personal visual analytics"	172	IEEE Transactions on Visualization and Computer Graphics	(Huang *et al.*, 2014)
14	"Scraping the social?: Issues in live social research"	172	Journal of Cultural Economy	(Marres and Weltevrede, 2013)

#	Title of paper	TCs	Journal	Reference
15	"Conversations and medical news frames on twitter: Infodemiological study on COVID-19 in South Korea"	162	Journal of Medical Internet Research	(Park *et al.*, 2020)
16	"Semi-supervised learning for big social data analysis"	162	Neurocomputing	(Hussain and Cambria, 2018)
17	"Classifying Twitter Topic-Networks Using Social Network Analysis"	160	Social Media and Society	(Himelboim *et al.*, 2017)
18	"Mapping Cilento: Using geotagged social media data to characterize tourist flows in southern Italy"	158	Tourism Management	(Chua *et al.*, 2016)
19	"Effects of user-provided photos on hotel review helpfulness: An analytical approach with deep leaning"	154	International Journal of Hospitality Management	(Ma *et al.*, 2018)
20	"Polarization and acculturation in US Election 2016 outcomes – Can twitter analytics predict changes in voting preferences"	151	Technological Forecasting and Social Change	(Grover *et al.*, 2019)
21	"The Audience-Oriented Editor: Making sense of the audience in the newsroom"	151	Digital Journalism	(Ferrer-Conill and Tandoc, 2018)
22	"A survey of text mining in social media: Facebook and Twitter perspectives"	151	Advances in Science, Technology and Engineering Systems	(Salloum *et al.*, 2017)

Source: own elaboration

3.1.6 Article co-citation network

A co-citation network analysis, which is an integral form of co-citation analysis, is a method rooted in work of Small (1973). Small proposed exploring the network of co-cited references, where the fundamental units are articles and co-citation clusters represent the underlying intellectual structures of a particular field. Following the approach advocated by Chen *et al.* (2010), the examination of article co-citation facilitates the interpretation of the nature of cited articles within a cluster and the connections between clusters. This study aimed to employ article co-citation analysis to uncover the structure of significant contributions in the research domains of "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics."

The results, illustrated in Figure no. 4 derived from VOSviewer, showcase the article co-citation network. Notably, co-cited articles are linked by thick arcs, indicating a robust relationship and suggesting similarities in specific topics within the realm of "social media marketing," "social media strategy," "social media management," "social media platforms," "social media trends," "social media contest," and "social media analytics." Conversely, slender arcs indicate a feeble co-citation association among co-cited articles, implying an absence or weakness of content similarities (Alsharif *et al.*, 2021). For instance, the robust co-citation link represented by a thick arc between Chae (2015) and Dwivedi *et al.* (2015) suggests a strong relationship, indicating shared ideas or related concepts. A parallel pattern is evident between Fan and Gordon (2014) and Xiang *et al.* (2017). In contrast, the frail arc connecting Fan and Gordon (2014) and Stieglitz *et al.* (2014) signifies a weak co-citation strength, highlighting a lack of content similarities (Ahmed, 2021). With a citation threshold set at a minimum of five citations per article, Figure no. 4 displays only 87 nodes, representing the most co-cited articles in the co-citation network. The node radius provides insight into its

total link strength, the sum of link strengths with all other nodes. Furthermore, VOSviewer generated eight clusters in the analysis.

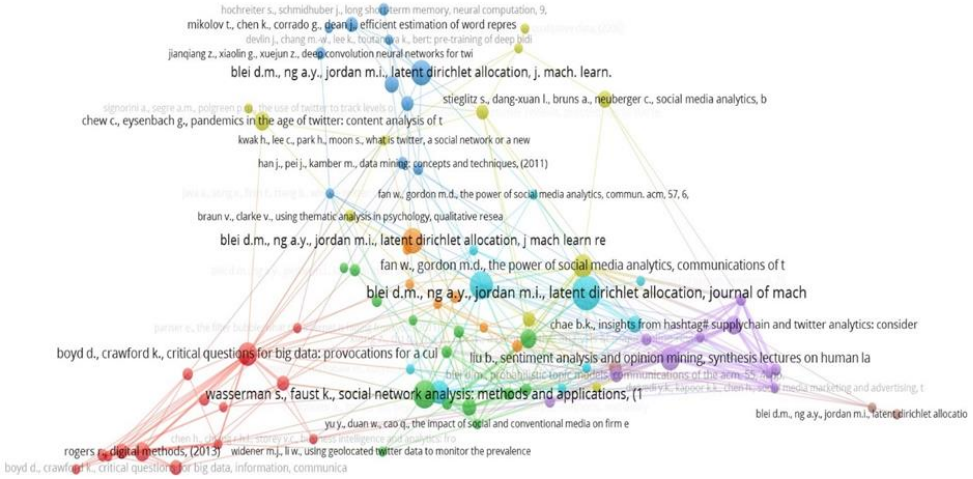


Figure no. 4 – Articles co-citation network with a minimum of five citations for each article
Source: own elaboration

4. CONCLUSION

Social media marketing has revolutionized the advertising landscape, offering unparalleled opportunities and challenges for businesses in the digital age. Platforms like Facebook, Instagram, and Twitter serve as dynamic marketplaces, enabling direct engagement and global connectivity. This fosters authentic relationships, humanizing brands and establishing trust across diverse audiences. The strength of social media marketing lies in its data-driven approach, providing insights into consumer behavior and allowing real-time optimization of campaigns. However, the crowded digital space demands constant creativity and adaptability, with a need for crisis management strategies to address potential negative publicity.

Influencer marketing has risen prominently, with influencers acting as powerful intermediaries between brands and consumers. Leveraging influencers amplifies brand messages and taps into niche markets. As technology evolves, integrating AI and AR into social media platforms, marketers must stay agile, embracing new tools to remain effective. Social media marketing's multifaceted nature necessitates a strategic blend of creativity and data-driven decision-making for sustained success. In this dynamic landscape, ongoing innovation and staying abreast of emerging trends are paramount for brands seeking to navigate and thrive in the ever-evolving social media sphere.

In the ever-evolving fields of “social media marketing,” “social media strategy,” “social media management,” “social media platforms,” “social media trends,” “social media contest,” “social media analytics,” have garnered significant attention in pursuing a deeper understanding of consumer behavior, such as customer attitude, loyalty, preference, and trust toward brands or products field. Motivated by this exciting quest, the present study undertook a remarkable investigation following the PRISMA framework. The aim was to uncover and examine global academic research trends within the relevant field. The researchers

bibliometrically analyzed 1,198 articles from the Scopus database between January 2013 and November 2023. A bibliometric analysis was conducted to gain a profound understanding of the global academic landscape. This analysis unveiled prominent countries, distinguished academic institutions, influential authors, prestigious journals, and captivating citation trends. These findings are significantly fruitful for future studies in the relevant domain, offering valuable time-saving insights for emerging scholars.

The bibliometric analysis conducted in this study unveiled the remarkable scholarly contributions of various countries, institutions, journals, and authors in the relevant domain. The U.S.A emerged as the most productive country, boasting 366 influential articles that garnered 7851 citations. The U.K also showcased their intellectual prowess, contributing 212 articles that received 6553 citations. Within this scholarly landscape, the "University of Toronto" took center stage with its 18 articles, demonstrating its significant research output. Other esteemed institution, such as the "The University of Sydney" has published 16 articles, but "Indian Institute of Technology Delhi" has published ten articles, with the highest number of citations (914). That leads to infer that number of publications does not necessarily reflect the journal's impact. Hong Kong is positioned at the lower end among the most prominent countries (20 articles), and its notable academic institution, the "The Hong Kong Polytechnic University", has contributed five articles to the body of research.

The "IEEE Access" journal is widely respected, having released 34 articles and accumulated 920 citations. "Information" journal ahs published the least number of articles in the list, with ten articles and 41 citations. Particularly noteworthy is the "Journal of Big Data," boasting a significant CS of 15.1, hosting the most frequently cited article titled "Uncertainty in big data analytics: survey, opportunities, and challenges," accruing 245 citations. Following closely, "IEEE Access," with a CS of 8.9, has presented the second-highest cited paper titled "CityPulse: Large Scale Data Analytics Framework for Smart Cities," garnering 177 citations. Furthermore, the "IEEE Transactions on Visualization and Computer Graphics" journal, with a CS of 9.4, has contributed the third-highest cited article, "Personal visualization and personal visual analytics," amassing 172 citations.

The "Social media analytics – Challenges in topic discovery, data collection, and data preparation" is the highest-cited paper with 463 citations, published in the "International Journal of Information Management". The highest second and third-cited papers, namely "Virality prediction and community structure in social networks" and "Social media analytics: a survey of techniques, tools and platforms," were featured in "Scientific Reports" and "AI and Society," with 414 and 379 citations, respectively. For the article co-citation network, the thick arc linking Chae (2015) and Dwivedi *et al.* (2015) suggests that these articles have a strong co-citation relationship and share common ideas and/or related concepts. A similar pattern can be observed between Fan and Gordon (2014) and Xiang *et al.* (2017). In contrast, the thin arc between Fan and Gordon (2014) and Stieglitz *et al.* (2014) reflects a weak co-citation strength. Furthermore, the co-word analysis revealed that "Social" is connected with 16 co-words from 8 clusters; "Analytics" linked with 14 co-words and 9 clusters; "Social Media" is correlated with seven co-words and three clusters. The rest of the words, such as "Digital," "Platform," and "Marketing," are linked with three co-words each, as tabulated in Table no. 5.

The relevant research represents an intriguing and promising avenue for future exploration, particularly during crises and pandemics. It is hoped that there will be an increase in the availability of training courses for scholars to gain the necessary skills and knowledge

to effectively leverage this field. This, in turn, can lead to improved marketing strategies and enhanced advertising campaign effectiveness.

5. LIMITATIONS AND FUTURE DIRECTIONS

The objective of this paper was to minimize methodological constraints in the study; however, despite efforts, some limitations were encountered, prompting recommendations for future research. The study focused exclusively on articles published in English-language journals between 2013 and November 2023, specifically those indexed in the Scopus database. This narrow scope omitted other types of documents, such as conference papers, review papers, books, book chapters, letters, erratum, and editorials, potentially introducing bias into the study. To mitigate this limitation, the authors suggest that scholars from emerging countries contribute their work to ensure a more comprehensive foundation for future investigations.

This paper offers a comprehensive overview of the "(social media marketing OR social media strategy OR social media management OR social media platforms OR social media trends or social media contest OR social media analytics)" research between 2013 and November 2023, based on the analysis of published literature. While the study acknowledges its methodological restrictions, it is a valuable resource for understanding the relevant domain during the specified period.

Acknowledgements

The authors would like to thank the Applied Science Private University (ASU) and University of Science Malaysia (USM) for supporting this study.

ORCID

Ahmad Khraiwish https://orcid.org/0000-0002-5391-4717
Ahmed H. Alsharif https://orcid.org/0000-0002-1364-3545

References

Ahmed, H. A. (2021). Neuromarketing research in the last five years: A bibliometric analysis. *Cogent Business & Management, 8*(1), 1978620. http://dx.doi.org/10.1080/23311975.2021.1978620

Ahmed, H. A. (2022). Biomedical Technology in Studying Consumers' Subconscious Behavior. *International Journal of Online & Biomedical Engineering, 18*(8), 98-114. http://dx.doi.org/10.3991/ijoe.v18i08.31959

Al-Gasawneh, J. A., AlZubi, K. N., Ngah, A. H., & Ahmad, A. M. (2023). Multidimensionality of visual social media marketing and its impact on customer purchase intention on the real estate market. *Innovative Marketing, 19*(1), 101-112. http://dx.doi.org/10.21511/im.19(1).2023.09

Alsharif, A., Salleh, N., Baharun, R., & Safaei, M. E. H. D. I. (2020a). Neuromarketing approach: An overview and future research directions. *Journal of Theoretical and Applied Information Technology, 98*(7).

Alsharif, A., Salleh, N. Z. M., & Pilelienė, L. (2023a). A Comprehensive Bibliometric Analysis of fNIRS and fMRI Technology in Neuromarketing. *Scientific Annals of Economics and Business, 70*(3), 1-14. http://dx.doi.org/10.47743/saeb-2023-0031

Alsharif, A., Salleh, N. Z. M., Pilelienė, L., Abbas, A. F., & Ali, J. (2022a). Current Trends in the Application of EEG in Neuromarketing: A Bibliometric Analysis. *Scientific Annals of Economics and Business, 69*(3), 393-415. http://dx.doi.org/10.47743/saeb-2022-0020

Alsharif, A. H., & Pilelienė, L. (2023). A Bibliometric Analysis of Human Hormones in Consumer Neuroscience and Human Behavior Research: Trends and Insights with Implications for Marketing. *Baltic Journal of Economic Studies, 9*(5), 1-12. http://dx.doi.org/10.30525/2256-0742/2023-9-5-1-12

Alsharif, A. H., Salleh, N. O. R. Z. M. D., & Baharun, R. O. H. A. I. Z. A. T. (2020b). Bibliometric analysis. *Journal of Theoretical and Applied Information Technology, 98*(15), 2948-2962.

Alsharif, A. H., Salleh, N. Z. M., Abdullah, M., Khraiwish, A., & Ashaari, A. (2023b). Neuromarketing Tools Used in the Marketing Mix: A Systematic Literature and Future Research Agenda. *SAGE Open, 13*(1), 21582440231156563. http://dx.doi.org/10.1177/21582440231156563

Alsharif, A. H., Salleh, N. Z. M., Al-Zahrani, S. A., & Khraiwish, A. (2022b). Consumer Behaviour to Be Considered in Advertising: A Systematic Analysis and Future Agenda. *Behavioral Sciences (Basel, Switzerland), 12*(12), 472-493. http://dx.doi.org/10.3390/bs12120472

Alsharif, A. H., Salleh, N. Z. M., Alrawad, M., & Lutfi, A. (2023c). Exploring global trends and future directions in advertising research: A focus on consumer behavior. *Current Psychology (New Brunswick, N.J.)*, 1-24. http://dx.doi.org/10.1007/s12144-023-04812-w

Alsharif, A. H., Salleh, N. Z. M., Baharun, R., Abuhassna, H., & Alharthi, R. H. E. (2022c). A global research trends of neuromarketing: 2015-2020. *Revista de comunicación, 21*(1), 15-32. http://dx.doi.org/10.26441/rc21.1-2022-a1

Alsharif, A. H., Salleh, N. Z. M., Baharun, R., Alharthi, H. E. R., Mansor, A. A., Javed, A., & Abbas, A. F. (2021). Neuroimaging Techniques in Advertising Research: Main Applications, Development, and Brain Regions and Processes. *Sustainability, 13*(11), 6488-6493. http://dx.doi.org/https://doi.org/10.3390/su13116488

Alsharif, A. H., Salleh, N. Z. M., Hashem E, A. R., Khraiwish, A., Putit, L., & Arif, L. S. M. (2023d). Exploring Factors Influencing Neuromarketing Implementation in Malaysian Universities: Barriers and Enablers. *Sustainability (Basel), 15*(5), 4603-4632. http://dx.doi.org/10.3390/su15054603

Alsharif, A. H., Salleh, N. Z. M., Khraiwish, A., & Homsi, L. N. (2023e). Exploring the Path of Biomedical Technology in Consumer Neuroscience Research: A Comprehensive Bibliometric Analysis. *International Journal of Online & Biomedical Engineering,, 19*(16), 127-144. http://dx.doi.org/10.3991/ijoe.v19i16.44667

Arora, A., Bansal, S., Kandpal, C., Aswani, R., & Dwivedi, Y. (2019). Measuring social media influencer index-insights from facebook, Twitter and Instagram. *Journal of Retailing and Consumer Services, 49*(1), 86-101. http://dx.doi.org/10.1016/j.jretconser.2019.03.012

Batrinca, B., & Treleaven, P. C. (2015). Social media analytics: A survey of techniques, tools and platforms. *AI & Society, 30*(1), 89-116. http://dx.doi.org/10.1007/s00146-014-0549-4

Bilgin, Y. (2018). The effect of social media marketing activities on brand awareness, brand image and brand loyalty. *Business & management studies: an international journal, 6*(1), 128-148. http://dx.doi.org/10.15295/bmij.v6i1.229

Chae, B. K. (2015). Insights from hashtag# supplychain and Twitter Analytics: Considering Twitter and Twitter data for supply chain practice and research. *International Journal of Production Economics, 165*(1), 247-259. http://dx.doi.org/10.1016/j.ijpe.2014.12.037

Chaudhari, D. D., & Pawar, A. V. (2021). Propaganda analysis in social media: A bibliometric review. *Information Discovery and Delivery, 49*(1), 57-70. http://dx.doi.org/10.1108/IDD-06-2020-0065

Chen, C., Ibekwe-SanJuan, F., & Hou, J. (2010). The structure and dynamics of cocitation clusters: A multiple-perspective cocitation analysis. *Journal of the American Society for Information Science and Technology, 61*(7), 1386-1409. http://dx.doi.org/10.1002/asi.21309

Chua, A., Servillo, L., Marcheggiani, E., & Moere, A. V. (2016). Mapping Cilento: Using geotagged social media data to characterize tourist flows in southern Italy. *Tourism Management, 57*, 295-310. http://dx.doi.org/10.1016/j.tourman.2016.06.013

Dahnil, M. I., Marzuki, K. M., Langgat, J., & Fabeil, N. F. (2014). Factors influencing SMEs adoption of social media marketing. *Procedia: Social and Behavioral Sciences, 148*(2), 119-126. http://dx.doi.org/10.1016/j.sbspro.2014.07.025

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285-296. http://dx.doi.org/10.1016/j.jbusres.2021.04.070

Dwivedi, Y. K., Kapoor, K. K., & Chen, H. (2015). Social media marketing and advertising. *The Marketing Review, 15*(3), 289-309. http://dx.doi.org/10.1362/146934715X14441363377999

Emini, A., & Zeqiri, J. (2021). Social media marketing and purchase intention: Evidence from Kosovo. *Ekonomska Misao i Praksa, 30*(2), 475-492. http://dx.doi.org/10.17818/emip/2021/2.8

Fan, W., & Gordon, M. D. (2014). The power of social media analytics. *Communications of the ACM, 57*(6), 74-81. http://dx.doi.org/10.1145/2602574

Faruk, M., Rahman, M., & Hasan, S. (2021). How digital marketing evolved over time: A bibliometric analysis on scopus database. *Heliyon, 7*(12), e08603. http://dx.doi.org/10.1016/j.heliyon.2021.e08603

Ferrer-Conill, R., & Tandoc, E. C. (2018). The audience-oriented editor: Making sense of the audience in the newsroom. *Digital Journalism, 6*(4), 436-453. http://dx.doi.org/10.1080/21670811.2018.1440972

Fresneda, J., & Chandrashekaran, R. (2021). Guest editorial. *South Asian Journal of Business Studies, 10*(3), 273-277. http://dx.doi.org/10.1108/sajbs-09-2021-422

Gao, P., Meng, F., Mata, M. N., Martins, J. M., Iqbal, S., Correia, A. B., . . . Farrukh, M. (2021). Trends and future research in electronic marketing: A bibliometric analysis of twenty years. *Journal of Theoretical and Applied Electronic Commerce Research, 16*(5), 1667-1679. http://dx.doi.org/10.3390/jtaer16050094

Goldie, D., Linick, M., Jabbar, H., & Lubienski, C. (2014). Using bibliometric and social media analyses to explore the "echo chamber" hypothesis. *Educational Policy, 28*(2), 281-305. http://dx.doi.org/10.1177/0895904813515330

Golob, M., Štadáni, D., & Bolek, Š. (2022). Consumers' attitudes toward social media and targeted advertising in the Czech Republic *Zbornik radova Veleučilišta u Šibeniku, 16*(3-4), 59-75. http://dx.doi.org/10.51650/ezrvs.16.3-4.3

Grover, P., Kar, A. K., Dwivedi, Y. K., & Janssen, M. (2019). Polarization and acculturation in US Election 2016 outcomes–Can twitter analytics predict changes in voting preferences. *Technological Forecasting and Social Change, 145*, 438-460. http://dx.doi.org/10.1016/j.techfore.2018.09.009

Hariri, R. H., Fredericks, E. M., & Bowers, K. M. (2019). Uncertainty in big data analytics: Survey, opportunities, and challenges. *Journal of Big Data, 6*(1), 1-16. http://dx.doi.org/10.1186/s40537-019-0206-3

Himelboim, I., Smith, M. A., Rainie, L., Shneiderman, B., & Espina, C. (2017). Classifying Twitter topic-networks using social network analysis. *Social Media + Society, 3*(1), 2056305117691545. http://dx.doi.org/10.1177/2056305117691545

Huang, D., Tory, M., Aseniero, B. A., Bartram, L., Bateman, S., Carpendale, S., . . . Woodbury, R. (2014). Personal visualization and personal visual analytics. *IEEE Transactions on Visualization and Computer Graphics, 21*(3), 420-433. http://dx.doi.org/10.1109/TVCG.2014.2359887

Huda, M., Maseleno, A., Atmotiyoso, P., Siregar, M., Ahmad, R., Jasmi, K., & Muhamad, N. (2018). Big data emerging technology: Insights into innovative environment for online learning resources. *International Journal of Emerging Technologies in Learning, 13*(1), 23-36. http://dx.doi.org/10.3991/ijet.v13i01.6990

Hussain, A., & Cambria, E. (2018). Semi-supervised learning for big social data analysis. *Neurocomputing, 275*, 1662-1673. http://dx.doi.org/10.1016/j.neucom.2017.10.010

Hussain, W. M. H. W., & Aziz, N. A. (2022). Mobile marketing in business sustainability: A bibliometric analysis. *TEM Journal, 11*(1), 111-119.

Jami Pour, M., Hosseinzadeh, M., & Amoozad Mahdiraji, H. (2021). Exploring and evaluating success factors of social media marketing strategy: a multi-dimensional-multi-criteria framework. *foresight, 23*(6), 655-678.

Joshi, Y., Lim, W. M., Jagani, K., & Kumar, S. (2023). Social media influencer marketing: Foundations, trends, and ways forward. *Electronic Commerce Research*, 1-55. http://dx.doi.org/10.1007/s10660-023-09719-z

Key, T. M. (2017). Domains of digital marketing channels in the sharing economy. *Journal of Marketing Channels, 24*(1-2), 27-38. http://dx.doi.org/10.1080/1046669X.2017.1346977

Koesharijadi, K., Merthayasa, A. A. A., & Nendi, I. (2022). Development of Digital Marketing Strategy and Service Quality Using Social Media Towards Digital Economy. *Journal of Social Sciences, 3*(4), 799-804. http://dx.doi.org/10.46799/jss.v3i4.375

Koseoglu, M. A., Rahimi, R., Okumus, F., & Liu, J. (2016). Bibliometric studies in tourism. *Annals of Tourism Research, 61*, 180-198. http://dx.doi.org/10.1016/j.annals.2016.10.006

Krishen, A. S., Dwivedi, Y. K., Bindu, N., & Kumar, K. S. (2021). A broad overview of interactive digital marketing: A bibliometric network analysis. *Journal of Business Research, 131*(2), 183-195. http://dx.doi.org/10.1016/j.jbusres.2021.03.061

Li, F., Larimo, J., & Leonidou, L. C. (2021). Social media marketing strategy: Definition, conceptualization, taxonomy, validation, and future agenda. *Journal of the Academy of Marketing Science, 49*(1), 51-70. http://dx.doi.org/10.1007/s11747-020-00733-3

Liang, F., Das, V., Kostyuk, N., & Hussain, M. M. (2018). Constructing a data-driven society: China's social credit system as a state surveillance infrastructure. *Policy and Internet, 10*(4), 415-453. http://dx.doi.org/10.1002/poi3.183

Ma, Y., Xiang, Z., Du, Q., & Fan, W. (2018). Effects of user-provided photos on hotel review helpfulness: An analytical approach with deep leaning. *International Journal of Hospitality Management, 71*(2), 120-131. http://dx.doi.org/10.1016/j.ijhm.2017.12.008

Madan, A., & Rosca, M. I. (2022). Current trends in digital marketing communication. *Journal of Marketing Research & Case Studies, 2022*, 1-13. http://dx.doi.org/10.5171/2022.981169

Marres, N., & Weltevrede, E. (2013). Scraping the social? Issues in live social research. *Journal of Cultural Economics, 6*(3), 313-335. http://dx.doi.org/10.1080/17530350.2013.772070

Miah, S. J., Vu, H. Q., Gammack, J., & McGrath, M. (2017). A big data analytics method for tourist behaviour analysis. *Information & Management, 54*(6), 771-785. http://dx.doi.org/10.1016/j.im.2016.11.011

Muchardie, B. G., Yudiana, N. H., & Gunawan, A. (2016). Effect of social media marketing on customer engagement and its impact on brand loyalty in caring colours cosmetics, Martha Tilaar. *Binus Business Review, 7*(1), 83-87. http://dx.doi.org/10.21512/bbr.v7i1.1458

Noor, S., Guo, Y., Shah, S. H. H., Nawaz, M. S., & Butt, A. S. (2020). Bibliometric analysis of social media as a platform for knowledge management. *International Journal of Knowledge Management, 16*(3), 33-51. http://dx.doi.org/10.4018/IJKM.2020070103

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews, 10*(1), 89. http://dx.doi.org/10.1186/s13643-021-01626-4

Palácios, H., de Almeida, M. H., & Sousa, M. J. (2021). A bibliometric analysis of trust in the field of hospitality and tourism. *International Journal of Hospitality Management, 95*, 102944. http://dx.doi.org/10.1016/j.ijhm.2021.102944

Park, H. W., Park, S., & Chong, M. (2020). Conversations and medical news frames on Twitter: Infodemiological study on COVID-19 in South Korea. *Journal of Medical Internet Research, 22*(5), e18897. http://dx.doi.org/10.2196/18897

Pilelienė, L., Alsharif, A. H., & Alharbi, I. B. (2022). Scientometric analysis of scientific literature on neuromarketing tools in advertising. *Baltic Journal of Economic Studies, 8*(5), 1-12. http://dx.doi.org/10.30525/2256-0742/2022-8-5-1-12

Priansa, D. J., & Suryawardani, B. (2020). Effects of E-marketing and social media marketing on E-commerce shopping decisions. *Jurnal Manajemen Indonesia, 20*(1), 76-82. http://dx.doi.org/10.25124/jmi.v20i1.2800

Puiu, D., Barnaghi, P., Tönjes, R., Kümper, D., Ali, M. I., Mileo, A., . . . Farajidavar, N. (2016). Citypulse: Large scale data analytics framework for smart cities. *IEEE Access: Practical Innovations, Open Solutions, 4*(1), 1086-1108. http://dx.doi.org/10.1109/ACCESS.2016.2541999

Pulido, C. M., Villarejo-Carballido, B., Redondo-Sama, G., & Gómez, A. (2020). COVID-19 infodemic: More retweets for science-based information on coronavirus than for false information. *International Sociology, 35*(4), 377-392. http://dx.doi.org/10.1177/0268580920914755

Sadli, T., Hartono, V. C., & Proboyo, A. (2022). The Mediation Role of Purchase Intention on The Relationship Between Social Media Marketing, Brand Image, and Brand Loyalty: A Case Study of J&T Express Indonesia. *Petra International Journal of Business Studies, 5*(2), 206-216. http://dx.doi.org/10.9744/ijbs.5.2.206-216

Salloum, S. A., Al-Emran, M., Monem, A. A., & Shaalan, K. (2017). A survey of text mining in social media: Facebook and Twitter perspectives. Advances in Science. *Advances in Science. Technology and Engineering Systems Journal, 2*(1), 127-133. http://dx.doi.org/10.25046/aj020115

Sánchez-Fernández, J., Casado-Aranda, L. A., & Bastidas-Manzano, A. B. (2021). Consumer Neuroscience Techniques in Advertising Research: A Bibliometric Citation Analysis. *Sustainability (Basel), 13*(3), 1589. http://dx.doi.org/10.3390/su13031589

Sharma, S., & Verma, H. V. (2018). Social media marketing: Evolution and change. *Social media marketing: Emerging concepts and applications, 2*, 19-36. http://dx.doi.org/10.1007/978-981-10-5323-8_2

Sianturi, C. M., Pasaribu, V. A., Pasaribu, R. M., & Simanjuntak, J. (2022). The impact of social media marketing on purchase intention. *SULTANIST: Jurnal Manajemen dan Keuangan, 10*(1), 60-68. http://dx.doi.org/10.37403/sultanist.v10i1.425

Singh, A., Shukla, N., & Mishra, N. (2018). Social media data analytics to improve supply chain management in food industries. *Transportation Research Part E, Logistics and Transportation Review, 114*, 398-415. http://dx.doi.org/10.1016/j.tre.2017.05.008

Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for Information Science, 24*(4), 265-269. http://dx.doi.org/10.1002/asi.4630240406

Stieglitz, S., Dang-Xuan, L., Bruns, A., & Neuberger, C. (2014). Social media analytics: An interdisciplinary approach and its implications for information systems. *Business & Information Systems Engineering, 6*(2), 89-96. http://dx.doi.org/10.1007/s11576-014-0407-5

Stieglitz, S., Mirbabaie, M., Ross, B., & Neuberger, C. (2018). Social media analytics–Challenges in topic discovery, data collection, and data preparation. *International Journal of Information Management, 39*(2), 156-168. http://dx.doi.org/10.1016/j.ijinfomgt.2017.12.002

Stubb, C., Nyström, A. G., & Colliander, J. (2019). Influencer marketing: The impact of disclosing sponsorship compensation justification on sponsored content effectiveness. *Journal of Communication Management (London), 23*(2), 109-122. http://dx.doi.org/10.1108/jcom-11-2018-0119

Sumague, E. N. R., & Briones, J. P. (2022). Impact of social media marketing on the perceptions of e-shopping customers in the City of Santo Tomas, Batangas, Philippines. *American Journal of Social Sciences and Humanities, 7*(2), 85-96. http://dx.doi.org/10.55284/ajssh.v7i2.793

Sun, X. (2021). Research on the influence of video marketing of social media influencers on consumers purchase intention of beauty products—Taking YouTube as example. *Journal of Business and Management, 3*(2), 1-7. http://dx.doi.org/10.25236/ajbm.2021.030201

Wang, C. L. (2021). New frontiers and future directions in interactive marketing: Inaugural Editorial. *Journal of Research in Interactive Marketing, 15*(1), 1-9. http://dx.doi.org/10.1108/JRIM-03-2021-270

Watson, H. J. (2014). Tutorial: Big data analytics: Concepts, technologies, and applications. *Communications of the Association for Information Systems, 34*(1), 65. http://dx.doi.org/10.17705/1cais.03465

Weng, L., Menczer, F., & Ahn, Y.-Y. (2013). Virality prediction and community structure in social networks. *Scientific reports, 3*(1), 1-6. http://dx.doi.org/https://doi.org/10.1038/srep02522

Widyaningrum, P. W. (2016). Peran media sosial sebagai strategi pemasaran pada sewa kostum Meiyu Aiko Malang. *Al Tijarah, 2*(2), 230-257. http://dx.doi.org/10.21111/tijarah.v2i2.744

Wymbs, C. (2011). Digital marketing: The time for a new "academic major" has arrived. *Journal of Marketing Education, 33*(1), 93-106. http://dx.doi.org/10.1177/0273475310392544

Xiang, Z., Du, Q., Ma, Y., & Fan, W. (2017). A comparative analysis of major online review platforms: Implications for social media analytics in hospitality and tourism. *Tourism Management, 58*(1), 51-65. http://dx.doi.org/10.1016/j.tourman.2016.10.001

Yao, X., Wang, X., Xu, Z., & Skare, M. (2022). Bibliometric analysis of the energy efficiency research. *Acta Montanistica Slovaca, 27*(2), 505-521. http://dx.doi.org/10.46544/AMS.v27i2.17

Zhang, J., & Mao, E. (2016). From online motivations to ad clicks and to behavioral intentions: An empirical study of consumer response to social media advertising. *Psychology and Marketing, 33*(3), 155-164. http://dx.doi.org/10.1002/mar.20862

Zhang, X., Meng, Y., Chen, H., Yu, J., Sun, Y., de Pablos, P. O., & He, J. W. (2017). A bibliometric analysis of digital innovation from 1998 to 2016. *Journal of Management Science and Engineering, 2*(2), 95-115. http://dx.doi.org/10.3724/SP.J.1383.202005

Scientific Annals of Economics and Business
71 (4), 2024, 519-546
DOI: 10.47743/saeb-2024-0024

Impact of Innovation and Trade Participation on Economic Growth Among Selected African Countries

Victor Ushahemba Ijirshar[*], Isa Jibrin Okpe[**], Jerome Terhemba Andohol[***]

Abstract: This study examines the impact of innovation and trade participation on economic growth among selected African countries from 1996 to 2021. This study applied nonstationary heterogeneous panel models utilizing pooled mean group estimators, mean group estimators and dynamic fixed effects estimators. Based on the results of the Hausman test, the PMG estimator was considered for the data analysis. The study revealed the significant role of industrial design, patents, trademarks, research and development, exports, and balanced trade policies in driving long-term economic growth in Africa. The synergies between innovation and trade participation are studied, emphasizing their amplified impact on economic growth. The study suggests practical policy recommendations for the selected African countries, urging governments to establish innovation ecosystems, encourage investments in design, strengthen intellectual property protection, prioritize infrastructure development, and develop balanced trade policies. Focusing on SMEs, offering incentives for research and development, and establishing trade promotion agencies are also recommended to create a conducive environment for innovation, trade, and sustained economic growth.

Keywords: economic growth; innovation; trade participation.

JEL classification: F43; F14; O31; O47; O55.

[*] Department of Economics, Benue State University, Makurdi-Nigeria; e-mail: *ijirsharvictor@gmail.com* (corresponding author).
[**] Department of Economics, Benue State University, Makurdi-Nigeria; e-mail: *ijokpe@yahoo.co.uk*.
[***] Department of Economics, Benue State University, Makurdi-Nigeria; e-mail: *torsaa2002@yahoo.com*.

Article history: Received 14 June 2024 | Accepted 11 December 2024 | Published online 16 December 2024

To cite this article: Ijirshar, V. U., Okpe, I. J., Andohol, J. T. (2024). Impact of Innovation and Trade Participation on Economic Growth among Selected African Countries. *Scientific Annals of Economics and Business*, 71(4), 519-546. https://doi.org/10.47743/saeb-2024-0024.

1. INTRODUCTION

The objective of any economy is to achieve greater national output and foster economic growth, which is recognized as a pivotal macroeconomic goal. This overarching aim is substantiated by a body of research conducted by scholars such as Espeche *et al.* (2023), Haldar *et al.* (2023), and Chien (2015). These studies collectively indicate that economic growth hinges on several key factors, notably capital, labour, technology, investment, expenditure, and net trade. Capital and labour represent the fundamental building blocks of economic production, with technology serving as a catalyst for productivity enhancement. Investment fuels economic growth by promoting infrastructure development and business growth. Moreover, expenditures stimulate demand and, consequently, production. One of the most influential drivers of economic growth is international trade, as highlighted by Wen *et al.* (2023). International trade or trade participation enables countries to specialize in the production of goods and services in which they have a comparative advantage, thereby enhancing efficiency and overall economic growth. Concurrently, innovation emerges as a powerful catalyst for heightened productivity, enabling businesses to achieve more with fewer resources. The innovation and trade participation nexus, as viewed in the catch-up theory, constitutes a pivotal consideration in the pursuit of economic growth and the augmentation of national output.

Statistics have shown that in 2022, Mauritius secured the top spot for innovation in Africa, while South Africa was the second most innovative nation (Ngila, 2022; Oluwole, 2022). South Africa led sub-Saharan Africa in both exports and imports, trailed by Egypt, Morocco, Nigeria, and Algeria (WIPO, 2023). Out of the total export value of US$24,227,433 million from the total number of 4,615 products with 239 trading partners in 2021, sub-Saharan Africa has a total export value of US$310,083 million (1.3 percent) from the total number of 4,536 products (98.29 percent) with 227 partners (94.98 percent). Turning to imports, Sub-Saharan Africa was involved in the import of goods worth US$305,528 million, equivalent to 1.4% of the total global import value, which amounted to US$21,931,213 million. These imports covered a spectrum of 4,624 product categories, encompassing a substantial 99.63% of the total global product variety (WIPO, 2023). This means that Sub-Saharan Africa has a significant number of trading partners globally and participates in a wide variety of product categories both in terms of exports and imports. However, the value of their trade transactions as a percentage of the global market is relatively small. This could reflect the need for further economic development, infrastructure improvement, and trade diversification within the region to enhance its position in the global trade landscape.

Empirical evidence supports the significance of innovation and trade participation as key determinants of economic growth. This has necessitated policies and strategies that encourage advancements in technology and facilitate global trade by governments and organizations seeking to bolster their economies. Consequently, achieving higher levels of economic growth requires a multifaceted approach that encompasses these critical factors, ultimately contributing to a nation's prosperity and well-being since international trade and innovation in the current wave of globalization are seen as important forces in determining global economic outcomes.

International trade is the integration of nations in the world in terms of free trade, free movement of capital and financial activities (Igudia, 2004). It is a well-known concept dating back to Smith's analysis of market specialization and Ricardo's theory of comparative advantage that international trade promotes the efficient allocation of resources and allows for the dissemination of knowledge and technology and improved levels of competition in domestic

and international markets (Smith, 1776; Ricardo, 1817; Ijirshar, 2019). Innovation is also described as the development and application of ideas and technologies that improve goods and services or make their production more efficient. According to Cohen (2020), the role of innovation has been critical to the economic growth and development of several countries over time. It has been seen as a significant driver of economic growth (Gurbiel, 2003; Rosenberg, 2005; Gurría, 2008; European Central Bank, 2017; Broughel and Thierer, 2019).

Both innovation and trade participation can influence the national income of an economy. Both innovation and trade participation generate earnings and boost growth (Economic Commission for Africa, 2016). Theoretical work has demonstrated the growth-promoting impacts of trade participation when trade-promoted specializations experience increasing economies of scale (Grossman and Helpman, 1991a, 1991b; Young, 1991; Lee, 1993; Eicher, 1999; Chang *et al.*, 2009). Contrary to this claim, international trade can result in the underutilization of capital and human resources, concentration in extractive economic activities, or specialization away from technologically sophisticated, increasing-return industries if there are market or institutional inefficiencies (Grossman and Helpman, 1991b; Matsuyama, 1992). The supporters of free trade highlighted some benefits of international trade due to the specialization of countries in the production and distribution of goods that have comparative advantages. Such countries engage in foreign trade to meet their other needs. However, there are tendencies toward the dumping of goods by developed countries in developing economies that are capable of harming developing nations. Given this argument, the impact of international trade on economic growth is still a hotly debated topic among academics, despite the overwhelming support of the theoretical literature for its advantages.

The African continent stands at a pivotal juncture in its economic development, where the intersection of innovation and trade participation plays a crucial role in shaping the trajectory of economic growth. The dynamism of global markets and the rapid evolution of technology have intensified the imperative for African nations to strategically engage in international trade and foster innovation. This study aims to examine the relationships among innovation, trade participation, and economic growth, focusing on a select group of African countries. This study seeks to unravel the impacts of trade participation and innovation on the economic growth of selected African countries by examining factors such as export-led growth, market diversification, and the role of trade policies in fostering sustainable economic development.

The debates about the growing impacts of trade participation and the importance of innovation to economic growth have prompted further research into the nature of the effect of trade participation and innovation on growth, particularly in developing economies such as African countries. This has raised the empirical question of whether the realization of potential growth benefits can occur without incurring large offsetting costs. The growth effects of innovation and trade participation may differ across countries based on the category of the items traded, the trade pattern, or other peculiarities surrounding the phenomenon. Moreover, the importance of innovation has been reinforced by foreign trade, which has opened up new forms of global competition and markets for innovative products and services. However, a comprehensive approach that examines the dynamics among innovation, trade participation and economic growth while also taking into account the diverse country-specific effects on the responses and behaviours of the tradeable items that comprise exports and imports remains limited in Africa.

Recognizing the nature of innovation and trade participation, this study seeks to elucidate the synergistic impact of these two factors on economic growth in selected African countries. Furthermore, by investigating the interactive effects, this study aims to discern

whether innovation amplifies the growth benefits derived from trade participation. This holistic approach aims to capture the dynamics that shape the economic growth of the selected African countries. In addressing these research questions, this study endeavours to contribute valuable insights to the ongoing discourse on economic development in Africa. By examining the relationships among innovation, trade participation and economic growth, this research aims to inform policymakers, businesses, and scholars about strategies that can foster sustainable and inclusive economic growth in the selected African nations.

This study used panel data from 1996 to 2021 on 25 African countries representing all five regions of the continent and aimed to analyse the interplay between innovation, trade participation, and economic growth. Various trade components, such as agricultural and manufactured goods, are considered alongside measures of innovation, such as patent applications and research expenditure. This study employs statistical models to account for country-specific effects and emphasizes the dynamic and heterogeneous nature of the analysed countries. The study provides valuable perspectives for governments, businesses, investors, and academia. To address the gap in understanding country-specific effects, this paper explores the impact of innovation and trade participation on economic growth in Africa. The findings are expected to inform policymaking for sustainable growth, aid businesses in identifying innovative sectors, guide foreign investors, and benefit regional organizations. This study enhances theoretical frameworks and aligns with UN Sustainable Development Goals, emphasizing the potential of innovation to drive economic progress and improve living standards across Africa.

2. LITERATURE REVIEW

2.1 Theoretical Review

The Comparative Advantage Theory, introduced by Ricardo in 1817, posits that even if a country is at a complete disadvantage in producing both goods, favourable trade can still occur (Ricardo, 1817; Boehm *et al.*, 2022; Lin *et al.*, 2022; Zapata *et al.*, 2023). This theory suggests specialization in goods or services with the least disadvantage, fostering economic globalization. Africa's application of this theory faces criticism for static measurements and challenges such as inadequate infrastructure and education. Applying comparative advantage theory to African countries, which possess diverse resource endowments, could enhance productivity and trade. Specialization in areas of comparative advantage, such as agriculture or technology, might stimulate economic growth through efficient goods exchange, access to advanced technologies, and innovation. However, challenges such as infrastructure deficits, dependence on commodity exports, trade barriers, and intellectual property issues need to be addressed for optimal results (Robinson, 1979).

Solow's growth theory, which is part of the neoclassical model, emphasizes factors such as capital, labour, and technological progress (Mankiw *et al.*, 1992; Michaelides and Papadakis, 2023; Seo, 2023). While it provides insights into the African context, critics argue that it overlooks continuous innovation and diminishing returns to capital and neglects institutional factors essential for long-term growth. Complementing Solow's model with a broader perspective is recommended for addressing multifaceted challenges faced by African nations. Keynes's theory of increasing government expenditure suggests that increased spending stimulates aggregate demand and national revenue (Mariati *et al.*, 2022; Michaelides and

Papadakis, 2023; Pham, 2023). While they can stabilize the economy, critics raise concerns about fiscal sustainability, fund allocation efficiency, and governance issues. Balancing growth stimulation with avoiding excessive deficits is crucial for African countries, ensuring that increased expenditures translate into tangible benefits for innovation and trade participation.

Catch-up theory, which originated post-World War II, proposes that less developed economies can achieve convergence with wealthier ones by adopting technologies (Gerschenkron, 1962; Burkett and Hart-Landsberg, 2003). In the African context, this theory suggests significant growth potential by embracing innovation and active participation in international trade. However, challenges in technology transfer, institutional capacity, and effective policies must be addressed for sustainable economic growth. The technology gap theory, formulated by Posner in 1961, also posits that ongoing inventions and innovations drive trade, even among nations with comparable factor ratios. While relevant to Africa, bridging the technology gap requires investments in technological infrastructure, education, and research. Challenges include technology transfer complexities, institutional capacity issues, and economic barriers, emphasizing the need for appropriate skills and supportive policies for successful implementation.

2.2 Empirical Review

Several empirical studies have examined the relationship between trade participation and economic growth, with limited studies on the impact of innovation on economic growth, particularly in developing countries such as Africa. These studies have employed different methodologies and focused on diverse aspects of trade, ranging from international trade to cross-border trade, trade policy, and trade liberalization.

Pham (2023) examined the elasticities of economic growth to changes in trade in Brazil, India, Russia, China, and South Africa. It emphasized that trade fosters short-term economic growth, but poor administration hinders its beneficial effects. This study used annual data from 1971 to 2020 to expand the scope of Gnoleba (2023), which included Côte d'Ivoire, Ghana, Nigeria, and Morocco. The authors found that cross-border trade within the Economic Community of West African States (ECOWAS) region can be beneficial if constraints are removed. Bunje *et al.* (2022), using balanced panel data from 52 African countries from 2000 to 2018, revealed conflicting effects of trade openness on economic expansion, suggesting that exports stimulate growth, while imports impede it. Zahonogo (2017) focused on sub-Saharan Africa and employed a dynamic growth model for 42 SSA countries between 1980 and 2012. This study identified a trade threshold below which greater trade openness has beneficial effects on economic growth. Furthermore, Iyoha and Okim (2017), utilizing panel data from 1990 to 2013 for ECOWAS member countries, found that exports, exchange rates, and investment were key predictors of per capita real income growth. These empirical studies primarily focus on the impact of trade (both exports and imports) on economic growth. While some studies include African countries (Iyoha and Okim, 2017; Zahonogo, 2017; Bunje *et al.*, 2022; Gnoleba, 2023), they cover either a broad region (e.g., sub-Saharan Africa) or specific groups of countries (e.g., ECOWAS). However, none of the studies specifically integrate the role of innovation in conjunction with trade participation on economic growth. Therefore, investigating how innovation (e.g., technological advancements and R&D expenditures) influences economic growth in conjunction with trade participation and assessing the combined effect of innovation and trade on economic growth in developing countries,

particularly with a more focused analysis of specific African countries that have shown varying levels of innovation and trade participation, is imperative.

In terms of country-specific studies, Luo and Qu (2023) focused on the export trade of China from 2000 to 2019 using linear regression and dynamic panel threshold techniques. A substantial single-threshold effect of export trade on China's economic development was found. Agudze and Olarewaju (2021) also investigated the impact of comparative growth on trade in the USA and China from 1985 to 2020. Their study revealed diverging growth benefits, with China experiencing consistently positive effects. Mohsen and Chua (2020) explored the impact of trade liberalization on the Chinese economy from 1980 to 2018, emphasizing that trade liberalization positively influences China's economic growth. Khadka (2019), examining the impact of trade liberalization on Nepal's economic growth from 1980 to 2013, found that trade openness had a positive influence on the economy. Elijah and Musa (2019), also focusing on Nigeria from 1980 to 2016, found a detrimental impact of trade on both short- and long-term growth, raising questions about the precise nature of the link between trade and economic growth.

Amna Intisar *et al.* (2020) examined the impact of trade and human capital on the economic growth of nineteen Asian countries from 1985 to 2017, revealing that trade openness and human capital strongly spur economic growth. Verico and Pangestu (2020) also evaluated the impact of globalization on Indonesia's economy from 1960 to 2018 and found that trade and investment have positive effects, increasing productivity and restructuring the economy. Ramzan *et al.* (2019), investigating the impact of trade on economic growth and considering total factor productivity (TFP), found a nonlinear relationship, suggesting that trade may hinder growth in nations with low TFP development but promote it in those meeting a minimum threshold.

Other empirical studies have explored the relationship between innovation and economic growth across various regions, with a focus on both cross-country analyses and country-specific examinations. In a cross-country analysis from a global perspective, Razzaq *et al.* (2023) investigated the influence of technological innovation on economic growth across ten countries with the highest national income. Positive effects were observed, highlighting the role of technology in high-income countries. However, the study acknowledged variations in technology levels, especially when comparing high-income countries to developing African nations. Kusumawardhana (2020) assessed the effects of innovation and technology on economic growth in Asian countries from 2000 to 2017. The study revealed significant effects of patent applications on economic growth in both upper- and lower-middle-income countries. Using the European Perspective, Maradana *et al.* (2017) examined 19 European countries from 1989 to 2014. The study utilized cointegration and Granger causality methods, revealing a long-run relationship between innovation and per capita economic growth. However, empirical studies on this relationship in Africa are lacking.

Bujari and Mart'ınez (2016) explored the growth effect of technological innovation in 12 Latin American countries from 1996 to 2008. Using the generalized method of moments (GMM) system, the study revealed a positive impact of technological innovation on economic growth in the region. For Central and Eastern Europe, Pece *et al.* (2015) examined the relationship between innovation and economic growth in Poland, the Czech Republic, and Hungary from 2000 to 2013. The study, using ordinary least squares, found a positive influence of innovation on economic development. Using a global sample on the relationship between industrial and developing countries, Agénor and Neanidis (2015) assessed

interactions between innovation, public capital, and human capital across 38 industrial and developing countries from 1981 to 2008. The study revealed that public capital affects growth through multiple channels, including innovation capacity and human capital accumulation.

For country-specific studies, Law *et al.* (2020) and Le and Homel (2015) conducted country-specific studies in Malaysia. Law *et al.* (2020) emphasized the quality of the innovation measure, using patents granted, and found a significant positive effect on economic growth. Le and Homel (2015), using qualitative techniques, asserted that innovation determines economic growth in Malaysia. Ali *et al.* (2022) focused on Pakistan by employing an autoregressive distributive lag and found that technology innovation had a positive influence on economic growth. However, the study has limitations in terms of generalizability.

For African countries, several studies, including Razzaq *et al.* (2023), have emphasized the lack of empirical evidence regarding the relationship between innovation and economic growth in African countries. Acheampong *et al.* (2022) also used a dynamic system generalized method of moments for determining the effects of technological innovation on economic growth, noting a U-shaped relationship. LeBel (2008) also explored the role of creative innovation in economic growth across 103 countries. This study, using fixed and random effect regression estimators, revealed a positive role of creative innovation in economic growth globally. Many of the empirical studies concentrate on countries such as China, the USA, Indonesia, and European and Asian nations. Thus, there is a clear absence of focused empirical studies on African countries, with a few studies that integrate both innovation and trade as dual contributors to economic growth with recent trends in both innovation and trade. Although some studies address the relationship in some African countries, specific analyses on the selected African countries considering both innovation and trade participation are lacking. The lack of empirical evidence in African countries emphasizes a crucial gap in the literature, calling for more targeted research in this region.

3. METHODOLOGY

3.1 Research Design

This study employs a quasiexperimental technique aligned with its underlying theory, utilizing a quantitative research design to explore the relationships between trade participation, innovation, and economic growth in selected African nations. Employing a positivist research approach, the study mitigates researcher bias by utilizing linear and nonlinear panel autoregressive models within a dynamic panel framework. To ensure clarity and quantifiability, observable variables are assessed using appropriate proxies. By adopting a deductive research approach, this study investigates the hypothesis of a positive relationship between innovation, trade participation, and economic growth. Secondary data from sources such as the World Development Indicators, WTO, WIPO, UNCTAD, and The World Economic Forum are utilized. This study focuses on 25 African countries, collecting cross-sectional time-series data spanning 1996 to 2021, covering various indicators such as industrial design, patents, trademarks, research and development, GDP per capita, labour force, households, and trade-related variables. After interpolating missing observations, the data underwent rigorous consistency checks.

3.2 Empirical model for economic growth

Following the theoretical postulations of Keynes (1936), the theory states the following:

$$Y = C + I + G + (X - M) \tag{1}$$

where Y=national income, C=consumption by households, I=investment, G=government expenditure, and (X – M) = trade balance. According to Solow's theory of growth, output is determined by the rate of savings, population growth, and technological progress as exogenous (Mankiw *et al.*, 1992). The theory considers two inputs, capital and labour, and assumes a Cobb–Douglas production function where the output at time t is stated as:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{2}$$

where Y is the output, K is the capital, L is the labour, and A is the level of technology. Taking the natural logarithm of a complex exponential equation can simplify it into a more manageable linear form, stabilize variance and normalize the distribution of data, which is particularly valuable when dealing with datasets that have a right-skewed or exponential distribution, and helps satisfy the assumptions of linear regression models. Thus, by transforming equation (2) by taking the natural logarithm, it can be restated as:

$$\ln Y_t = \ln A_t + a \ln K_t + (1-\alpha) \ln L_t) \tag{3}$$

Considering the theoretical model of Keynes (1936) as stated in equation (1) in the natural logarithm and Solow's growth theory as specified in equation (3) and using the real gross domestic product per capita for output, innovation for the level of technology, labour force for labour (L), household consumption expenditure for consumption expenditure (C), capital investment for investment (I), capital (K) forms part of the capital investment, government spending for government expenditure (G), and capturing the components of exports and imports separately. However, to avoid paramitarism and based on the usefulness of the variables, household expenditure, gross fixed capital formation, and government expenditure were excluded from the model. The economic growth model can be specified with semi-transformation as follows:

$$\ln GDPP_{it} = f(INN_{it}, \ln EXPT_{it}, \ln IMPT_{it}) \tag{5}$$

where GDPP is GDP per capita, PPP (constant 2017 international $), INN is an innovation indicator (that is, industrial design applications, patent applications, trademark applications, research and development expenditure (% of GDP)), EXPT is exports of goods and services (current US$), IMPT is imports of goods and services (current US$), i is the cross-sections and t is the time dimension. The other variables are not transformed by taking the natural logarithm because they are percentages and indices ranging from 0 to 100 or 1 to 7. It is important to note that savings are assumed to be equal to investment at equilibrium. By further decomposing the indicators of innovation (industrial design applications, patent applications, trademark applications, and R&D expenditures), equation (5) can be restated as follows:

$$\ln GDPP_{it} = f(IND_{it}, PAT_{it}, \ln TRD_{it}, RAD_{it}, \ln EXPT_{it}, \ln IMPT_{it}) \tag{6}$$

where IND is an industrial design application, PAT is a patent application, TRD is a trademark application, and RAD is a research and development expenditure. Converting equation (6) to a stochastic form, we obtain:

$$\ln GDPP_{it} = \beta_0 + \beta_1 IND_{it} + \beta_2 PAT_{it} + \beta_3 \ln TRD_{it-1} + \beta_4 RAD_{it} + \beta_5 \ln EXPT_{it} + \beta_6 \ln IMPT_{it} + u_{it} \quad (7)$$

A panel autoregressive lagged model (panel ARDL) is specified in a dynamic form as:

$$\ln GDPP_{it} = \beta_0 + \delta \ln GDPP_{it-1} + \beta_1 IND_{it} + \beta_2 PAT_{it} + \beta_3 \ln TRD_{it-1} + \beta_4 RAD_{it} + + \beta_5 \ln EXPT_{it} + \beta_6 \ln IMPT_{it} + u_{it} \quad (8)$$

where

$\beta_1 - \beta_6$ = parameters to be estimated, and ε_{it} =mutually independent idiosyncratic error.

This study used equation (8) to determine the effects of innovation and trade participation on economic growth in the selected African countries. The study also interacts the innovation indicators with the trade participation indicators using equation (8) as follows:

$$\ln GDPP_{it} = \beta_0 + \delta \ln GDPP_{it-1} + \beta_1 IND_{it} + \beta_2 PAT_{it} + \beta_3 \ln TRD_{it} + \beta_4 RAD_{it} + \beta_5 \ln EXPT_{it} + \beta_6 \ln IMPT_{it} + \beta_8 IND * \ln EXPT_{it} + \beta_9 PAT * \ln EXPT_{it} + \beta_{10} \ln TRD * \ln EXPT_{it} + \beta_{11} RAD * \ln EXPT_{it} + \beta_{12} IND * \ln IMPT_{it} + \beta_{13} PAT * \ln IMPT_{it} + \beta_{14} \ln TRD * \ln IMPT_{it} + \beta_{15} RAD * \ln IMPT_{it} + u_{it} \quad (9)$$

This study used the economic growth model with the interactive effects of innovation and trade participation to examine the interactive effect of innovation and trade participation on economic growth in the selected African countries. The marginal effect of innovation on economic growth in equation (9) is

$$\frac{\partial \ln GDPP}{\partial IND} = \beta_1, \frac{\partial \ln GDPP}{\partial PAT} = \beta_2, \frac{\partial \ln GDPP}{\partial \ln TRD} = \beta_3, \frac{\partial \ln GDPP}{\partial RAD} = \beta_4,$$

while the marginal effect of innovation on economic growth when there is trade participation in the multiplicative interaction equation (9) is

$$\frac{\partial \ln GDPP}{\partial IND} = \beta_1 + \beta_7 \ln EXPT \text{ and } \frac{\partial \ln GDPP}{\partial IND} = \beta_1 + \beta_8 \ln IMPT$$

(and it is applicable to other innovation indicators and trade participation indicators). The assumption is that innovation significantly increases economic growth if and only if trade participation increases, and vice versa). On the other hand, the marginal effect of trade participation on economic growth in equation (9) is

$$\frac{\partial \ln GDPP}{\partial \ln EXPT} = \beta_5, \frac{\partial \ln GDPP}{\partial \ln IMPT} = \beta_6$$

while the marginal effect of trade participation on economic growth when there is innovation in multiplicative interaction equation (9) is

$$\frac{\partial \ln GDPP}{\partial \ln EXPT} = \beta_5 + \beta_8 IND \text{ and } \frac{\partial \ln GDPP}{\partial \ln IMPT} = \beta_6 + \beta_{12} IND$$

for trade participation and industrial design applications (and it is applicable to other innovation indicators). The assumption is that trade participation will significantly increase economic growth if and only if innovation increases, and vice versa).

4. RESULTS AND DISCUSSION

4.1 Panel Unit Root Test Results

To determine the stationarity of the variables, panel unit root tests were conducted. The results of these tests, presented in Table no. 1, provide insights into whether the variables are stationary or nonstationary. The panel unit root tests were conducted using various methodologies, including the Levin–Lin–Chu (LLC), Im–Pesaran–Shin (IPS), and Fisher-type augmented Dickey-Fuller (ADF-Fisher) tests. The null hypothesis for these tests is that the variable has a unit root and is nonstationary, while the alternative hypothesis suggests that the variable is stationary. However, for the Hadri LM test, the null hypothesis states that all panels are stationary, while the alternative hypothesis is that at least some of the panels contain unit roots. The significance level for the tests is set at the 5% critical level.

Table no. 1 – Panel Unit Root Test Results

Panel Unit Root Tests	**lnimpt**	**d.lnimpt**	**lnexpt**	**d.lnexpt**
Harris-Tsavalis (rho)	0.9249	-0.1486***b	0.9254	-0.0630***b
Brei tung (lambda)	5.6169	-5.8208***b	5.7147	-4.8003***b
Levin-Lin chu	-9.6805***a	-1.1649***	-10.7720***a	-1.7943***
Im–Persaran–Shin	3.8792	-9.6502***b	3.7596	-9.7921***b
Fisher-type	2.9942***a	-0.7062	1.2304***a	-1.0137
Pesaran	1.092	-1.221	-1.110	0.888
Hadri LM	60.6129***	-0.1389 b	60.0899***	0.5905 b
Panel Unit Root Tests	**ind**	**d.ind**	**pat**	**d.pat**
Harris-Tsavalis (rho)	0.6055***a	-0.2383***	0.8176***a	0.0527***
Brei tung (lambda)	9.0394	-5.6515***b	4.4588	-8.0935***b
Levin-Lin chu	0.5231*	-5.1256***b	-0.0230*	-26.0678***b
Im–Persaran–Shin	-	-	-0.5704	-12.8431***b
Fisher-type	0.5563	1.9659***b	-3.2415	18.0431***b
Pesaran	4.955	4.383	3.569	1.012
Hadri LM	25.7843***	-3.5150 b	35.7291***	-1.7836 b
Panel Unit Root Tests	**rad**	**d.rad**	**lntrd**	**d.lntrd**
Harris-Tsavalis (rho)	1.031	0.3341***b	0.8748	-0.1756***b
Brei tung (lambda)	9.1162	-5.9085***b	4.9131	1.0882
Levin-Lin chu	0.5843	-5.7283***b	-42.867***a	1.9894
Im–Pesaran–Shin	6.8806		3.4536	-6.9075***b
Fisher-type	5.2991***a	-9.143***	2.6515	5.8026***b
Pesaran	1.726	2.431	-0.537	-1.201
Hadri LM	56.4971***	13.3743***	41.5165***	1.8039**
Panel Unit Root Tests	**lngdpp**	**d.lngdpp**		
Harris-Tsavalis (rho)	0.9706	0.1207***b		
Brei tung (lambda)	11.6048	-8.3938***b		

Panel Unit Root Tests	lnimpt	d.lnimpt	lnexpt	d.lnexpt
Levin-Lin chu	-3.8136***a	-4.7758***		
Im–Pesaran–Shin	1.2939	-10.8485***b		
Fisher-type	1.4535*	-0.8283		
Pesaran	-1.412	1.413		
Hadri LM	75.0793***	9.4630***		

Note: The asterisks (*** ** and *) denote rejection of the null hypothesis at the 1 percent, 5 percent and 10 percent levels of significance, while a and b indicate stationarity at the level and first difference, respectively.

Source: Extracts from STATA 15 Output

From the results in Table no. 1, the first part of the results indicates that some of the variables under consideration were found to be stationary at the level, while others were not. After applying the first difference to all the variables, they became stationary for most of the tests. The results also indicate that the significance level used for assessing stationarity was set at the 5% critical level.

4.2 Correlation Test for Multicollinearity

To assess multicollinearity, the correlation matrix of the predictor variables was examined, and the results are presented in Table no. 2.

Table no. 2 – Results of the correlation test for multicollinearity

Explanatory Variables	Ind	Pat	lntrd	rad	lnexpt	lnimpt
ind	1					
pat	0.4342	1				
lntrd	0.4954	0.4639	1			
rad	0.337	0.4036	0.2674	1		
lnexpt	0.3886	0.4702	0.5305	0.3583	1	
lnimpt	0.4159	0.5032	0.5582	0.4379	0.9745	1

Source: Extracts from STATA 15 Output

The results of the correlation test reveal that weak associations exist among the explanatory variables within the model. These findings indicate the absence of substantial multicollinearity within these models.

4.3 Results of Cointegration Analysis

The panel cointegration results for the economic growth model are presented in Table no. 3.

Table no. 3 – Panel Cointegration Results

Statistics/Probabilities	Statistic	p value
Kao *et al.* (1999) **Test of Cointegration**		
Modified Dickey-Fuller t	1.7465**	0.0404
Dickey-Fuller t	1.4539*	0.073
Augmented Dickey-Fuller t	1.7689**	0.0385
Unadjusted modified Dickey-Fuller	1.3807*	0.0837
Unadjusted Dickey-Fuller t	1.085	0.139

Statistics/Probabilities	Statistic	p value
Predoni Test of No Cointegration		
Modified Phillips-Perron t	4.6299***	0.000
Phillips-Perron t	-4.824***	0.000
Augmented Dickey-Fuller t	-3.863***	0.0001
Westerlund (2005) **Test of No Cointegration [Alternative hypothesis: cointegration in some panels]**		
Variance ratio	-0.1573	0.4375
Westerlund (2005) **Test of No Cointegration [Alternative hypothesis: All panels are cointegrated]**		
Variance ratio	-0.3306	0.3705

Source: Extracts from STATA 15 Output

According to the results in Table no. 3, there is cointegration among the variables. Panel cointegration implies that there exists a long-run relationship among the variables. The use of multiple tests (Kao, Predoni, and Westerlund) to confirm panel cointegration adds robustness and credibility to the study's findings.

4.4 Long-run Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

The study estimated pooled mean group estimators based on the results of the Hausman test. The long-term results of the estimated pooled mean group estimator are presented in Table no. 4.

Table no. 4 – Long-run Results on the Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

Variables	PMG
ind	7.53e-05***
	(0.0000)
pat	0.000214**
	(0.0001)
lntrd	0.0374*
	(0.0207)
rad	0.249***
	(0.0760)
lnexpt	0.403***
	(0.0436)
lnimpt	-0.0128
	(0.0444)
observations	625

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Extracts from STATA 15 Output

From Table no. 4, the estimated coefficient of 7.53e–05 signifies a statistically significant positive impact of industrial design applications on economic growth in the selected African countries in the long run at the 1% significance level. This means that a one-unit increase in industrial design applications corresponds to an estimated increase of 7.53e–05 units in economic growth, while holding other relevant factors constant. This is because industrial design applications often involve innovation and enhancement of product

aesthetics, functionality, and market appeal. This can stimulate demand for products, driving economic activity and growth. Moreover, improved design can lead to higher-value products, which can command premium prices in the market, compete effectively in international markets, drive demand, expand export opportunities and boost economic growth through increased trade. The positive impact of industrial design applications on economic growth suggests that industrial design applications play a role in driving economic growth in the selected African countries. This is consistent with the findings of LeBel (2008) and Snieska and Valodkiene (2015), who found a positive and significant influence of innovation on economic growth.

The coefficient of 0.000214 demonstrates a statistically significant positive effect of patent applications on long-term economic growth in Africa at the 1% significance level. The implication is that a one-unit rise in patent applications is associated with an estimated growth increase of 0.000214 units, while considering other factors. This suggests that patents foster innovation, attract investment, encourage technology transfer, and create higher-value products. This implies that promoting intellectual property through patents can contribute meaningfully to Africa's economic expansion over time. Patents enable innovators to reap rewards, fostering a culture of innovation and contributing to higher-value products. Thus, a proactive approach to patent applications can serve as a catalyst for sustainable economic growth in Africa, aligning with the broader global emphasis on intellectual property rights as drivers of innovation and economic development. This is consistent with the findings of LeBel (2008) and Snieska and Valodkiene (2015), who found a positive and significant influence of innovation on economic growth.

The estimated coefficient of 0.0374 indicates a statistically significant positive impact of trademark applications on economic growth in the selected African countries over the long term at the 10% significance level. For each one-unit increase in trademark applications, there is an estimated growth increase of 0.0374 units when accounting for other factors. Trademarks signify branding and intellectual property protection, which can attract investment, enhance product differentiation, and encourage innovation. This result suggests that focusing on trademark applications can contribute positively to Africa's economic growth trajectory by fostering innovation and business development. This is consistent with the findings of LeBel (2008) and Snieska and Valodkiene (2015), who found a positive and significant influence of innovation on economic growth.

The estimated coefficient of 0.249 denotes a significantly positive influence of R&D expenditure on long-term economic growth in the selected African countries at the 1 percent level of significance. Each unit increase in R&D corresponds to an estimated growth increase of 0.249 units when controlling for other variables. This may be attributed to the fact that R&D activities stimulate innovation, technological advancement, and productivity enhancement, thus fostering economic growth. This suggests that investing in R&D can yield substantial economic benefits for Africa by fostering innovation-led growth, attracting investment, and boosting global competitiveness. It has emerged as a pivotal driver of the continent's sustainable development, aligning with the global emphasis on knowledge-based economies and innovation ecosystems. This finding is consistent with the findings of Law *et al.* (2020), who found a positive and significant influence of innovation on economic growth.

The estimated coefficient of 0.403 signifies a strong and statistically significant positive impact of the export of goods and services on economic growth in selected African countries in the long run at the 1% significance level. This means that each unit increase in exports is

associated with an estimated increase in economic growth of 0.403 units, while other factors are held constant. This shows that exports play a pivotal role in generating foreign exchange earnings, attracting investment, and fostering international competitiveness. Thus, export-driven growth indicates a nation's ability to tap into global markets, fostering revenue generation, job creation, and technology transfer. The study findings suggest that expanding exports can significantly contribute to Africa's economic development, and by enhancing international competitiveness, promoting trade diversification, and attracting foreign investment, exports emerge as a vital engine for driving sustained economic growth across the continent in the long run. This is consistent with the findings of Bunje *et al.* (2022) and Khadka (2019), who found a positive and significant influence of trade on economic growth.

The estimated coefficient of -0.0128 implies a negative, yet statistically insignificant, impact of imports of goods and services on long-term economic growth in the selected African countries. This negative relationship suggests that excessive reliance on imports might hinder local industries. While the estimated result does not reach significance at the 5% critical level, the study emphasizes the need for balanced trade policies that prioritize domestic industries to promote self-reliance and sustainable growth.

4.5 Short-run Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

The study also examined the short-term impact of innovation and trade participation on economic growth in the selected African countries. The results are presented in Annexes 1 to 3. The results revealed a positive and significant impact of lagged real gross domestic product (GDP) on current economic growth in Algeria, Angola, Botswana, Congo DR, Ghana, Kenya, and Zambia in the short run. This implies that past economic performance, as measured by lagged GDP, has a significant influence on current economic growth in the short run. The justification for this significance could be twofold. First, it reflects the persistence of economic growth patterns; when an economy has grown well in the past, it is more likely to continue that growth trajectory due to positive feedback loops, increased investments, and consumer spending. Second, these findings suggest that these countries might be experiencing economic dynamics that are less prone to abrupt changes or external shocks, allowing for the influence of past economic conditions to prevail over the short term. These findings are particularly relevant for resource-rich economies such as Angola and Zambia, where the positive impact could stem from the dependence on commodity exports and their effects on both lagged and current GDP growth. Similarly, the significance might be influenced by policy continuity, investment cycles, or the gradual effects of economic reforms that unfold over time.

The negative and significant impact of lagged real gross domestic product (GDP) on current economic growth in Mauritius, Morocco, and Tanzania suggests that past economic performance, as indicated by lagged GDP, has a strong negative influence on current economic growth in the short run. Policy changes, external shocks, or unique sectoral dependencies could compound the relationship between past and current economic growth. The positive and significant impact of industrial design applications on economic growth in Botswana, Cabo Verde, Mauritius, Morocco, and Tunisia indicates that increased emphasis on industrial design activities contributes to short-term economic growth in these countries. This is consistent with the findings of Lee *et al.* (2022), who found that industrial design drives growth. This is because industrial design applications often involve innovation and

value addition, making products more appealing and competitive in the market. This can boost consumer demand, increase sales, and stimulate economic activity. Second, an active focus on industrial design reflects a commitment to improving product quality, brand recognition, and market positioning, which can attract foreign investment and foster job creation. Third, a culture of innovation through industrial design can drive entrepreneurship, contributing to a vibrant business ecosystem that fuels economic growth.

The estimated positive and significant impact of patent applications on short-term economic growth in Algeria, Botswana, Morocco, Rwanda, Sao Tome, Principe, and Zambia explains the role of innovation and intellectual property protection in driving economic growth. This is consistent with the findings of Lee *et al.* (2022), who found that patent applications drive growth. Patents encourage the development of novel products, technologies, and processes, enhancing economic productivity and positioning these countries as hubs of innovation. In economies such as Botswana and Zambia, this significance aligns with strategies for diversifying and strengthening economic foundations. The study also revealed a positive and significant impact of trademark applications on short-term economic growth in Angola, Botswana, Sao Tome, Principe, and Uganda. This explains the significance of branding and intellectual property protection in driving economic growth. This finding is consistent with that of Phung *et al.* (2019). In countries such as Angola and Botswana, where economic diversification is crucial, and in Uganda and Sao Tome and Principe, which are striving for economic resilience, the robustness of the results adds credibility to the notion that investing in trademarks can yield tangible economic benefits by enhancing branding, fostering entrepreneurship, and driving short-term growth.

The results also show that the positive and significant impact of R&D expenditure on economic growth in Burkina Faso, Kenya, Mauritius, Namibia, South Africa, Tanzania, Uganda, and Zambia in the short run explains the vital role of research expenditure (as a proxy of innovation) in driving economic advancement. This finding is consistent with that of Yazgan and Yalçinkaya (2018). In countries such as South Africa and Mauritius, which emphasize technology-driven growth, and in less industrialized economies such as Burkina Faso and Uganda, the robustness of the results supports the notion that R&D investments yield substantial economic benefits.

The study also revealed a positive and significant impact of exports of goods and services on economic growth in Algeria, Angola, Cabo Verde, the Congo DR, Egypt, Mauritius, Morocco, Mozambique, and Namibia in the short term. This explains why exports of goods and services are crucial in driving economic growth. This finding is consistent with the findings of Nguyen (2020), who found that exports drive exports. The significance of this relationship is particularly relevant for countries such as Angola and Mozambique, where natural resources dominate exports, and for economies such as Mauritius and Cabo Verde, which rely on tourism and services exports. Additionally, the importance of the results reinforces the idea that promoting exports can yield tangible economic benefits, drive entrepreneurship, enhance competitiveness, and generate short-term growth.

In the short run, the influx of imports of goods and services has had a positive and significant impact on economic growth in Algeria, Burkina Faso, Uganda, and Zambia. These countries benefit from imports by accessing a diverse range of products, including raw materials and capital goods, at competitive prices, thereby boosting domestic production and industrialization. Imports also lead to technological spillovers and knowledge transfer, enhancing productivity and innovation. This is consistent with the findings of Hine *et al.* (2005),

who found a negative impact in developed countries. However, prudent policy measures are required to ensure that imports do not negatively impact local industries. On the other hand, the inflow of imports of goods and services has led to negative and significant impacts on economic growth in the Democratic Republic of Congo (DRC) and Mauritius in the short run. Both nations face challenges due to excessive reliance on imports, which can hamper domestic industries, limit employment opportunities, and hinder technological progress. This finding conforms to the findings of Taghavi *et al.* (2012) and Hine *et al.* (2005), who reported a negative impact in developing countries. In the case of the DRC, heavy import dependence undermines the development of local industries, hindering economic diversification and sustainable growth. In Mauritius, although historically reliant on imports for consumption and tourism, overreliance has led to trade imbalances and potential currency depreciation.

The study also revealed that across Botswana, Cabo Verde, Egypt, Ghana, Mauritius, Morocco, Mozambique, Namibia, Nigeria, South Africa, Sudan, Tunisia, and Uganda, a common trend is the negative and significant speed of adjustment towards long-run equilibrium in economic growth. This implies that these countries experience sluggishness in returning to their sustainable growth paths after economic shocks or deviations. The slow pace of adjustment can be attributed to structural complexities, policy uncertainties, or external vulnerabilities. This phenomenon can lead to prolonged periods of economic instability, hindering the ability to harness the benefits of long-term equilibrium. Therefore, policymakers need to address bottlenecks, enhance policy coordination, and implement reforms that promote swift adjustments. By doing so, these nations can reduce the impact of short-term disturbances on their economies and achieve more consistent and sustainable growth trajectories in the long run.

In the context of economic growth in Angola, Burkina Faso, Cabo Verde, the Democratic Republic of Congo (DRC), Mauritius, and Uganda, the positive and significant estimated constant term denotes a baseline level of growth that is not explained by the other variables in the model. This suggests the presence of underlying, consistent factors that contribute to economic growth. These could encompass demographic trends, geopolitical advantages, natural resources, or initial economic conditions. The significance of the constant term highlights the fundamental resilience of these economies, enabling them to sustain growth even amidst varying external influences or policy changes. On the other hand, the negative and significant estimated constant term in the economic growth models of Egypt, Ghana, Morocco, Mozambique, and Rwanda implies that there are fundamental challenges or limitations intrinsic to these economies that hinder their growth potential. This constant might capture factors such as structural weaknesses, institutional inefficiencies, or historical constraints that persistently affect economic performance. Its significance suggests that these countries experience difficulties in achieving sustainable growth without substantial reforms.

4.6 Long-run Interactive Effect of Innovation and Trade Participation on Economic Growth in the Selected African Countries

This study examines the long-term interactive effect of innovation and trade participation on economic growth in the selected African countries using the results of dynamic fixed effects with and without interactive effects, and the results are presented in Table no. 5.

Table no. 5 – Long-run Results of the Interactive Effect of Innovation and Trade Participation on Economic Growth in the Selected African Countries

Variables	Economic Growth Model without Interactive Effects	Economic Growth Model with Interactive Effects
ind	7.47e-05	0.00255
	(0.000251)	(0.00227)
pat	0.000239	0.0102
	(0.000543)	(0.00785)
lntrd	0.152**	0.724
	(0.0694)	(0.707)
rad	0.844***	1.731
	(0.319)	(5.786)
lnexpt	0.251	0.646
	(0.192)	(0.760)
lnimpt	0.00468	-0.545
	(0.202)	(0.823)
indvlnexpt		0.000572
		(0.000468)
patvlnexpt		0.000457
		(0.00148)
lntrdvlnexpt		0.0907
		(0.0994)
radvlnexpt		0.0349
		(0.630)
indvlnimpt		-0.000674
		(0.000453)
patvlnimpt		5.74e-05
		(0.00140)
lntrdvlnimpt		0.116
		(0.112)
radvlnimpt		0.0774
		(0.638)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Extracts from STATA 15 Output

From the results in Table no. 5, the findings reveal a positive yet statistically insignificant impact of industrial design applications on economic growth in Africa in the long run at the 5 percent level of significance. The coefficient of 7.47e–05 suggests a small positive effect, indicating that industrial design could play a role in fostering economic growth. This implies that while industrial design holds promise as a contributor to economic growth, its influence might be constrained by various factors. The lack of statistical significance could stem from complex interactions between industrial design and other variables affecting economic growth, such as infrastructure, innovation ecosystems, and macroeconomic stability. Despite the nonsignificant result, acknowledging the positive direction of the impact shows the potential importance of fostering industrial design practices for enhancing economic growth. In the model with the interaction term, the coefficient of 0.00255 signifies stronger industrial design applications for economic growth in Africa. A higher coefficient implies that when innovation and trade are considered together, the positive influence of industrial design on economic growth in the region is enhanced. In contrast, the model without the interaction term

might show a lower marginal effect for industrial design applications on economic growth. This indicates that in the absence of the interactive effect of innovation and trade, the impact of industrial design alone might be less pronounced. Therefore, the integration of innovation and trade as interactive factors could lead to a greater marginal effect of industrial design applications on economic growth in Africa, emphasizing the interconnected nature of these elements in driving economic development in the long run.

The positive but nonsignificant impact of patent applications on economic growth in Africa suggests a theoretical link between innovation and economic development. The coefficient (0.000239) indicates that for each additional patent application, a small positive effect on economic growth is expected. However, the lack of significance at the 5 percent level implies that other factors might play a more dominant role in driving economic growth. This could be due to various challenges that African countries face, such as limited technology transfer, inadequate infrastructure, or lack of supportive policies. While patents promote innovation, their impact on economic growth might be constrained by broader structural issues. The greater marginal effects of patent applications on economic growth in Africa, as indicated by the coefficients of 0.000239 and 0.0102 from the two economic growth models, suggest that fostering innovation through patents could have a more substantial impact on economic growth. In the model with the interaction term of innovation and trade (0.0102), the coefficient implies that for each additional patent application, there is a larger positive effect on economic growth. This suggests that the synergy between innovation and trade amplifies the benefits of patents. While the coefficient without the interaction term (0.000239) is smaller, it still signifies a positive connection between patents and economic growth in Africa.

The estimated positive and significant impact of trademark applications on economic growth in Africa (coefficient of 0.152) at the 5% significance level indicates that protecting intellectual property through trademarks contributes to fostering economic growth in Africa. Trademarks play a crucial role in enhancing brand recognition, promoting innovation, and attracting investments, which collectively drive economic activities. The estimated positive (0.844) and significant impact of R&D expenditures on economic growth in Africa at the 5 percent level of significance signifies the crucial role of innovation in driving economic prosperity. Research and development investments lead to technological advancements, new product development, and process improvements, enhancing productivity and competitiveness. The significance of this impact shows that fostering a culture of innovation and investing in research and development activities can lead to greater economic growth.

From the results, the estimated positive (0.251) but insignificant impact of exports of goods and services on economic growth in Africa at the 5 percent level of significance suggests that while there is a theoretically expected relationship between exports and economic growth, the statistical analysis did not find strong enough evidence to establish a significant causal link. This could be due to various factors, such as limited export diversification, trade imbalances, or domestic structural constraints. While exports can potentially contribute to economic growth by generating foreign exchange, technology transfer, and market expansion, the lack of significance implies that other factors might influence economic growth more significantly in the selected African countries. The greater marginal effect of exports of goods and services on economic growth in Africa, represented by coefficients of 0.251 and 0.646 from the two economic growth models (with and without the interaction term of innovation and trade, respectively), signifies the importance of considering the interaction between innovation, trade, and economic growth. The presence of the interaction term in the second model demonstrates that when innovation and

trade are combined, the positive impact of exports on economic growth becomes even more pronounced. This suggests that innovation-driven exports can have a stronger influence on economic growth than can exports in isolation. An increase in the coefficient from 0.251 to 0.646 indicates that for each additional unit of exports, the growth impact is magnified by the presence of innovation and trade interactions. Similarly, the study explored the interactive impact of various innovation indicators – resident industrial design applications, resident patent applications, resident trade mark applications, and research and development – in conjunction with imports of goods and services on Africa's long-term economic growth. The findings suggested a positive trend in these interactions, which indicates that a combination of innovative activities and imports can potentially contribute to economic growth. The negative interactive effect of resident trade mark applications on economic growth, albeit not statistically significant, is an intriguing finding that explains the role of innovation in reducing the level of imports.

4.7 Short-run Interactive Effect of Innovation and Trade Participation on Economic Growth in the Selected African Countries

This study also examines the short-term interactive effect of innovation and trade participation on economic growth in the selected African countries using the results of dynamic fixed effects with and without interactive effects, and the results are presented in Table no. 6.

Table no. 6 – Short-run Results of the Interactive Effect of Innovation and Trade Participation on Economic Growth in the Selected African Countries

Variables	Economic Growth Model without Interactive Effects	Economic Growth Model with Interactive Effects
ect	-0.0450***	-0.0484***
	(0.00872)	(0.00975)
D.llngdpp	0.0745*	0.0700*
	(0.0386)	(0.0383)
D.ind	1.10e-05	0.000288
	(1.21e-05)	(0.000219)
D.pat	-3.67e-05	0.00165**
	(3.87e-05)	(0.000682)
D.lntrd	0.00344	-0.0302
	(0.00496)	(0.0836)
D.rad	-0.0215	-0.422
	(0.0511)	(0.727)
D.lnexpt	0.0527***	0.203***
	(0.0121)	(0.0538)
D.lnimpt	-0.0143	-0.158**
	(0.0118)	(0.0648)
D.indvlnexpt		7.21e-05**
		(3.01e-05)
D.patvlnexpt		0.000253***
		(9.31e-05)
D.lntrdvlnexpt		-0.0108
		(0.00698)
D.radvlnexpt		0.190***
		(0.0643)

Variables	Economic Growth Model without Interactive Effects	Economic Growth Model with Interactive Effects
D.indvlnimpt		6.06e-05**
		(2.96e-05)
D.patvlnimpt		-0.000324***
		(9.55e-05)
D.lntrdvlnimpt		0.0121
		(0.00847)
D.radvlnimpt		0.205***
		(0.0696)
Constant	0.172***	0.346
	(0.0589)	(0.249)

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Source: Extracts from STATA 15 Output

From the results in Table no. 6, the low marginal effects of the negative and significant speed of adjustment towards long-run equilibrium in economic growth for Africa, represented by the coefficients of -0.0450 and -0.0484 from the two economic growth models, indicate the sensitivity of the system to deviations from equilibrium, especially in the presence of the interactive term of innovation and trade. These negative coefficients signify that any deviation from the long-run equilibrium is corrected at a slow pace in the economies studied. The presence of the interactive term of innovation and trade seems to reinforce this adjustment process, suggesting that the incorporation of innovation and trade factors enhances the speed of convergence to equilibrium. This could reflect economies' resilience and ability to self-correct imbalances over time.

The estimated positive and significant impact of lagged economic growth on the current level of economic growth in Africa, as observed in the short run at the 10 percent level of significance, suggests the presence of a persistent growth pattern. This phenomenon could be attributed to the cumulative effects of past economic activities, indicating that higher economic growth in the past contributes to higher current economic growth. This positive relationship signifies the presence of economic momentum or path dependence, where past economic conditions continue to shape and influence the current trajectory. The positive and significant impact of patent applications on economic growth in Africa, observed in the short run at the 5 percent level of significance, suggests that innovative activities that lead to patent applications can play a role in driving economic development. Patents are often indicators of new technologies, processes, or products that can enhance productivity and competitiveness in the economy. This result aligns with the idea that patents provide incentives for firms and individuals to invest in R&D, leading to technological advancements and knowledge spillovers that contribute to economic growth.

The study also revealed a positive and significant impact of exports of goods and services on economic growth in Africa, which was observed in the short-run at the 1 percent level of significance. Exports can serve as catalysts for economic growth by introducing domestic products to global markets, thereby increasing demand and generating revenue. Export-oriented industries often spur technological innovation and productivity enhancements to remain competitive in the international market. The greater marginal effects of exports of goods and services on economic growth in Africa, as indicated by the short-run coefficients of 0.0527 and 0.203 from the two economic growth models (with and without the interaction term of

innovation and trade, respectively), signify the significance of trade activities in driving immediate economic expansion. In the model without the interaction term, the coefficient of 0.0527 suggests that for every unit increase in exports of goods and services, short-term economic growth increases by 0.0527 units. This finding implies that boosting export activities can have a positive and direct impact on short-term economic growth, underscoring the importance of trade diversification and market access. When considering the model with the interaction term, a higher coefficient of 0.203 suggests a stronger influence of exports on economic growth. This indicates that the presence of innovation and trade interaction amplifies the positive impact of exports on short-term economic growth, emphasizing the role of technological advancements and trade synergies in accelerating economic expansion.

The estimated negative and significant impact of imports of goods and services (0.158) on economic growth in Africa in the short run at the 5 percent level of significance shows the potential challenges posed by high import dependency. This outcome might be attributed to the fact that excessive reliance on imports can lead to trade deficits, currency depreciation, and reduced domestic production.

The significant positive interactive effect (7.21e-05) of residential industrial design applications and exports of goods and services on economic growth in Africa in the short run at the 5 percent level of significance indicates the potential synergy between innovation in design and international trade. The estimated coefficient of 7.21e-05 implies that a unit increase in residential industrial design applications, in conjunction with exports of goods and services, leads to a corresponding increase in economic growth of 7.21e-05 units. This outcome suggests that economies with higher resident industrial design applications might experience enhanced trade competitiveness, possibly due to innovative and uniquely designed products that capture global market demand. The interactive effect highlights the importance of combining innovative design efforts with effective export strategies to promote economic growth. The significant positive interactive effect (0.000253) of resident patent applications and exports of goods and services on economic growth in Africa in the short run at the 1 percent level of significance suggests a synergistic relationship between innovative patent activity and international trade. This finding implies that countries actively engaging in patent applications and simultaneously focusing on exporting their goods and services may experience greater economic growth. The interactive effect explains the importance of protecting intellectual property rights and fostering a conducive environment for innovation while also emphasizing the role of international trade in translating innovation into economic gains.

The results further reveal the significant positive interactive effect (0.19) of R&D and exports of goods and services on economic growth in Africa in the short run at the 1 percent level of significance. This highlights the crucial role of innovation-driven exports in fostering economic growth. This finding shows the importance of investing in research and development to enhance a country's competitiveness in the global market. When research and development efforts result in innovative products or services that are successfully exported, they contribute to economic growth through increased market share, job creation, and technological advancement. This symbiotic relationship can drive long-term economic development and help African countries diversify their economies and reduce their dependency on traditional sectors. Thus, to capitalize on this positive linkage, strategies that encourage patenting activities, strengthen intellectual property rights enforcement, and facilitate trade opportunities need to be developed.

The significant positive interactive effect (6.06e-05) of industrial design applications and imports of goods and services on economic growth in Africa in the short run at the 1 percent level of significance indicates the potential for design-led imports to contribute to immediate economic expansion. The estimated coefficient of 6.06e-05 implies that a unit increase in industrial design applications, combined with imports of goods and services, leads to an increase in economic growth of 6.06e-05 units. This finding explains the importance of incorporating innovative design elements into imported products, which can enhance their appeal, quality, and competitiveness in the local market. The significant negative interactive effect (-0.000324) of patent applications and imports of goods and services on economic growth in Africa in the short run at the 1 percent level of significance suggests that an increased emphasis on patenting activities in conjunction with imports may not necessarily lead to immediate economic benefits. This could be attributed to factors such as limited technology absorption capacity or potential negative effects of excessive patenting on competition and innovation.

The study also shows a significant positive interactive effect (0.205) of R&D and imports of goods and services on economic growth in Africa in the short run at the 1% level of significance, which implies that combining R&D efforts with imports can have a synergistic effect on short-term economic growth. This finding explains the importance of fostering an environment that promotes innovation through research and development activities and facilitates the efficient utilization of imported goods and services. This suggests that importing complementary inputs or advanced technologies can enhance the impact of domestic research and development efforts, leading to accelerated economic growth in the short term. The positive and significant impact of the constant term (0.172) on economic growth in Africa in the short run at the 1 percent level of significance signifies the baseline level of growth that is not accounted for by the explanatory variables in the model.

5. CONCLUSION

The study also highlights industrial design, patents, trademarks, research and development, exports, and balanced trade policies as contributors to long-term economic growth in Africa. The study further concludes that the interactive effects of innovation and trade participation, particularly in amplifying the impact of industrial design and patents on economic growth, offer valuable insights for policymakers and stakeholders seeking to leverage both aspects of development. Based on the insightful findings of the study, several practical policy recommendations can be proposed to enhance innovation, trade participation, and economic growth in selected African countries:

The governments of African countries should focus on fostering innovation ecosystems that support research and development activities. This can be achieved through the establishment of research institutes, innovation hubs, and collaboration between universities, research centers, and industries. These initiatives would facilitate knowledge exchange, technological advancements, and the creation of high-value products.

By recognizing the positive yet potentially impactful role of industrial design applications in the region, policymakers should encourage investments in design capabilities. Initiatives such as design education, workshops, and design competitions can help industries create innovative and appealing products that stand out in global markets.

The governments of African countries should strengthen intellectual property protection mechanisms, including those for patents and trademarks. Robust protection incentivizes

innovation and ensures that businesses can reap the benefits of their creativity, fostering an environment conducive to both domestic and international trade.

Given that efficient logistics systems are essential for facilitating trade, policymakers should prioritize infrastructure development, including transportation, communication, and trade routes, to reduce trade barriers, lower transaction costs, and ensure timely delivery of goods. This would enhance efficient logistic systems that could enhance trade participation and economic growth.

The governments of African countries should develop balanced trade policies that promote both export growth and import sustainability. This involves nurturing domestic industries while fostering trade relationships, ensuring that excessive import reliance does not undermine local production capabilities. SMEs often drive innovation and contribute significantly to trade. Policymakers should implement initiatives that provide SMEs with access to financing, training, and technology transfer to enable them to participate more actively in trade activities.

The governments of African countries should offer incentives for R&D activities, such as tax breaks, grants, and subsidies. This would encourage businesses to invest in innovative solutions, leading to the creation of higher-value products and enhancing trade competitiveness. Moreover, establishing or strengthening trade promotion agencies can help businesses navigate international markets, identify trade opportunities, and overcome export and import challenges. These agencies can provide market research, networking, and export-import assistance.

Incorporating these recommendations into policy frameworks can contribute to fostering a conducive environment for innovation, trade participation, and sustained economic growth in selected African countries. By aligning policies with the intricate relationships highlighted by the study's findings, governments can work towards creating resilient and prosperous economies that thrive in the global marketplace.

References

Acheampong, A. O., Dzator, J., Dzator, M., & Salim, R. (2022). Unveiling the effect of transport infrastructure and technological innovation on economic growth, energy consumption and CO2 emissions. *Technological Forecasting and Social Change, 182*, 121843. http://dx.doi.org/10.1016/j.techfore.2022.121843

Agénor, P.-R., & Neanidis, K. C. (2015). Innovation, public capital, and growth. *Journal of Macroeconomics, 44*, 252-275. http://dx.doi.org/10.1016/j.jmacro.2015.03.003

Agudze, K. M., & Olarewaju, F. (2021). The growth impact of trade openness: A comparative analysis of the USA and China. *The Journal of International Trade & Economic Development, 31*(1), 23-45. http://dx.doi.org/10.1080/09638199.2021.1965646

Ali, M., Kirikkaleli, D., Sharma, R., & Altuntaş, M. (2022). The nexus between remittances, natural resources, technological innovation, economic growth, and environmental sustainability in Pakistan. *Environmental Science and Pollution Research, 29*, 75822-75840. http://dx.doi.org/10.1007/s11356-022-21228-4

Amna Intisar, R., Yaseen, M. R., Kousar, R., Usman, M., & Makhdum, M. S. A. (2020). Impact of trade openness and human capital on economic growth: A comparative investigation of Asian countries. *Sustainability (Basel), 12*(7), 1-19. http://dx.doi.org/10.3390/su12072930

Boehm, J., Dhingra, S., & Morrow, J. (2022). The comparative advantage of firms. *Journal of Political Economy, 130*(12), 3025-3100. http://dx.doi.org/10.1086/720630

Broughel, J., & Thierer, A. (2019). *Technological innovation and economic growth: A brief report on the evidence*: Mercatus Research, Mercatus Center at George Mason University.

Bujari, A., & Mart'ınez, F. V. (2016). Technological innovation and economic growth in Latin America. *Revista Mexicana de Economía y Finanzas, 11*(2), 77-89.

Bunje, M. Y., Abendin, S., & Wang, Y. (2022). The effects of trade openness on economic growth in Africa. *Open Journal of Business and Management, 10*(2), 614-642. http://dx.doi.org/10.4236/ojbm.2022.102035

Burkett, P., & Hart-Landsberg, M. (2003). A critique of "catch-up" theories of development. *Journal of Contemporary Asia, 33*(2), 147-171. http://dx.doi.org/10.1080/00472330380000101

Chang, R., Kaltani, L., & Loayza, N. V. (2009). Openness can be good for growth: The role of policy complementarities. *Journal of Development Economics, 90*(1), 33-49. http://dx.doi.org/10.1016/j.jdeveco.2008.06.011

Chien, Y. (2015). What Drives Long-Run Economic Growth? Retrieved from https://www.stlouisfed.org/on-the-economy/2015/june/what-drives-long-run-economic-growth

Cohen, M. (2020). Does the COVID-19 outbreak mark the onset of a sustainable consumption transition? *Sustainability: Science, Practice and Policy, 16*, 1-3. http://dx.doi.org/10.1080/15487733.2020.1740472

Economic Commission for Africa. (2016). *Innovation, competitiveness and regional integration. Assessing regional Integration in Africa VII*. Retrieved from https://kmss.uneca.org/sites/default/files/Lib_resources_digest_attachment/b11560812.pdf

Eicher, T. (1999). Trade, development and converging growth rates: Dynamic gains from trade reconsidered. *Journal of International Economics, 48*(1), 179-198. http://dx.doi.org/10.1016/S0022-1996(98)00028-2

Elijah, S., & Musa, A. B. (2019). Dynamic impact of trade openness on the economic growth in Nigeria. *International Journal of Engineering and Advanced Technology, 8*(5C), 609-616. http://dx.doi.org/10.35940/ijeat.E1087.0585C19

Espeche, J. F. T., Sacristán-Navarro, M., Zúñiga-Vicente, J. Á., & Crespo, N. F. (2023). Innovation and internationalization during times of economic growth, crisis, and recovery prior to Covid-19: A configurational approach comparing Spanish manufacturing family and non-family firms. *Journal of Family Business Strategy, 14*(1), 100513. http://dx.doi.org/10.1016/j.jfbs.2022.100513

European Central Bank. (2017). How does innovation lead to growth? . Retrieved from https://www.ecb.europa.eu/ecb-and-you/explainers/tell-me-more/html/growth.en.html#:~:text=One%20of%20the%20major%20benefits,other%20words%2C%20the%20economy%20grows

Gerschenkron, A. (1962). *Economic Backwardness in Historical Perspective*: Harvard.

Gnoleba, Z. (2023). Cross-border trade and economic growth: An application to Côte d'Ivoire, Ghana, Morocco, and Nigeria. *Journal of Economics and International Finance, 15*(1), 1-11. http://dx.doi.org/10.5897/JEIF2022.1166

Grossman, G. M., & Helpman, E. (1991a). *Innovation and Growth in the Global Economy*: The MIT Press.

Grossman, G. M., & Helpman, E. (1991b). Trade, knowledge spillovers, and growth. *European Economic Review, 35*(2-3), 517-526. http://dx.doi.org/10.1016/0014-2921(91)90153-A

Gurbiel, R. (2003). *Impact of innovation and technology transfer on economic growth: The Central and Eastern Europe Experience*: Warsaw School of Economics.

Gurría, A. (2008). [Globalisation and Innovation: Responding to a Changing Global Economy].

Haldar, A., Sucharita, S., Dash, D. P., Sethi, N., & Chandra Padhan, P. C. (2023). The effects of ICT, electricity consumption, innovation and renewable power generation on economic growth: An income level analysis for the emerging economies. *Journal of Cleaner Production, 384*, 135607. http://dx.doi.org/10.1016/j.jclepro.2022.135607

Hine, R. C., Li, X., & Greenaway, D. (2005). Service imports and economic growth. A dynamic panel analysis. *ICE, Revista De Economía, 1*(824), 7-24.

Igudia, P. (2004). *Globalization and economic development: Nigeria's experience and prospects. Globalization and Africa's economic development*: Nigerian Economic Society.

Ijirshar, V. U. (2019). Impact of trade openness on economic growth among ECOWAS countries: 1975-2017. *CBN Journal of Applied Statistics (JAS), 10*(1), 75-96.

Iyoha, M., & Okim, A. (2017). The impact of trade on economic growth in ECOWAS member countries: Evidence from panel data. *CBN Journal of Applied Statistics (JAS), 8*(1), 23-49.

Kao, C., Chiang, M. H., & Chen, B. (1999). International R&D spillovers: An application of estimation and inference in panel cointegration. *Oxford Bulletin of Economics and Statistics, 61*(S1), 691-709. http://dx.doi.org/10.1111/1468-0084.0610s1691

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. London: Palgrave Macmillan.

Khadka, R. B. (2019). Impact of trade liberalization on economic growth of Nepal. *Janapriya Journal of Interdisciplinary Studies, 8*, 136-148. http://dx.doi.org/10.3126/jjis.v8i0.27306

Kusumawardhana, D. (2020). The effect of innovation and technology towards economic growth in Asia. *Jurnal Ilmu Ekonomi Terapan, 5*(1), 53-63. http://dx.doi.org/10.20473/jiet.v5i1.19633

Law, S. H., Sarmidi, T., & Goh, L. T. (2020). Impact of innovation on economic growth: Evidence from Malaysia. *Malaysian Journal of Economic Studies, 57*(1), 113-132. http://dx.doi.org/10.22452/MJES.vol57no1.6

Le, H. T., & Homel, R. (2015). The impact of child labor on children's educational performance: Evidence from rural Vietnam. *Journal of Asian Economics, 36*, 1-13. http://dx.doi.org/10.1016/j.asieco.2014.11.001

LeBel, P. (2008). The role of creative innovation in economic growth: Some international comparisons. *Journal of Asian Economics, 19*, 334-347. http://dx.doi.org/10.1016/j.asieco.2008.04.005

Lee, J. (1993). International trade, distortions, and long-run economic growth. *Staff Papers (International Monetary Fund), 40*(2), 299-328. http://dx.doi.org/10.2307/3867316

Lee, K., Kang, R., & Park, D. (2022). How industrial design matters for firm growth at different stages of development: Evidence from Korea, 1970s to 2010s. *Asian Economic Journal, 36*(2), 101-126. http://dx.doi.org/10.1111/asej.12264

Lin, G., Jiang, D., Fu, J., & Zhao, Y. (2022). A review on the overall optimization of production–living–ecological space: Theoretical basis and conceptual framework. *Land, 11*(3), 1-15. http://dx.doi.org/10.3390/land11030345

Luo, H., & Qu, X. (2023). Export Trade, Absorptive Capacity, and High-Quality Economic Development in China. *Systems, 11*(2), 54.

Mankiw, N., Romer, D., & Weil, D. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics, 107*(2), 407-437. http://dx.doi.org/10.2307/2118477

Maradana, R. P., Pradhan, R. P., Dash, S., Gaurav, K., Jayakumar, M., & Chatterjee, D. (2017). Does innovation promote economic growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship, 6*(1), 1-23. http://dx.doi.org/10.1186/s13731-016-0061-9

Mariati, W., Yuesti, A., & Tahu, G. P. (2022). Economic growth based on the Keynes theory. *International Journal of Sustainability, Education, and Global Creative Economic, 5*(2), 61-72.

Matsuyama, K. (1992). Agricultural productivity, comparative advantages, and economic growth. *Journal of Economic Theory, 58*(2), 317-334. http://dx.doi.org/10.1016/0022-0531(92)90057-O

Michaelides, P. G., & Papadakis, T. E. (2023). John Maynard Keynes (1883–1946). In P. Macmillan (Ed.), *History of Economic Ideas: From Adam Smith to Paul Krugman* (pp. 55-65). Cham: Springer International Publishing. http://dx.doi.org/10.1007/978-3-031-19697-3_5

Mohsen, A. S., & Chua, S. Y. (2020). Trade liberalization and economic growth in China. *Asian Journal of Economics and Business, 1*(2), 169-184.

Ngila, F. (2022). Which African countries were most innovative in 2022? *Quartz*.

Nguyen, H. C. (2020). The Impact of Foreign Direct Investment, Aid and Exports on Economic Growth in Vietnam. *Journal of Asian Finance Economics and Business, 7*, 581-589. http://dx.doi.org/10.13106/jafeb.2020.vol7.no10.581

Oluwole, V. (2022). These are the most innovative African countries in 2022. *Business Insider Africa*.

Pece, A. M., Simona, O. E. O., & Salisteanu, F. (2015). Innovation and economic growth: An empirical analysis for CEE countries. *Procedia Economics and Finance, 26*, 461-467. http://dx.doi.org/10.1016/S2212-5671(15)00874-6

Pham, M. H. (2023). Does public investment stimulate economic growth in Vietnam? An ARDL approach to test Keynes's theories. *Journal of Eastern European and Central Asian Research, 10*(2), 301-310. http://dx.doi.org/10.15549/jeecar.v10i2.1155

Phung, T. D., Van, V. T. T., Thuong, T. T. H., & Ha, N. T. T. (2019). Innovation and economic growth: The contribution of institutional quality and foreign direct investment. *Asian Economic and Financial Review, 9*(11), 1266-1278. http://dx.doi.org/10.18488/journal.aefr.2019.911.1266.1278

Ramzan, M., Sheng, B., Shahbaz, M., Song, J., & Jiao, Z. (2019). Impact of trade openness on GDP growth: Does TFP matter? *The Journal of International Trade & Economic Development, 28*(8), 960-995 http://dx.doi.org/10.1080/09638199.2019.1616805

Razzaq, A., Fatima, T., & Murshed, M. (2023). Asymmetric effects of tourism development and green innovation on economic growth and carbon emissions in Top 10 GDP Countries. *Journal of Environmental Planning and Management, 66*(3), 471-500. http://dx.doi.org/10.1080/09640568.2021.1990029

Ricardo, D. (1817). On the Principles of Political Economy and Taxation. In P. Sraffa (Ed.), *The Works and Correspondence of David Ricardo* (Vol. 1). Cambridge: Cambridge University Press.

Robinson, J. (1979). *Aspects of Development and Underdevelopment*: Cambridge University Press.

Rosenberg, N. (2005). *Innovation and economic growth*: Stanford University.

Seo, S. N. (2023). Robert Solow's modern economic growth. In P. Macmillan (Ed.), *The Economics of Optimal Growth Pathways: Evaluating the Health of the Planet's Natural and Ecological Resources* (pp. 191-208). Cham: Springer International Publishing. http://dx.doi.org/10.1007/978-3-031-20754-9_9

Smith, A. (1776). *Enquiry into the Nature and Causes of the Wealth of Nations*: Penguin.

Snieska, V., & Valodkiene, G. (2015). Impact of innovations upon economic growth during recession. *Technological and Economic Development of Economy, 21*(4), 626-642. http://dx.doi.org/10.3846/20294913.2015.1055615

Taghavi, M., Goudarzi, M., Masoudi, E., & Gashti, H. P. (2012). Study on the impact of export and import on economic growth in Iran. *Journal of Basic and Applied Scientific Research, 2*(12), 12787-12794.

Verico, K., & Pangestu, M. E. (2020). The economic impact of globalisation in Indonesia. *ERIA Discussion Paper Series, 338*, 1-32. Retrieved from https://www.eria.org/uploads/media/discussion-papers/The-Economic-Impact-of-Globalisation-in-Indonesia.pdf

Wen, Y., Song, P., Gao, C., & Yang, D. (2023). Economic openness, innovation and economic growth: Nonlinear relationships based on policy support. *Heliyon, 9*(1-11), e12825. http://dx.doi.org/10.1016/j.heliyon.2023.e12825

Westerlund, J. (2005). New simple tests for panel cointegration. *Econometric Reviews, 24*(3), 297-316. http://dx.doi.org/10.1080/07474930500243019

WIPO. (2023). Top Exporters and Importers. from World Integrated Trade Solution

Yazgan, Ş., & Yalçinkaya, Ö. (2018). The effects of research and development (R&D) investments on sustainable economic growth: Evidence from OECD countries (1996-2015). *Review of Economic Perspectives, 18*(1), 3-23. http://dx.doi.org/10.1515/revecp-2018-0001

Young, A. (1991). Learning by doing and the dynamic effects of international trade. *The Quarterly Journal of Economics, 106*(2), 369-405. http://dx.doi.org/10.2307/2937942

Zahonogo, P. (2017). Trade and economic growth in developing countries: Evidence from sub-Saharan Africa. *Journal of African Trade, 3*(1-2), 41-56. http://dx.doi.org/10.1016/j.joat.2017.02.001

Zapata, A. N., Arrazola, M., & de Hevia, J. (2023). Technological intensity in manufacturing trade between ASEAN and the EU: Challenges and opportunities. *Asia Europe Journal, 21*, 23–42. http://dx.doi.org/10.1007/s10308-023-00661-1

ANNEX 1

Short-run Results on the Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

Variables	Algeria	Angola	Botswana	Burkina Faso	Cabo Verde	Congo DR	Egypt	Ethiopia	Gambia
ect	0.125	-0.0419	-0.473***	0.0394	-0.292***	-0.0676	-0.476***	0.0761	-0.0642
	(0.0852)	(0.0535)	(0.1110)	(0.0361)	(0.0847)	(0.0440)	(0.1230)	(0.0647)	(0.0659)
D.llngdpp	0.220*	0.298**	-0.259**	-0.197	-0.0315	0.530***	-0.103	0.212	0.27
	(0.1330)	(0.1420)	(0.1300)	(0.1880)	(0.1460)	(0.1360)	(0.1800)	(0.2560)	(0.1710)
D.ind	-1.1E-05	-6008	0.0112***	3.73E-05	0.00523*	-10205	2.55E-05	0.000306	0
	(0.0000)	0.0000	(0.0030)	(0.0001)	(0.0029)	0.0000	(0.0000)	(0.0003)	(0.0008)
D.pat	0.000522**	-0.00019	0.0162***	-7.6E-05	-0.0428	-0.00025	-0.00013	-0.00303	73762
	(0.0002)	(0.0004)	(0.0038)	(0.0002)	(0.0791)	(0.0017)	(0.0001)	(0.0025)	0.0000
D.lntrd	-0.034	0.226**	0.196***	-0.0477	0.138	-0.0104	-0.0369	-0.028	-0.0148
	(0.0236)	(0.1050)	(0.0642)	(0.0361)	(0.1660)	(0.0295)	(0.0536)	(0.0300)	(0.0125)
D.rad	-0.0449	3387000	-0.383	0.201*	0	-0.0982	-0.205	-0.335	-0.703
	(0.0827)	0.0000	(0.3770)	(0.1080)	0.0000	(0.3160)	(0.1860)	(0.4110)	(0.4650)
D.lnexpt	0.0754***	0.108***	0.0185	-0.0174	0.127**	0.107**	0.0985*	-0.132	-0.0401
	(0.0227)	(0.0345)	(0.0743)	(0.0377)	(0.0554)	(0.0430)	(0.0578)	(0.2240)	(0.0459)
D.lnimpt	0.119**	-0.0108	0.0812	0.118**	0.0167	-0.0710**	0.0187	0.234	0.0192
	(0.0479)	(0.0359)	(0.0633)	(0.0475)	(0.0722)	(0.0313)	(0.0811)	(0.1470)	(0.0569)
Constant	0.0762	20,454***	0.167	0.0943*	0.161*	258.2***	-0.364**	0.247	-24587
	(0.0561)	(0.0557)	(0.1550)	(0.0529)	(0.0890)	(0.1130)	(0.1830)	(0.1820)	0.0000
Observations	625	625	625	625	625	625	625	625	625

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Extracts from STATA 15 Output

ANNEX 2

Short-run Results on the Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

Variables	Ghana	Kenya	Madagascar	Mauritius	Morocco	Mozambique	Namibia	Nigeria	Rwanda
ect	-0.342***	-0.0246	0.00808	-0.0457**	-0.257***	-0.301***	-0.248***	-0.0818*	-0.0116
	(0.1220)	(0.0342)	(0.0715)	(0.0194)	(0.0555)	(0.0584)	(0.0808)	(0.0439)	(0.0764)
D.llngdpp	0.479***	0.466**	-0.289	-0.277***	-0.373***	-0.127	0.129	0.234	-0.159
	(0.1450)	(0.1850)	(0.2080)	(0.0991)	(0.0955)	(0.1510)	(0.1710)	(0.1790)	(0.1820)
D.ind	3.22E-05	-0.00025	0.000143	0.000953**	2.84e-05***	-0.00021	-0.00062	-1.4E-05	-0.0104
	(0.0001)	(0.0002)	(0.0001)	(0.0005)	(0.0000)	(0.0004)	(0.0005)	(0.0000)	(0.0064)
D.pat	-0.00767	-0.00022	0.00169	-0.00243	-0.000395***	-0.00077	0.00103	0.000151	0.00567*
	(0.0162)	(0.0002)	(0.0019)	(0.0024)	(0.0001)	(0.0008)	(0.0013)	(0.0002)	(0.0032)
D.lntrd	0.0973	-0.0152	-0.0308	0.0747	0.00333	-0.0364	0.00103	0.0637	0.00332
	(0.0667)	(0.0918)	(0.0748)	(0.0520)	(0.0466)	(0.0254)	(0.0090)	(0.0775)	(0.0139)
D.rad	0.0499	0.183*	0.0452	0.281**	-0.0812	-0.11	1.426**	-0.242	3086000
	(0.2990)	(0.0982)	(0.2420)	(0.1330)	(0.0548)	(0.1010)	(0.5660)	(2.2280)	0.0000
D.lnexpt	-0.0434	0.00935	0.134	0.380***	0.204**	0.111**	0.106*	8.25E-05	-0.0313
	(0.0891)	(0.0949)	(0.0834)	(0.1000)	(0.0827)	(0.0479)	(0.0625)	(0.0187)	(0.0424)
D.lnimpt	0.0322	0.0406	-0.0353	-0.145*	-0.101	-0.0258	0.00989	0.0261	0.0223
	(0.0536)	(0.0689)	(0.1030)	(0.0830)	(0.0715)	(0.0269)	(0.0504)	(0.0199)	(0.0682)
Constant	-0.316**	-0.01	0.0228	0.0735***	-0.200*	-0.553***	0.0296	-0.117	-456.1***
	(0.1550)	(0.0484)	(0.0989)	(0.0194)	(0.1150)	(0.1640)	(0.0769)	(0.0769)	(0.0854)
Observations	625	625	625	625	625	625	625	625	625

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Extracts from STATA 15 Output

ANNEX 3

Short-run Results on the Impact of Innovation and Trade Participation on Economic Growth in Selected African Countries

Variables	Tome and Principe	South Africa	Sudan	Tanzania	Tunisia	Uganda	Zambia
ect	0.0716	-0.103**	-0.0277*	0.113	-0.336**	0.250**	0.003
	(0.0498)	(0.0512)	(0.0156)	(0.117)	(0.147)	(0.123)	(0.0313)
D.llngdpp	-0.0332	-0.314	-0.00489	-0.458**	-0.0657	-0.282	0.185*
	(0.097)	(0.216)	(0.152)	(0.2230)	(0.154)	(0.2190)	(0.108)
D.ind	20317	1.53E-05	6.44E-05	0.00519	0.000265*	0.000164	4.14E-05
	0.0000	(0.0000)	(0.0001)	(0.0098)	(0.0002)	(0.0002)	(0.0002)
D.pat	5,100***	6.24E-06	2.92E-05	-0.0686*	-1.2E-05	0.000392	0.00190***
	(0.0890)	(0.0000)	(0.0001)	(0.0381)	(0.0002)	(0.0015)	(0.0005)
D.lntrd	0.0165***	-0.0901	0.0345	0.00546	-9.711	0.140*	-0.0248
	(0.0059)	(0.0567)	(0.0212)	(0.0109)	(7.3430)	(0.0846)	(0.0163)
D.rad	1366000	0.290*	-0.463	0.870***	0.057	0.329**	0.362**
	0.0000	(0.166)	(0.44)	(0.313)	(0.128)	(0.162)	(0.143)
D.lnexpt	5.34	0.0707	0.0499	0.043	0.22	-0.0485	0.0234
	(4.501)	(0.0902)	(0.0354)	(0.0803)	(0.158)	(0.0541)	(0.0257)
D.lnimpt	-3.441	0.0422	-0.0519	0.0844	-0.14	0.241***	0.0819**
	(3.052)	(0.0816)	(0.0321)	(0.0536)	(0.152)	(0.0925)	(0.0371)
Constant	-4983	-0.0688	-0.00176	0.213	-0.332	0.348**	0.018
	0.0000	(0.0653)	(0.0139)	(0.172)	(0.232)	(0.16)	(0.032)
Observations	625	625	625	625	625	625	625

Scientific Annals of Economics and Business
71 (4), 2024, 547-582
DOI: 10.47743/saeb-2024-0026

Analysis of Public Debt in the Context of Crises Generated by Socio-Economic Events. Case Study: European Union Countries

Alin Vasile Străchinaru*

Abstract: In the current geopolitical configuration, generated by socio-economic and political-military events, with an impact on economic development, the public debt dynamics take on new dimensions. Public debt, as an indispensable concept for improving development strategies in an economic and geopolitical context, is influenced by the macroeconomic indicators' variation, but also by the internal and external factors' impact, which generate instability in a dynamic of unpredictable phenomena. Therefore, the study indicates proposals, based on multivariate regression, to capture the most sensitive variations of macroeconomic indicators on sustainable development at the European Union countries level. Moreover, the current European level configuration requires a detailed capture of the connection between public debt and economic growth, by using a VAR model (public debt, a concept that takes on new values in the current context, and economic growth, as the central pillar of sustainable development, analyzed from the perspective of the studied indicators fluctuation). Finally, I analyzed the public debt dynamics for the next period (2000 – 2022) to create a realistic picture, using the ARMA model. The results confirm the direct impact of each event on economic growth and development, and the limitation and elimination of negative effects vary depending on how it is managed and prevented. Also, the link between the economic growth and public debt is confirmed and, at the same time, it constitutes a benchmark that captures the importance of the decisions of the responsible factors regarding the financial-monetary instruments implemented or what is requested to be adopted. In other words, forecasting the public debt dynamics gives a certain stability, but also a strategic vision, offering viable solutions to support sustainable development efforts at European states level.

Keywords: autoregressive integrated moving average (ARMA); autoregressive model (VAR); macroeconomic indicators; public debt; regression.

JEL classification: C33, E44, E60.

* Alexandru Ioan Cuza University of Iasi, Romania; e-mail: *alinstrachinaru@yahoo.com*.

Article history: Received 12 April 2024 | Accepted 10 July 2024 | Published online 18 December 2024

To cite this article: Străchinaru, A. V. (2024). Analysis of Public Debt in the Context of Crises Generated by Socio-Economic Events. Case Study: European Union Countries. *Scientific Annals of Economics and Business*, 71(4), 547-582. https://doi.org/10.47743/saeb-2024-0026.

1. INTRODUCTION

Approaching the public debt concept, at the European Union countries level, requires a thorough and rational analysis of both factors and phenomena. They are characterized by a high degree of unpredictability, further amplifying the effect on the economy. In this sense, a special emphasis is placed both on forecasting future fluctuations of macroeconomic indicators, and on the objective assessment of public policies that need to be adopted. The last decades have highlighted, as research in the field also supports, the numerous syncopes that must be accepted, prevented and, not least, managed with even greater responsibility, on the part of the decision-makers. In this sense, it can be stated that a concept, like that of public debt, is not fully defined only by a more theoretical analysis. But, as can be seen from everyday activity, it takes various forms of manifestation. These are influenced by the nature of the phenomena, which create insecurity, a certain instability at the community level, generating periods of crisis. Therefore, the analysis captures the impact of public debt on the entire economic circuit, in a dynamic context, even of overlapping crises. This is evidenced by the impact of fiscal measures, monetary policies and implemented strategies, by the perception of investors and last but not least by the response of the working population.

Another element that is becoming more and more current is represented by the investments depreciation, which in the current geopolitical context, takes on two forms of manifestation. Thus, it is considered, on the one hand, the orientation of financial resources towards those strategic sectors, also analyzed from the perspective of government securities, with attractive interest rates in the medium and long term, and on the other hand, the realization of a significant profit, in the long term short. This last detail is due to the uncertainty of the business environment, which in turn comes with high and assumed risks. The implementation of successful strategies depends very much on the analysis, down to the smallest detail, of the events and especially of the impact they have. Examples, in the sense of the mentioned, are represented by the financial crisis with its lack of liquidity, by the COVID 19 pandemic, by socio-economic expenses, and last but not least by the armed conflict in Eastern Europe, with its uncertain outcome. In other words, the influence of the mentioned events gives rise to concern through the way of manifestation and perception regarding the durability and uncertainty installed. At the same time, it must be remembered that the economies of the less developed countries feel and cope with the new challenges more and more difficult, which involve assumed costs, far above the forecasted ones. A temporary solution was to resort to loans, but as is well known, in the long term, these also create other costs, which further forces the economy to respond promptly and well-argued. In other words, the macroeconomic indicators reflect, at a given moment, the state of health of the economy.

In other words, the promotion of a healthy, even linear economic growth is the central pillar on which the continuation of reforms, the stability of jobs and the population's income depends, as well as the provision of solid investments in realistic infrastructure projects, based on studies, with a visible impact on economic development. Their management is influenced by the evolution of the capital market at the European and even global level. Therefore, in order to optimally manage resources, a self-assessment of one's own economic and investment potential is required, also reflected in the degree of affordability of the economy. In another way, through the allocated funds, within the implemented programs, the aim is to increase productivity and increase the degree of trust. Last but not least, I want

to put into practice those viable strategies, capable of preventing the occurrence of similar phenomena, with a harmful impact on economic development.

Regarding the public debt, as database and dynamics, it is worth remembering that in the last two decades, Spain (a member country of the European Union since 1986), was among the few countries that managed to significantly reduce it. Concretely, in the mid-2000s he managed to reduce the public debt from approx. 65% of G.D.P. (1996) at approx. 35% of G.D.P. (2007).

The public debt data base, at the European Union countries level, is captured in Figure no. 1.

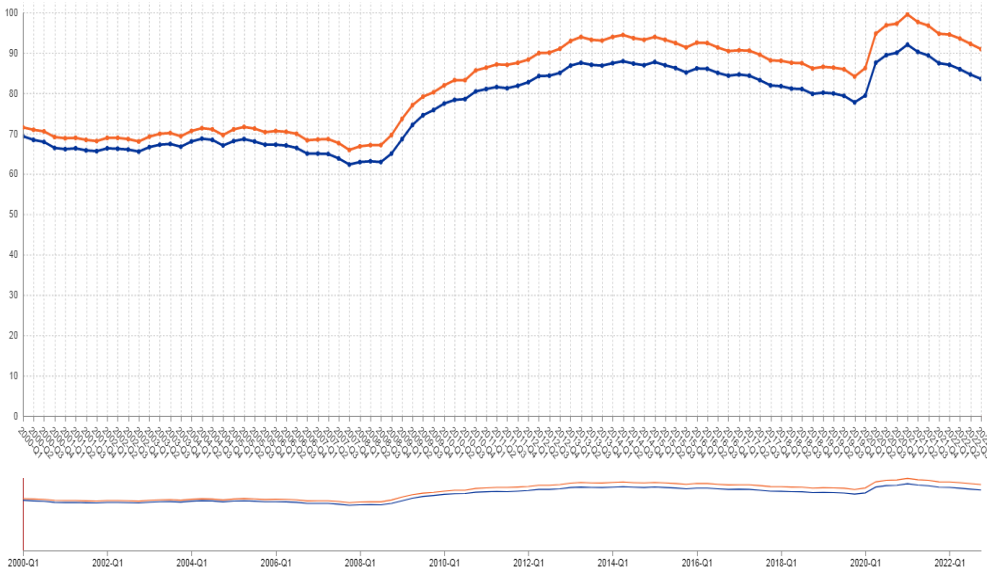


Figure no. 1 – Public debt at the European Union level (2000-2022)
Source: European Union, respectively Euro area

According to them (Eurostat) the public debt at the European Union level reflects an average threshold of approx. 83% of G.D.P. Greece remains the most indebted country in Europe with a percentage of approx. 172.6%, followed by Italy (141.7%), and at the opposite pole is Estonia with approx. 18.5%, followed by Bulgaria (22.6%) and Luxembourg (24.7%). These data confirm the existence of a variation, not necessarily linear (regardless of the period and the phenomena that have characterized the last decades) and in this sense, an analysis of the evolution of the debt is all the more necessary as it can provide clear information, realistic solutions regarding the impact policies, strategies adopted at the level of the analyzed countries.

2. LITERATURE REVIEW

Considering the events dynamics, the strategies implementation, with a pronounced impact on economic growth, has aroused real interest at the European and global level, taking into account the size and complexity of the phenomena, from the last decades, with their

influence on economic development. Moreover, scientists analyze the problem of public debt not necessarily from the point of view of the threshold mentioned in the Maastricht Treaty, but more recently they try to find answers regarding those optimal thresholds and whether they exist in terms of the percentage of G.D.P. intended for investment, research, development, innovation, etc. In the end, there should be a direct relationship between the human factor and the financial one, fully connected to the realities of the time, able to bring added value, in the current context, ground by various turmoil, fueled by less justified decisions. The studies in the field are vast, and they present different syntheses and interpretations depending on the existing and less foreseen situations. At the same time, it should be noted that a special emphasis must be placed on those detailed situations (e.g.: the increase in budget expenditures fueled by social imbalances, etc.) generating risk and implicitly crisis periods which, in turn, cause a significant fluctuation of the indicators macroeconomics.

The deepening of the specialized literature also requires an analysis of the truly major events that have marked the last decades. They are based, on the one hand, on the assessment, the most realistic interpretation of the fluctuation of the indicators, which show the health of the economy at a given moment, reflected in G.D.P. On the other hand, it is necessary to deepen the existing relationship between public debt and economic growth in order to outline a clearer picture of the real development prospects. Under this aspect, it is clear that it (economic growth) represents the central pillar of sustainable development.

Thus, Heimberger (2023) analyzes the impact of public debt on economic growth. The research used regression (meta-regression) on 816 estimates, considering 47 primary studies. The analyzed period includes the interval 1982-2019, highlighting two very important aspects. So, to what extent can the high levels of public debt support economic growth, considering the manifestation of some phenomena in the analyzed period (1982-2019). On the other hand, to what extent the "unification" of fiscal policies, taking into account the events of nature, represented an asset, or rather the lack of adaptability, of a government, taking into account the unpredictability of events. It should be noted that there is a "balance dose" between countries that are owed is below the threshold of 60% of GDP. Maastricht Treaty - 13 countries and states whose economy reports a debt above the mentioned threshold - 14 countries (annual data, https://www.worldbank.org). The research results highlight, as a measure in the development of future policies, prudence because these (public policies high levels of indebtedness) must have an open relationship, carefully monitored, in order not to endanger economic stability. At the same time, it is shown in the practices of the last years that there is a not so significant interest, on the part of the population, regarding the current level of contracted loans, of debts already accumulated. But how can this mentioned aspect be observed? To understand this detail even better, the perception of the population is analyzed at the level of developed economies (for example: Great Britain and Germany).

Therefore, a much more in-depth analysis is necessary regarding these mentioned aspects, because the last decades have been loaded with socio-economic phenomena that have destabilized the economies of European countries (not only those analyzed in the study) and imposed a new relocation of ideas, a new approach to growth strategies and sustainable development.

In other words, Rommerskirchen and van der Heide (2023), in his research, argues that public debt management rarely attracts real public interest. At the same time, it is also mentioned that the political factor has its own influence in the management of public

finances and available resources. From here two other currents "depart", which seem to contribute to a political calm, at least: on the one hand, there is low interest towards the threshold reached and, in the same mentioned context, the dominance of "market discipline" prevents the modification of rates interest and costs. In other words, there are two studied factors that reflect the way public debt is managed (from the authors' point of view). Looking at things from another angle, silence facilitates the creation of a space of cooperation between states but also between them and the banking system. As a detail, it is also mentioned that both the banks and the state are dependent on each other due to their capacities to act on economic sustainability at the European level. Another element of detail, subject to analysis, but with uncertain results, "talks" about the fact that countries with a level of public debt below the threshold of 60% of GDP. It does not succeed with certain competitive advantages, to reach the economic situation like this (example: Bulgaria, even Romania), while countries with a debt level, above the mentioned one (example: 80-90% of GDP) report positive evolution, even in the short term (e.g. Croatia, France, Portugal). There are situations, slightly paradoxical, but which clearly and concisely present the way in which the available resources must be reached, so that the management of the population experiences positive developments, materialized in decent incomes. On the other hand, the economic analysis viewed from the perspective of the public deficit, associated with expenses of any kind, in relation to the public debt, shows an imbalance at the European level. Thus, there are countries whose debt is below 20% of GDP. the case of Estonia (18.5%) and the debt countries exceeds the threshold of 100% of G.D.P. (example: Greece, which holds the last position with 172.6%). Basically, the last decades have surprised by the nature of the phenomena, which has led to hasty and less documented analyses. Or the current context, requires the study of even the smallest details, able to provide the necessary levers, the factors of responsibility in the development of the best strategies for growth and sustainable development at the European level.

The case of the last of them, of Greece, of the economy that defines it, is analyzed in detail by Revuelta (2021) who analyzes the period 2010-2015, with reference also to the events that marked the economy, both before and after the mentioned period. Concretely, the three economic aid programs (E.P.E.) implemented at the country level, severely affected by the financial crisis, by social turmoil after the 2000s, are analyzed, the SCM study application. The culminating point was represented by the COVID 19 pandemic, which amplified the economic situation even more, placing it in last place, as public debt at the level of the European Union.

Thus, through the initiated and political surveillance mechanisms, which included the entire economic environment, as well as the social protection measures of the population, the objectives of stability could only be achieved in some places. Well, even more so in the years before the outbreak of the COVID 19 pandemic, as a result of the strategies implemented, in the analyzed period 2010 - 2015, an unemployment level of over 15% of G.D.P. was recorded. (17%, year 2019). On the one hand, Greece was dependent on assistance and financial support, and on the other hand, the country's economy had to comply with certain rules, imposed, which even led to a decrease in G.D.P. per capita. The 2013-2014 period represented, both for Greece and for most states, a certain flexibility in terms of identifying the policies adopted, but at the population level in terms of income. In general, the austerity measures did nothing but make it more difficult for the business environment. The long-awaited effect was not at the proposed level, a fact recognized by specialists in the field. Of course, not only in the case of

the Greek state it can be said that the expenses, as the main harmful factor, had a harmful effect on the economy, but also in the case of Romania, which felt both the shock of the economic crisis, in the context in which the country's economy presented a high level of confidence (with an increase of approx. 8.5%, year 2008), as well as the shock of the COVID 19 pandemic. Basically, from a public debt of 12.8% of G.D.P. in 2008, it reached 36.8% at the end of 2012, and after the first year of the pandemic (2021), it is around the threshold of 50% (48.6%) of G.D.P. There are aspects of interest that must be correlated and always updated considering the unpredictability of the phenomena but also the economic stability in the region.

These mentioned aspects, regarding the case of Romania, a country with a remarkable capacity for recovery and economic development, are analyzed by the authors Popescu and Diaconu (Maxim) (2021). The research analyzes, based on regression, two theories, that of Wagner, respectively that of Keynes. The studied period includes the interval: 1995-2018, half-yearly data. The first claims that the increase in spending can also be attributed to economic growth and development, while the second theory that, in managing the function as it is, can also represent an important tool to stimulate it. Therefore, there is a close, direct link between public spending and economic growth (real G.D.P.). Based on the Granger test, it is stated that only in the short run can a double causality relationship be supported and that in the long run, the test does not indicate the existence of cointegrating vectors. According to the same study, it is stated that economic growth attracts additional, but their less responsible allocation can lead to inefficiency, also felt in the incomes of the population. Of course, in the dynamic geopolitical public context, greater attention must be paid to finances and policies, as well as fiscal measures. Because, they create the conditions for a sustainable development capable of supporting the economy with notable results in the medium and long term. The last few decades have been littered with more responsible decisions by decision-makers regarding the resizing of available resources. Thinking too lightly (sometimes) of public money has determined a certain instability that must be prevented (in the future) and managed (responsibly) based on measures and public policies characterized by recognized flexibility and adaptability.

A pronounced analysis of the impact is supported by the authors Onofrei *et al.* (2021) who emphasize the importance and implications of such policies and rules on the fiscal behaviors of governments. Panel data were used for the developing countries of the European Union, and the reference period falls within the range: 2000 - 2014. Thus, by creating the control and risk management mechanism, the achievement of the performance of the public sector and more is aimed at. It is also important to strengthen the interactions between the legal and the institutional framework, in order to respect the stability commitments and achieve the proposed objectives. They can also be achieved by creating independent fiscal institutions, capable of improving the budget preparation process, ensuring a real process of fiscal consolidation. The specified rules were introduced with the aim of ensuring fiscal sustainability, which is characterized primarily by stability and transparency. In the case of discretionary fiscal-budgetary policies, it is stated that they suffer from two major disadvantages. These refer, first of all, to the tendency to increase budget deficits, and secondly, a budget deficit implies higher expenses than revenues, generating instability and crisis. Looking at things from another angle, it can be stated that economic development, thought at the European level, was affected by various disturbances, which alternated, fueled the uncertainty regarding the strategies implemented, requiring a rearrangement of ideas and

realization of economic growth prospects at the European community level. Thus, future sustainable development strategies must take into account every aspect analyzed and at the same time provide security and confidence in investment trust, as the main axis of sustainable economic growth.

The history of the last decades has highlighted the need to pay special attention to digitization, the IT industry and their effects. Thus, the authors Toader *et al.* (2021) emphasize the alternative measures thought and implemented in relation to the ill effects of the pandemic (2019-2021). The purpose of the research is to examine the log-run association between higher education in OECD countries based on the Solow endogenous growth model. At the same time, econometric methods related to ARD were considered for the use of different unit tests in order to verify the stationarity of the involved series. Even if the economic activity was interrupted, for a period of time, it required a reconfiguration and at the same time it will have, which was realized through technology and readjustment according to the evolution of the pandemic values. The effect was found to be beneficial, as it creates much more viable and realistic premises for development. This, digitization was not necessarily new, not even for higher education, but emerging situations, generated by the pandemic and not only, have emphasized the importance, usefulness and at the same time require the development of such programs, optimal for development. By fulfilling the established objectives, the reduction of the effect of isolation among students and the development of interactions between people was achieved. In conclusion, the analysis attests to the positive impact of digitization on education and beyond, with a direct effect on economic development.

The specialized literature includes analyzes that succinctly, realistically and dynamically present the impact of the turmoil that marked the last decades. The evolution of the market through mechanisms of monitoring, correction and recovery surprised even the strongest European economies. The fluctuation of macroeconomic indicators fueled by socio-economic instability, but also politics in the region, further amplified the economic decline, raising real problems at the level of the analyzed countries. The impact of factors, both internal and external, combined with the fluctuation of some of the most sensitive macroeconomic indicators (inflation, deficit, etc.) had a direct impact, interpreted differently by the governments of European countries, whether we are strictly speaking of those of the European Union or countries from Central and Eastern Europe (not part of the community). Even if events such as the pandemic, the financial crisis and, more recently, the war have had a negative impact, it must be remembered that part of the given situation also depends on how the available resources are managed. The analysis of the macroeconomic situation reflected in the level of public debt arouses real interest, and the levers and reforms used in this sense come to the support of governments. In all this context, it is necessary to comply with some directives, as a recommendation, capable of revitalizing, where appropriate, the business environment. At the level of the European community, there are countries with a debt level below 60% of GDP. - 13 countries (annual data) but also countries whose debt threshold varies greatly, being above the mentioned level. This last category includes a number of 14 countries, with a debt level between approx. 66%, the case of Germany, respectively Greece with its level of approx. 172.6% of G.D.P. The way of understanding, preventing and responding to existing challenges differentiates these countries, but at the same time, sustained efforts are being made to reduce the level reached, through a realistic allocation of funds so as not to affect economic stability in the area. At the same time, a favorable evolution is observed, from an economic point of view, after the first year of the

COVID19 pandemic with official data, whose values give confidence and security. In order to capture the most sensitive variations of economic indicators, in a dynamic context of socio-economic, but also political-military events, I present the methodological framework. Thus, I propose to highlight the mentioned aspects, together with viable measures for recovery, growth and economic development at the level of the countries studied.

3. METHODOLOGY AND DATA USED

3.1 Multivariate regression

As the first analysis method, within the study, I opted for multivariate regression. This model aims to study economic growth, from the events perspective that "characterized" it, based on the macroeconomic indicators past data series, which proved to be significant (in explaining it) and stationary (level), being expressed as a percentage.

So, I used panel data and the method of least squares (OLS) in Eviews software. The panel data model equation is:

$$y_{it} = \alpha + X'_{it}\beta + \mu_{it} + \vartheta_{it}, \qquad \text{i=1, ... ,N; t=1,...,T} \tag{1}$$

where: i = cross-section size, t= time series size; α, β= coefficients of the equation, X'_{it} = observation *it* of the explanatory variables, μ_{it} = the effect specific-individual unobservable and ϑ_{it}= residue (the remainder disturbance).

The econometric method may estimate two types of models: the fixed effect model or the random effect model. By using Hausman test (H0: the random effect model is appropriate; H1: the fixed effect model is appropriate), I select the appropriate model. Thus, if the "p-value" registers a statistically significant value, e.g. < 5%, I will choose the fixed effect model, otherwise I will take into account the random effect model. In order to capture the impact of the independent variables on the dependent variable, I analyzed the correlation between the indicators.

The data base and relationships description (multivariate regression)

In order to capture, in dynamics, the evolution of the most volatile indicators, with a pronounced impact on economic growth, I considered the reference period: 2000 - 2022, official data, with an annual frequency. Data were taken from specialized websites of European and world financial institutions, such as Eurostat, OECD, Wordbank and IMF respectively.

Table no. 1 – The correlation matrix

	C.A.	EXP	E.B.	F.D.I.	F.D.O	GDP_A	GDP_C	IND	INF	POP_A	T_REV	UNEM
C.A.	1.000	-0.076	**0.668**	-0.062	0.001	-0.174	-0.225	-0.142	-0.345	-0.345	-0.038	-0.186
EXP.	-0.076	1.000	-0.179	0.018	-0.008	-0.050	-0.004	-0.122	-0.045	-0.051	**0.980**	0.190
E.B.	**0.668**	-0.179	1.000	0.008	0.056	-0.016	-0.136	-0.183	-0.240	-0.045	-0.133	-0.296
F.D.I.	-0.062	0.018	0.008	1.000	**0.822**	0.020	-0.014	-0.195	-0.030	0.237	0.054	-0.038
F.D.O.	0.001	-0.008	0.056	**0.822**	1.000	-0.040	-0.062	-0.161	-0.055	0.196	0.015	-0.005
GDP_A	-0.174	-0.050	-0.016	0.020	-0.040	1.000	**0.972**	0.208	0.272	0.124	-0.001	-0.144
GDP_C	-0.225	-0.004	-0.136	-0.014	-0.062	**0.972**	1.000	0.266	0.311	0.089	0.027	-0.060
IND.	-0.142	-0.122	-0.183	-0.195	-0.161	0.208	0.266	1.000	0.211	0.205	-0.164	-0.100

	C.A.	EXP	E.B.	F.D.I.	F.D.O	GDP_A	GDP_C	IND	INF	POP_A	T_REV	UNEM
INF	-0.345	-0.045	-0.240	-0.030	-0.055	0.272	0.311	0.211	1.000	0.066	-0.036	-0.194
POP_A	-0.345	-0.051	-0.045	0.237	0.196	0.124	0.089	0.205	0.066	1.000	-0.077	0.086
T_REV	-0.038	**0.980**	-0.133	0.054	0.015	-0.001	0.027	-0.164	-0.036	-0.077	1.000	0.116
UNEMP	-0.186	0.190	-0.296	-0.038	-0.005	-0.144	-0.060	-0.100	-0.194	0.086	0.116	1.000

Note: C.A. - CURRENT_ACCOUNT; EXP - EXPENSE_OF_GDP; E.B. - EXTERNAL_BALANCE; F.D.I. - FOREIGN_DIRECT_INFLOWS; F.D.O. - FOREIGN_DIRECT_OUTFLOWS; G.D.P._A. - GDP_GROWTH_ANNUAL; G.D.P._C. - GDP_PER_CAPITA_GROWTH; IND – INDUSTRY; INF - INFLATION; POP_A - POPULATION_AGE; T_REV - TAX_REVENUES; UNEMP - UNEMPLOYMENT

Source: author's calculations, with Eviews software

Taking into account the proposed confidence interval (-0.7; 0.7), I applied the *correlation matrix* in order to obtain valid results, for a clearer picture of the economic situation. They are presented in Table no. 1.

The recorded values fall within the proposed range (-0.7; 0.7). Redundant indicators of economic significance are eliminated, including: GDP_per_capita_growth, Foreign_direct_outflows, External balance, Expense of GDP etc.

The correlation matrix, presented in Table no. 2 verify indicators with their impact on economic growth.

Table no. 2 – The correlation matrix

	GDP__A	C.A.	IND.	INF	POP_A
GDP_A	1				
C.A.	-0.17393	1			
IND.	0.207746	-0.14177	1		
INF.	0.271629	-0.34451	0.211008	1	
POP_A.	0.124115	-0.34466	0.205451	0.065601	1

Source: author's calculations, with Eviews software

Considering the aforementioned, I opted for updating the database with new indicators, including the "updating" of the dependent variable, *real G.D.P*.

These are presented in Table no. 3.

Table no. 3 – Presentation of variables

Variables	Specification	Data source
The dependent variable		
REAL_GDP	*REAL G.D.P. GROWTH, annual %*	International Monetary Fund
The independent variables		
CAB	Current account balance (% of G.D.P.)	Eurostast
ICP	Inflation consumer prices (annual %)	*The World Bank*
GCF	Gross capital formation (% of G.D.P.)	The World Bank
GRE	Guvernment revenue, expenditure (% of G.D.P.)	Eurostast
UNE	Unemployment, total (% of total labor force)	The World Bank
TRA	Trade (% of G.D.P.)	The World Bank
INC	Industry (including construction) (% of G.D.P.)	The World Bank
FDI_I	Foreign direct investment, net inflows (% G.D.P.)	The World Bank
FDI_O	Foreign directinvestment, net outflows(% of G.D.P.)	The World Bank
POP	Population 15 - 64 age (% of population)	*The World Bank*

Source: author's representation

Given the current economic and geopolitical context, a much more responsible analysis of disruptive factors, of macroeconomic indicators, really significant for the economy of a country, of a community that currently includes 27 states, is required. Besides, the last decades are sprinkled with significant phenomena that imposed more or less assumed decisions, and the results were not always the expectations. So, one of the questions that needs to be clarified is the analysis of the most representative indicators. In other words, the presented indicators can have a positive or negative impact on economic growth. The studies (specialized literature) show significant variations of these indicators, over time, decision-making functions of the responsibility factors, but also of unpredictability that characterize the socio-economic and political phenomena of the analyzed period. Therefore, in an "accredited" description, both in the specialized literature and as required by the evolution, for a sustainable development it is necessary to describe them alongside the hypotheses (positive/negative impact) that are taken into account. The mentioned can be found in Table no. 4.

Table no. 4 – Description of variables used

Variable	Description	Hypotheses
	The dependent variable	
REAL GDP	*It represents the real growth of the economy (P.I.B. real)*	-
	The independent variables	
CAB	- provides information on a country's transactions; - covers those transactions (other than those in financial elements) with goods, services, income (primary/secondary)	**H_0**
FDI_I	- foreign direct investments, net inflows, into the economy	**H_0**
FDI_O	- foreign direct investment, net outflow.	H_0 / **H_1**
GCF	looks at those expenditures for the addition of fixed assets of the economy, even net changes in the level of stocks.	**H_0** / H_1
GRE	- captures a ratio of government revenues to expenditures as a percentage of GDP	**H_0** / H_1
INC	- includes effectively, production, added value.	**H_0**
ICP	reflects the annual cost change for the average consumer (purchasing a shopping basket that can be fixed/changed with different impact on economic growth).	**H_0** / **H_1**
POP	describes the population aged 15-64, as a percentage of the total population, which counts all residents, regardless of legal status or citizenship.	**H_0**
TRA	- trade is the sum of exports and imports (goods, services).	**H_0**
UNE	characterizes the share of the labor force, without work, but available and looking for a job.	H_0 / **H_1**

Source: author's representation

Legend: General assumptions, from which they "start":

H_0 (**H_0** / H_1) - positive impact (rather positive) on the dependent variable;

H_1 (H_0 / **H_1**) - negative impact (rather negative) on the dependent variable.

The following correlation matrix (Table no. 5) reflects the importance and degree of correlation of the analyzed indicators, in a dynamic of phenomena, sometimes difficult to anticipate (with accuracy).

Table no. 5 – The correlation matrix

	CAB	FDI	GCF	GRE	ICP	INC	POP	TRA	UNE
CAB	1.0000	-0.0769	-0.4987	0.2611	-0.3107	-0.1587	-0.3417	0.2055	-0.1836
FDI	-0.0769	1.0000	-0.0203	-0.0971	-0.0523	-0.1399	0.1987	0.1724	-0.0209
GCF	-0.4987	-0.0203	1.0000	-0.3189	0.2868	0.4821	0.1194	-0.0055	-0.3073
GRE	0.2611	-0.0971	-0.3189	1.0000	-0.2078	-0.2746	-0.3776	-0.3389	0.1075
ICP	-0.3107	-0.0523	0.2868	-0.2078	1.0000	0.2157	0.0920	-0.0277	-0.1326
INC	-0.1587	-0.1399	0.4821	-0.2746	0.2157	1.0000	0.2047	-0.2470	-0.0966
POP	-0.3417	0.1987	0.1194	-0.3776	0.0920	0.2047	1.0000	0.2326	0.0918
TRA	0.2055	0.1724	-0.0055	-0.3389	-0.0277	-0.2470	0.2326	1.0000	-0.3115
UNE	-0.1836	-0.0209	-0.3073	0.1075	-0.1326	-0.0966	0.0918	-0.3115	1.0000

Source: author's calculations, with Eviews software

The correlation matrix showed that there is a not so significant correlation between the individual variables.

Estimating and testing the significance of the analyzed parameters

For the estimation, as realistic as possible and at the same time testing the significance of the analyzed parameters, I applied the Hausman Test, obtaining (Table no. 6):

Table no. 6 – The results of the indicators estimation

Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	51.956839	10	0.0000

Source: author's calculations, with Eviews software

The probability associated with the Hausman test: p<0,05. In this case, according to the test and taking into account the probability value, the null hypothesis cannot be rejected, so the appropriate model for estimation is the fixed-effects model. In other words, the term "fixed effects" refers to the fact that even though the intercept may vary across the variables, the intercept of each factor is time-invariant.

Their representation (*fixed effects*) are highlighted in the following table (Table no. 7):

Table no. 7 – Fixed effects

Dependent Variable: ***REAL_GDP***
Sample: 2000 - 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.283235	0.086885	3.259860	0.0012
CAB	0.002867	0.054673	0.052439	0.9582
FDI	0.000507	0.003361	0.150917	0.8801
GCF	0.244247	0.065561	3.725473	0.0002
GRE	-0.478061	0.047472	-10.07046	0.0000
ICP	0.060925	0.039574	1.539504	0.1242

INC	-0.008220	0.073349	-0.112066	0.9108
POP	-0.198025	0.112441	-1.761150	0.0787
TRA	0.016121	0.007747	2.081032	0.0379
UNE	0.154282	0.049772	3.099775	0.0020
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	*0.371761*	Mean dependent var		0.024918
Adjusted R-squared	*0.334175*	S.D. dependent var		0.038303
F-statistic	9.890712	*Durbin-Watson stat*		*1.881369*
Prob (F-statistic)	*0.000000*			

Source: author's calculations, with Eviews software

I eliminated, again, the statistically insignificant indicators, they have a probability >0.5, respectively 0.10. Thus, the final regression is obtained - with fixed effects (Table no. 8).

Table no. 8 – The final regression (*equation*)

Dependent Variable: ***REAL_GDP***
Sample: 2000 - 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.283981	0.077275	3.674950	0.0003
GCF	0.241065	0.043380	5.557027	0.0000
GRE	-0.477042	0.042236	-11.29455	0.0000
ICP	0.060296	0.038906	1.549767	0.1217
POP	-0.201916	0.103450	-1.951825	0.0514
TRA	0.016253	0.007277	2.233408	0.0259
UNE	0.155199	0.049301	3.147989	0.0017
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	*0.371722*	Mean dependent var		0.024918
Adjusted R-squared	*0.337530*	S.D. dependent var		0.038303
S.E. of regression	0.031176	Akaike info criterion		-4.046667
Sum squared resid	0.571498	Schwarz criterion		-3.811186
Log likelihood	1289.490	Hannan-Quinn criter.		-3.955141
F-statistic	10.87161	*Durbin-Watson stat*		*1.882029*
Prob(F-statistic)	*0.000000*			

Source: author's calculations, with Eviews software

Thus, the equation that "defines" the model used has the following form:

$$\textbf{\textit{REAL\_G.D.P.}} = 0.283980730692 + 0.24106518718*GCF - 0.477042278069*GRE + 0.0602957346444*ICP - 0.201915727904*POP + 0.0162526384547*TRA + 0.155199483764*UNE + C$$

Analyzing the above equation, it can be seen that there are indicators with a positive but also a negative impact on the dependent variable. Among those with a positive impact are: GCF (gross capital formation), TRA (trade), UNE (unemployment rate) and last but not least ICP (inflation). In other words, at a 1 pp (percentage point) increase in G.C.F. a change in the same direction (increase) is observed in the dependent variable (real GDP) with approx. 24.1%. On the other hand, there is also a negative influence on the dependent variable, and here we find the population (POP), respectively of G.R.E. (government revenues, expenses, etc.). Basically, at a 1 pp (percentage point) increase in G.R.E. a change in the opposite direction (decrease) of the dependent variable (real GDP) is observed by approx. 47.7%.

In order to paint a real picture of the economic situation, from the European level, the statistical F Test "coming" and reinforces this by validating the model by its very significance, with a probability of over 95% (Prob = 0.00000 <0.05).

In other words, the independent variables analyzed and included in the model explain the variation of the dependent variable, for the analyzed period: 2000-2022.

Testing the Autocorrelation Hypothesis - The Durbin-Watson Test

DW test captures the autocorrelation errors degree and describes certain limits, which must be taken into account in order to express the results interpretation. In other words, if the value of the test is lower than "2", we can mention that there is a positive autocorrelation, and if it exceeds the mentioned limit, the autocorrelation becomes negative. When the test records a value around the number "2", the errors are not correlated. The estimated value of the Durbin-Watson test is equal to 1.882, and this result certifies, once again, that the model is valid.

Verification/ Testing the normality of the residual - Jarque - Bera test

The test determines to what extent the empirical distribution can be expressed as a normal one (Figure no. 2). Therefore, it takes into account both the flattening coefficient and the asymmetry coefficient. At the same time, the series created by the residuals includes all the errors of the estimated variable

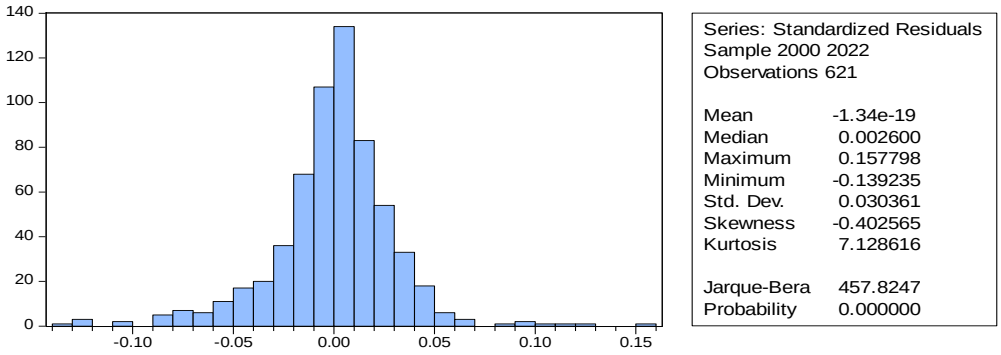


Figure no. 2 – Jarque - Bera test results
Source: author's calculations, with Eviews software

The dynamics of the events determined an important fluctuation of the macroeconomic indicators and due to this fact, the hypotheses (Table no. 4) considered, were or were not confirmed. They are presented in Table no. 8.

Table no. 8 – Confirmation of the assumptions of the model used

Variable	Description	Hypotheses
	Dependent variable: **REAL G.D.P.**	
	Independente variables	
CAB	- Indicator "annihilated" by its own evolution, with a not so significant impact on economic growth of 2.87%, but with a very high probability (>10, approx. 95.82%).	-
FDI_I	- Indicator "annihilated" by its own evolution, with a very high probability (>10, approx. 88.01%).	-
FDI_O	- Indicator "annihilated" by its own evolution, statistically insignificant.	-
GCF	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
GRE	- Negative impact on economic growth (unconfirmed hypothesis).	***H_1***
INC	- Indicator "annihilated" by its own evolution, with a very high probability (>10, approx. 91.08%).	-
ICP	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
POP	- Negative impact on economic growth (unconfirmed hypothesis).	***H_1***
TRA	- Positive impact on economic growth (hypothesis confirmed).	**H_0**
UNE	- Positive impact on economic growth (hypothesis confirmed).	**H_0**

Source: author's representation

Legend: General assumptions, from which they "start":
H_0 ($\mathbf{H_0}$ / H_1) - positive impact (rather positive) on the dependent variable;
H_1 (H_0 / $\mathbf{H_1}$) - negative impact (rather negative) on the dependent variable.

The results reveal an directly proportional relationship between the events produced and the fluctuation of macroeconomic indicators. They "speak" how important the measures are, the public policies that are required to be implemented, characterized by a recognized flexibility, alongside prudent decisions, assumed by the responsible factors.

Interpretation of model results

Economic activity viewed from the perspective of results also shows a dependency relationship between socio-economic events and the fluctuation of macroeconomic indicators.

As the economic reality also certifies, at least in the last years, 2020-2022, even 2023, the income/expenditure ratio seems to be against the first variable (income), determined by the need for additional financial funds, which cannot be covered in totality of the receipts obtained from the state budget. But, on the other hand, it can be observed the need for a continuous, responsible improvement of the personnel, of the population able to work in order to represent a resource capable of facing the new challenges. Even if the technological level has reached a very high level, human capital, for now, cannot be fully substituted. In the same, dynamic context, it can be stated that inflation, as the main publicized indicator (at least in recent years) has come to "play" a double role. On the one hand, to encourage economic growth through "consumption", and on the other hand, it raises serious counter-problems, with medium and long-term impact. At the same time, a positive influence of unemployment can be observed, which in the short term can be associated with a low level of inflation. How can this detail be "translated"? In the short term, a low inflation rate can cause the unemployment rate to increase, and this aspect (low inflation) can stimulate the allocation of substantial investment funds in large-scale projects with a direct impact on sustainable development. Regarding trade, it is clear that it must generate added value in an increasingly fierce competitive environment. As data, I can say that in the first place, as an economy, with a percentage of approx. 393% (2021) is Luxembourg, and the last place is held by Italy with approx. 46% (2003), followed by Greece with 47% (2009).

An obvious thing, after all, but which requires special attention from the responsible factors supported by responsible measures and policies characterized by proven prudence. At the same time, it is intended to increase the degree of awareness, prevention, management of each event along with a transparent allocation of resources, so that future obstacles, regardless of their size and scope, do not cause as important a disruption as that of the financial crisis or the COVID 19 pandemic. There were two events that demonstrated, on the one hand, the weak organization at the government level and the strengthening of the capacities of forces and means, and on the other hand, the subjectivity of the personnel with management positions, with power of decision, to accept the objective point of view of the specialists. With the help of multivariate regression, the most important variations were captured, but also the fact that there is no defined number of indicators that describe reality from all points of view.

In these conditions, studied, both during the listed events and after them, certain aspects can be observed. For example: if the global financial crisis required an update and at the same time a flexibility of decisions lasting 3-4 years in order to be able to observe really positive developments, the COVID 19 pandemic highlighted a certain accumulated "experience", a fact that mattered and contributed to the reduction of the payback period, with visible results even after the first year. Concretely, the most significant economic growth was recorded by the economy of Ireland in 2015 (approx. 24%), and at the opposite pole is the economy of Lithuania with approx. -15% (2009), a not so solid economy, but with real prospects for development.

As a first conclusion, it can be stated that the studied indicators explain the variation of the dependent variable (real G.D.P.). In the sense of what was presented, inflation is distinguished as an impact on the business environment, a sensitive indicator and at the same time, a scourge that can grind any economy, this being analyzed separately in the research: Is: Inflation determined fiscally? (Bazzaoui & Nagayasu, 2021) whose results confirm, once again, that budget deficits, depending on how they are managed, can cause increases or decreases in the inflation rate. In other words, a poorly structured monetary policy, at the level of the country, region, can be assimilated to increased values of the mentioned indicator. The data in this sense highlight a report, which places Romania's economy with a percentage of approx. 45% (2000), and that of Ireland with approx. -4.5% (2009), at opposite poles. At the same time, inflation influences the exchange rate, with an effect on economic growth. And in support of this claim, the study: Exchange rate volatility, inflation and economic growth in developing countries: Panel data approach for SADC (Olamide *et al.*, 2022) investigate in detail this effect and whose results confirm the importance of responsible fiscal-budgetary policies, characterized by increased flexibility.

The data taken into account, as a period, also included the year 2022 (official data), the year of the outbreak of the armed conflict in Eastern Europe, and this has its own implications, at least at the level of expenses and psychological factors, both at the level of the population and at the level of the whole economic system. As is known, unlike the COVID 19 pandemic, the tangible effects of the war are considered to be already felt, but in terms of the level of expenditure and the true implications, they are still far from being fully known. In the sense of the mentioned, there are studies that talk about an increasingly significant fluctuation in the stock market, either as indices, or as tradable commodities, or as a logical correlation between them. At the same time, in the economic environment, a certain recession is brought more and more often at the European and world level. According to some specialists, this, for now, seems to be managed successfully, but in the face of a deepening conflict involving vital economic resources such as oil and gas, alternative sources are being considered that also do not they seem to be inexhaustible. In the conditions of a much more efficient management of resources associated with a recognized prudence, in the decision-making process, it is desired to increase the degree of trust, both on the part of the population and on the part of the investment environment for the continuation of reforms and plans for recovery, growth and development at the level of countries European Union. Analyzing the events from another perspective, it can be stated that the public debt is in a relationship as open as possible with economic growth. Thus, in the following, I submit to the attention, the analysis of the relationship between the two mentioned variables, with the help of the autoregressive model (V.A.R.). The way this report is understood and interpreted depends on the fulfillment of the objectives, the purpose of which is represented by sustainable economic growth and development.

3.2 Autoregressive model (V.A.R.)

Description of data and correlation of indicators used

The data used have a quarterly frequency (GDP_GROWTH and GOVERNMENT_GROSS), for the reference period 2000 - 2022, and their source is Eurostat, O.E.C.D. respectively the World Bank. In order to obtain valid results, data series

were stationary (level, being expressed as a percentage) and seasonally adjusted. Also, I applied the correlation matrix (Table no. 9)

Table no. 9 – The correlation matrix

	GDP_GROWTH	GUVERNMENT_GROSS
GDP_GROWTH	1	-0.2683025542191922
GOVERNMENT_GROSS	-0.2683025542191922	1

Source: author's calculations, with Eviews software

Considering the correlation matrix (Table no. 9) we can say that the data are not strongly correlated, so we can base decisions on the findings.

The optimal number of lags is checked.

VAR Lag Order Selection Criteria
Sample: *2000 - 2022*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3185.800	NA	23540.23	15.74222	15.76199	15.75005
1	***-2350.400***	***1658.424***	***387.9158***	***11.63654***	***11.69586****	***11.66002****
2	-2344.691	11.27569	384.6578	11.62811	11.72697	11.66724
3	-2336.676	15.75306*	377.1077	11.60828	11.74668	11.66306
4	-2333.293	6.616313	378.2608	11.61132	11.78927	11.68176
5	-2329.338	7.694359	378.3502	11.61155	11.82904	11.69764
6	-2324.481	9.402417	376.7587*	11.60731*	11.86435	11.70906
7	-2323.454	1.978349	382.3395	11.62200	11.91858	11.73939
8	-2319.527	7.524869	382.4887	11.62235	11.95848	11.75540

Source: author's calculations, with Eviews software

According to the table above, it can be seen that the maximum number of lags is "1".

Estimation of indicators based on the autoregressive model V.A.R.

Table no. 10 shows the results of the estimation of the V.A.R. model:

Table no. 10 – Estimation results of the V.A.R. model equation

Vector Autoregression Estimates
Sample (adjusted): 2001 2022

	GDP_GROWTH	***GOVERNMENT_GROSS***
GDP_GROWTH(-1)	0.239336	-0.352440
	(0.04070)	(0.06392)
	[5.88050]	[-5.51346]
GOVERNMENT_GROSS(-1)	-0.009273	0.988723
	(0.00453)	(0.00711)
	[-2.04847]	[139.064]

C	2.369390	2.523846
	(0.35223)	(0.55322)
	[6.72677]	[4.56211]
R-squared	0.078434	**0.973513**
Adj. R-squared	0.075315	*0.973424*
Sum sq. resids	8116.552	20021.96
S.E. equation	3.705886	5.820491
F-statistic	25.14980	10861.12
Log likelihood	-1619.440	-1887.608
Akaike AIC	5.462759	6.365684
Schwarz SC	5.484915	6.387840
Mean dependent	2.392963	61.46786
S.D. dependent	3.853853	35.70372
Determinant resid covariance (dof adj.)		261.2776
Determinant resid covariance		258.6451
Log likelihood		-3335.670
Akaike information criterion		11.25141
Schwarz criterion		11.29572

Source: author's calculations, with Eviews software

The table above shows that statistically, the most appropriate model would be the one with R-squared = 0.973513 (dependent variable: public debt). Regarding the mentioned indicator, an inertia effect can be noted in its evolution (Table no. 10).

At the same time, an effect opposite to economic growth can also be observed. Following the estimation of the equation V.A.R. with a significance threshold greater than 0.7 (R squared: 0.973513), the following formula is obtained:

GOVERNMENT_GROSS *(public debt)* = - 0.352439977357*GDP_GROWTH(-1) + 0.988723149565*GOVERNMENT_GROSS(-1) + 2.52384630199

Practically, this equation supports the idea that public debt is directly influenced by economic growth. Therefore, the efforts to support the environment of business, can only have a favorable effect on economic development, with a direct impact on the public debt.

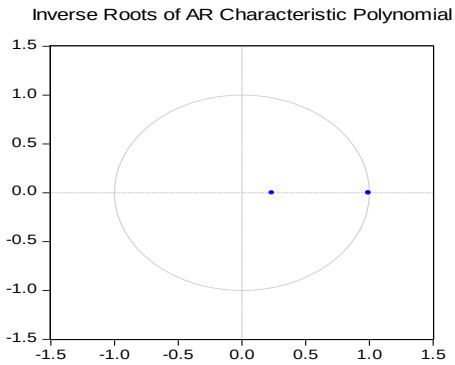


Figure no. 3 – The roots of the polynomial
Source: author`s calculations, with Eviews software

According to Figure no. 3, the roots of the polynomial are subunit, so the model can be considered as a valid one. The next stage, of the model used, involves the analysis of the "variance decomposition" that is reflected in Figure no.4.

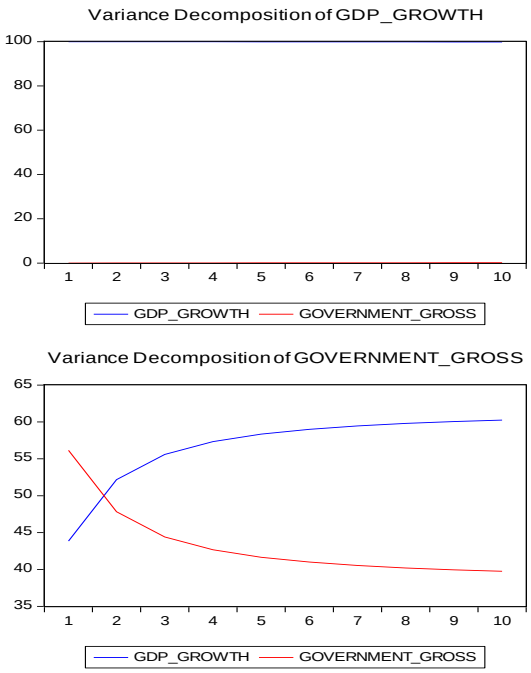


Figure nr. 4 – Variance decomposition
Source: author`s calculations, with Eviews software

This confirms the existence of an inverse relationship, the percentage being 100% (one taking the place of the other in weight/proportion). According to Figure no. 4, the dynamics

of the public debt is explained, proportional to approx. 54 - 55% of its own variation, and starting with the second lag, the effect being a decreasing one of up to approx. 40%.

In explaining the other variable "public debt", the effect of "economic growth" is more visible, also with the second lag, reaching values of up to 60%

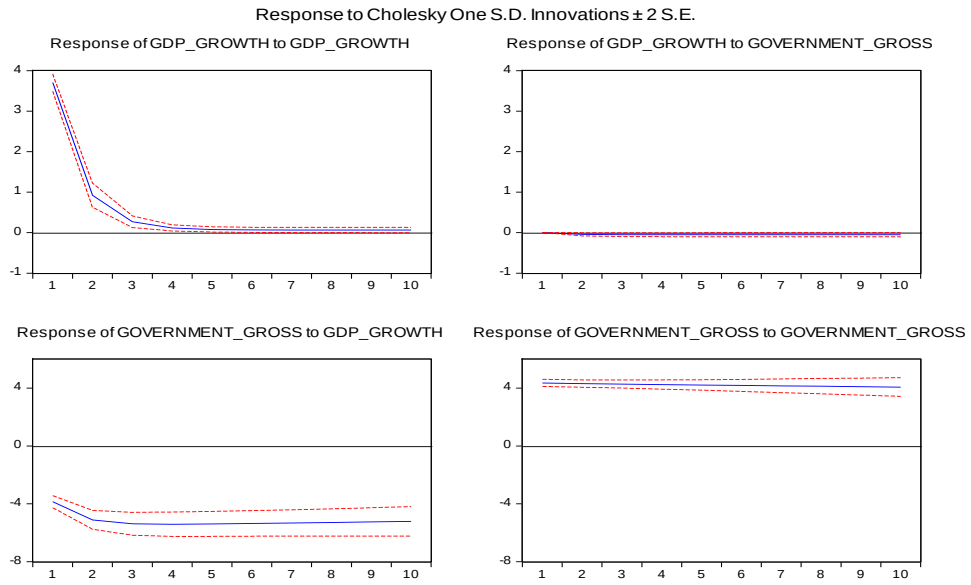


Figure no. 5 – Impulse response functions
Source: author`s calculations, with Eviews software

Analyzing in detail Figure no. 5, which analyzes the impulse response functions, we can see that the significant variations are more relevant in the last 2 (two) representations.

Therefore, an inversely proportional relationship can be observed between the two mentioned variables (public debt, respectively economic growth), which can be explained by the fact that a sustainable economic growth can cause a stagnation and even a reduction of the already accumulated public debt. On another note, the last Figure (bottom right) reinforces the economic reality, according to which the increase in public debt determines a more constant trend for the next forecast period.

Testing for GRANGER causality relationships (the same data series of GDP GROWTH and PUBLIC DEBT)

The hypotheses proposed in this test are:

H0: G.D.P._GROWTH does not influence PUBLIC_DEBT

H1: G.D.P._GROWTH influences PUBLIC_DEBT

The significance thresholds "talk" with and about the validity of the test used. Therefore, considering a significance threshold of 5%, one can support the idea that public debt influences this GDP and because the probability associated with the Granger test does not exceed the confidence interval (Table no. 11).

Table no. 11 – GRANGER test results

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 2000 - 2022
Dependent variable: *GDP_GROWTH*

Excluded	Chi-sq	df	Prob.
GOVERNMENT_GROSS	4.196223	1	0.0405
All	4.196223	1	0.0405

Dependent variable: *GOVERNMENT_GROSS*

Excluded	Chi-sq	df	Prob.
GDP_GROWTH	30.39823	1	0.0000
All	30.39823	1	0.0000

Source: author`s calculations, with Eviews software

Analyzing the second probability, associated with the test, (prob < 0.01) it can be concluded that G.D.P. influences PUBLIC_DEBT, as the associated probability does not exceed 1%. Interpreting these results, it can be stated that the influence of economic growth on public debt is more pronounced, at a lower threshold of significance (1% < 5%). Practically, the impact of the envisaged reforms can also be interpreted through a stronger ability to repay an important part of the contracted loans.

Interpretation of model results

The analysis of the correlation between the two analyzed variables represents a first landmark that has special implications on economic development. At the same time, analyzing the impact of public debt represents an important step in terms of harmonizing and homogenizing long-term development plans and strategies. Of course, as can be seen from the specialized literature, which presents V.A.R. as an evaluation method. public debt influences economic growth. On the other hand, it is found that each factor has its own influence and there is no certain social, economic or political event that does not affect its evolution. In this sense, I believe that there is a need for even greater responsibility that must be assumed and not "passed" from one to another, because every decision has its own repercussions, at least in the short term. An approach to public debt, from a different angle, but which confirms the results, is presented in the study: Debt overhang, gazelles' growth, and fiscal policy: A note from the quantile regression approach (Anton *et al.*, 2021). It examines the relationship between leverage and business growth, companies and the impact of fiscal policy. The period includes the interval 2006 - 2014, and the results show that the level of public debt has a negative impact on vital resources (Example: energy, otherwise a current problem). Also, on production and its transport, much more obvious at the level of not so developed countries, with low incomes. In the same context, it is mentioned that the impact of debts on the growth of companies is positive and pronounced. This analysis

certifies how important fiscal policies are, which must be continuously evaluated, updated, always adapted to society's problems.

In the sense of what has been stated, special attention must be paid to public finances and, at the same time, to monetary policies that truly support the efforts of recovery, growth and development at the level of European countries. At the same time, a much deeper analysis is required in terms of budget expenditures and more, which directly support the business environment. In another way, the cyclical nature of the phenomena determines certain episodes of well-being, embodied in the credits that can be accessed or the non-refundable funds made available. Of major importance is the realization of a budget as balanced as possible with revenues and expenses that will encourage economic growth efforts, this also by encouraging the investment environment, through concrete, viable measures with long-term applicability.

Another conclusion that emerges, regarding the evolution of macroeconomic indicators, which present the state of health of the economy at a given moment, as trends in the following years, is dependent, on the one hand, on the measures and policies implemented and which require a high degree of flexibility. But, on the other hand, this evolution also depends on financial resources that, through innovation, research and development, can bring added value to the economic environment.

3.3 Autoregressive Integrated Moving Average (A.R.M.A.)

In order to achieve a more complete picture, it is necessary to forecast the evolution of the public debt, at the level of European countries. As expected, this analysis requires, in the current geopolitical context, much more attention. This, at the level of the studied countries, presents values that fall within a not negligible range. Specifically, the smallest public debt is held by the Estonian economy (approx. 18.5% of GDP), and the most indebted country is Greece (approx. 172.6% of GDP). In what follows, I propose, based on the ARMA model, to analyze the evolution of public debt, both for countries whose debt exceeds the threshold of 60% of G.D.P. as well as at the level of countries with a debt below the mentioned threshold

This forecasting model (p,d,q) represents a generalization of the moving average autoregressive models, where:

p = the number of lags of the dependent variable AR;

d = the number of differentiations needed to transform the series into a stationary one;

q= the number of lags of the residual term (MA terms).

A. Countries with a level of public debt above 60% of GDP (14 countries)

Description and verification of data stationarity

In developing the ARMA model, annual series of public debt data were used, expressed as a percentage (%) of GDP. for European Union countries. The data were collected from the OECD, respectively the World Bank for the period 2000-2022. Modeling a variable using the Box-Jenkins methodology (ARMA models). To make an ARMA forecast, the Box-Jenkins Methodology is followed, which involves testing the stationarity of the data series.

In this sense, we used the Augmented Dickey-Fuller (ADF) test (Table no. 12), starting from the following assumptions:

a) Null hypothesis: the public debt has a unit root, the series is non-stationary,

b) alternative hypothesis: the series is stationary

Table no. 12 – Augmented Dickey-Fuller test

Null Hypothesis: *HIGH_GOVERNMENT*
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.715605	**0.0042**
Test critical values:	1% level	-3.450617	
	5% level	-2.870359	
	10% level	-2.571538	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: (HIGH_GOVERNMENT)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HIGH_GOVERNMENT(-1)	-0.071281	0.019136	-3.725056	0.0002
D(HIGH_GOVERNMENT(-1)	0.172373	0.055260	3.119341	0.0020
C	-0.022459	0.010033	-2.238607	0.0259

R-squared	0.060009	Mean dependent var	-0.000994
Adjusted R-squared	0.054079	S.D. dependent var	0.150628
S.E. of regression	0.146499	Akaike info criterion	-0.994272
Sum squared resid	6.803396	Schwarz criterion	-0.958944
Log likelihood	162.0835	Hannan-Quinn criter.	-0.980165
F-statistic	10.11867	Durbin-Watson stat	2.036208
Prob(F-statistic)	0.000055		

Source: author`s calculations, with Eviews software

Analyzing the results of the stationarity test, reflected in the table above, it can be seen that the probability associated with it falls within the 5% confidence interval (prob: 0.0042).

In other words, the test presents sufficient arguments to continue the analysis, the series being stationary by logarithmization (natural logarithm - Figure no. 6).

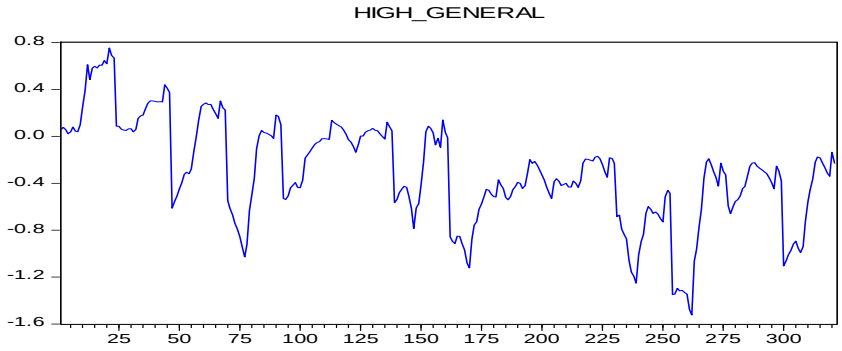
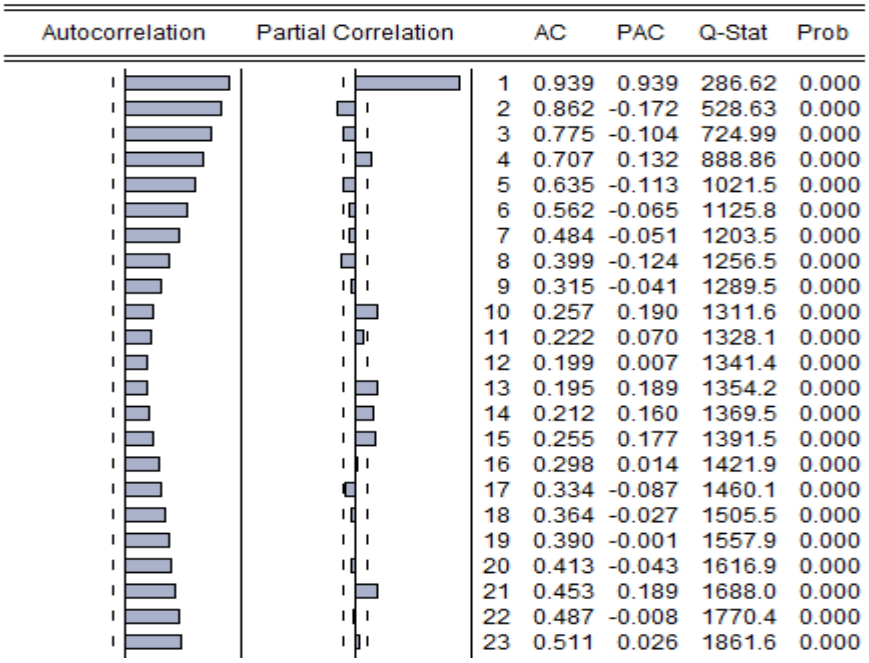


Figure no. 6 – Stationary series - public debt
Source: author`s calculations, with Eviews software

Identifying the type of ARMA model, using a correlogram, by determining the optimal values for p and q for the AR(p) and MA(q) models, based on the characteristics of the autocorrelation function (FAC) as well as the partial autocorrelation function (FACP).

Sample: 1 322
Included observations: 322



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.939	0.939	286.62	0.000
		2	0.862	-0.172	528.63	0.000
		3	0.775	-0.104	724.99	0.000
		4	0.707	0.132	888.86	0.000
		5	0.635	-0.113	1021.5	0.000
		6	0.562	-0.065	1125.8	0.000
		7	0.484	-0.051	1203.5	0.000
		8	0.399	-0.124	1256.5	0.000
		9	0.315	-0.041	1289.5	0.000
		10	0.257	0.190	1311.6	0.000
		11	0.222	0.070	1328.1	0.000
		12	0.199	0.007	1341.4	0.000
		13	0.195	0.189	1354.2	0.000
		14	0.212	0.160	1369.5	0.000
		15	0.255	0.177	1391.5	0.000
		16	0.298	0.014	1421.9	0.000
		17	0.334	-0.087	1460.1	0.000
		18	0.364	-0.027	1505.5	0.000
		19	0.390	-0.001	1557.9	0.000
		20	0.413	-0.043	1616.9	0.000
		21	0.453	0.189	1688.0	0.000
		22	0.487	-0.008	1770.4	0.000
		23	0.511	0.026	1861.6	0.000

Figure no. 7 – Correlogram of the data series
Source: author`s calculations, with Eviews software

AR variables appear as lags of the dependent variable, and MA variables are defined as MA(x), where x represents the order (Codirlaşu and Chidesciuc, 2008). With the help of the

autocorrelation coefficients, identified based on the autocorrelation function (FAC) and the partial correlation coefficients, identified on the basis of the partial autocorrelation function (FACP), the type of autoregressive model is determined in order to analyze the time series.

So, as we can see in the figure above, the most suitable ARMA model is (1,1,1)

Estimation of the public debt dynamics

Estimation of the identified model, using various methods such as: method of moments, maximum likelihood, O.L.S. (Table no. 13).

Table no. 13 – Representation of the ARMA model (1,1,1)

Dependent Variable: **HIGH_GOVERNMENT**
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.317942	0.124038	-2.563262	0.0108
AR(1)	0.923816	0.022745	40.61624	0.0000
MA(1)	0.143185	0.059222	2.417743	0.0162

R-squared	**0.887602**	Mean dependent var	-0.303929
Adjusted R-squared	**0.886720**	S.D. dependent var	0.436922
S.E. of regression	0.147132	Akaike info criterion	-0.985559
Sum squared resid	6.797388	Schwarz criterion	-0.949986
Log likelihood	159.2111	Hannan-Quinn criter.	-0.971349
F-statistic	1236.325	*Durbin-Watson stat*	**1.965054**
Prob(F-statistic)	0.000000		

Inverted AR Roots	.92
Inverted MA Roots	-.14

Source: author`s calculations, with Eviews software

The value of the Durbin Watson statistic, respectively *1.965054*, is close to 2 and we can conclude that there is sufficient evidence to attest to the lack of serial correlation between residuals, a fundamental feature in explaining the characteristics of a model.

Another test that reinforces this statement is the Serial Correlation LM Test, with which we check the residuals (Table no. 14).

Table no. 14 – Residue check

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.026372	Prob. F(1,313)	0.0029
Obs*R-squared	8.885478	Prob. Chi-Square(1)	0.0029

Source: author`s calculations, with Eviews software

Testing the characteristics of estimated autoregressive models

In order to ensure the validity of the model that will be used in the forecast, we analyzed its structure, according to the Box-Jenkins methodology (Figure no. 8).

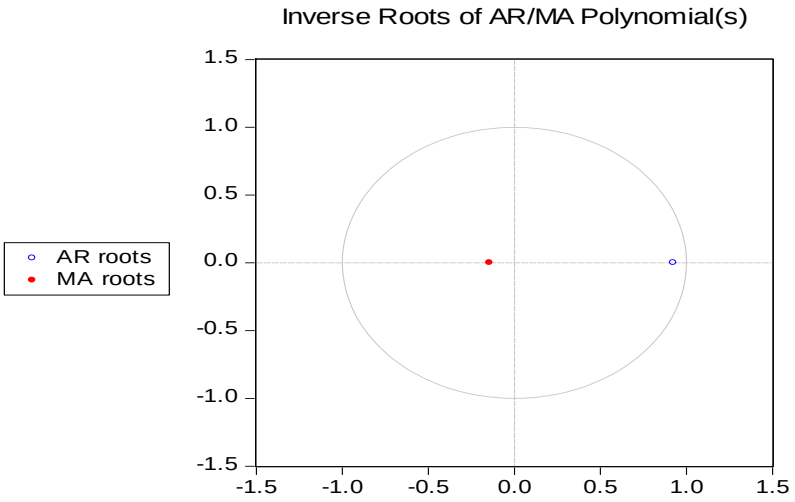


Figure no. 8 – Evaluation of the model

Source: author`s calculations, with Eviews software

Thus, Figure no. 8 certifies that the model is *stable* and *suitable* for forecasting.

Making forecasts, based on the selected model

In this sense, we tried to capture the evolution of the public debt over a period of four years (Figure no. 9).

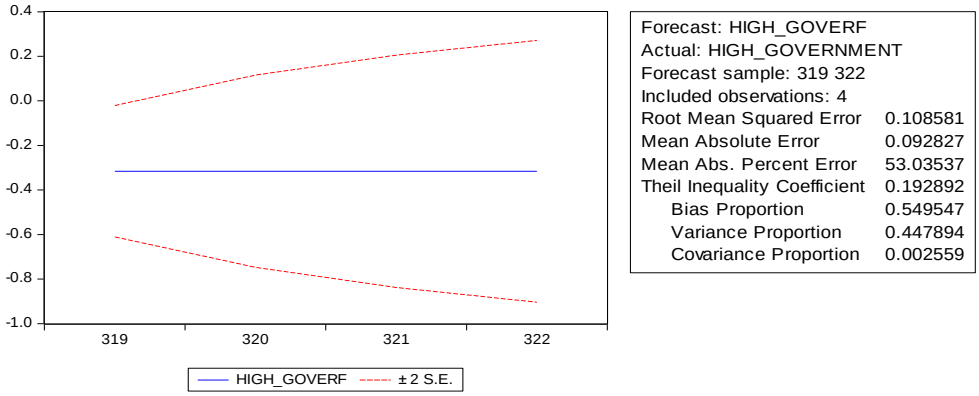


Figure no. 9 – The public debt dynamics

Source: author`s calculations, with Eviews software

The figure above shows the forecast range for public debt at a significance threshold of 5%. The forecast was made based on the ARMA (1,1,1) model.

As can be seen the blue line represents the forecast for the next period. This indicates a linear trend - continuous and without major oscillations, as a whole.

B. Countries with a level of public debt below 60% of G.D.P. (13 countries)

Description and verification of data stationarity

In developing the ARMA model, annual data series of the public debt, expressed as a percentage (%) of GDP, were used. for European Union countries. The data were collected from the OECD, respectively the World Bank for the period 2000-2022. One variable modeling using the Box-Jenkins methodology (ARMA models). In order to make an ARMA forecast, the Box-Jenkins Methodology is followed, which involves the following steps:

Testing the stationarity of the time series and its stationarity in case it turns out to be non-stationary. In this sense, we used the Augmented Dickey-Fuller (ADF) test (Table no. 15), starting from the following assumptions:

a) Null hypothesis: the public debt has a unit root, the series is non-stationary,

b) alternative hypothesis: the series is stationary.

Table no. 15 – Augmented Dickey-Fuller test

Null Hypothesis: *LOW_GOVERNMENT*
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.256548	**0.0179**
Test critical values:	1% level	-3.452141	
	5% level	-2.871029	
	10% level	-2.571897	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: (LOW_GOVERNMENT)
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOW_GOVERNMENT(-1)	-0.069705	0.021405	-3.256548	0.0013
C	-0.074339	0.027844	-2.669879	0.0080

R-squared	0.034589	Mean dependent var	0.003097
Adjusted R-squared	0.031327	S.D. dependent var	0.254076
S.E. of regression	0.250065	Akaike info criterion	0.072498
Sum squared resid	18.50963	Schwarz criterion	0.097310

Log likelihood	-8.802135	Hannan-Quinn criter.	0.082430
F-statistic	10.60510	Durbin-Watson stat	1.745536
Prob(F-statistic)	0.001259		

Source: author`s calculations, with Eviews software

Analyzing the results of the stationarity test, reflected in the table above, it can be seen that the probability associated with it falls within the 5%. (prob: 0.0179).

In other words, the test presents sufficient arguments to continue the analysis, the series being stationary by logarithm (natural logarithm - Figure no. 10).

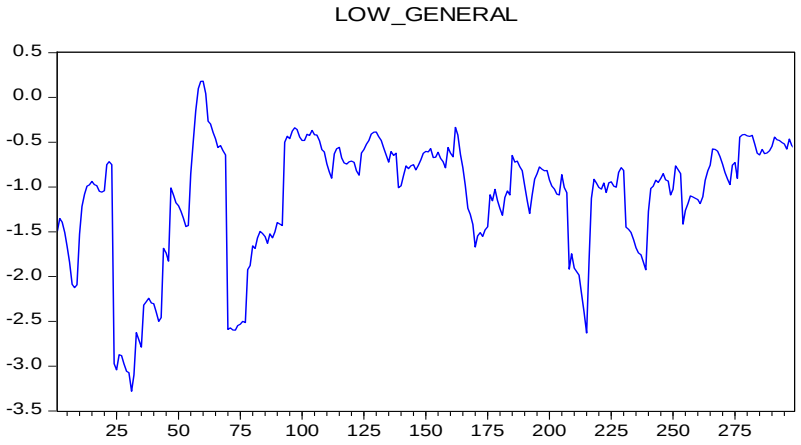


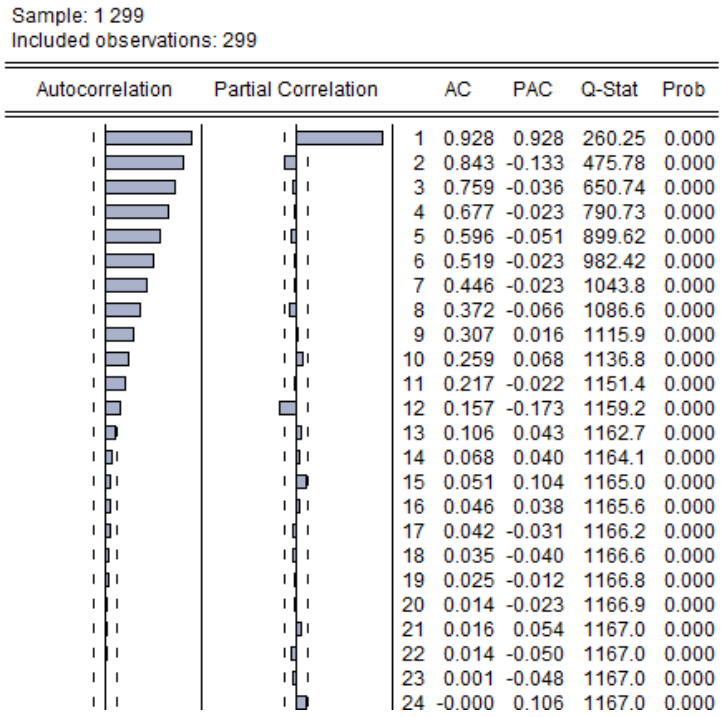
Figure no. 10 – Stationary series - public debt
Source: author`s calculations, with Eviews software

Identifying the type of ARMA model, using a correlogram, by determining the optimal values for p and q for the AR(p) and MA(q) models, based on the characteristics of the autocorrelation function (FAC) as well as the partial autocorrelation function (FACP).

AR variables appear as lags of the dependent variable, and MA variables are defined as MA(x), where x represents the order (Codirlașu and Chidesciuc, 2008.

With the help of the autocorrelation coefficients, identified based on the autocorrelation function (FAC) and the partial correlation coefficients, identified on the basis of the partial autocorrelation function (FACP), the type of autoregressive model is determined in order to analyze the time series.

So, as we can see in the Figure no. 11, the most suitable ARMA model is (1,1,1)



	AC	PAC	Q-Stat	Prob
1	0.928	0.928	260.25	0.000
2	0.843	-0.133	475.78	0.000
3	0.759	-0.036	650.74	0.000
4	0.677	-0.023	790.73	0.000
5	0.596	-0.051	899.62	0.000
6	0.519	-0.023	982.42	0.000
7	0.446	-0.023	1043.8	0.000
8	0.372	-0.066	1086.6	0.000
9	0.307	0.016	1115.9	0.000
10	0.259	0.068	1136.8	0.000
11	0.217	-0.022	1151.4	0.000
12	0.157	-0.173	1159.2	0.000
13	0.106	0.043	1162.7	0.000
14	0.068	0.040	1164.1	0.000
15	0.051	0.104	1165.0	0.000
16	0.046	0.038	1165.6	0.000
17	0.042	-0.031	1166.2	0.000
18	0.035	-0.040	1166.6	0.000
19	0.025	-0.012	1166.8	0.000
20	0.014	-0.023	1166.9	0.000
21	0.016	0.054	1167.0	0.000
22	0.014	-0.050	1167.0	0.000
23	0.001	-0.048	1167.0	0.000
24	-0.000	0.106	1167.0	0.000

Figure no. 11 – Correlogram of the data series
Source: author`s calculations, with Eviews software

Estimation of the public debt dynamics

Estimation of the identified model, using various methods such as: method of moments, maximum likelihood, OLS (Table no. 16).

Table no. 16 – Representation of the ARMA model (1,1,1)

Dependent Variable: **LOW_GOVERNMENT**
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.080808	0.187657	-5.759495	0.0000
AR(1)	0.911599	0.025975	35.09567	0.0000
MA(1)	0.136938	0.062323	2.197232	0.0288

R-squared	**0.875657**	Mean dependent var	-1.115580
Adjusted R-squared	**0.868843**	S.D. dependent var	0.679549
S.E. of regression	0.249836	Akaike info criterion	0.074127
Sum squared resid	18.16363	Schwarz criterion	0.111714
Log likelihood	-7.896641	Hannan-Quinn criter.	0.089179
F-statistic	938.3509	*Durbin-Watson stat*	**1.989120**

Prob(F-statistic)	0.000000
Inverted AR Roots	.91
Inverted MA Roots	-.14

Source: author`s calculations, with Eviews software

The value of the Durbin Watson statistic, respectively 1.989120, is close to 2 and we can conclude that there is sufficient evidence to attest to the lack of serial correlation between residuals, a fundamental feature in explaining the characteristics of a model.

Another test that reinforces this statement is the Serial Correlation LM Test, with which we check the residuals (Table no. 17).

Table no. 17 – Residue check

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.026372	Prob. F(1,313)	0.0029
Obs*R-squared	8.885478	Prob. Chi-Square(1)	0.0029

Source: author`s calculations, with Eviews software

Testing the characteristics of estimated autoregressive models

In order to ensure the validity of the model that will be used in the forecast, we analyzed its structure, according to the Box-Jenkins methodology (Figure no. 12).

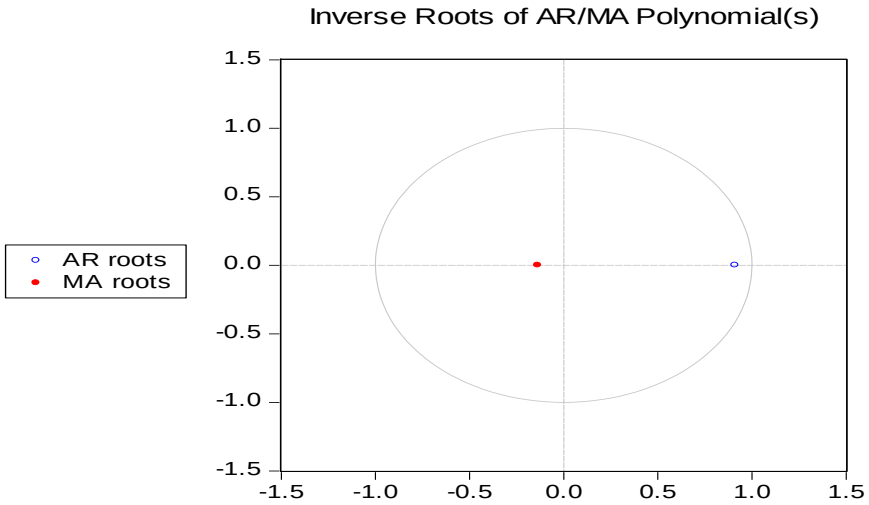


Figure no. 12 – Description of the model

Source: author`s calculations, with Eviews software

Thus, Figure no. 12 certifies that the model is *stable* and *suitable* for forecasting.

Making forecasts, based on the selected model. In this sense, we tried to capture the evolution of the public debt over a period of four years (Figure no. 13).

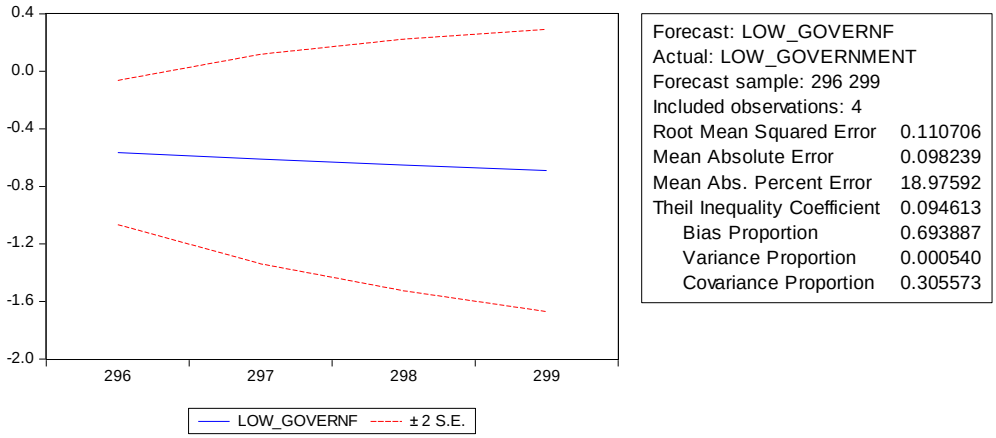


Figure no. 13 – The public debt forecasting
Source: author`s calculations, with Eviews software

The figure above shows the forecast range for public debt at a significance threshold of 5%. The forecast was made based on the ARMA (1,1,1) model. As can be seen the blue line represents the forecast for the next period. This indicates a slightly downward trend, without major oscillations during the forecasted period.

4. RESULTS AND DISCUSSION

Public debt, from analysis to management, as a macroeconomic indicator with a pronounced impact on economic development, includes a set of studies, principles and measures that, by nature and objective approach, create the premises for sustainable development at the level of the countries studied. Considering the results obtained, following the estimation of the two categories of data, two large "classes" can be distinguished. On the one hand, countries whose economy complies with the provisions of the Maastricht Treaty regarding the threshold of 60% of G.D.P. and countries whose economic state does not fall within the respective mentioned provisions. This detail is analyzed from the perspective of the fact that the measures thought at a strategic and then decision-making level do not "fit" into a clear understanding at the level of the business environment and even the population, either because of the existing geopolitical context or because of perception, interpretation of the events that follow, at an alert pace. Moreover, reference is made to that link, which would provide, on the one hand, confidence and stability to the economic environment and implicitly to investors (investments are absolutely necessary for sustainable development), and on the other hand, to ensure the income of the population, at a level decent and increasing confidence in the existing development potential, dependent on the optimal allocation of financial, human and material resources.

At the same time, the same data confirm, as a forecast, the fact that for the next period the public debt seems to follow a linear and even decreasing trend, more pronounced at the

level of those states whose debt does not exceed the threshold ratified in the Treaty signed in February 1992. Practically, the same confusion comes to the fore: *What effect, impact does public debt have or can have*? Certainly, sustained efforts are being made regarding the optimal management of resources in relation to their own economic potential and the unpredictability of the phenomena. The governments' concerns are encouraging, but analyzing in detail the results obtained, it seems that it was not possible to stop the public debt, as a pronounced effect on economic development, but rather to mitigate its impact on the business environment. It is a noteworthy aspect and the continuation of reforms and public policies whose goal is the self-sustainability of one's own economy is encouraged. At the same time, we must not forget the external support, received with great openness by the governments of the member states. But even this, in order to be accessed, requires certain recommendations, obligations to be respected, which for some countries seems like a difficult obstacle to reach. Even in these uncertain conditions of the market economy there is availability, flexibility that must be respected and exploited, so that the economy can "breathe" and contribute, as a basic pillar, to a sustainable economic development.

The results of the analysis can be analyzed from 3 perspectives ("angles"). First, based on the regression, an interdependence with immediate impact is observed between the macroeconomic indicators, which show the health of the economy at a given moment, and the current development prospects. In other words, it is confirmed that each event has its own influence on the well-being of the economy, depending on how it is prevented, perceived, interpreted and managed. Second, the same results certify an open, carefully monitored relationship between public debt and economic growth. The analysis of the interdependence of the two analyzed variables (the autoregressive V.A.R. model) constitutes a benchmark that evaluates the importance of monetary policy decisions able to support the economic growth of European countries. Last but not least, considering the ARMA model, the public debt dynamics for the next period were evaluated. The latter is analyzed from two other perspectives, the first targeting countries whose debt is below the threshold of 60% of GDP, and the other at the level of countries with a debt "starting" from the mentioned threshold. They are analyzed in stages, specific to each economy at the level of the European community, because depending on how each event is interpreted, the central bank's resources and policies can be characterized by a different degree of flexibility

Just as economic growth is rightly considered the central pillar of sustainable economic development, it in turn depends on investments in large-scale projects with real economic impact. This is the positive part, which in the last decades, (economic development) has experienced different stages. However, the negative impact should not be neglected, which, in addition to the fluctuation of macroeconomic indicators fueled by socio-economic imbalances, was fueled by the need for funds, increased financial resources, associated with ever-increasing expenses. Their impact, of spending on the level of public debt, is also confirmed by the authors Butkus *et al.* (2021). On the other hand, the correlation between public debt and economic growth is also evaluated by the authors Yamin *et al.* (2023) who claim that the two mentioned variables are dependent "on each other" and each measure, in the current geopolitical configuration, must be "weighed", with a and greater responsibility. The latter must be supported by two other components, flexibility and prudence, so that the events that have substantially affected economic growth (the financial crisis, the COVID 19 pandemic) do not repeat themselves, at least at the same level.

The results of the analysis capture another aspect, as "a complement and at the same time confirmation" of the research: The economy and the pandemic. What's next? (Daianu, 2021). In other words, the business environment "responded faster" after the shock of the pandemic than after the financial crisis (most analysts were skeptical, with forecasts between 3-4% of GDP). Practically, after the first year of the COVID 19 pandemic (2021), an economic growth of approx. 5.5% of G.D.P. (as an average of the European Union). However, what followed, starting from February 2022 (whose data was included in the study), negatively affected economic growth and development, forcing policymakers to re-scale and re-examine economic development strategies for the coming period. Moreover, as reported and in support of the efforts initiated by member countries (whether we consider all 27 states or only those in the euro area - 20 countries, starting from 2023), they must make sustained efforts of awareness, prevention, preparation and management of future events, which do not affect long-term economic stability. So, these approaches initiated by the governments of the countries through the fiscal policies, supported by the financial institutions, must determine, with tangible results, towards a homogenization, standardization of growth and sustainable development strategies. In this sense, banking consortia, together with firm policies and practices from the government, can support such measures, with attractive "offers" to induce investors to allocate significant sums in those strategic sectors of the economy. This detail can be observed, more visibly, at the level of not so developed countries, and in support of this statement the authors Shaukat *et al.* (2019) confirm the importance such an approach. As another conclusion, the economy depends on the word "depends". In other words, the unpredictability of events that have characterized the last decades and caused countless "damages" requires an approach "charged" with prudence (which is recommended, even from the central level), responsibility and not least the awareness that every decision has its own effect.

5. CONCLUSIONS

The economic and geopolitical context of the European level can be characterized as dynamic but also unpredictable. This leads to certain interpretations (sometimes sensitive from the business environment) in terms of the results in relation to the proposed objectives.

As the economic reality also confirms, they are analyzed from several perspectives, and the conclusions prove that "it is not enough to want, but also to be able". In support of these statements, the plans initiated at the European Union level come and support the efforts of governments for economic recovery, growth and development. On the other hand, the acceptance of political influence in the economy must be analyzed in a much more responsible context, more reasoned in relation to the plans and decisions undertaken.

In the same context, the idea is accepted that there must be a direct, much closer connection between financial resources, investments and human capital, from the point of view of the reforms and strategies implemented. At the same time, the competition and uncertainty of investments, from the point of view of their depreciation, could be transformed into an asset with beneficial implications for healthy economic growth as a central pillar of sustainable development. Moreover, it is observed that this existing link - both between macroeconomic indicators that express the state of health and balance of the economy (at a given moment), as well as between economic growth and public data - has determined, in recent years, a reduction in its level, not only at the level of the analyzed countries, but also as an "average" of the European community. For the following years, according to the forecast (2024-2025), this is "slightly" over 83% of G.D.P. (83.1%, 2022).

In the same context, it must be accepted that the public debt cannot increase indefinitely, and its evolution depends on the way public finances are managed, and the need for financial resources must be interpreted only in a constructive sense. A reduction or at least a stagnation of the dynamics of its evolution is also due to the fact that most governments have understood, have accumulated "experience" (from the economic, social, but also political-military events that have characterized the last decades). This detail is more visible at the level of countries whose threshold does not exceed the limit specified in the Maastricht Treaty (60% of G.D.P.) And not because these countries do not need additional funds to develop, but because the management of reserves, resources available provide enough opportunities for development, but at an acceptable level. It is one of the arguments supporting these results, but on the other hand, the other countries whose debt exceeds the mentioned threshold, have accumulated this debt in the sense of reaping the fruits of the market. In the end, no government became insolvent in the long run.

From another perspective, analyzing the economy, the mentioned report explains, as another solid argument, the difference between the truly developed countries (example: the countries that are part of the G7 group and have a debt above the mentioned level, except for Greece) and the countries on who want to align themselves with the standards imposed by the most developed states. In all this amalgam of improbable situations, also characterized by a divergence of opinions, a reanalysis of ideas is required, a delimitation of requirements and at the same time of responsibilities, reflected in a harmonious development. This is the final objective, but its achievement requires the optimal allocation of financial and material resources to those strategic branches of the economy, such as: research, development, innovation, etc. Along with these, the development of relations is required, the result of which must be concretized in bilateral (multilateral) treaties and agreements concluded, aimed at increasing security in the area, providing resources, essential products and last but not least, increasing the degree of trust.

6. LIMITATIONS AND FUTURE RESEARCH

The conclusions that emerge, following the analysis carried out, attest that the mentioned events were characterized by a high degree of unpredictability, uncertainty and present some limitations. First, it targets the states of the European Union, which, even if there are 27 of them, cannot cover the entire range of countries that can be analyzed, with the implications, mechanisms and strategies that are implemented as a result of the events and conflicts analyzed.

Secondly, the analysis focuses on the period 2000-2022, and including a longer period could provide more concrete results. In this context, a much more detailed analysis in terms of the number of countries, factors and indicators that can be considered, would lead to more solid results that can be exploited, both by the economic and the academic environment.

References

Anton, S. G., Onofrei, M., Gogu, E., Neculau, B. C., & Mihai, F. (2021). Debt Overhang, Gazelles' Growth, and Fiscal Policy: A Note from the Quantile Regression Approach. *Sustainability (Basel), 13*(8), 1-10. http://dx.doi.org/10.3390/su131810457

Barro, R. J. (1995). Inflation and Economic Growth. Retrieved from http://dx.doi.org/10.3386/w5326

Bazzaoui, L., & Nagayasu, J. (2021). Is Inflation Fiscally Determined? *Sustainability (Basel), 13*(20), 1-26. http://dx.doi.org/10.3390/su132011306

Butkus, M., Cibulskiene, D., Garsviene, L., & Seputiene, J. (2021). The Heterogeneous Public Debt - Growth Relationship: The Role of the Expenditure Multiplier. *Sustainability (Basel), 13*(9), 1-22. http://dx.doi.org/10.3390/su13094602

Daianu, D. (2021). *The Economy and the Pandemic.What's Next?* : Polirom Publishing House.

De Soyres, C., Kawai, R., & Wang, M. (2022). *Public Debt and Real GDP: Revisiting the Impact*: International Monetary Fund.

Dincă, G., Dincă, M. S., Negri, C., & Bărbuță, A. M. (2021). The Impact of Corruption and Rent-Seeking Behavior upon Economic Wealth in the European Union from a Public Choice Approach. *Sustainability (Basel), 13*(12), 1-23. http://dx.doi.org/10.3390/su13126870

Ding, K., Xu, H., & Yang, R. (2021). Taxation and Enterprise Innovation: Evidence from China's Value-Added Tax Reform. *Sustainability (Basel), 13*(10), 1-20. http://dx.doi.org/10.3390/su13105700

Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics* (5th ed. ed.): McGraw-Hill Irwin.

Heimberger, P. (2023). Do Higher Public Debt Levels Reduce Economic Growth? *Journal of Economic Surveys, Wiley Blackwell, 37*(4), 1061-1089. http://dx.doi.org/10.1111/joes.12536

Iwedi, M. (2024). Digital Finance Infrastructure and Growth of Commercial Banking Firms in Nigeria. *Discover Analytics, 2*(1), 16. http://dx.doi.org/10.21203/rs.3.rs-4051890/v1

Mencinger, J., Aristovnik, A., & Verbic, M. (2014). The Impact of Growing Public Debt on Economic Growth in the European Union. *Amfiteatru Economic Journal, 16*(35), 403-414.

National Recovery and Resilience Plan. (2022). *Next Generation EU: Funds for modern and reformed Romania*.

Olamide, E., Ogujiuba, K., & Maredza, A. (2022). Exchange Rate Volatility, Inflation and Economic Growth in Developing Countries: Panel Data Approach for SADC. *Economies, 10*(3), 1-19. http://dx.doi.org/10.3390/economies10030067

Onofrei, M., Toader, T., Vatamanu, A. F., & Oprea, F. (2021). Impact of Governments' Fiscal Behaviors on Public Finance Sustainability: A Comparative Study. *Sustainability (Basel), 13*(7), 1-16. http://dx.doi.org/10.3390/su13073739

Popa, A. F., Jimon, S. A., David, D., & Sahlian, D. N. (2021). Influence of Fiscal Policies and Labor Market Characteristics on Sustainable Social Insurance Budgets-Empirical Evidence from Central and Eastern European Countries. *Sustainability (Basel), 13*(11), 1-14. http://dx.doi.org/10.3390/su13116197

Popescu, C. C., & Diaconu (Maxim), L. (2021). Government Spending and Economic Growth: A Cointegration Analysis on Romania. *Sustainability (Basel), 13*(12), 1-16. http://dx.doi.org/10.3390/su13126575

Poudel, O., Kharel, K. R., Acharya, P., Simkhada, D., & Kafle, S. C. (2024). *ARIMA Modeling and Forecasting of National Consumer Price Index in Nepal* (Vol. 5): Interdisciplinary Journal of Management and Social Sciences. http://dx.doi.org/10.3126/ijmss.v5i1.62666

Rahman, N. H. A., Ismail, S., & Ridzuan, A. R. (2019). How does Public Debt Affect Economic Growth? A Systematic Review. *Cogent Business & Management, 6*(1), 1-16.

Revuelta, J. (2021). The Effects of the Economic Adjustment Programmes for Greece: A Quasi Experimental Approach. *Sustainability (Basel), 13*(9), 1-15. http://dx.doi.org/10.3390/su13094970

Rommerskirchen, C. W., & van der Heide, A. (2023). The Quiet Side of Debt: Public Debt Management in Advanced Economies. *Socio-economic Review, 21*(2), 1151-1170. http://dx.doi.org/10.1093/ser/mwac070

Sardoni, C. (2024). Public Spending and Growth: A Simple Model. *Structural Change and Economic Dynamics, 69*(June), 56-62. http://dx.doi.org/10.1016/j.strueco.2023.12.002

Shaukat, B., Zhu, Q., & Khan, M. I. (2019). Real Interest Rate and Economic Growth: A Statistical Exploration for Transitory Economies. *Physica A, 534*(November), 122-193. http://dx.doi.org/10.1016/j.physa.2019.122193

Stiglitz, J. E. (2017). *Euro - How the Single Currency Threatens the Future of Europe*: Publica Publishing House.

Străchinaru, A. V. (2023). The Impact of Macroeconomic Indicators of Economic Growth: An Empirical Analysis of Central and Eastern European Countries. *Journal of Financial Studies, 15*(8), 153-174. http://dx.doi.org/10.55654/JFS.2023.SP.23

Străchinaru, A. V., Siriteanu, A. A., & M, D. E. (2023). Analysis of Public Debt from the Perspective of Multicultural Factors. *Review of Economic and Business Studies, 16*(2), 23-54. http://dx.doi.org/10.47743/rebs-2023-2-0002

Thi Thuy, D. P., & H., N. T. (2021). Impacts of Openness on Financial Development in Developing Countries: Using a Bayesian Model Averaging Approach. *Cogent Economics & Finance, 9*(May), 1-17. http://dx.doi.org/10.1080/23322039.2021.1937848

Toader, T., Safta, M., Titirisca, A. C., & Firtescu, B. (2021). Effects of Digitalisation on Higher Education in a Sustainable Development Framework-Online Learning Challenges during the COVID-19 Pandemic. *Sustainability (Basel), 13*(11), 1-25. http://dx.doi.org/10.3390/su13116444

Todorov, I., Durova, K., & Aleksandrov, A. (2018). *The Economy of Bulgaria: Structural Funds, Growth and Cyclical Recurrence, A Monographic Study*: Sciendo a de Gruyter Company. http://dx.doi.org/10.2478/9783110619218

Yamin, I., Al Kasasbeh, O., Alzghoul, A., & Alsheikh, G. (2023). The Influence of Public Debt on Economic Growth: A Review of Literature. *International Journal of Professional Business Review, 8*(4), 1-11. http://dx.doi.org/10.26668/businessreview/2023.v8i4.1772

Zaman, M. J. (1998). *Correlations Between Real Interest Rates and Output in a Dynamic International Model: Evidence from G-7 Countries*: International Monetary Fund.

Zeng, G., Zhang, C., Li, S., & Sun, H. (2021). The Dynamic Impact of Agricultural Fiscal Expenditures and Gross Agricultural Output on Poverty Reduction: A V.A.R. Model Analysis. *Sustainability (Basel), 13*(11), 1-13. http://dx.doi.org/10.3390/su13115766

Scientific Annals of Economics and Business
71 (4), 2024, 583-603
DOI: 10.47743/saeb-2024-0027

Re-investigation of Financial Development on Income Inequality: An Empirical Analysis for G-20 Emerging Economies

Asiye Öznur Ümit*, Sinem Eyüboğlu**

Abstract: This research examines effects of financial development, economic growth, government expenditures, urbanization, and trade openness on income inequality in the leading emerging economies of the G-20 (Argentina, Brazil, China, India, Indonesia, Mexico, Russia, and Turkiye) for the period from 1989 to 2021. The findings confirm the existence of a cointegration nexus among the variables over the long-term. According to the common correlated effects mean group estimator, financial development has negative effects on income inequality in the panel. Factors such as government expenditures and trade openness demonstrate positive effects on income inequality. In the country-specific effects, we find that the impact of financial development on income inequality is negative and statistically significant in Argentina, India, and Russia. The influence of economic growth on income inequality is positive and significant in Indonesia, Mexico, and Turkiye. Government expenditures on income inequality appear to be positive in Argentina, Indonesia, and Mexico. Finally, trade openness demonstrates a positive and significant effect in India, Indonesia, Mexico, and Turkiye. Among the reasons for the differences in test results across countries are variations in their political structures, particularly the high inflation and macroeconomic instability in Turkey, the presence of the informal economy and corruption in Brazil, Indonesia, Turkey, and China, as well as regional inequalities. In this context, based on the overall panel test results, it is recommended that policymakers increase financial inclusion, reduce regional disparities, reduce corruption, increase social assistance, and balanced trade policy to enhance the impact of financial development on income distribution.

Keywords: : financial development; income inequality; economic growth; emerging countries.

JEL classification: F41; G20; O15; O16.

* Department of Economics, Faculty of Economics and Administrative Sciences, Ondokuz Mayıs University, Samsun/Türkiye; e-mail: *oumit@omu.edu.tr* (corresponding author).

** Department of Customs Management, Faculty of Applied Sciences, Tarsus University, Mersin/Türkiye; e-mail: *sinemeyuboglu@tarsus.edu.tr*.

Article history: Received 16 October 2024 | Accepted 29 October 2024 | Published online 19 December 2024

To cite this article: Ümit, A. Ö., Eyüboğlu, S. (2024). Re-investigation of Financial Development on Income Inequality: An Empirical Analysis for G-20 Emerging Economies. *Scientific Annals of Economics and Business*, 71(4), 583-603. https://doi.org/10.47743/saeb-2024-0027.

1. INTRODUCTION

Income inequality (IE) remains a pressing concern for policymakers and researchers worldwide, particularly in emerging economies where rapid economic growth (GDP) often coincides with widening income disparities. Understanding the multifaceted relationship between financial development (FD) and IE is crucial for formulating effective policies to promote inclusive growth. FD, encompassing the expansion and deepening of financial markets and institutions, is traditionally considered a catalyst for GDP. However, its impact on IE is more complex and nuanced, varying significantly across different contexts and stages of GDP.

In recent years, FD has emerged as a critical determinant of economic outcomes for the G-20 group of leading emerging economies, including Argentina, Brazil, China, India, Indonesia, Mexico, Russia, and Turkiye. These nations have witnessed substantial transformations in their financial sectors, characterized by increased access to financial services, greater market depth, and enhanced financial infrastructure. Despite these advancements, the benefits of FD have not been uniformly distributed, raising concerns about its potential to exacerbate IE.

The widely accepted view in the relevant literature is that FD positively influences GDP through various channels. This perspective was first explored in studies conducted by Bagehot (1873) and Schumpeter (1934) and has since been the subject of increased research. Schumpeter (1934) posited that financial intermediaries performing their functions effectively provide funds for technological development, thereby contributing to GDP through efficient investments. Levine (2005), on the other hand, argued that FD promotes GDP through multiple channels. The first of these channels is the facilitation of the exchange of goods and services through the distribution of payment systems in a developed financial system. The second is to ensure efficient utilization of savings via the financial system. The third is to supervise investments and implement corporate governance. Additionally, FD minimizes intertemporal risk and enhances liquidity. Through these channels, a well-developed financial system facilitates the productive allocation of resources, which in turn supports economic progress. Developing countries, which typically have low savings rates and require financial resources for investment, particularly benefit from an effective financial system.

On the contrary, economic globalization and the progression of information and communication technologies since the 1990s have significantly contributed to the growth of financial markets in developing countries. The financial system's development allows investors in these countries with limited savings to access resources to finance their productive projects. Consequently, these countries can experience sustained growth through increased investments, and it is believed that a fair distribution of income can be achieved with an increase in per capita income. Hence, this study aims to investigate the influence of FD on IE for the emerging G-20 countries using panel data analysis during the period 1989 to 2021. Certainly, one of the most significant features of the emerging G-20 countries is their high growth rates. However, these countries often lack sufficient domestic savings to complete their economic development processes, which necessitates the need for a well-developed financial system that can efficiently allocate resources to investors. Additionally, it is important to note that despite their high growth rates, these countries do not always have a fair distribution of income. Therefore, it is essential to examine the impact of FD on IE in emerging G-20 countries. The study's analysis includes the emerging G-20 countries

identified by the International Monetary Fund's (IMF) country classification, which includes Argentina, Brazil, China, India, Indonesia, Mexico, Russia, and Turkiye. However, data for the examination period concerning Saudi Arabia and South Africa, which are among the emerging G-20 countries, could not be obtained from the relevant statistical institutions. For this reason, Saudi Arabia and South Africa could not be included in the analysis of the study, and this situation highlights the limitations of the study.

A comprehensive review of existing literature indicates that despite numerous studies exploring the influence of FD on income distribution in developed and developing countries using diverse analytical techniques and time frames, a consensus has yet to be reached on this topic. Thus, it is essential to continue investigating the nexus between FD and income distribution, particularly in developing countries where income distribution is markedly unequal. Furthermore, it is noteworthy that no studies have been identified in the literature specifically examining the effect of FD on income distribution in emerging G-20 countries. To address this gap in the literature, this study examines the nexus between FD and IE in emerging G-20 countries. In line with this objective, variables that affect income distribution, such as economic growth, government expenditures, trade openness, and urbanization rate, have been included in the analysis as control variables. Within this framework, the main questions of the study are as follows:

- Does financial development in emerging G-20 countries increase, decrease, or first increase and then decrease income inequality?
- Does economic growth in emerging G-20 countries reduce income inequality?
- Do government expenditures in emerging G-20 countries improve income inequality?
- Does trade openness in emerging G-20 countries have an increasing or decreasing effect on income inequality?
- Does urbanization in emerging G-20 countries reduce income inequality?

Furthermore, the current study employs advanced econometric techniques such as the Westerlund (2008) cointegration test and the common correlated effects mean group (CCEMG) estimator to provide robust empirical evidence of the long-run nexus among the variables. The results of this research reveal heterogeneity in the effects of FD across various countries, emphasizing the importance of tailored policy interventions. This study not only advances academic understanding but also offers practical insights for policymakers aiming to promote inclusive GDP and reduce IE in emerging economies. These aspects of the research demonstrate its originality and contribute to the relevant literature.

The organization of this study's sections is as follows: Section 2 provides a literature review, Section 3 outlines the data set and methodology, Section 4 presents the empirical findings, and Section 5 gives conclusions and policy recommendations.

2. THEORETICAL STUDIES IN THE LITERATURE AND EMPIRICAL STUDIES IN THE LITERATURE

The relevant literature has mainly examined the impact of financial market development on economic growth. The first studies to examine the relationship between these variables were carried out by Bagehot (1873) and Schumpeter (1934). Bagehot (1873) argued that the financial sector played a crucial role in British economic growth by financing the capital necessary for economic development. Schumpeter (1934), on the other

hand, argued that if financial intermediaries performed their functions effectively, they would support investors by providing funds for technological development, thereby contributing positively to economic growth through efficiently utilised investment.

Since the 1990s, the idea that FD has significant effects on both gross domestic product GDP and income inequality IE has gained prominence in the academic literature. Three main hypotheses have been proposed to explain the relationship between FD and IE. The first hypothesis is the Financial Kuznets Curve (FKC) introduced by Greenwood and Jovanovic (1990). The theoretical basis of the Financial Kuznets Curve is derived from Kuznets (1955) inverted-U hypothesis, which examines the relationship between economic development and income inequality. According to this hypothesis, income inequality increases in the early stages of rising per capita income, but once per capita income reaches a certain threshold, further economic growth leads to a reduction in income inequality. In line with the Financial Kuznets Curve approach, FD initially exacerbates IE but later helps to reduce it. In other words, during the early phases of economic development, financial markets are nonexistent. As GDP progresses, financial markets emerge gradually. At this juncture, high-income individuals gain access to financial instruments, thereby widening the income disparity between high- and low-income individuals. However, as economic development proceeds and financial markets continue to evolve, low-income individuals also gain access to financial instruments, ultimately reducing IE. Ultimately, in the final stage of economic development, IE diminishes, and income distribution becomes more equitable among individuals (Greenwood & Jovanovic, 1990, p. 4).

The second hypothesis that addresses the nexus between FD and IE is the inequality-narrowing hypothesis, which was proposed by Galor and Zeira (1993) and Banerjee and Newman (1993). This hypothesis posits that FD has a diminishing effect on IE. The premise of this hypothesis is founded on a theoretical growth model that emphasizes the role of human capital investment, as outlined by Galor and Zeira (1993). The following growth model suggests that economies experiencing high-IE and underdeveloped financial markets exhibit lower growth rates compared to those with more equitable income distribution and well-developed financial markets. In these economies, the low growth rates exacerbate the problem of IE. Consequently, the increase in FD has a positive impact on GDP by stimulating capitalization. As a result, in a growing economy, IE tends to decrease. Moreover, with increased financial development, low-income individuals can more easily access the financial resources necessary to meet their basic needs and invest in their education. These efforts aimed at improving human capital can help to reduce IE (Canavire-Bacarreza & Rioja, 2008, p. 8).

The third hypothesis, proposed by Rajan and Zingales (2003), posits the inequality-widening hypothesis. This hypothesis postulates a positive and linear nexus between FD and IE. The hypothesis suggests that in economies where financial institutions are underdeveloped, high-income individuals enjoy a significant advantage in accessing credit relative to low-income individuals. This is because high-income individuals can utilize their assets as collateral to mitigate the risk of default when borrowing from financial intermediaries. With the expansion of financial markets, the likelihood of the low-income segment obtaining resources from the financial system remains exceedingly low. Consequently, as high-income individuals have an easier time accessing financial resources than low-income individuals, IE is expected to persist and widen (Clarke *et al.*, 2006, p. 580).

In addition to studies examining the impact of financial development on income inequality in the theoretical literature, the empirical analysis of the relationship between

these variables has attracted the attention of researchers. In this context, since the 2000s there has been an increase in the number of studies that empirically examine the relationship between these variables in the context of the GJ hypothesis, the inequality-reducing hypothesis and the inequality-increasing hypothesis.

The empirical studies that reach results supporting the GJ hypothesis are summarized as follows. Shahbaz *et al.* (2015) used the autoregressive distributed lag (ARDL) method with data for Iran for the period 1965-2011. The authors also concluded that economic growth worsens income inequality, while inflation and globalisation improve it. Zhang and Chen (2015) applied structural vector autoregression (SVAR) analysis for Iran with data for the period 1978-2013. Park and Shin (2017) used panel data method for OECD countries with data for the period 1960-2011. Meniago and Asongu (2018) used generalised method of moments (GMM) as the analytical method for 48 African countries with data for the period 1996-2014. Younsi and Bechtini (2018) applied Pedroni panel cointegration, Kao residual panel cointegration test, pooled ordinary least square (POLS) and GMM methods for BRICS countries (Brazil, Russia, India, China and South Africa) with data for the period 1995-2015. Cong Nguyen *et al.* (2019) used dynamic ordinary least squares (DOLS) and fully modified ordinary least squares (FMOLS) methods for 21 emerging economies with data for the period 1961-2017. Bittencourt *et al.* (2019) applied the fixed effects estimation method for the 50 states of the United States of America (US) with data from 1976-2011. They categorised states into two groups based on whether they had below-average or above-average IE. Their results indicated that the GJ hypothesis is only valid for states with below-average IE. Chakroun (2020) used the instrumental variable threshold regression method with cross-sectional data for 60 developed and developing countries between 1980 and 2019. Destek *et al.* (2020) developed four financial development indices for Turkiye using principal component analysis (PCA) with data for the period 1995-2015 and used the ARDL method. The authors also find that real income and government expenditures reduce income inequality. However, they also find that inflation increases income inequality in the short run and decreases it in the long run. In their study, Khanday and Tarique (2023) applied the nonlinear autoregressive distributed lag (NARDL) method and the Hatemi-j-asymmetric causality test analysis method with data for India for the years 1980-2019.

Among the empirical studies that support the inequality-narrowing hypothesis, Shahbaz and Islam (2011) used the ARDL method for Pakistan for the period 1971-2005. Moreover, contrary to the theoretical expectation, the authors find that economic growth further increases income inequality and income distribution worsens due to trade openness. Baiardi and Morana (2016) used the GMM method for 19-euro area (EA) countries with data for the period 1985-2013. Moreover, the test results show that financial development promotes economic growth. Bumann and Lensink (2016) applied the GMM method for 106 countries with data for the period 1978-2008. They found that financial liberalization improves income inequality in countries with high financial depth. Ahmed and Masih (2017) used ARDL, Granger causality test and variance decomposition (VDC) method with data covering the period 1970-2007 for Malaysia. In addition, the authors find that trade openness also reduces income inequality. Baiardi and Morana (2018) applied panel regressions for both linear and log-log specifications for 19 EA countries between 1985 and 2013. The results of the analysis show that financial development both positively affects economic growth and reduces income inequality. Jung and Vijverberg (2019) used spatial dependence modeling technique with provincial data of China for the years 1998-2014.

Thornton and Di Tommaso (2020) conducted their study with heterogeneous panel cointegration techniques for 119 countries between 1980-2015. Alshubiri (2021), who conducted his studies with data for 32 Organization Economic Cooperation and Development (OECD) and ASIAN countries for the years 2002-2018, used pooled ordinary least squares (OLS), the pooled OLS group and GMM estimator methods.

The empirical studies that reach results supporting the inequality-widening hypothesis are summarized as follows. Sehrawat and Giri (2015) used the ARDL method for the period 1982-2012 with data from India. In addition, the authors find that economic growth and inflation increase income inequality in both the short and long run, while trade openness decreases it. Jauch and Watzka (2016) applied the fixed effects static and dynamic GMM estimations method with a data set covering 138 developed and developing countries between 1960-2008. Nandelenga and Oduor (2020) used the Nonlinear Autoregressive Distributed Lag (NARDL) method with the data of 20 sub-Sahara African countries between 1980-2018. The authors find that a negative financial inclusion shock and a positive financial inclusion shock increase income inequality in sub-Sahara African countries. However, the results show that trade openness, GDP per capita and human capital reduce income inequality.

Some of the important studies in the empirical literature are shown in Table no. 1.

Table no. 1 − Summary on Literature Review on Emprical Analysis

Author(s)	Data period	Country (ies)	Type of data sources	Methodology	Results
Law and Tan (2009)	1980-2000	Malaysia	Country level	ARDL	The impact of FD on reducing IE is weak and statistically insignificant.
Shahbaz *et al.* (2015)	1965-2011	Iran	Country level	ARDL	The GJ hypothesis is valid.
Zhang and Chen (2015)	1978-2013	Iran	Country level	SVAR	The GJ hypothesis is valid.
Baiardi and Morana (2016)	1985-2013	19 EA countries	Country level	GMM method	Inequality-narrowing hypothesis is valid
Seven and Coskun (2016)	1987-2011	45 developing countries	Country level	Dynamic panel data	FD does not improve IE.
Park and Shin (2017) used panel data method for	1960-2011.	OECD countries	Country level	Panel data method	The GJ hypothesis is valid.
Baiardi and Morana (2018)	1985-2013	19 EA countries	Country level	Panel regressions for both linear and log-log specification	The inequality-narrowing hypothesis is valid
Bittencourt *et al.* (2019)	1976-2011	U.S.	States level	Fixed effects estimation method	GJ hypothesis is only valid for states with below-average IE
Nandelenga and Oduor (2020)	1980-2018	20 sub-Sahara African countries	Country level	NARDL	The inequality-widening hypothesis is valid
Thornton and Di Tommaso (2020)	1980-2015	119 countries	Country level	Heterogeneous panel cointegration techniques	The inequality-narrowing hypothesis is valid.

Author(s)	Data period	Country (ies)	Type of data sources	Methodology	Results
Alshubiri (2021)	2002-2018	32 OECD and ASIAN countries	Country level	The pooled OLS group and GMM estimator	The inequality-narrowing hypothesis is valid.

Note: The abbreviations are as follows: ARDL; autoregressive distributed lag, EA; euro area, FD; financial development, GMM; Generalized Method of Moments, IE; income inequality, NARDL; Nonlinear Autoregressive Distributed Lag, OLS; ordinary least squares, SVAR; structural vector autoregression

Some of the studies in the literature have concluded that both the inequality-narrowing hypothesis and the inequality-widening hypothesis are valid for different countries. Among these studies, Chiu and Lee (2019) analyzed the impact of both financial development and country risks on income inequality when country risks change for 59 countries for the period 1985-2015 using the panel smooth transition regression model. The results of the analysis show that the inequality-widening hypothesis holds under unstable economic, stable financial and policy conditions for the entire sample. When the authors divided the sample into high-income countries and low-income countries, they found that the inequality-narrowing hypothesis is valid in high-income countries, while the inequality-widening hypothesis is valid in low-income countries. Koçak and Uzay (2019) investigated the linear and nonlinear effects of financial development on income inequality for Turkiye by using DOLS and FMOLS methods with data for the years 1980-2013. They found that the inequality-widening hypothesis is valid in the estimation results of the linear relationship and the GJ hypothesis is valid in the estimation results of the non-linear relationship for Turkiye.

Bolarinwa *et al.* (2021) examined financial development and income inequality with the financial development indicator developed by using four financial development measures consisting of financial deepening/efficiency, stability/access with PCA analysis method for 40 African countries with data between 1995-2015. The results of the System Generalized Method of Moments (SGMM) tests indicated that the inequality-narrowing hypothesis is valid for high and middle-low-income African countries. However, the authors found that financial development does not affect income distribution inequality for low-income African countries. Bolarinwa and Akinlo (2021) used the dynamic panel threshold model method with data for the period 1999-2015 for 40 African countries. The authors concluded that the inequality-widening hypothesis is valid for high-income African countries, while the inequality-narrowing hypothesis holds true for low- and middle-income African countries.

Kavya and Shijin (2020) analyzed the validity of the GJ hypothesis using the dynamic panel GMM estimation model with data from 85 high-, middle-, and low-income countries for the period 1984-2014. The authors did not find sufficient evidence in their test results to suggest that financial and economic development significantly reduces income inequality.

In the empirical literature, there are many studies investigating the impact of financial development on income distribution for different countries/countries in different periods and with different analysis methods. However, the results of these studies have shown that different hypotheses are valid for the country/country groups they examined. This shows that there is no consensus in the empirical literature in line with the theoretical literature. In other words, this situation indicates that there is a gap in the empirical literature in line with the theoretical literature. Therefore, it is important to reinvestigate the effect of financial development on income inequality, especially in developing countries, in line with the

theoretical literature. Moreover, it has been observed that there is no study in the empirical literature that analyzes the theoretical theories for developing G-20 countries. Therefore, in this study, the effect of financial development on income inequality is analyzed by panel data method for developing G-20 countries in line with the theoretical literature. Therefore, this study attempts to fill the gap between the theoretical literature and the empirical literature.

3. DATA AND METHODOLOGY

3.1 Data and Empirical Model

The study uses annual panel data for the emerging leading countries in G-20 (Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Turkiye) during the period 1989 to 2021. Since data for Russia is available starting from 1989, the study period has been initiated from that year. Data for the examination period concerning Saudi Arabia and South Africa, which are among the emerging G-20 countries, could not be obtained from the relevant statistical institutions. Therefore, Saudi Arabia and South Africa could not be included in the analysis.

The multivariate models used in the studies conducted by Shahbaz and Islam (2011), Shahbaz *et al.* (2015), Jauch and Watzka (2016), Cong Nguyen *et al.* (2019), Koçak and Uzay (2019), Destek *et al.* (2020), Kavya and Shijin (2020), Alshubiri (2021), Bolarinwa and Akinlo (2021), and Khanday and Tarique (2023) have served as a reference for analyzing the nexus among the variables. Thus, our model can be shown as:

$$lIE_{it} = \beta_0 + \beta_1 FD_{it} + \beta_2 lGDP_{it} + \beta_3 lGOV_{it} + \beta_4 URB_{it} + \beta_5 lTO_{it} + \varepsilon_{it} \qquad (1)$$

where *i*, *t*, and l symbolize cross-sections, and the time and natural logarithm; ε indicates the normally distributed error term.

Upon examining the empirical literature, it is clear that the Gini coefficient is commonly utilized to approximate IE (Bolarinwa & Akinlo, 2021). As a result, the Gini coefficient is adopted as the variable for IE in this research.

On the other hand, GOV has an impact on IE. Specifically, transfer expenditures and social assistance provided by the public sector to meet the basic needs of low-income groups, such as education, healthcare, and housing, help reduce IE. Furthermore, by increasing total demand in the economy through the procurement of goods and services, public expenditures can positively impact employment and growth, thereby contributing to the reduction of IE. Similarly, TO also plays a significant role in IE. According to the income distribution theory developed by Stolper and Samuelson (1941), TO increases the demand for low-skilled labour in developing countries, resulting in higher wages for this group and thereby reducing IE. However, in developed countries, the increase in international trade raises the demand for skilled labour while decreasing the demand for unskilled labour. This situation leads to an increase in IE (Stockhammer, 2017). Additionally, URB also has effects on IE, which can either increase or decrease it. URB can increase employment opportunities, enabling low-income groups to earn additional income. Thus, URB can effectively reduce IE.

Taking into account the impact of GDP, GOV, TO, and URB on IE, as well as the models utilized in literature, these factors have been integrated as control variables into the model to improve its explanatory power. The use of variables in natural logarithmic form is a commonly applied method in econometrics, and there are several reasons for this. Linearizing relationships and interpreting the coefficients as elasticities in models where both the dependent and independent variables are logged are two of the main reasons for this. Therefore, all variables are transformed into their natural logarithmic forms.

The data used in the model and their sources are detailed in Table no. 2.

Table no. 2 – Variables and Data Sources

Variables	Symbol	Definition	Source
Gini Coefficient	IE	Gini coefficient	Standardized World Income Inequality Database (SWIID, 9.6) (Solt, 2019)
Financial Development Index	FD	Financial Development Index	International Monetary Fund (IMF)
Economic growth	GDP	GDP per capita is GDP divided by midyear population	World Bank, Indicators
Government expenditures	GOV	General government final consumption expenditure to GDP	World Bank, Indicators
Urbanization	URB	Urban population to total population	World Bank, Indicators
Trade openness	TO	The total of exports and imports of goods and services to GDP	World Bank, Indicators

3.2 Empirical Methodology

In the study, the CD test developed by Pesaran (2004) was first conducted to test for possible cross-sectional dependence (CSD) among the series. Subsequently, to determine whether the dataset is homogeneous, the Swamy approach by Pesaran and Yamagata (2008) was used. If panel time-series data is not homogeneous and cross-sectionally independent, conventional panel unit root tests yield inconsistent and unreliable results. After identifying CSD and slope heterogeneity, we opted to use the cross-sectionally augmented panel unit root test (CIPS) to explore the stationary levels of the variables. The presence of a cointegrating relationship among the variables was assessed using the Westerlund (2008) cointegration test. Long-term cointegration coefficients were obtained using the common correlated effects mean group (CCEMG) estimator, which provides consistent results even in the presence of CSD.

3.2.1 Testing Cross-Sectional Dependence

Managing CSD is essential when dealing with panel data. Ignoring this dependency can result in serious consequences, such as significant inaccuracies in unit root tests. Cross-correlated errors can emerge from a variety of sources, including spatial effects, overlooked common influences, or interactions within socioeconomic networks (Sencer Atasoy, 2017). We assess CSD using the CD test developed by Pesaran (2004). The CD test assesses the presence of cross-sectional dependence among units. It remains robust in cases of weak cross-sectional dependence and can effectively manage data with non-normally distributed random errors (Pesaran, 2004).

The slope homogeneity test developed by Pesaran and Yamagata (2008) assesses whether the influence of the explanatory variable varies across different cross-sections. This test retains its validity even in the presence of CSD. As outlined by Sencer Atasoy (2017), the Pesaran and Yamagata slope homogeneity test, remains robust under such conditions.

3.2.2 Panel Unit Root Test

Banerjee *et al.* (2004) highlighted the inadequacy of first-generation unit root tests for evaluating cross-sectional properties. Consequently, second-generation unit root tests have been developed to overcome this shortcoming. After identifying cross-sectional dependency and slope heterogeneity, we opted to use the CIPS, which accommodates parameter heterogeneity and serial correlation among cross-sections when analyzing the stationarity of variables. Pesaran (2007) introduced the CIPS test as a novel method for assessing stationarity. These second-generation panel unit root tests have become increasingly popular in empirical research, playing a vital role in examining stationary properties across various contexts.

3.2.3 Panel Cointegration and Causality Test

In addressing cross-sectional dependency (CSD), researchers frequently turn to the Durbin-Hausman panel cointegration test, which provides a valuable method without requiring prior knowledge of the variables' order of integration (Westerlund, 2008). The fact that this test specifically addresses the issue of CSD makes it an important choice in our study. The Durbin-Hausman test comprises two separate assessments: the Durbin-Hausman Panel (DH_p) test and the Durbin-Hausman Group (DH_g) test. The DH_p statistic operates based on the assumption of slope homogeneity, while the DH_g statistic operates under the assumption of slope heterogeneity. When the calculated test statistics surpass the critical value, it indicates rejecting the null hypothesis of "no cointegration." This way, it provides an appropriate methodology for testing cointegration among variables while addressing cross-sectional dependence. Once cointegration is established among the variables, we turn to the CCEMG estimator to investigate the long-term effects of the independent variables. Pesaran (2006) presents two distinct estimators for panel data analysis. The first one is the CCEMG estimator, which considers parameter heterogeneity across individual entities. The second estimator is the common correlated effects pooled (CCEP), assuming parameter homogeneity across all entities in the panel.

Considering cross-sectional dependence and heterogeneous slopes is crucial for the econometric model to make accurate predictions. Given the presence of both CSD and heterogeneity in slopes, we utilize the CCEMG panel data estimator. This method, developed by Pesaran (2006), is resilient to variations in slopes across different groups and considers the interdependence among cross-sectional units. Kapetanios *et al.* (2011) extended Pesaran (2006) methods to cover the case where unobserved common factors are nonstationary. They have showed that, despite the presence of unit roots in the unobserved common factors, the CCE estimators remain consistent and are also robust to structural breaks in the means of these factors. This ensures more reliable and robust results. This estimator works efficiently when the data involves panel heterogeneity and multifactor error components. Therefore, it utilizes the group averages of common effects and variables in a

linear combination (Dong *et al.*, 2017). The insights derived from the outcomes of the CCEMG estimators provide a valuable understanding of how independent variables influence IE. However, these results do not establish causal relationships between our variables of interest.

Dumitrescu and Hurlin (2012) state that the causality relationship existing for any given country within the context of panel data is also valid for different countries, and provides effective results with an increase in the number of observations. To deepen our insights, we integrate the causality test formulated by Dumitrescu and Hurlin (2012), lauded for its robustness against cross-sectional dependency (CSD) and parameter diversity. Their Granger causality test is adept for unbalanced and heterogeneous panels, as well as when (T > N) or (T < N). This test overcomes the uniformity assumption of a standard Granger causality test and effectively tackles CSD issues in panel data.

4. FINDINGS AND DISCUSSION

In panel data studies, the standard assumption is that the series are cross-sectionally independent, neglecting the presence of CSD within the panel. Overlooking this aspect can result in substantial bias and distortion in the results. Table no. 3 demonstrates the implications of CSD and homogeneity in the panel data. The findings indicate the existence of CSD and heterogeneous slope coefficients, suggesting that a shock experienced by one of the leading emerging countries can have a propagating effect on other nations.

Table no. 3 – CSD and Slope Homogeneity Tests

	Statistics	**Prob.**
CD Test	17.100	0.001
$\tilde{\Delta}$	10.880	0.001
$\tilde{\Delta}_{adj}$	11.990	0.001

Note: Δ and Δ_{adj} symbolize delta (Δ) and the adjusted delta on Swamy approach
Source: Author's estimations.

In the empirical analysis, the determination of the unit root properties of the variables constitutes the second step. Given that the variables exhibit unit roots, employing traditional estimators such as ordinary least squares, fixed effects, and random effects may lead to spurious regression. Thus, it is crucial to ascertain the unit root properties of the variables and utilize estimators that appropriately account for these properties.

First-generation tests inadequately address the CSD or heterogeneity present within panel data. Table no. 4 presents the results of the CIPS test. The findings indicate that the variables contain unit roots at their levels. However, when considering the first differences of the variables, the null hypothesis is rejected. In other words, all variables become stationary in their first differences at the 0.01 significance level.

Table no. 4 – CIPS Panel Unit Root Test

	Level	First Difference	Result
lIE	-1.766	-2.674**	I(1)
lFD	-1.886	-3.820***	I(1)
lGDP	-1.824	-4.102***	I(1)
lGOV	-1.414	-4.218***	I(1)
lURB	-1.553	-2.720***	I(1)
lTO	-2.194	-4.129***	I(1)

Note: ***, **, denote significance at 0.01, 0.05.
Source: Author's estimations.

Upon establishing that the variables display stationary behavior at I(1), the subsequent inquiry is focused on determining if there exists a cointegrating relationship among them. This determination is made through the application of the Westerlund (2008) cointegration test, a widely utilized method in the literature for this purpose. The cointegration analysis aims to uncover if a long-term relationship exists between the variables. Identifying a cointegration relationship is essential, as it enables the formulation of policies based on the pertinent variables. Table no. 5 showcases the panel cointegration results. The null hypothesis, positing the absence of cointegration, is rejected at the 1% significance level. Consequently, the findings validate the presence of a cointegration nexus among the variables in the long-term.

Table no. 5 –Westerlund (2008) Cointegration Test

	Test Statistics
DH_g	319.81***
DH_p	73.096***

Note: *** indicates significance at 0.01.
Source: Author's estimations

After revealing the cointegration linkages among variables, long-term coefficients are estimated by the CCEMG estimator. The results are presented in Table no. 6.

Table no. 6 – CCEMG Long-Term Coefficients

Country	**lFD**	**lGDP**	**lGOV**	**lURB**	**lTO**
Argentina	-0.054***	0.027	0.003*	-0.4	0.012
Brazil	-0.055	-0.433***	0.003	0.01	-0.013
China	-0.058	-0.320*	0.082	0.655***	0.004
India	-0.115*	-0.018	0.075	0.209	0.221***
Indonesia	-0.177	0.163***	0.111***	0.215	0.073***
Mexico	0.001*	0.098*	0.080**	-0.692	0.063**
Russia	-0.037***	-0.116**	-0.084	0.142***	-0.021
Turkiye	0.019	0.167***	0.028	0.752	0.026**
Panel	-0.039***	-0.005	0.004**	0.111	0.045*

Note: ***, **, and * indicate significance for 0.01, 0.05 and 0.10.
Source: Author's estimations.

According to the CCEMG estimator, FD negatively affects IE in the panel. This finding is consistent with Shahbaz and Islam (2011), Shahbaz *et al.* (2015), Baiardi and Morana (2016), Bumann and Lensink (2016), Ahmed and Masih (2017), Baiardi and Morana (2018), Jung and Vijverberg (2019), Thornton and Di Tommaso (2020). The negative trade-off between FD and IE can be explained in several different ways. First improved FD often leads to greater access to financial services for individuals across different income levels. This access allows lower-income individuals to invest in education, health, and entrepreneurship, thereby enhancing their income-generating opportunities. Second FD fosters entrepreneurship and innovation by providing funding and support to small and medium-sized enterprises (SMEs) and startups. This can lead to the creation of new job opportunities and income sources, particularly benefiting those at the lower end of the income distribution. Third a well-functioning financial system can facilitate wealth redistribution through mechanisms such as progressive taxation, social welfare programs funded by financial intermediaries, and targeted lending programs for disadvantaged groups. These initiatives can help reduce IE by ensuring that wealth is more equitably distributed across society.

Other factors that positively affect IE are GOV and TO. If GOV is disproportionately allocated towards sectors or programs that primarily benefit higher-income groups (such as subsidies for industries dominated by wealthy individuals or lavish infrastructure projects in affluent areas), it can widen income disparities. Also, government subsidies and transfers aimed at providing social assistance or support to low-income households may not always effectively reach their intended beneficiaries. Inefficient targeting mechanisms or corruption can lead to leakage of funds, benefiting wealthier individuals or groups instead of the intended recipients. Excessive GOV financed through money creation or deficit spending can lead to inflation, which tends to disproportionately affect the purchasing power of low-income households. This can widen IE by eroding the real incomes of the poor while having less impact on the wealthier segments of society.

TO can lead to structural changes in the economy, with resources shifting from sectors that employ low-skilled workers (such as agriculture or traditional manufacturing) to sectors that employ high-skilled workers (such as technology or services). This can exacerbate IE by reducing employment opportunities and wages for low-skilled workers while benefiting high-skilled workers. TO may favor larger, more productive firms better equipped to compete in international markets, while smaller firms may struggle to survive or be forced out of business. This can result in an increased concentration of wealth and income among a small number of large firms and their owners, leading to higher IE. In some cases, governments may respond to increased import competition by implementing policies that disproportionately benefit certain groups or sectors, leading to further income disparities. For example, subsidies or protectionist measures may be introduced to support declining industries, benefiting specific groups while imposing costs on others.

On the other hand, we find that there are no statistically significant effects of GDP and URB on IE. It is commonly assumed GDP leads to higher incomes for all segments of society, thereby reducing IE through a trickle-down effect. However, the finding suggests that any such effect may be non-existent in the studied context. This could imply that the benefits of GDP are not evenly distributed across different income groups. URB can have both positive and negative effects on IE. While URB may provide opportunities for economic growth, job creation, and access to services, it can also lead to increased

competition for resources and employment, as well as spatial segregation between affluent and impoverished urban areas. In this case, the net effect of URB on IE may be negligible.

Moreover, Table no.6 also reports the long-term coefficients for each country. The effect of FD on IE is negative and statistically significant in Argentina, India, and Russia. This finding supports the studies conducted by Baiardi and Morana (2016), Ahmed and Masih (2017), Baiardi and Morana (2018), Thornton and Di Tommaso (2020), Alshubiri (2021) in the literature. Policies aimed at promoting financial inclusion and expanding access to financial services for marginalized and underserved populations can play a crucial role in reducing IE. By empowering individuals to participate more fully in economic activities and access resources for investment and consumption, FD can contribute to a more inclusive and equitable society in these countries. We also explore that FD has a positive effect on IE in Mexico. This finding is consistent with the studies conducted by Sehrawat and Giri (2015), Seven and Coskun (2016), Jauch and Watzka (2016), and Koçak and Uzay (2019). While FD may lead to overall GDP and development, it may also exacerbate IE if the benefits of financial services are unequally distributed among different income groups. In Mexico, the expansion of financial services may primarily benefit wealthier individuals or certain sectors of the economy, leading to widening income disparities. FD has no statistically significant effect on IE in Brazil, China, Indonesia, and Turkiye. In these countries, the existence of an informal economy limits the impact of financial development on income distribution. Namely, individuals who work informally cannot benefit from the services provided by the financial sector (-credit etc. provided by the banking sector). Therefore, the limited financial inclusion due to the informal economy in these countries leads to a decrease in the impact of financial sector development on income distribution. The existence of corruption in these countries is also one of the important factors that reduce the efficiency of the financial sector. Corruption prevents the efficient allocation of financial resources and makes it difficult for economic agents to benefit from financial opportunities. In addition, the inadequacy of regulatory and supervisory institutions in the financial system and the lack of financial literacy in these countries limit the impact of the financial sector on income distribution. In addition, especially in Turkey, macroeconomic instability and high inflation significantly reduce the purchasing power of low- and middle-income individuals. This situation leads high-income individuals to benefit more from the services provided by the financial sector in Turkey, thus reducing the impact of the financial sector on income distribution.

The impact of GDP on IE is positive and significant in Indonesia, Mexico, and Turkiye. GDP may disproportionately benefit certain segments of the population, such as wealthy individuals or specific industries, leading to widening income disparities. In Indonesia, Mexico, and Turkiye, the benefits of GDP may not be evenly distributed across different income groups, resulting in an increase in IE. Results also indicate that impact of GDP on IE is negative and significant in Brazil and Russia. Both Brazil and Russia are rich in natural resources, such as oil, gas, and minerals, which can drive GDP and contribute to reductions in IE. Revenue generated from the extraction and export of natural resources may be used to fund social programs, infrastructure development, and poverty alleviation initiatives, benefiting a wide range of individuals and communities.

The effect of GOV on IE appears to be positive in Argentina, Indonesia, and Mexico. Inefficient allocation and management of government resources may contribute to IE by failing to address the needs of the poorest segments of society. In Argentina, Indonesia, and Mexico, corruption, bureaucracy, and lack of transparency in public spending may limit the effectiveness

of government interventions aimed at reducing income disparities. Broader macroeconomic factors, such as inflation, fiscal deficits, and debt levels may also influence the relationship between GOV and IE. In Argentina, Indonesia, and Mexico, unsustainable fiscal policies or macroeconomic instability may exacerbate IE by undermining GDP and increasing poverty levels.

Another factor that positively affects IE is the URB in China and Russia. URB in China and Russia may exacerbate IE by widening the gap between urban and rural areas. Rapid URB may lead to unequal access to economic opportunities, social services, and infrastructure between urban centers and rural regions, resulting in higher IE. URB may lead to large-scale migration from rural to urban areas in China and Russia, creating challenges in integrating migrants into the urban labor market. Migrant workers may face discrimination, low wages, and limited access to social welfare benefits, contributing to income disparities within urban areas and overall IE.

Finally, TO has a positive and significant effect on IE in India, Indonesia, and Mexico, and Turkiye. TO may lead to structural changes in the economy, with certain industries benefiting more from increased trade than others. In India, Indonesia, Mexico, and Turkiye, trade liberalization may disproportionately benefit industries that are capital-intensive or export-oriented, leading to income disparities between sectors and contributing to overall IE. TO may lead to changes in labor market dynamics, including shifts in employment patterns, wage differentials, and job insecurity. In India, Indonesia, Mexico, and Turkiye, increased competition from foreign goods and changes in comparative advantage may lead to displacement of workers in less competitive sectors, exacerbating IE and widening the wage gap between skilled and unskilled workers. Similar results have also been obtained in different studies. Aghion *et al*. (2004), in their study, found similar results for India, stating that India's 1991 trade liberalization promoted growth only in the most productive Indian industries located in already advantaged states. They also emphasized that this increased regional inequalities. In addition, Daumal (2013) found that in India, the increase in industrial exports compared to agricultural exports has reinforced this inequality. Kuncoro and Murbarani (2016) found that the increase in TO has a positive effect on IE between provinces in Indonesia. The main reason for this is that approximately 60% of exports are concentrated in three provinces. Another reason is that Indonesia's exports are concentrated in the main export products of only a few provinces. González Rivas (2007) stated that in Mexico, trade openness benefits regions with higher income and infrastructure, thereby increasing IE. Topuz and Dağdemir (2020) stated that TO increases IE in Turkiye. They also found that as the income gap between the agricultural and industrial sectors widens, there is an increasing trend in overall income inequality.

The Dumitrescu and Hurlin (2012) causality test is used to causality nexus among IE, FD, GDP, GOV, URB, and TO the results are presented in Table no. 7.

Table no. 7 – Dumitrescu and Hurlin Panel Causality Test

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
ΔlIE does not homogeneously cause ΔlFD	2.317	2.171	0.030
ΔlFD does not homogeneously cause ΔlIE	8.010	6.163	0.001
ΔlIE does not homogeneously cause ΔlGDP	2.405	2.326	0.020
ΔlGDP does not homogeneously cause ΔlIE	1.808	1.280	0.200

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
ΔlIE does not homogeneously cause ΔlGOV	0.588	-0.856	0.392
ΔlGOV does not homogeneously cause ΔlIE	2.369	2.262	0.024
ΔlIE does not homogeneously cause ΔlURB	2.502	2.496	0.013
ΔlURB does not homogeneously cause ΔlIE	0.600	-0.835	0.404
ΔlIE does not homogeneously cause ΔlTO	1.447	0.648	0.517
ΔlTO does not homogeneously cause ΔlIE	2.565	2.606	0.009

Note: Δ symbolizes first differences.

Source: Author's estimations

Findings indicate a bidirectional causality relationship between FD and IE. This result indicates that any change in FD will affect IE and vice versa in the short-term. An increase in FD, such as improvements in access to financial services, development of capital markets, or expansion of banking services, may lead to changes in income distribution. For example, increased access to credit and investment opportunities may stimulate GDP and job creation, potentially reducing IE. Conversely, if FD primarily benefits wealthier individuals or exacerbates financial exclusion, it may lead to widening income disparities.

We also found causality from IE to GDP in the panel. The channels through which IE affects GDP can vary and may include both demand-side and supply-side factors. On the demand side, IE may lead to lower levels of aggregate demand as lower-income households have limited purchasing power, which can dampen consumer spending and investment. On the supply side, IE may affect factors such as human capital accumulation, labor market efficiency, and technological innovation, all of which are critical determinants for GDP.

The identification of causality from GOV to IE in the short-term suggests that changes in government expenditures can lead to immediate adjustments in IE levels. For example, increases in GOV on social assistance programs or progressive taxation policies may result in a reduction in IE in the short-term as resources are redistributed to lower-income groups. Conversely, cuts in government spending on social programs or austerity measures may exacerbate IE by reducing support for vulnerable populations.

We find that IE is the cause of URB. IE can affect patterns of URB through various channels. Higher levels of IE may lead to rural-urban migration as individuals seek better economic opportunities and living conditions in urban areas. Income disparities can create push factors such as limited job prospects and low wages in rural areas, while pull factors such as higher wages, access to services, and social mobility in urban centers may attract migrants. As a result, increasing IE may drive higher rates of URB as more people move to cities in search of improved livelihoods.

The other finding of the Dumitrescu and Hurlin (2012) test is that TO is the cause of IE. TO refers to the degree to which an economy is integrated into the global economy through trade in goods and services. Changes in trade policies, such as tariff reductions, trade agreements, and globalization, can affect income distribution within a country. TO may lead to positive and negative effects on IE, depending on various factors such as the economy's structure, the competitiveness of domestic industries, and the distributional effects of trade liberalization.

These results indicate that FD, GOV, and TO are important determinants of IE in the short-term. Overall, the identification of FD, GOV, and TO as important determinants of the IE in the short-term underscores the multifaceted nature of IE and the diverse range of factors that can influence its dynamics. Policymakers should consider implementing targeted interventions and policies aimed at addressing these determinants to promote more equitable socio-economic outcomes and foster inclusive development.

5. CONCLUSION AND POLICY IMPLICATIONS

Analyzing the effect of FD on IE in emerging G-20 nations is a significant issue, especially for developing countries that lack equitable income distribution or a well-developed financial system. This research examines the impact of FD on IE for emerging G-20 countries from 1989 to 2021 using panel data methodology. The study includes the emerging G-20 countries identified in the IMF country classification, such as Argentina, Brazil, China, India, Indonesia, Mexico, Russia, and Turkiye. Unfortunately, due to a lack of data, Saudi Arabia and South Africa, though part of the emerging G-20 group, were not included in the analysis.

According to the study, the Westerlund (2008) cointegration test revealed a long-term relationship among the variables. The CCEMG estimator results for the panel demonstrated that FD has a negative impact on IE, which supports the inequality-narrowing hypothesis. However, the findings also showed that GOV and TO have a positive effect on IE. Furthermore, the results indicated that GDP and URB do not have a statistically significant impact on IE in the panel.

At the country-specific level, CCEMG analysis results indicate that FD reduces IE in Argentina, India, and Russia. For Mexico, the test results indicate that FD worsens IE. In this context, it can be said that the inequality-widening hypothesis is valid in Mexico during the study period. In Brazil, China, Indonesia, and Turkiye, FD was found no statistically significant impact on IE.

On the other hand, CCEMG results show that GDP increases IE in Indonesia, Mexico, and Turkiye. In Brazil and Russia, GDP was found to contribute to equitable income distribution. Additionally, the results indicate that GOV increases IE in Argentina, Indonesia, and Mexico. URB was found to worsen IE in China and Russia, while TO was found to worsen IE in India, Indonesia, Mexico, and Turkiye.

Policy recommendations to address IE in emerging G-20 countries include enhancing financial inclusion by promoting access to financial services through microfinance, mobile banking, and financial literacy programs, and by providing funding and support to SMEs and startups to foster entrepreneurship and create job opportunities for lower-income individuals. Governments should ensure efficient allocation of expenditures by targeting social programs and subsidies to low-income households, improving transparency and efficiency in public spending, and investing in public goods like education, healthcare, and infrastructure to promote inclusive growth. Balanced trade policies are also essential, with measures to support and retrain workers displaced by trade liberalization and promote inclusive trade policies that benefit a wide range of industries and workers. Addressing urban-rural disparities through investments in rural infrastructure, education, and healthcare can reduce income gaps, while inclusive URB policies can ensure equitable access to economic opportunities and services in urban areas. Additionally, macroeconomic stability

should be pursued through sustainable fiscal policies and measures to control inflation, protect the purchasing power of low-income households, and reduce income disparities. By implementing these comprehensive policy measures, emerging G-20 countries can effectively harness the benefits of FD while mitigating its potential adverse effects on IE, leading to more inclusive and sustainable GDP and a fairer income distribution.

The recommended policies for Argentina, India and Russia where the inequality-narrowing hypothesis is valid are as follows:

- The financial sector should provide microfinance to facilitate access to the financial system for low-income households and small-scale enterprises. In this way, more individuals can have opportunities to invest capital and start new businesses.

- Digital financial services need to be made more widespread. In this way, access to financial services, especially for individuals in rural areas, can be facilitated. This may reduce inequality in income distribution.

- In these countries, the concentration of financial services in specific regions increases income inequality. Therefore, it is recommended to eliminate regional disparities in these countries.

For Mexico, where the inequality-widening hypothesis is applicable, it is recommended to establish a more balanced and stable economic structure. Financial development can support economic growth; however, only high-income individuals benefit from this growth, which can increase income inequality. In this context, it is crucial to ensure access to financial services for low-income groups and to strengthen the oversight of regulatory institutions in the financial system. Stricter regulations should be implemented in Mexico's financial system to limit the impact of speculative activities and excessive risk-taking on low-income groups. Furthermore, a fairer trade policy is necessary in Mexico. A fair-trade policy can enable small and medium-sized enterprises to benefit more from trade opportunities, thereby reducing income inequality. Additionally, to prevent the concentration of financial development in certain regions, special incentives should be provided for rural areas, and infrastructure investments should be increased. This would help address regional imbalances and create a more balanced income distribution in both urban and rural areas. In addition to these policy recommendations, Mexico should also pursue a fair tax policy aimed at reducing income inequality, increase social assistance for low-income groups, and improve the education system.

Future research could concentrate on comparing various regions or income groups within countries or investigating the effects of FD on different sectors of the economy and their respective contributions to IE. By identifying which sectors gain the most from FD, policymakers can develop more targeted and effective interventions. Moreover, since data for Saudi Arabia and South Africa, which are among the emerging G-20 countries, were not available during the period under review, these countries could not be included in the analysis. This situation shows the limitations of the study. Due to this limitation of the study, it is suggested that future studies on this topic should be conducted for these countries as well, if the relevant data for these countries can be obtained.

ORCID

Asiye Öznur Ümit https://orcid.org/0000-0003-0459-4240
Sinem Eyüboğlu https://orcid.org/0000-0002-3525-9173

References

Aghion, P., Burgess, R., Redding, S., & Zilibotti, F. (2004). The Unequal Effects of Liberalization: Theory and Evidence from India. *Society for Economic Dynamics, Discussion Paper*(40).

Ahmed, A. R., & Masih, M. (2017). What is the link between financial development and income inequality? Evidence from Malaysia. *MRPA Paper*(79416), 1-28.

Alshubiri, F. (2021). Financial deepening indicators and income inequality of OECD and ASIAN countries. *The Journal of Economic Asymmetries*(24), 1-21. http://dx.doi.org/10.1016/j.jeca.2021.e00211

Bagehot, W. (1873). *Lombard street (1962 Edition). Richard D. Irwin Publishing: Homewood, Illinois*.

Baiardi, D., & Morana, C. (2016). The financial Kuznets curve: Evidence for the euro area. *Journal of Empirical Finance, 39*(Part B, December), 265–269. http://dx.doi.org/10.1016/j.jempfin.2016.08.003

Baiardi, D., & Morana, C. (2018). Financial development and income distribution inequality in the euro area. *Economic Modelling, 70*(C), 40-55. http://dx.doi.org/10.1016/j.econmod.2017.10.008

Banerjee, A., Marcellino, M., & Osbat, C. (2004). Some cautions on the use of panel methods for integrated series of macroecnomic data. *The Econometrics Journal, 7*(2), 322-340. http://dx.doi.org/10.1111/j.1368-423X.2004.00133.x

Banerjee, A. V., & Newman, A. F. (1993). Occupational choice and the process of development. *Journal of Political Economy, 101*(2), 274–298. http://dx.doi.org/10.1086/261876

Bittencourt, M., Chang, S., Gupta, R., & Miller, S. M. (2019). Does financial development affect income inequality in the US States? *Journal of Policy Modeling, 41*(6), 1043-1056. http://dx.doi.org/10.1016/j.jpolmod.2019.07.008

Bolarinwa, S. T., & Akinlo, A. E. (2021). Is there a nonlinear relationship between financial development and income inequality in Africa? Evidence from dynamic panel threshold. *The Journal of Economic Asymmetries, 24*(e00226), 1-9. http://dx.doi.org/10.1016/j.jeca.2021.e00226

Bolarinwa, S. T., Vo, X. V., & Olufolahan, T. J. (2021). The effect of financial development on income inequality in Africa. *Development Southern Africa, 38*(2), 311-329. http://dx.doi.org/10.1080/0376835x.2020.1838261

Bumann, S., & Lensink, R. (2016). Capital account liberalization and income inequality. *Journal of International Money and Finance, 61*(March), 143-162. http://dx.doi.org/10.1016/j.jimonfin.2015.10.004

Canavire-Bacarreza, G. J., & Rioja, F. K. (2008). Financial development and the distribution of income in Latin America and the Caribbean. *IZA Discussion Paper, 3796*, 1-20. http://dx.doi.org/10.2139/ssrn.1293588

Chakroun, M. (2020). Threshold effects in the relationship between financial development and income inequality. *International Journal of Finance & Economics, 25*(3), 365–387. http://dx.doi.org/10.1002/ijfe.1757

Chiu, Y. B., & Lee, C. C. (2019). Financial development, income inequality, and country risk. *Journal of International Money and Finance, 93*(May), 1-18. http://dx.doi.org/10.1016/j.jimonfin.2019.01.001

Clarke, G. R., Xu, L. C., & Zou, H. F. (2006). Finance and income inequality: What do the data tell us? *Southern Economic Journal, 72*(3), 578-596. http://dx.doi.org/10.1002/j.2325-8012.2006.tb00721.x

Cong Nguyen, T., Ngoc Vu, T., Hong Vo, D., & Thi-Thieu Ha, D. (2019). Financial development and income inequality in emerging markets: a new approach. *Journal of Risk and Financial Management, 12*(4), 1-14. http://dx.doi.org/10.3390/jrfm12040173

Daumal, M. (2013). The Impact of Trade Openness on Regional Inequality: The Cases of India and Brazil. *The International Trade Journal, 27*(3), 243–280. http://dx.doi.org/10.1080/08853908.2013.796839

Destek, M. A., Sinha, A., & Sarkodie, S. A. (2020). The relationship between financial development and income inequality in Turkiye. *Journal of Economic Structures, 9*(11), 1-14. http://dx.doi.org/10.1186/s40008-020-0187-6

Dong, K., Sun, R., & Hochman, G. (2017). Do Natural Gas and Renewable Energy Consumption Lead to Less CO2 Emission? Empirical Evidence from a Panel of BRICS Countries. *Energy, 141*(December), 1466-1478. http://dx.doi.org/10.1016/j.energy.2017.11.092

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for granger non-causality in heterogeneous panels. *Economic Modelling, 29*(4), 1450–1460. http://dx.doi.org/10.1016/j.econmod.2012.02.014

Galor, O., & Zeira, J. (1993). Income distribution and macroeconomics. *The Review of Economic Studies, 60*(1), 35-52. http://dx.doi.org/10.2307/2297811

González Rivas, M. (2007). The effects of trade openness on regional inequality in Mexico. *The Annals of Regional Science, 41*, 545–561. http://dx.doi.org/10.1007/s00168-006-0099-x

Greenwood, J., & Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *Journal of Political Economy, 98*(5, Part 1), 1-42. http://dx.doi.org/10.1086/261720

IMF. Financial Development Index. Retrieved 23 April 2024 https://data.imf.org/?sk=f8032e80-b36c-43b1-ac26-493c5b1cd33b

Indicators, W. D. Retrieved from: https://databank.worldbank.org/source/world-development-indicators

Jauch, S., & Watzka, S. (2016). Financial development and income inequality: A panel data approach. *Empirical Economics, 51*, 291–314. http://dx.doi.org/10.1007/s00181-015-1008-x

Jung, S. M., & Vijverberg, C. P. C. (2019). Financial development and income inequality in China–A spatial data analysis. *The North American Journal of Economics and Finance, 48*(April), 295–320. http://dx.doi.org/10.1016/j.najef.2019.03.001

Kapetanios, G., Pesaran, M. H., & Yamagata, T. (2011). Panels with non-stationary multifactor error structures. *Journal of Econometrics, 160*(2), 326-348. http://dx.doi.org/10.1016/j.jeconom.2010.10.001

Kavya, T. B., & Shijin, S. (2020). Economic development, financial development, and income inequality nexus. *Borsa Istanbul Review, 20*(1), 80-93. http://dx.doi.org/10.1016/j.bir.2019.12.002

Khanday, I. N., & Tarique, M. (2023). Does income inequality respond asymmetrically to financial development? Evidence from India using asymmetric cointegration and causality tests. *The Journal of Economic Asymmetries, 28*(e00341), 1-19. http://dx.doi.org/10.1016/j.jeca.2023.e00341

Koçak, E., & Uzay, N. (2019). The effect of financial development on income inequality in Turkiye: An estimate of the Greenwood-Jovanovic hypothesis. *Review of Economic Perspectives, 19*(4), 319–344. http://dx.doi.org/10.2478/revecp-2019-0017

Kuncoro, M., & Murbarani, N. (2016). Regional inequality in Indonesia, 1994-2012. *The Business and Management Review, 8*(1), 38-52.

Kuznets, S. (1955). Economic Growth and Income Inequality. *The American Economic Review, 45*(1), 1-28.

Law, S. H., & Tan, H. B. (2009). The role of financial development on income inequality in Malaysia. *Journal of Economic Development, 34*(2), 153-168. http://dx.doi.org/10.35866/caujed.2009.34.2.008

Levine, R. (2005). Finance and Growth: Theory and Evidence. *Handbook of economic growth, 1*, 865-934.

Meniago, C., & Asongu, S. A. (2018). Revisiting the finance-inequality nexus in a panel of African countries. *Research in International Business and Finance, 46*, 399-419. http://dx.doi.org/10.1016/j.ribaf.2018.04.012

Nandelenga, M. W., & Oduor, J. (2020). Asymmetric analysis of finance-Inequality nexus: Evidence from sub-Saharan Africa. *The Journal of Economic Asymmetries, 22*(e00184), 1-13. http://dx.doi.org/10.1016/j.jeca.2020.e00184

Park, D., & Shin, K. (2017). Economic growth, financial development, and income inequality. *Emerging Markets Finance and Trade, 53*(12), 2794-2825. http://dx.doi.org/10.1080/1540496x.2017.1333958

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers *Economics, 1240*(1).

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica, 74*(4), 967-1012. http://dx.doi.org/10.1111/j.1468-0262.2006.00692.x

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*(2), 265–312. http://dx.doi.org/10.1002/jae.951

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics, 142*(1), 50-93. http://dx.doi.org/10.1016/j.jeconom.2007.05.010

Rajan, R. G., & Zingales, L. (2003). The great reversals: The politics of financial development in the twentieth century. *Journal of Financial Economics, 69*(1), 1-62. http://dx.doi.org/10.1016/s0304-405x(03)00125-9

Schumpeter, J. A. (1934). *The theory of economic development (R. Opie, Trans.).*

Sehrawat, M., & Giri, A. K. (2015). Financial development and income inequality in India: An application of ARDL approach. *International Journal of Social Economics, 42*(1), 64-81. http://dx.doi.org/10.1108/ijse-09-2013-0208

Sencer Atasoy, B. (2017). Testing the environmental Kuznets curve hypothesis across the US: Evidence from panel mean group estimators. *Renewable & Sustainable Energy Reviews, 77*(September), 731–747. http://dx.doi.org/10.1016/j.rser.2017.04.050

Seven, U., & Coskun, Y. (2016). Does financial development reduce income inequality and poverty? Evidence from emerging countries. *Emerging Markets Review, 26*, 34-63. http://dx.doi.org/10.1016/j.ememar.2016.02.002

Shahbaz, M., & Islam, F. (2011). Financial development and income inequality in Pakistan: An application of ARDL approach. *Munich Personal RePEc Archive Paper, 28222*, 1-21.

Shahbaz, M., Loganathan, N., Tiwari, A. K., & Sherafatian-Jahromi, R. (2015). Financial development and income inequality: Is there any financial Kuznets curve in Iran? *Social Indicators Research, 124*, 357–382. http://dx.doi.org/10.1007/s11205-014-0801-9

Stockhammer, E. (2017). Determinants of the wage share: A panel analysis of advanced and developing economies. *British Journal of Industrial Relations, 55*(1), 3-33. http://dx.doi.org/10.1111/bjir.12165

Stolper, W. F., & Samuelson, P. A. (1941). Protection and Real Wages. *Review of Economic Studies, 9*, 58-73.

Thornton, J., & Di Tommaso, C. (2020). The long-run relationship between finance and income inequality: Evidence from panel data. *Finance Research Letters, 32*, 1-6. http://dx.doi.org/10.1016/j.frl.2019.04.036

Topuz, S. G., & Dağdemir, Ö. (2020). Analysis of the relationship between trade openness, structural change, and income inequality under Kuznets curve hypothesis: The case of Turkiye. *The Journal of International Trade & Economic Development, 29*(6), 647-664. http://dx.doi.org/10.1080/09638199.2019.1711146

Westerlund, J. (2008). Panel cointegration tests of the Fisher effect. *Journal of Applied Econometrics, 23*(2), 193–233. http://dx.doi.org/10.1002/jae.967

Younsi, M., & Bechtini, M. (2018). Economic growth, financial development and income inequality in BRICS countries: Evidence from panel granger causality tests. *Munich Personal RePEc Archive Paper, 85182*, 1-17.

Zhang, Q., & Chen, R. (2015). Financial development and income inequality in China: An application of SVAR approach. *Procedia Computer Science, 55*(1), 774–781. http://dx.doi.org/10.1016/j.procs.2015.07.159

Scientific Annals of Economics and Business
71 (4), 2024, 605-623
DOI: 10.47743/saeb-2024-0029

Network Effects on Platform Markets. Revisiting the Theoretical Literature

Isabel Soares*, Manuel Nieto-Mengotti**

Abstract: The characteristics of the bilateral network markets were already studied before 2003, but they focused on specific markets (credit cards or newspaper advertising) without relating implications with third parties. But since the emergence of new business models based on digital platform markets, especially since 2007 with the arrival of the smartphone, business scalability and network effects have skyrocketed. In this article, we carry out a review of the main contributions on network effects in the markets and their implications for the governance of platforms, which is of vital importance to understand the regulatory impacts when trying to limit the effects. negative effects of the market power. In the end, we found that in most studies, same-sided negative network effects are rarely considered, so despite multiple analyzes and empirical studies, there may still be some blind spots in the analysis of the network effects for the platform economies that can be transcendental for the understanding of all the market variables affected by the governance of platforms in monopolistic competition.

Keywords: network effects; platform economy; governance; market power; bilateral market.

JEL classification: D47; L12; Y30.

* Faculty of Economics, University of Porto, Portugal; e-mail: *isoares@fep.up.pt* (corresponding author).
** Faculty of Economics, University of A Coruña, Spain; e-mail: *m.nieto1@udc.es*.

Article history: Received 11 February 2023 | Accepted 29 October 2024 | Published online 20 December 2024

To cite this article: Soares, I., Nieto-Mengotti, M. (2024). Network Effects on Platform Markets. Revisiting the Theoretical Literature. *Scientific Annals of Economics and Business*, 71(4), 605-623. https://doi.org/10.47743/saeb-2024-0029.

1. INTRODUCTION

The rapid development of digital platforms is currently at the heart of the issues analyzed by industrial organization theory. These intermediary platforms provide a transaction cost solution that blurs the traditional boundaries between the two predominant forms of organization. of economic activity and causes the alteration of costs enabled by new digital technologies (Sundararajan, 2016).

In the last two decades, a new current of study has emerged around what is already a paradigm within the economic field: the so-called "Platform Economies based on digital environments". We specify the term “digital”, because prior to the emergence of smartphones, and with it, the vertiginous development of platform economies, other types of economic platforms existed and persist, such as electronic payment platforms (Visa, Mastercard, or American Express) which are echoed in the first two articles collected in this study (Rochet & Tirole, 2002; Caillaud & Jullien, 2003). In a certain way, those authors launched the theoretical foundations allowing us to understand the functioning of the mechanisms that have led these economic platforms to develop spectacular and very rapid growth over time.

After examining multiple papers on the subject, the underlying question seems to be the following: the new competitive scenarios in digital markets are generating situations of market monopoly power as if the scenario generated through the mechanism of the platform economy, would necessarily lead to a situation of natural monopoly. There are currently many examples, without a doubt the most notorious is the conglomerate formed by the American company "Meta" (Facebook, Instagram, WhatsApp) which tries to unite, in the West, the monopoly of social networks. But there are many more examples, even without considering China, of digital companies that try to impose themselves as companies with monopoly power in the market (Google, Uber, Amazon, and a long, etc.). This leads us to a new problem: how to raise the fight of state regulatory bodies against the negative effects derived from monopolistic behavior or contrary to free competition, which is exercised in the field of new digital platforms? In this sense, it is highly instructive to read the report prepared by Motta and Peitz (2020) for the European Commission concerning intervention triggers and underlying theories of harm, in which they outline the difficulties that regulatory bodies encounter when it comes to detecting collusive behavior and monopolistic practices in digital markets. Also, Katz (2019) or Evans (2019) identify that there are critical aspects in which the body of academic knowledge does not provide useful advice to the agencies and courts in charge of enforcing competition law.

All this has led us to try to achieve a greater understanding of the fundamental element that underlies this "new" economic system and where there is academic consensus when determining that network effects are the true catalyst source of the growing market power.

Notwithstanding, from our point of view after analyzing several case studies, it is not entirely easy to understand the implications of this complex mechanism in which direct and indirect cross-network effects are intertwined with respect to other complementary markets, adding to other effects difficult to determine.

There are numerous studies such as Armstrong (1998), Berry *et al.* (1999), Spulber and Yoo (2002), Roson (2005), Rysman (2009), Katz (2019) or Halaburda and Yehezkel (2019) that affect issues related to network markets in platform economies, but the vast majority focus on certain aspects and characteristics that affect only part of the framework of network

effects that underlie each of the markets. In this article we assemble these investigations into three thematic fields that are influenced by these network effects.

Our effort to bring together articles of a theoretical nature as opposed to empirical ones is what causes most of the selected articles to be "older", the research production after them being focused on empirical studies on certain specific topics. Even so, these also offer us interesting theoretical advances, such as Chen *et al.* (2022). Another selection criterion for the articles has been their influence on the number of citations by other researchers. Although that has not been our main selection criterion, its own theoretical interest, it has guided us when deciding on one or another author when it was a coincident topic.

As we have commented previously, it was not until the publication of the article "Platform Competition in Two-Sided Markets" by Rochet and Tirole (2003), as well as "Chicken and egg: competition among mediation service providers" by Caillaud and Jullien (2003), that a wide variety of articles have emerged focusing on the study of network effects applied to bilateral platforms in the digital market.

The purpose of this article is to present a critical review of the existing literature, on how, the measurement, and implications of network effects in the so-called platform markets in the digital have been treated. We take advantage of this introduction to justify the selection of the articles that we have used in this review. Although they all deal, with one approach or another, with issues that affect or are affected by network effects in platform economies, we have found it convenient to include in this review those that have been cited most frequently in numerous subsequent investigations. In the following chapter we will make a detailed summary of the analysis and argumentation used by these researchers around network effects, and we end with an outline of the approaches that are the subject of this review. Our goal is to facilitate the understanding of theoretical advances in the field of market competition on digital platforms and to understand the implications for current competitive models characterized by increasingly frequent development of monopolistic behavior and market failures. Moreover, this also seems to be of general importance to policymakers.

2. THEORETICAL FRAMEWORK

2.1 Introduction

The study of network effects is important, in economic terms, because its design generates the adhesion of many users, charging a potential economic value due to the implications of managing a channel of communication, dissemination, and exchange among its members.

One must go back to Euler (1736) (Nielsen, 1999) to find the first introduction to the study of these connections, with his magnificent mathematical solution to the "seven bridges of Königsberg" dilemma, orchestrating the first graph theory to solve these problems. Mathematically, a graph G is defined as the pair of sets $G = (V, E)$, where $V$is a set of nodes $\{v_1, \dots, v_n\}$ and E is a set of links $\{e_1, e_2, \dots, e_m\}$ between pairs of nodes of V, $e_k \equiv e_{ij} = \{v_i, v_j\}$ (that is, $E \in VxV$).

From this approach, many contributions have emerged to try to determine the potential scope of network effects. For example, the well-known Metcalfe's Law (Nielsen, 1999), established a network evaluation rule considering the number of users that a network has, as

well as the subjective evaluation of everyone for belonging to said network. It is a linear assessment in which the user values positively the fact that there are other users connected to the network, and benefits from it, which will result in a multiplicative value for the number of existing users (except in the assessment of himself).

However, Nielsen (1999) proposes that if a very large network is partitioned into N disconnected components, considering p = 1, then the value of that subnetwork will be (following Metcalfe's law)

$$V_{subred} = \frac{1}{N(N-1)} = \frac{1}{N^2 - N}$$

Existing N subnets in the partition, we would have: $V_{N\ subredes} = \frac{N}{N^2-N} = \frac{1}{N-1}$

That is, from a network that is worth n^2we are left with a sum of networks that in total are worth $1/n$.

Newman (2003), establishes another method to obtain a global value of the grouping from the fraction of existing triangles in the graph with respect to the total number of possible triangles of contiguous nodes that can be defined in a graph with the same number of nodes.

$$\text{Clustering coefficient: } C = \frac{number\ of\ triangles\ in\ the\ network}{maximum\ number\ of\ possible\ triangles}$$

But Euler's solution and the ones that followed, like Newman (2003) that preceded it, do not explain the mechanism by which a network, which generates the adhesion of many users, has a potential economic value by itself. In what way does it serve as a catalyst for the information it generates, and what are the implications for dissemination and exchange among its members.

There is consensus in the academic field that the enhancement of network effects in digital markets has introduced new competitive scenarios with a tendency to concentrate market power. It is not possible to regulate a market trying to prevent anti-competitive conduct without a good understanding of the operation and dynamics of network effects in these markets.

The most recurrent themes in these articles speak, for the first time, of "bilateral markets" (network effects and the chicken-and-egg problem had already been discussed for decades), mixing in many cases the literature on the " network economics" and the "multiproduct pricing". These authors observed that the platforms that operate in the bilateral markets focus on the structure of their prices rather than on their total level. Among the many problems analyzed, in this paper we observe three axes around which our work is developed. In the following Section 2.2 we expose both the approach by Belleflamme and Peitz (2015) and the one proposed by Caillaud and Jullien (2003) where they analyze the model from the point of view of competition price imperfection between intermediary service providers. In Section 2.3 we identify the different approaches to one of the platform markets that raises the most debates: "competition between matchmakers". For this, we have selected authors such as Hagiu and Wright (2015), Galeotti and Moraga-González (2009), and Haucap and Heimeshoff (2014). In this section, we derive a subject as relevant as Multihoming, from which apparently contradictory conclusions are drawn regarding pricing strategies for brokerage platform owners. In Section 2.4 we address one of the critical aspects of the design of the digital platform. Here, in the hands of Caillaud and

Jullien (2003), Rochet and Tirole (2003), Hagiu and Wright (2015), and Haucap and Heimeshoff (2014), we see the characteristics that platform governance must have to optimize its performance and how it affects the surplus of users or the benefit of the platform. To conclude, we propose how these three sections come together when explaining how the platforms internalize the Indirect Network Effects to gain greater shares of market power, even when the calculation of the maximization of benefits can generate the establishment of prices. negative (a form of subsidy) on one of the sides, even above the Marginal Cost, which raises concern in the antitrust authorities (Jullien, 2004). And if negative prices cannot be established on the one hand, rates are reduced on the other. The result is a profit-maximizing monopoly platform that internalizes Indirect Network Effects, which is in line with the social criterion of total welfare maximization.

Table no. 1 – Summary of selected articles arranged chronologically

Selected articles	Description	Conclusion	Issue for research paper
"**Chicken and egg: competition among intermediation service providers"** Caillaud and Jullien (2003)	*"They lay the foundations for the study of network effects in two-sided markets"*	*"It is proved that, under the assumption that any generated matching surplus is shared efficiently, the efficient market structure can be either monopolistic or duopolistic, and that equilibrium always exists with the efficient market structure. But inefficient trade-offs also exist, especially when matching technology is effective or the ability to rely on transaction fees is limited."*	*Modeling the demand for a network good / Platform Governance*
"Platform competition in two-sided markets" Rochet and Tirole (2003)	*"Analyzes the different effects on the price and consumer surplus according to the type of governance of the platform and its user subsidy policy"*	*"A market with network externalities is bilateral that platforms can subsidize even by discriminating between different categories of end users. It also highlights reasons why platforms may be unable to cross-subsidize."*	*Modeling the demand for a network good / Platform Governance*
"Platform intermediation in a market for differentiated products" Galeotti and Moraga-González (2009)	*"They carry out a study of how sellers of differentiated products compete for consumers within the platform, and how the platform manager must price their services to buyers and companies to maximize profits."*	*"If the platform was limited and for example positive subscription fees could not be established for consumers, then it would increase the offer fees and result in an inefficient number of offers. An increase in the number of retailers increases the degree of variety on the platform, but at the same time increases competition. Anticipating that the equilibrium price of goods will fall, the platform lowers the rates paid by companies and increases the rates paid by consumers."*	*Competition between matchmakers*

Selected articles	Description	Conclusion	Issue for research paper
"Two-sided platforms: Product variety and pricing structures" Hagiu (2009)	*" Indirect network effects are determined endogenously, by variety and competition between producers, pointing to three important characteristics of platform markets"*	*"The result of the study is the obtaining of three key ideas about the behavior of the prices of the bilateral platforms. It first identifies the intensity of consumer preferences for variety as a key factor driving platform pricing structures. Second, it demonstrates that cross-platform competition can create counterintuitive dynamics and run counter to conventional wisdom derived from earlier models. Third, it rationalizes platform usage fees as a result of a conflict between two objectives: to provide appropriate investment incentives to producers and to reduce a platform retention problem that arises when producers make their decisions. of platform adoption before consumers."*	*Competition between matchmakers*
"Marketplace or Reseller?", Hagiu and Wright (2015)	*"They try to explain the reasons that motivate an intermediary to become a "marketplace" (bilateral market) or a "reseller" (unilateral market)."*	*"Intermediaries should choose the market model for the following types of products: (1) products for which providers have a significant (respectively small) information advantage about how best to market products relative to the intermediary, (2) products whose prices and marketing activities have limited (respectively, large) indirect effects on other products, (3) long-tail (respectively, short-tail) products when the market mode has a marginal cost disadvantage (respectively, advantage) and (4) products provided by late-stage (respectively, early-stage) ventures."*	*Platform Governance*
"**Industrial Organization. Markets and strategies"** Belleflamme and Peitz (2015)	*"Indirect Network Effects Arising from Product Variety in the Context of Monopolistic Competition"*	*"Indirect network effects can arise in a buyer-seller context due to the effect of consumer participation on quality, price, and variety. But, in the reduced form, the consumer's utility ultimately depends directly on the number of consumers"*	*Modeling the demand for a network good*

Selected articles	Description	Conclusion	Issue for research paper
"Google***, Facebook, Amazon, eBay: Is the Internet driving competition or market monopolization? "*** Haucap and Heimeshoff (2014)	*"They highlight how the different types of network effects affect and determine the monopolistic tendencies of digital platforms as opposed to traditional platforms."*	*"The existence of a single large market from an economic point of view is usually efficient since it allows to reduce search costs for consumers, which could not happen if there were many small markets. This situation would occur in the case of a centralized market. To conclude, the authors affirm that the success and market power obtained by the platforms are based on two main axes: high switching costs and enormous externalities or network effects."*	*Platform Governance*
"Platforms and Network Effects" Belleflamme and Peitz (2018)	*"They highlight that in most markets, user benefits depend on the participation and usage decisions of other users that result in network effects. Being the intermediaries that manage these network effects and, therefore, act as platforms that bring users together."*	*"They explain the functioning of the platform structures depending on whether they act as singlehoming (as would be the case of the "Amazon Marketplace" platform) or as Multihoming (real estate portals). Multihomed sellers have access to all buyers but pay the switching cost that buyers have. Buyers are better off in the multihoming environment because they benefit from higher seller participation and lower fees. As for sellers, they prefer the singlehoming environment."*	*Modeling the demand for a network good*
"Platform governance design in platform ecosystems: Implications for complementors' multihoming decision" Chen *et al.* (2022)	*"It explains the multilateral interdependence between different producer groups within a platform ecosystem. We theorize about how the governance design of platform owners can create friction between platform providers"*	*"The resulting complexity of the new ecosystem created on the platform not only counteracts the rival's ability but also discourages the practice of multihoming by users. On the contrary, the study shows that in the case of an open governance design, it is the complementors who must bear the cost of misalignment and the resulting frictions."*	*Competition between matchmakers*

Sursa: own elaboration

2.2 Modelling the demand for a network good

To quantify the network effects subject to a wide variety of markets in the current boom of the so-called Platform Economy, multiple methods have emerged in the economic literature that start from the axiom that the demand for any good or service affected by network effects, tends to increase as the size of the network to which it is associated expands. Amazon, PayPal, Microsoft, Apple, Twitter, and Salesforce are some of the most

impressive and relevant companies in the world and specifically in the digital economy. Although quite different in many ways, there is a single property that defines them all and is behind their success: how they manage the network effect.

Therefore, using the demand for a good as an econometric predictor can generate difficulties due to correlations with unobserved attribute variables, and even -from a dynamic point of view- due to learning effects. Its execution is further complicated by the appearance of new products and services generated in this context, forcing us to carry out a more elaborate analysis of indirect network effects (Belleflamme & Peitz, 2015).

The mechanism of the game would be sequential: first n consumers buy the hardware, for example, a smartphone (they do not know the number of applications that will be available in the second period). The programmers observe the adoption decision of the consumers and provide m variety of software (APP) in the second period.

Consumers have the following utility function (Belleflamme & Peitz, 2015):

$$U = q_0 + \mu\left[\left(\int_0^m q_j^{\rho}\, dj\right)^{1/\rho}\right]^{\beta} \tag{1}$$

where, q_0 is the amount of the external good,

μ denotes the type of consumer

q_j the amount of software j.

As far as software utility is concerned, Belleflamme and Peitz (2015) employ a CES utility function to capture the idea that the software service level increases proportionally with the variety of software packages available. To do this, they impose a standard restriction that ensures the operation of monopolistic competition: $0 < \rho < 1$ and $\beta < \rho$ (Which implies that the marginal benefit of an additional variety of software is decreasing).

Let be I the numeraire amount of income of all consumers, which they will be able to spend either on the competitively supplied external good, or on hardware sold at price p_h and each variety j of software sold at price p_j.

Let be $E = \int_0^m p_j q_j\, dj$ the total spending on software,

We can express the consumer's budget constraint as: $q_0 + p_h + E = I$

Combining the last expression with (1), we can write the consumer's indirect utility in purchasing the hardware/software combination as:

$$v = I - p_h - E + \mu\left[\left(\int_0^m q_j^{\rho}\, dj\right)^{\frac{1}{\rho}}\right]^{\beta} \tag{2}$$

The approach that emerges from this formulation only indicates that users obtain the utility of a system that combines hardware and software, but the purchase of hardware independently does not offer any utility to the user.

In this market structure, the number of firms adjusts so that each software firm's profit equals zero, given that the firms face negatively sloping demand with zero equilibrium profit due to the free entry of competitors.

The CES utility function implies that firms have a price elasticity of $1/(1-\rho)$ and a constant monopoly margin of $(1-\rho)/\rho$. The monopoly price for each variety j is, therefore, $p_j = \frac{c}{\rho}$ and the zero-profit condition implies

$$(p_j - c)q_j - f = 0 \Leftrightarrow q_j = \frac{\rho}{1-\rho}\frac{f}{c} \equiv q \tag{3}$$

Considering this condition valid for all companies in the industry, we equate the total fixed costs to the total income within the industry (mf). While the total income comes from the n buyers who jointly demand the combination of software/hardware (nE). Therefore: $mf = nE$, which means that the number of computer programs is determined endogenously as$m = nE/f$.

Now we can plug qy $m$into expression (2) and get:

$$v = I - p_h - E + \mu q^{\beta}\left(\frac{nE}{f}\right)^{\frac{\beta}{\rho}} = I - p_h - E + \mu A n^{\alpha} E^{\alpha} \tag{4}$$

With $\alpha \equiv \frac{\beta}{\rho}$and $A \equiv \frac{q^{\beta}}{f^{\alpha}}$maximizing expression (4) for the optimal spending E on software, we find:

$$E^{*} = (\mu\alpha A n^{\alpha})^{\frac{1}{1-\alpha}} \tag{5}$$

Substituting (5) into (4), we get the "**indirect utility of a consumer based on the number of consumers who buy the hardware/software combination":**

$$v = I - p_h + \mu^{\frac{1}{1-\alpha}} K n^{\frac{\alpha}{1-\alpha}}, \quad (6) \tag{6}$$

with

$$K \equiv (1-\alpha)(\alpha A)^{\frac{1}{1-\alpha}}$$

The corollary drawn from this reasoning is that "indirect network effects can arise naturally from the interrelationship between buyers and sellers due to the effect of consumer influence on product variables such as quality, price, and variety. But, that consumer's utility ultimately depends directly on the total number of consumers. The more consumers, the greater influence.

This corollary is a good argument for why hardware companies try to include software applications in their devices, so by internalizing the demand for them by linking it to their devices, they manage to seize the consumer surplus that was available to purchase the devices. device apps independently. In other words, manufacturers take advantage of the complementarity of both services to package the final product and thus achieve a greater increase in demand without having to lower the price of the device.

Graphically would like this:

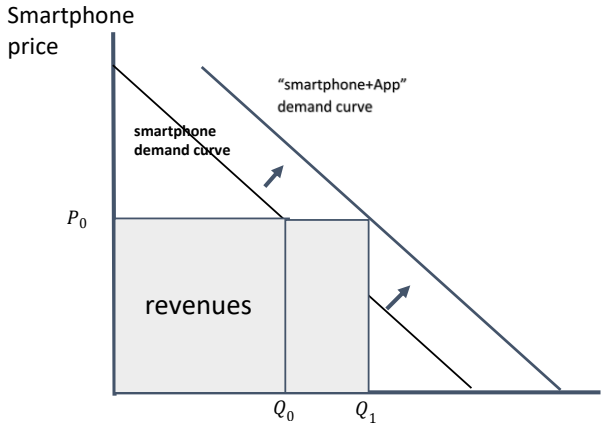


Figure no. 1 – Extension of demand holding the price constant
Source: author's elaboration

We have just seen how providers of two complementary services take advantage of synergies within the network industry and the corollary is quite intuitive. However, this model already anticipates the preponderant role played by the intermediary platform. In this case, Caillaud and Jullien (2003) analyze the model from the point of view of imperfect price competition between intermediary service providers.

Perhaps one of the most interesting findings they make is that intermediaries have incentives to offer non-exclusive services, since this moderates competition and allows them to exercise market power. they study the competition between intermediaries observing that platforms act as matchmakers, even using sophisticated prices such as registration fees, and transaction fees whenever the intermediaries carry out transactions. In fact, another contribution is to show that the dominant intermediary companies, when they want to prevent entry, are better off charging transactions instead of registration prices. They also show that competition is more intense when platforms fail to deter *multihomer*.

The authors' approach not only highlights the relevance of indirect network externalities for an intermediation platform but also reveals the importance of the possibility for users to use the non-exclusive services of different intermediaries. Given that the new digital platforms operate in multilateral markets, serving at least two different groups of users, who expect higher profits the greater the number of users on the other side of the market, this is known as market externalities. indirect network. Indirect externalities give rise to a "chicken and egg" problem: to attract buyers, the intermediary must have a large base of registered sellers, but they will only be willing if they expect many buyers. So, what comes first: the chicken or the egg? (For example: "On Tinder", a user will register on the platform if they know that there is a wide variety of users on the other side of the market and, for them, it will be attractive to participate in this app if they know that there will be more users each time, otherwise it would be of no use to them).

Another existing network effect and, in addition, from which digital platforms generally also benefit, is the direct. That is, the value of a product increases when the number of its users on the same side of the market increases. (Instagram, the value of this

social network increases as registered users increase, that is, as an Instagram user I will only use this app if I know that my friends will also use it).

Throughout the article, various propositions are developed, considering in the first place a basic model (framework) with exclusive services, that is: "a simple pairwise matching model, with two homogeneous populations, labeled as $\{i = 1\ y\ 2\}$, each of which consists of in a mass of ex-ante identical agents. For a given broker, there is only one pairing on the other side of the market with whom the trade is valuable; the total gross profit from trade between matching partners is normalized to one." Matching partners follow an efficient trading process until the transaction price is reached. The efficient negotiation process determines the optimal price of the transaction, linearly distributing the trade surplus between the two agents ($1\ y\ 2$). Although we have normalized the participation surplus to 1, u_1, u_2, the truth is that if we consider a better negotiating position for agents of type 2 (for $u_1 + u_2 = 1$), makes $u_2 \geq \frac{1}{2} \geq u_1$, then the intermediary's technology identifies the coincident matches, effectively reducing the costs of search associated with the exchange process. Let us remember that the Belleflamme and Peitz (2015) proposal established the utility of users as a function that depended on two complementary goods (2). However, now we are witnessing the confrontation of the utilities of two types of users who simply exchange goods or services through an intermediation platform, and we verify that the network effects are used by the matchmaker to deploy its profit-maximizing strategy.

2.3 Competition between matchmakers

Two matchmakers, $k \in \{I, E\}$, compete using the same intermediation technology, each of them assuming a cost c_i. We assume that intermediation is efficient if $\lambda > c \equiv c_1 + c_2$. The two options for intermediaries are: a) charge each user a connection fee; b) charge each user a registration fee. In both cases, the matchmaker can apply a subsidy that would translate into a negative price, with the aim of stimulating adherence to its exchange platform.

It should be borne in mind that the option of applying a transactional fee means that the net profits of the trading users will depend on the sum of the transaction fees, that is, the cost of the total transaction, under the conditions of a trading solution of Nash or a price that equals the net utilities of the users. Thus, in this basic model, a first proposition is proposed in which it is established that with exclusive intermediation services, an intermediary (which would be the dominant company) captures all the users, simply subsidizing the registry and charging the maximum transaction price. But for the rule general, the services of intermediation, especially those based on the Internet, are not exclusive. So, users could use several platforms simultaneously, which we call "multihoming". Also, we assume that the processes of the pairing of the " matchmakers" are independent. Then, when $j - users$ they do " multihoming ", a $i - user$ could have two reasons for doing it: first, increases the probability of pairing Y, second, in the case of a double pairing, the $i - users$ can save money in the rates transaction, since, can conclude the transaction a through of intermediary with the rates of the transaction plus low.

But most Internet services are not exclusive, and therefore users can use the services of both matchmakers simultaneously looking for the best option. It is what is called in the jargon: " multihoming ", which allows the user to conclude the transaction through the

intermediary that offers the lowest transaction fee. Then the market allocation is defined, in the case of multihoming, as $N = \{n_i^I, n_i^E, n_i^M\}$, where n_i^I o n_i^E, are the masses of users $i$that are associated with one or the other platform, exclusively, and n_i^Mcorresponds to that mass of users that are associated with both platforms simultaneously (doing multihoming). When $\lambda(1-\lambda) < c$, market efficiency requires a single operator for everything i; but when $\lambda(1-\lambda) > c$, it will be more efficient to multi-home globally. We thus reach the second proposition, which it analyzes the two possible best responses for the platform depending on whether the players perform multihoming or grant exclusivity to the platform.

An interesting implication of these propositions, in relation to the network effects of the intermediation platform, is the one related to the exclusivity of choice and entry. And it is that exclusivity exacerbates competition between providers of intermediation services reducing profits to zero, while non-exclusivity (multihoming) allows a full range of strictly profitable equilibria.

In conclusion, we find that certainly, here network effects can favor market concentration, but they do not necessarily lead to a higher price or lower quality. On the contrary, in the presence of network effects, the existence of a single platform could maximize the welfare of consumers. Also, the transfer of these efficiencies is likely when at least one of the user groups can subscribe to several platforms by performing multihoming.

Hagiu (2009) extends this analysis by extracting key insights into the price behavior of two-sided platforms under network effects. It is really a combination of the two previous studies, in which consumers are interested in buying on a platform for a variety of products, and where producers compete together.

First, the intensity of consumer preferences for product variety has been identified as a key factor driving the pricing structure. If consumers have a high concern for this variety, the platform will take better advantage of the suppliers' side.

In addition to considering the preference for the variety of products, it is necessary to look at the bargaining power of the producers. Where, if the measure to reduce prices is ineffective, the strategies on the consumer side will be aimed at driving producers away from the platform because they bear a higher price. All this decreases if we introduce economies of scale. But for Hagiu (2009), network effects influence the economic factors that determine whether platforms should try to extract more benefits from consumers relative to producers or vice versa. To do this, the platform adjusts its price structure according to the bargaining power of the providers, which is determined by the network effects implicit in their incorporation to the platform, but this, in turn, is also determined by the intensity of consumers when joining the platform based on their preferences.

Galeotti and Moraga-González (2009) propose a game between three types of agents: the administrator of an exchange platform, N sellers and M consumers. In this game, the platform tries to attract the maximum number of vendors, with differentiated products, to incorporate the maximum number of consumers and vice versa. The first option that arises would be to apply an advertising fee for sellers and a subscription fee for consumers. With this approach, 2 stages arise in the game. In the first stage, the platform advertises its product and the price at which it is offered. In the second, it is the consumer who chooses the option that is most useful to him.

The problem arises to the extent that by increasing the number of sellers, the products become closer substitutes from the point of view of consumers and, therefore, the competition of the companies becomes fiercer, reducing profit margins of the companies.

The authors explain this result based on how it is related to the network effects that the two groups of participants exert on each other. Since the platform will now become more attractive to buyers, ceteris paribus, an increase in the subscription price for buyers will not decrease the participation of buyers since they obtain higher profits. Sellers, for their part, must increase the frequency of their ads, and pay the corresponding fee to the platform administrator, so that consumers can find (on average) a better match.

Therefore, a higher engagement rate from businesses would only be consistent with the expectation that consumers would also join the platform more frequently.

This argument is because the positive cross-network effects that characterize the trade-off between consumer share and firm share imply that monopoly platform profits are increased strictly by subscription fees. On the contrary, greater product differentiation softens the competition of companies within the platform, so prices will rise. As a result, business rates increase, and consumer charges also increase. The explicit model of interaction within the platform has been the focus of this article. When the platform administrator can charge businesses and consumers to participate, platform prices fully internalize the network externalities present in the market.

Chen *et al.* (2022), take a different approach when considering the interdependence between different producers within an ecosystem, in a multilateral way.

The hypothesis of Chen *et al.* (2022) is that the governance design of the platform can create friction between providers and developers within the platform. Governance that is more open to vendor autonomy can lead to a more complex ecosystem for software developers. This would be due to the fact that the complexity of the open system causes an increase in the cost of customization of the product by the developers. Let's take as an example the case of an application developer that must make the same application compatible for two operating systems as different as iOS or Android, or a game that could be available for the Switch or PlayStation platform.

This is an interesting proposal aimed at dissuading multihoming, by proposing that investments be made to customize the platform interface with a more complex ecosystem but one that includes complementary services that prevent the user from having to change platforms.

So far we have seen platform scholars argue that a platform owner should strive to make their platform more focused through quality-enhancing investments or advertising investments (Halaburda & Yehezkel, 2019), Chen *et al.* (2022), specify in their research that the platform must strive to attract an increasing number of complementors, which are the source of indirect network effects while preventing them from supplying the same complementary product to rival platforms, thus undermining the advantages derived from network effects, as well as its differentiated position in the market.

The result of the study by Chen *et al.* (2022), highlights that the resulting complexity of the new ecosystem created on the platform not only counteracts the rival's ability but also discourages the practice of multihoming by users. On the contrary, the study shows that in the case of an open governance design, it is the complementors who must bear the cost of misalignment and the resulting frictions.

2.4 Platform Governance

While Caillaud and Jullien (2003) focus their analysis on the possibilities of users having access to platforms with exclusive services or being able to access several platforms with the same service (multihoming), Rochet and Tirole (2003) focus their analysis on the management o platform governance by establishing a platform competition model with two-sided markets that determines pricing and sharing of end-user surplus based on different governance structures (profit-maximizing platforms versus non-profit joint ventures); that is, those platforms that are made up of a monopolist versus a platform made up of a planner that adopts the Ramsey price.

In most markets with network externalities, their main characteristic is the presence of two different sides whose final benefit derives from the interaction through a common platform. Platform owners must address the famous chicken-and-egg problem raised by Caillaud and Jullien (2003). Taking as an example that of video game platforms such as Sonic-Sega and Nintendo, which earn money for game developers through royalties per game unit, while on the side of the players it indicates fixed fees for kits or consoles of game; On the contrary, software development platforms for PCs and other devices have adopted an opposite business model, trying to maximize profit on the consumer side by marking the vendor side as the loss leader. Therefore, the choice of the business model seems to be the key to the success of a platform, since, as we have observed in different strategic approaches throughout history, we obtain totally different results.

Thus, a characteristic of these two-sided markets is that the platforms often treat one side as the center or support of their profits while the other side treats it as a leader in losses.

The interaction between the two sides gives rise to strong complementarities, which, according to the traditional oligopoly theory (Rochet & Tirole, 2003), are not assumed by the final users; On the other hand, in the theory of the network economy, these externalities are emphasized; and in the multi-product pricing literature, both monopolistic and competitive also emphasize cross-elasticities, which can also be affected by third-party intervention in the industry. We can see in the example proposed by Brunekreeft (2015), in which he raises the problem caused by the congestion of an electrical network. In this case, it refers to two possible solutions: either expand the network to relieve congestion or invest in a new storage facility (accumulators). But there would be a third solution that would allow it to maintain the installations without having to increase investments: the owner can choose to discriminate prices to different consumers and during different periods (consumption time slots) and obtain additional commercial income that would optimize the network while decongests the time slots most saturated by demand. Even so, he must consider the indirect effects caused by the strategy that he decides since that will determine the competitive strategy of his potential rivals in the market.

The analysis of bilateral markets becomes more complex in the presence of Multihoming, which is the possibility that several of the agents on one or both sides of the market can opt for different platforms, as would be the case of a credit card user credit that is available to pay with Visa or Mastercard, and in the same way the seller can make one means or the other available to you. “Multihoming on one side, therefore, intensifies price competition on the other side, as platforms use low prices to drive end users on the latter side into an exclusive relationship. Just as VISA would do to promote the use of its card against its rival AMERICAN EXPRESS”.

This working paper studies how the allocation of prices between the two sides of the market is affected by these six variables: platform governance, the end user cost of multihoming, platform differentiation, the ability of platforms to use volume-based pricing, the presence of externalities on the same side, and platform compatibility.

The starting point of the cross-analysis is a basic model in which it is assumed that end users do not incur fixed usage costs and that the price of the platform is linear, like that of credit cards. In this case, economic value is created through interactions or transactions between pairs of end users: buyers and sellers. These transactions are mediated by a platform. We assume in this model that the marginal platform cost of a transaction is denoted by $c \geq 0$. In the absence of usage costs and fixed fees, the demand of the buyers (sellers) will depend only on the price $P^b(P^s)$charged by the monopoly platform. There are network externalities in the sense that a buyer's surplus depends on the number of sellers. Thus, the buyers' demand function could be understood as a quasi-demand function (a function that is used to reflect the fact that, in a two-sided market, actual demand depends on the decisions of both buyer and seller users).

$$\pi = (p^b + p^s - c)D^B(p^b)D^S(p^s)$$

Maximizing the profit function of the monopolist as the owner of the network through the first-order condition, we obtain the following equality

$$(D^B)'^{D^S} = D^B(D^S)'$$

The volume of the impact of a small price change has to be the same on both sides. Introducing the quasi-demand elasticities, and $\eta^B = \frac{p^B(D^B)'}{D^B}$, $\eta^S = \frac{p^S(D^S)'}{D^S}$the monopolist's prices can be characterized by a two-sided formula that is reminiscent of Lerner's formula: $p^B + p^S - c = \frac{p^B}{\eta^B} = \frac{p^S}{\eta^S}$=> in effect, the total price $p = p^B + p^S$chosen by the monopolist is given by Lerner's classic formula: $\frac{p-c}{p} = \frac{1}{\eta}$or $p = \frac{\eta}{\eta-1}c$, where $\eta = \eta^B + \eta^S$is the total volume of elasticity.

Therefore, Proposition 1 is as follows: a platform monopoly price $p = p^B + p^S$is given by Lerner's standard formula for the elasticity of the sum of two elasticities$\eta = \eta^B + \eta^S$

Next, the development of the argument continues, comparing this situation with that of a Ramsey monopolist, and later with a situation of competition between platforms, again comparing the different results.

A different approach to platform governance is proposed by Hagiu and Wright (2015) by focusing on the key difference between “reseller” and “marketplace”: the control exercised by the platform over non-contractual decisions that occur (price, distribution, marketing…). A marketplace will have little or no control over them (they fall to individual sellers) and a reseller will have high or total control over them (individual sellers become suppliers in this case).

Hagiu and Wright (2015) affirm that the reseller internalizes the externalities present in a bilateral market, turning it into a unilateral one. They are both intermediaries, but only one of them is a platform.

“Local information” refers to the knowledge sellers and intermediaries have about optimal levels of marketing, which can be more or less perfect. They cannot know the

optimal levels of marketing, but they can compare who has the most information, which will allow them to get closer to the optimal level of marketing.

Basic model

- They focus on the analysis of a single non-contractual relationship: promotional or marketing activities. They are carried out by the group that holds the control rights (marketplace sellers and reseller providers). The "local information" held by the vendors (marketplace) and the intermediary (reseller) is key.
- Demand: homogeneous consumers, must join the platform to consume. Marketing effects depend on private (not perfect) information and exhibit diminishing marginal returns. In the case of the marketplace, they do not pay an admission fee and do not have a surplus.
- Cost structure: in the base model it is assumed that the costs incurred by both models are equal, always having a positive benefit.
    - Marketplace: Sellers pay membership and transaction fees
    - Resellers: the platform incurs a fixed cost of quality control and inventory for each product it sells, in addition to its variable costs
    - Marketing: they are normalized with a cost 0
- Profit functions: the only difference between the profit functions of the two models is the variance of the "local information" of the individual sellers (marketplace) and the intermediary (reseller). In this way, the variance of this variable will determine the choice of one model or another based on the expected benefits.

The choice of one or the other model will be based on the "local information" of the intermediary and the sellers, defined through an inequality, which adds new terms that motivate the following results.

"Cross-product spillovers": marketing on one product affects others in its category. They are modeled linearly, and their presence motivates the choice of R over M. "Cost differences": the previous assumption of homogeneous cost structures is eliminated. If a model has lower costs, that will be chosen. In any other case, the results are ambiguous and may motivate the adoption of a hybrid strategy. "Network Effect with Unfavorable Expectations": ERIs are introduced for the first time in the model (in the form of vendor expectations). If they are unfavorable, their presence motivates the choice of R over M (due to the lower dependence of a reseller on Indirect Network Effects). This can also motivate the adoption of a hybrid strategy.

At the beginning of this chapter, we saw the analysis carried out by Rochet and Tirole (2003) on the behavior of a platform with monopoly power compared to one that applies Ramsey's social criteria. But what makes a platform able to obtain market monopoly power? Haucap and Heimeshoff (2014) analyze the different types of network effects that, in their opinion, affect and determine the monopolistic tendencies of digital platforms as opposed to traditional platforms.

For this, they distinguish between two types of Network Effects: Direct in which the utility of consumers increases directly with the number of other consumers on the platform (users benefit directly from the increase in users on their side of the market); and Indirect, in which the utility of consumers increases indirectly with the number of other consumers on the platform, as they attract more bidders.

In network effects, the following five points should be highlighted:

1. Degree of the strength of indirect network effects: the higher they are, the higher the concentration level. More users attract more providers, which makes the existence of a single platform more efficient than the existence of several.

2. Economies of scale (Degree of economies of scale): as we well know, those industries with economies of scale tend to present higher degrees of concentration.

3. Platform saturation (Capacity constraints): Traditionally it referred to the physical limitation of space, but nowadays it refers more to the advertising saturation that can occur when a single company dominates the market, saturating users and causing them to look for alternatives to it.

4. Degree of heterogeneity in the market (Scope of platform differentiation): the higher it is, the lower the concentration level. If we include several bidders and demanders with very different needs in a single platform, we increase transaction costs, so the platform loses its usefulness.

5. Platform change cost (Multihoming): the higher it is, the lower the level of concentration. If it is costly for the user to change platforms, they will tend to stay in the original one (loss of followers when you change social networks, the impossibility of transferring your good rating from one online sales platform to another...)

The externalities generated are also usually known as network effects that can be Direct when an increase in the use of a good causes its value to increase. It usually occurs in social networks, where access to valuable contacts translates into an increase in the recognition that social network receives.

But it is the Indirect ones that have great importance in the bilateral markets. It occurs when the increase in the use of a good causes the value and production of a complementary good to increase. An example would be eBay, where an increase in the number of potential buyers would attract a greater number of sellers as their chances of selling would increase.

The existence of a single large market from an economic point of view is usually efficient since it allows for reducing search costs for consumers, which could not happen if there were many small markets. This situation would occur in the case of a centralized market. In summary, the success and market power obtained by the platforms are based on two main axes: the high switching costs and the enormous externalities or network effects.

3. CONCLUSION

This review of the academic literature on how network effects work in platform markets shows that researchers have primarily focused on the cross-industry network effects of installed bases. They all start from the assumption that each unit sold adds one unit to the installed base and, therefore, remains active in the market indefinitely; however, intuition tells us that users can sign up for a platform and then become inactive after a while. Perhaps there is a potential gap in the actual number of subscribers in most networks that are often not considered when evaluating direct or indirect effects. This is a factor to consider when establishing market regulations that can sanction platforms based solely on their number of registered users.

We also find that in most studies, negative network effects on the same side are rarely considered, if adding more users to one side of the platform exerts positive network effects for adding more users. But in this review, which only includes a sample of what has been published so far, we have not found estimates of the possible negative effects that a possible

"saturation" could cause on the one hand. Think of an increase in Amazon buyers whose growth, initially, would positively influence the incorporation of more sellers (positive cross-effects), but a disproportionate growth in relation to the offer of buyers could result in a shortage of offers, and therefore in possible network congestion by buyers fed up with finding it difficult to match (direct negative network effects). This is perhaps most visible on social matchmaking platforms like Tinder, where an exacerbated increase in men relative to women would leave many of them dissatisfied, while the other side of the platform would need to attract more users to offset the imbalance. But for this, they must resort to negative rates (subsidies) to compensate the two sides of the market, which could be viewed with suspicion by a regulatory authority. This would be one more example of the difficulty in studying the mechanisms of action on a certain platform and explains why linear or rigid rules cannot be applied when detecting anti-competitive behavior.

Much remains to be investigated, and as more data becomes available, new empirical work may appear that helps to better understand the modeling of network effects in the platform economy.

Acknowledgements

This research article has been funded by the Luis Fernández Somoza Internationalization Chair of the UDC.

ORCID

Isabel Soares https://orcid.org/0000-0002-2707-7089
Manuel Nieto-Mengott https://orcid.org/0000-0002-2403-8682

References

Armstrong, M. (1998). Network interconnection in telecommunications. *Economic Journal (London), 108*(448), 545-564. http://dx.doi.org/10.1111/1468-0297.00304

Belleflamme, P., & Peitz, M. (2015). *Industrial organization: markets and strategies*: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781107707139

Belleflamme, P., & Peitz, M. (2018). Platforms and Network Effects: University of Mannheim/Department of Economics

Working Paper Series http://dx.doi.org/10.4337/9781788112789.00019

Berry, C. A., Hobbs, B. F., Meroney, W. A., O'Neill, R. P., & Stewart, W. R. (1999). Understanding how market power can arise in network competition: A game theoretic approach. *Utilities Policy, 8*(3), 139-158. http://dx.doi.org/10.1016/S0957-1787(99)00016-8

Brunekreeft, G. (2015). Network unbundling and flawed coordination: Experience from the electricity sector. *Utilities Policy, 34*(June), 11-18. http://dx.doi.org/10.1016/j.jup.2015.03.003

Caillaud, B., & Jullien, B. (2003). Chicken and egg: Competition among intermediation service providers. *The RAND Journal of Economics, 34*(2), 309-328. http://dx.doi.org/10.2307/1593720

Chen, L., Yi, J., Li, S., & Tong, T. W. (2022). Platform governance design in platform ecosystems: Implications for complementors' multihoming decision. *Journal of Management, 48*(3), 630-656. http://dx.doi.org/10.1177/0149206320988337

Evans, D. S. (2019). Basic principles for the design of antitrust analysis for multisided platforms. *Journal of Antitrust Enforcement, 7*(3), 319-338. http://dx.doi.org/10.1093/jaenfo/jnz012

Galeotti, A., & Moraga-González, J. L. (2009). Platform Intermediation in a Market for Differentiated Products. *European Economic Review, 53*(4), 417-428. http://dx.doi.org/10.1016/j.euroecorev.2008.08.003

Hagiu, A. (2009). Two-Sided Platforms: Product Variety and Pricing Structures. *Journal of Economics & Management Strategy, 18*(4), 1011-1043. http://dx.doi.org/10.1111/j.1530-9134.2009.00236.x

Hagiu, A., & Wright, J. (2015). Marketplace or reseller? *Management Science, 61*(1), 184-203. http://dx.doi.org/10.1287/mnsc.2014.2042

Halaburda, H., & Yehezkel, Y. (2019). Focality advantage in platform competition. *Journal of Economics & Management Strategy, 28*(1), 49-59. http://dx.doi.org/10.1111/jems.12308

Haucap, J., & Heimeshoff, U. (2014). Google, Facebook, Amazon, eBay: Is the Internet driving competition or market monopolization? *International Economics and Economic Policy, 11*(1-2), 49-61. http://dx.doi.org/10.1007/s10368-013-0247-6

Jullien, B. (2004). Two-Sided Markets and Electronic Intermediaries. *CESifo Working Paper, 1345*.

Katz, M. L. (2019). Platform economics and antitrust enforcement: A little knowledge is a dangerous thing. *Journal of Economics & Management Strategy, 28*(1), 138-152. http://dx.doi.org/10.1111/jems.12304

Motta, M., & Peitz, M. (2020). *Intervention triggers and underlying theories of harm. Expert advice for the Impact Assessment of a New Competition*: Expert Study for the European Commission. http://dx.doi.org/10.2763/487824

Newman, M. E. (2003). The structure and function of complex networks. *SIAM Review, 45*(2), 167-256. http://dx.doi.org/10.1137/S003614450342480

Nielsen, J. (1999). Metcalfe's law in reverse. Retrieved from http://www.nngroup.com/articles/metcalfes-law-in-reverse/

Rochet, J. C., & Tirole, J. (2002). Cooperation among Competitors: The Economics of Payment Card Associations. *The RAND Journal of Economics, 33*(4), 1-22. http://dx.doi.org/10.2307/3087474

Rochet, J. C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association, 1*(4), 990-1029. http://dx.doi.org/10.1162/154247603322493212

Roson, R. (2005). Auctions in a two-sided network: The market for meal voucher services. *Networks and Spatial Economics, 5*(4), 339-350. http://dx.doi.org/10.1007/s11067-005-6207-0

Rysman, M. (2009). The economics of two-sided markets. *The Journal of Economic Perspectives, 23*(3), 125-143. http://dx.doi.org/10.1257/jep.23.3.125

Spulber, D. F., & Yoo, C. S. (2002). Access to networks: Economic and constitutional connections. *SSRN*.

Sundararajan, A. (2016). *The Sharing Economy: The End of Employment and the Rise of Crowd-Based Capitalism*: MIT Press.

Scientific Annals of Economics and Business
71 (4), 2024, 625-640
DOI: 10.47743/saeb-2024-0030

The Determinants of Firm Value: A Panel Data Approach on the S&P 500 Companies

Alexandra Ioana Vintilă*

Abstract: Over the last two decades, the US companies have faced a series of challenges caused by the two of the most significant events, namely the global financial crisis and the Covid-19 pandemic crisis. To analyze the influence of these crises along with other factors on the firm value represented by Tobin's Q, there were estimated unbalanced panel data multiple regression models, with cross-section fixed effects, with cross-section and period fixed effects, with cross-section random effects, and with cross-section random effects with period fixed effects, using a sample of 442 non-financial companies included in the Standard & Poor's 500 index, over a period of 20 years, from 2004 to 2023. The independent variables are divided into three categories, namely financial indicators, corporate governance variables, and dummy variables that indicate the crisis periods. The results showed that the financial leverage, asset tangibility, liquidity, firm size, the number of meetings attended by the board members annually, the proportion of the independent members on the board and the Covid-19 pandemic crisis had a positive effect on the company value, while the firm age, CEO duality, the number of the members on the board, the proportion of the females on the board and the global financial crisis exerted a negative impact on the firm value. To better differentiate the determinants of the firm value in the context of the two major events that occurred during the analyzed period, there were estimated other empirical models using interaction variables between each dummy variable showing the crisis and the other factorial variables.

Keywords: firm value; financial indicators; corporate governance indicators; US companies; panel data regression.

JEL classification: C23; G32; G34; L25; O16.

* Faculty of Finance and Banking, Bucharest University of Economic Studies, Romania; e-mail: *alexandra.vintila@fin.ase.ro*.

Article history: Received 11 November 2024 | Accepted 17 December 2024 | Published online 20 December 2024

To cite this article: Vintilă, A. I. (2024). The Determinants of Firm Value: A Panel Data Approach on the S&P 500 Companies. *Scientific Annals of Economics and Business*, 71(4), 625-640. https://doi.org/10.47743/saeb-2024-0030.

1. INTRODUCTION

The US companies have faced a series of challenges over time due to the emergence of unforeseen unfavorable global events that have affected the companies' operational activity. The global financial crisis and the Covid-19 pandemic crisis represent two of the most significant events of the last two decades that led to the stock market crash and, consequently, to a decline in the companies' value. Considering these events, the purpose of the research is to analyze the determinants of the value of the 442 non-financial companies included in the Standard & Poor's 500 index, over a period of 20 years, from 2004 to 2023, the period that also includes the two major crises.

The research is focused on three directions, which follow (i) the impact of financial variables (financial leverage, asset tangibility, liquidity, firm age, firm size) on company value, (ii) the influence of corporate governance variables (CEO duality, board size, board meetings, board non-executive members, board independence, board gender diversity) on the firm value, and (iii) the effect produced by the global financial crisis and the Covid-19 pandemic crisis on the companies value.

The research begins with a review of previous studies from the international specialized literature that highlight positive or negative effects of the factorial variables on the firm value. There was identified both the positive (Su *et al.*, 2017; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Hutauruk, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024) and negative (Panaretou, 2014; Lee *et al.*, 2015; Sudiyatno *et al.*, 2020; Thakur *et al.*, 2021; Huang & Xiong, 2023; Caixe *et al.*, 2024; Intara *et al.*, 2024; Intara & Suwansin, 2024; Wu & Song, 2024) influence of indebtedness, the positive (Sudiyatno *et al.*, 2020; Sisodia *et al.*, 2021; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara & Suwansin, 2024) and negative (Lee *et al.*, 2015; Su *et al.*, 2017; Silva *et al.*, 2019; Saona *et al.*, 2020; Cho *et al.*, 2021; Thakur *et al.*, 2021; Benjamin *et al.*, 2022; Choi *et al.*, 2022; Cid *et al.*, 2022; Chen & Yoon, 2023; Huang & Xiong, 2023; Intara *et al.*, 2024; Tan *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025) impact of the firm size, the positive (Saona *et al.*, 2020; Huang & Xiong, 2023; Mishra *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025) or negative (Mishra *et al.*, 2024) effect of the board independence on the company value.

To analyze the impact of the influencing factors on the firm value, there were estimated unbalanced panel data multiple regression models, with cross-section fixed effects, with cross-section and period fixed effects, with cross-section random effects, and with cross-section random effects with period fixed effects, the dependent variable used as a proxy for company value being represented by Tobin's Q. At the end of the paper, there are presented the empirical results regarding the factors affecting the company value, the results being interpreted both from a statistical and an economic perspective, with reference to the previous studies from the literature review.

2. LITERATURE REVIEW

Over the last years, there has been an important number of studies that investigated the determinants of the firm value. In the international scientific literature, there has been identified a variety of financial factors that can lead to the increase or decrease in the company value, such as: profitability (Panaretou, 2014; Lee *et al.*, 2015; Silva *et al.*, 2019; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Choi *et al.*, 2022; Cid *et al.*, 2022; Huang,

2024; Hutauruk, 2024; Intara *et al.*, 2024; An *et al.*, 2025), leverage (Panaretou, 2014; Lee *et al.*, 2015; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Chen & Yoon, 2023; Huang & Xiong, 2023; Caixe *et al.*, 2024; Hutauruk, 2024; Intara *et al.*, 2024; Intara & Suwansin, 2024; Mishra *et al.*, 2024; An *et al.*, 2025), asset tangibility (Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022), liquidity (Cho *et al.*, 2021; Benjamin *et al.*, 2022; Choi *et al.*, 2022; Huang, 2024; Hutauruk, 2024), sales growth (Sisodia *et al.*, 2021; Chen & Yoon, 2023; Huang & Xiong, 2023; Caixe *et al.*, 2024), firm size (Lee *et al.*, 2015; Silva *et al.*, 2019; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Choi *et al.*, 2022; Cid *et al.*, 2022; Chen & Yoon, 2023; Huang & Xiong, 2023; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara *et al.*, 2024; Intara & Suwansin, 2024; An *et al.*, 2025), firm age (Lee *et al.*, 2015; Silva *et al.*, 2019; Cid *et al.*, 2022; Chen & Yoon, 2023).

In the last period, ESG practices have been increasingly used in modeling the firm value. In this regard, An *et al.* (2025) analyzed the impact of environmental, social, and governance information disclosure on the value of Chinese companies listed on Shanghai and Shenzhen stock exchanges, over the period 2013-2020. The authors found out that ESG disclosure, along with ESG environmental dimension and ESG social dimension have a positive impact on firm value, while the ESG governance dimension proved to be statistically insignificant. However, Mishra *et al.* (2024) identified a negative influence of the ESG score on the value of Indian companies, meaning that companies which have a high level of ESG score obtain a lower firm value due to the overutilization of resources that might be used to substantiate the needs of shareholders. Furthermore, Hardiningsih *et al.* (2024) studied the effects that environmental disclosure, social disclosure, governance disclosure, along with political connection have on firm value. The sample consists of 87 companies listed on Singapore Stock Exchange over the period 2018-2021. The findings of the study indicate that in order to increase the company value, it is important to disclose political relationships, but also environmental and governance performance, the firm value being not affected by the social performance disclosure.

In another scientific paper (Cid *et al.*, 2022) it is analyzed the impact of the founding-family control and ownership concentration on the firm value. The sample is represented by 160 non-financial Chilean companies listed on the Santiago Stock Exchange, over a period of 15 years, from 2005 to 2019. It can be observed that family ownership leads to an increase in the company value until the extreme point is reached, so then the value of the company decreases after the extreme point is exceeded. Moreover, ownership concentration has a significantly negative impact on firm value, as noted also by Saona *et al.* (2020) who studied the relationship between corporate governance, board of directors and the value of companies from Chile and Spain, and identified a U-shaped effect of the ownership concentration on firm value.

Benjamin *et al.* (2022) has an interesting approach, examining the relationship between social media sentiments and company value. The social media sentiments are classified into positive and negative sentiments, but also into specific types of positive and negative sentiments such as joy and sadness. The results showed that positive social media sentiments, joy social media sentiments and advertising expenses lead to an increase in the firm value, no matter whether the company has a high or low ESG score. According to Chen and Yoon (2023), education is an essential resource for both personal growth and a firm's growth, and highly educated people can start successful businesses. Therefore, human capital is a crucial resource bringing excess earning power to the companies. The authors (Chen & Yoon, 2023) examined how education enhance the Chinese firm value, over a period of 10 years, from

2010 to 2019. They found out that graduate degree holders affect firm value more positively than undergraduate degree holders, while the digitalization level further strengthens brain gain's positive effect on company value.

In the specialized literature there are other approaches to firm value from the perspective of the generalized neoclassical model of investment (Belo *et al.*, 2022). The study analyzed the economic determinants of the market value of the US publicly traded companies from 1975 to 2016, incorporating quasi-fixed labor, knowledge capital, and brand capital into the neoclassical model of investment. The conclusions of the research show that non-physical input for company value is substantial and varies across industries, suggesting that knowledge capital accounts for 20% to 43%, physical capital accounts for 30% to 40%, brand capital accounts for 6% to 25% and installed labor force accounts for 14% to 21% of companies' market value across industries.

The main independent variables used by the authors of previous studies are presented in Table no. 1.

Table no. 1 – Synthesis of the literature review

Author(s)	Sample	Period	Main independent variables
An *et al.* (2025)	703 China's A-share firms listed on China's Shanghai and Shenzhen Stock Exchanges	2013 – 2020	ESG score, Firm size, Leverage, Profitability, Board size, Board independence, Board gender diversity, Operating cash flow, R&D expenditures, Institutional ownership
Benjamin *et al.* (2022)	Fortune 500 firms	2010 – 2017	Positive Social Media Sentiments, Negative Social Media Sentiments, Joy Social Media Sentiments, Sadness Social Media Sentiments, Firm size, Leverage, Profitability, Cash ratio, Asset tangibility, R&D expenditures
Caixe *et al.* (2024)	136 Brazilian companies listed on the Brazilian Stock Exchange	2009 – 2018	Foreign institutional ownership, Domestic institutional ownership, Ownership concentration, Firm size, Sales growth, Leverage, Cash ratio, Profitability
Chen and Yoon (2023)	China's A-share listed firms	2010 – 2019	Brain gains, Digitalization level, Sales growth, Operating cash flow, Capital intensity, Interest-bearing liabilities, Firm age, Board size, State ownership
Cho *et al.* (2021)	Firms included in Compustat database	1992 – 2016	Investment, Market competition, Firm size, Leverage, Profitability, Cash ratio, Asset tangibility, CEO tenure, CEO gender
Choi *et al.* (2022)	Privately owned firms listed on China's Shanghai and Shenzhen Stock Exchanges	2005 – 2016	Executives' education, Executives' compensation, Executives' age, Executives' tenure, Executives' gender diversity, Firm size, Leverage, Liquidity, Profitability, R&D expenditures
Cid *et al.* (2022)	160 non-financial Chilean firms listed	2005 – 2019	Family ownership, CEO/chairman founder, CEO/chairman family, Pension

Author(s)	Sample	Period	Main independent variables
	on the Santiago Stock Exchange		funds' ownership, Board gender diversity, Ownership concentration, Firm size, Leverage, Firm age, Profitability, Asset tangibility
Diantimala *et al.* (2021)	234 non-financial firms listed on the Indonesia Stock Exchange	2012 – 2018	Capital structure, Profitability, Asset tangibility, Liquidity, Firm size
Hardiningsih *et al.* (2024)	87 firms listed on the Singapore Stock Exchange	2018 – 2021	Environmental score, Social score, Governance score, Political connection
Huang and Xiong (2023)	3305 Chinese listed firms	2007 – 2020	Firm size, Leverage, Investment, Dividend, Sales growth, Board size, Board independence, Ownership concentration, Managerial ability score
Huang (2024)	15813 firms from 116 countries	1987 – 2023	Board gender diversity, Board age, Board tenure, Board independence, CEO duality, Leverage, Cash holding, Asset tangibility, Firm size
Hutauruk (2024)	Palm oil firms listed on the Indonesia Stock Exchange	2019 – 2022	Technology innovation, Firm size, Liquidity, Leverage, Profitability, Asset turnover
Intara *et al.* (2024)	84 firms listed on the Stock Exchange of Thailand	2014 – 2021	Earnings quality, Corporate governance, Firm size, Sales growth, Net profit margin, Profitability, Leverage
Intara and Suwansin (2024)	390 firms listed on the Stock Exchange of Thailand	2012 – 2021	Intangible assets, R&D expenditures, Board independence, Institutional ownership, CEO duality, Firm size, Leverage
Lee *et al.* (2015)	Firms included in Compustat database	1993 – 2011	CEO duality, CEO tenure, CEO founder, Leverage, Profitability, Firm size, Firm age, R&D expenditures
Liow (2010)	336 public real estate investment and development firms	2000 – 2006	Firm size, Sustainable growth rate, Asset tangibility
Mishra *et al.* (2024)	420 firms listed on the National Stock Exchange of India	2016 – 2021	ESG score, Board independence, Board meetings, Board busyness, Board size, R&D expenditures, Leverage, Firm size, Sales growth
Panaretou (2014)	FTSE 350 firms	2003 – 2010	Leverage, Profitability, Growth opportunity, Dividend, Firm size
Saona *et al.* (2020)	Indexed non-financial firms from Chile and Spain	2007 – 2016	Board size, Board independence, Board gender diversity, Ownership concentration, Firm size, Profitability, Risk, Asset tangibility

Author(s)	Sample	Period	Main independent variables
Silva *et al.* (2019)	80 publicly traded Brazilian firms listed in the IBrX100 index of the Brazilian Stock Exchange	2004 – 2013	Firm size, Leverage, Sales growth, Firm age, Profitability
Sisodia *et al.* (2021)	1862 non-financial firms listed on the National Stock Exchange of India	2001 – 2019	Human capital, Firm size, Profitability, Leverage, Cash ratio, Asset tangibility, Dividend, Sales growth, R&D expenditures
Su *et al.* (2017)	All firms listed on China's Shanghai and Shenzhen Stock Exchanges	2003 – 2012	Corporate risk-taking, Firm size, Leverage, Profitability, Sales growth, Asset tangibility, Firm age
Sudiyatno *et al.* (2020)	184 manufacturing firms listed on the Indonesia Stock Exchange	2016 – 2018	Capital structure, Managerial ownership, Firm size, Profitability
Tan *et al.* (2024)	98 China's A-share listed pharmaceutical manufacturing companies	2012 – 2021	ESG performance, Technological innovation, Firm size, Leverage, Firm age, Board independence, Growth capacity, Profitability, Cash holding
Thakur *et al.* (2021)	4236 firms from 16 emerging market economies	2002 – 2015	Corruption, Cash holding, Leverage, Capital expenditure, Firm size, Asset tangibility, Profitability, Inflation, Economic growth
Wu and Song (2024)	A-share firms listed on the Chinese stock market	2018 – 2022	Performance of carbon neutrality, Firm size, Leverage, Asset tangibility, Ownership concentration, Board size, Board independence

Source: author's own processing

Based on the authors' results of the previous studies, there are considered 10 research hypotheses:

- **Hypothesis 1**: Financial leverage positively affects the firm value (Su *et al.*, 2017; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Hutauruk, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024).
- **Hypothesis 2**: Asset tangibility has a positive effect on the firm value (Saona *et al.*, 2020; Benjamin *et al.*, 2022).
- **Hypothesis 3**: Liquidity has a positive impact on the firm value (Hutauruk, 2024).
- **Hypothesis 4**: Firm age positively impacts the firm value (Su *et al.*, 2017; Silva *et al.*, 2019; Cid *et al.*, 2022; Chen & Yoon, 2023).
- **Hypothesis 5**: Firm size exerts a positive impact on the firm value (Sudiyatno *et al.*, 2020; Sisodia *et al.*, 2021; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara & Suwansin, 2024).

- **Hypothesis 6**: CEO duality negatively affects the firm value (Lee *et al.*, 2015; Intara & Suwansin, 2024).
- **Hypothesis 7**: Board size has a negative impact on the firm value (Chen & Yoon, 2023; Huang, 2024; Mishra *et al.*, 2024).
- **Hypothesis 8**: Board meetings exert a negative impact on the firm value (Mishra *et al.*, 2024).
- **Hypothesis 9**: Board independence positively influences the firm value (Saona *et al.*, 2020; Huang & Xiong, 2023; Mishra *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025).
- **Hypothesis 10**: Board gender diversity has a positive impact on the firm value (Saona *et al.*, 2020; Huang, 2024).

These hypotheses will be further tested, within the empirical models estimated for the companies included in the S&P 500 index.

3. RESEARCH METHODOLOGY

3.1 Database

To construct the sample, the data is collected from Eikon platform by Thomson Reuters and consists of 442 non-financial companies included in the Standard & Poor's 500 index, over a period of 20 years, from 2004 to 2023, amassing a total of 8840 statistical observations. Considering that for some companies there wasn't data available for the entire analyzed period, the final sample was reduced to a maximum number of 4263 observations. However, the number of observations differs depending on the estimated empirical model, varying from 3785 to 4263 observations. Moreover, to reduce the impact of outliers on empirical research, a 95% winsorization of the data was applied.

3.2 Variables definition

The dependent variable included in the empirical research is represented by Tobin's Q (TQ), used as a proxy for firm value, because it is a forward-looking valuation approach (Mishra *et al.*, 2024). Tobin's Q is defined as the market value of equity plus the book value of debt, all divided by total assets. Regarding the independent variables, they are divided into three categories, namely: financial indicators, corporate governance indicators and dummy variables for crisis periods.

The financial indicators are represented by: financial leverage (LEV) measured as total debt divided by total assets (Lee *et al.*, 2015; Su *et al.*, 2017; Silva *et al.*, 2019; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Thakur *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Huang & Xiong, 2023; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara *et al.*, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024; Wu & Song, 2024), reflecting how much of the firm's assets are financed by debt, asset tangibility (TANG) calculated as net property, plant, and equipment divided by total assets (Su *et al.*, 2017; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Thakur *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Huang, 2024), showing the proportion of fixed assets in total assets, liquidity (LIQ) represented by current ratio which is calculated as current assets to current liabilities (Choi *et al.*, 2022; Hutauruk, 2024), effective tax rate (ETR) used as a proxy for taxation and calculated as tax expenses to earnings before taxes, firm age (FAGE) meaning the years since company public

listing (Lee *et al.*, 2015; Su *et al.*, 2017; Silva *et al.*, 2019; Chen & Yoon, 2023; Tan *et al.*, 2024), natural logarithm of market capitalization (FSIZE) used as a proxy for firm size (Caixe *et al.*, 2024).

Regarding corporate governance, it is analyzed through indicators, such as: CEO duality (CEOD) expressed as a dummy variable which takes value 1 if the CEO is also the chairman, and value 0 otherwise (Lee *et al.*, 2015; Huang, 2024; Intara & Suwansin, 2024), board size (BSIZE) measured as the number of directors on the board (Saona *et al.*, 2020; Chen & Yoon, 2023; Huang & Xiong, 2023; Huang, 2024; Mishra *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025), board meetings (BMEET) calculated as the number of meetings attended by the board members annually (Mishra *et al.*, 2024), board non-executive members (BNEXEC) meaning the proportion of the non-executive members on the board, board independence (BINDEP) showing the proportion of independent members on the board (Saona *et al.*, 2020; Choi *et al.*, 2022; Huang & Xiong, 2023; Huang, 2024; Intara & Suwansin, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025), board gender diversity (BGDIV) expressed as the percentage of female directors on the board (Saona *et al.*, 2020; Cid *et al.*, 2022; Huang, 2024; An *et al.*, 2025).

In the empirical research, four new variables are proposed and used, which have not been identified in the previous studies, namely: effective tax rate (ETR) – to analyze the impact of taxation on firm value, board non-executive members (BNEXEC), and two dummy variables that capture the impact of the global financial crisis (FIN), respectively the Covid-19 pandemic crisis (COVID) on the firm value.

3.3 Research models

To examine the determinants of the firm value, there are estimated unbalanced panel data multiple regression models, with cross-section fixed effects, with cross-section and period fixed effects, with cross-section random effects, and with cross-section random effects with period fixed effects, using Stata 18 software, as follows:

$$TQ_{it} = \beta_0 + \beta_1 LEV_{it} + \beta_2 TANG_{it} + \beta_3 LIQ_{it} + \beta_4 ETR_{it} + \beta_5 FAGE_{it} + \beta_6 FSIZE_{it} + \beta_7 CEOD_{it} + \beta_8 BSIZE_{it} + \beta_9 BMEET_{it} + \beta_{10} BNEXEC_{it} + \beta_{11} BGDIV_{it} + \beta_{12} FIN_{it} + \beta_{13} COVID_{it} + \lambda_i + \mu_t + \varepsilon_{it}$$

$$TQ_{it} = \beta_0 + \beta_1 LEV_{it} + \beta_2 TANG_{it} + \beta_3 LIQ_{it} + \beta_4 ETR_{it} + \beta_5 FAGE_{it} + \beta_6 FSIZE_{it} + \beta_7 CEOD_{it} + \beta_8 BSIZE_{it} + \beta_9 BMEET_{it} + \beta_{10} BINDEP_{it} + \beta_{11} BGDIV_{it} + \beta_{12} FIN_{it} + \beta_{13} COVID_{it} + \lambda_i + \mu_t + \varepsilon_{it}$$

where TQ is Tobin's Q, LEV is financial leverage, TANG is asset tangibility, LIQ is liquidity, ETR is effective tax rate, FAGE is firm age, FSIZE is firm size, CEOD is CEO duality, BSIZE is board size, BMEET is board meetings, BNEXEC is board nonexecutive members, BINDEP is board independence, BGDIV is board gender diversity, FIN is a dummy variable for global financial crisis, COVID is a dummy variable for Covid-19 pandemic crisis, λ_i shows the unobserved individual effect, μ_t shows the unobserved time effect, ε_{it} is the error term.

3.4 Descriptive statistics

Table no. 2 shows the descriptive statistics of the variables.

Table no. 2 – Descriptive statistics

Variable	Mean	Median	Min	Max	SD
TQ	2.0802	1.5700	.5500	7.6300	1.5706
LEV	.4212	.4079	0	1.1651	.2673
TANG	.2709	.1689	.0192	.8966	.2508
LIQ	1.7913	1.4803	.4956	5.3203	1.0814
ETR	.2374	.2527	-.1680	.5306	.1429
FAGE	33.256	23	1	113	29.9262
FSIZE	23.5585	23.5103	21.0868	26.1535	1.2165
CEOD	.5504	1	0	1	.4975
BSIZE	10.6815	11	7	15	2.0151
BMEET	7.8130	7	4	16	2.9174
BNEXEC	.8583	.8824	.6667	.9333	.0684
BINDEP	.8240	.8462	.5556	.9333	.0969
BGDIV	.1930	.1818	0	.6667	.1066
FIN	.1500	0	0	1	.3571
COVID	.1500	0	0	1	.3571

Source: author's own computation

The average value of Tobin's Q is 2.08, while the median value is 1.57. Regarding the financial leverage, the companies total debt represents, on average, 42.12% of the total assets. Moreover, the fixed assets of a company represent, on average, 27.09% of its total assets. Additionally, in the S&P 500 index, the oldest company is 113 years old, whereas the youngest firm has only 1 year since public listing. Relative to corporate governance, the number of directors on the board varies from 7 to 15 people, the board of directors meets 4 to 16 times during the year. Furthermore, the average percentage of the female directors on the board represents only 19.30%.

3.5 Correlation analysis

Table no. 3 presents the correlation matrix for the variables used in the empirical research.

Table no. 3 – Correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) TQ	1.0000							
(2) LEV	-0.0374	1.0000						
(3) TANG	-0.0295	0.0661	1.0000					
(4) LIQ	0.0979	-0.4292	-0.1683	1.0000				
(5) ETR	-0.0988	-0.0530	0.1350	-0.0846	1.0000			
(6) FAGE	-0.0505	0.1134	0.0030	-0.1249	-0.0362	1.0000		
(7) FSIZE	0.0867	0.0943	0.0594	-0.1662	-0.1201	0.1679	1.0000	
(8) CEOD	-0.1346	0.0908	0.0565	-0.1529	0.0477	0.2409	0.1162	1.0000
(9) BSIZE	-0.0960	0.2579	0.0777	-0.2487	0.0023	0.2591	0.3950	0.1272
(10) BMEET	-0.0109	0.1492	0.0039	-0.1251	-0.0420	0.0511	0.0818	0.0522
(11) BNEXEC	-0.0586	0.2595	-0.0228	-0.1477	-0.0546	0.1713	0.2113	0.2094
(12) BINDEP	0.0260	0.2028	-0.0390	-0.1086	-0.1170	0.1615	0.1831	0.1968
(13) BGDIV	0.0324	0.2102	-0.0480	-0.2087	-0.1720	0.1729	0.3440	0.0766
(14) FIN	-0.1142	-0.0858	0.0444	-0.0017	0.1088	-0.0308	-0.1477	0.0667
(15) COVID	0.1533	0.0932	-0.0050	-0.0687	-0.2321	0.0537	0.2353	-0.0705

Variable	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(9) BSIZE	1.0000						
(10) BMEET	0.1503	1.0000					
(11) BNEXEC	0.2322	0.0895	1.0000				
(12) BINDEP	0.1017	0.0993	0.6450	1.0000			
(13) BGDIV	0.2020	0.0994	0.1884	0.2335	1.0000		
(14) FIN	-0.0244	0.0297	-0.0301	-0.0663	-0.1712	1.0000	
(15) COVID	0.0230	0.0486	0.0666	0.1253	0.4239	-0.1553	1.0000

Source: author's own computation

Moderate and positive correlations are identified between board non-executive members and board independence, so therefore, in order to avoid the phenomenon of multicollinearity of the factors, the two independent variables are included in different regression models.

4. EMPIRICAL ANALYSIS AND RESULTS

To analyze the factors affecting the value of the 442 non-financial companies included in the S&P 500 index over the period 2004-2023, there are estimated eight different models, and the empirical results are presented in Table no. 4. There is also conducted the Hausman test to determine which model is more appropriate, and the results indicate that the fixed effects estimator is preferred over the random effects estimator.

Table no. 4 – Empirical results

Variable	Models							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LEV	.2109*		.176*		.2855**	.2148*		
	(.1143)		(.1055)		(.1115)	(.11)		
TANG	.571**				.5459*			
	(.2912)				(.2801)			
LIQ	.0547**	.0521**	.0579**	.059**	.0499*	.0583**	.0433*	.0588**
	(.0271)	(.0255)	(.026)	(.0246)	(.0266)	(.0262)	(.0248)	(.0241)
ETR	-.1392		-.1679		-.0794	.0628	-.0833	
	(.1383)		(.1342)		(.1359)	(.1345)	(.1318)	
FAGE	-.0062	-.0679***	-.0036	-.0054**	-.0225***	-.0771***	-.0058**	-.0057**
	(.0065)	(.0157)	(.0024)	(.0025)	(.0058)	(.0158)	(.0023)	(.0024)
FSIZE	.5957***	.4486***	.5075***	.3778***	.5956***	.4528***	.4753***	.369***
	(.0381)	(.0357)	(.032)	(.033)	(.0363)	(.0372)	(.0308)	(.0317)
CEOD	-.0792*	-.0842**	-.1016**	-.0925**	-.0748*		-.093**	-.0921**
	(.0444)	(.0418)	(.0428)	(.0413)	(.0423)		(.0409)	(.0394)
BSIZE	-.0336***	-.0247**	-.0388***	-.0343***	-.0404***	-.0259**	-.0434***	-.0372***
	(.0125)	(.0118)	(.0121)	(.0116)	(.012)	(.0116)	(.0116)	(.0111)
BMEET	.0139**	.0123**	.0104	.0108*	.0137**		.0105*	.01*
	(.0065)	(.0062)	(.0064)	(.0061)	(.0063)		(.0062)	(.0059)
BNEXEC	-.042	-.1	-.2509	-.1331				
	(.2987)	(.2858)	(.2919)	(.2837)				
BINDEP					.3582	.4047*	.1886	.2371
					(.2495)	(.2442)	(.2385)	(.232)
BGDIV	-.6953***		-.6015***	-.7775***	-.4227*	-.5786**	-.4732**	-.5901**
	(.2487)		(.2302)	(.2374)	(.2406)	(.2392)	(.2237)	(.2301)
FIN	-.2575***	-.2133	-.2874***	-.5354***	-.3252***		-.3241***	-.5048***
	(.0577)	(.1707)	(.0545)	(.1591)	(.0545)		(.0525)	(.1151)

Variable	Models							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COVID	.2059***	.8194***	.2449***		.2542***	1.0369***	.2559***	
	(.0458)	(.3058)	(.0423)		(.0449)	(.2952)	(.0423)	
C	-11.7065***	-6.0884***	-9.2739***	-6.0403***	-11.3837***	-6.2637***	-8.6871***	-6.1454***
	(.8645)	(.9525)	(.7835)	(.8039)	(.8057)	(.9654)	(.7208)	(.7501)
Effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects
R-squared	.1748	.1981	.1708	.1965	.1623	.1894	.1561	.1846
Observations	3785	4051	3831	4044	3992	4083	4041	4263

Note: Significance level: *** p<.01, ** p<.05, * p<.1. Standard errors are displayed in brackets.
Source: author's own computation using Stata 18 software.

The empirical results indicate a positive impact of the financial leverage, asset tangibility and liquidity on the firm value, meaning that the more indebted the company is, the more fixed assets it has, and the more liquidity it is, the more its value increases. The findings are in accordance with the results of the international specialized and lead to the validation of hypothesis 1 (Su *et al.*, 2017; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Hutauruk, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024), hypothesis 2 (Saona *et al.*, 2020; Benjamin *et al.*, 2022) and hypothesis 3 (Hutauruk, 2024). Nevertheless, hypothesis 4 is rejected, because the firm age negatively influences the firm value. Firm size has a positive impact on firm value, and according to Sudiyatno *et al.* (2020), larger companies gain market confidence and the investors are more confident to invest in bigger firms since there is a better guarantee for their investments, which leads to the increase of the firm value. Thus, hypothesis 5 is accepted (Sudiyatno *et al.*, 2020; Sisodia *et al.*, 2021; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara & Suwansin, 2024).

CEO duality and board size negatively affect the company value, validating hypothesis 6 (Lee *et al.*, 2015; Intara & Suwansin, 2024) and hypothesis 7 (Chen & Yoon, 2023; Huang, 2024; Mishra *et al.*, 2024). Therefore, when the company CEO is also the company chairman, the firm value decreases. Moreover, larger boards could complicate the decision-making process, because of the divergent opinions of the members, which could negatively influence the firm value. Board meetings positively influence the firm value, while board gender diversity has a negative effect on the company value, so hypothesis 8 and hypothesis 10 are rejected. Board independence exerts a positive effect on the firm value, going to the validation of hypothesis 9 (Saona *et al.*, 2020; Huang & Xiong, 2023; Mishra *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025). An increase in the number of independent members could ensure an effective strategic leadership which generates an increase in the company value.

Regarding the four new variables proposed, effective tax rate and board non-executive members are statistically insignificant, the global financial crisis had a negative effect on the firm value, contrary to the Covid-19 pandemic crisis which had a positive impact on the company value.

Moreover, to better differentiate the determinants of the firm value in the context of the two major events that occurred during the analyzed period, namely the global financial crisis and the Covid-19 pandemic crisis, there were estimated other empirical models using interaction variables between the dummy variable representing the global financial crisis and the other independent variables (Table no. 5), on the one hand, and the dummy variable capturing the Covid-19 pandemic crisis and the other factorial variables (Table no. 6), on the other hand.

Table no. 5 – Empirical results on the determinants of firm value during the global financial crisis

Variable	Models							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LEV * FIN	-.5465*	-.2832	-.5466*	-.2827	-.577**	-.2226	-.5759**	-.2214
	(.285)	(.2742)	(.2843)	(.274)	(.2715)	(.2685)	(.2709)	(.2685)
TANG * FIN	-.1777	-.0848	-.19	-.0939	-.1339	-.0538	-.1469	-.0647
	(.2551)	(.2412)	(.2544)	(.2409)	(.2505)	(.2373)	(.2497)	(.2371)
LIQ * FIN	-.2212***	-.1472**	-.2147***	-.1412**	-.2396***	-.1583**	-.2341***	-.1532**
	(.0696)	(.069)	(.0695)	(.0689)	(.0665)	(.0666)	(.0663)	(.0666)
ETR * FIN	-1.2878***	-.9757**	-1.2594***	-.9518**	-1.1732***	-.8379**	-1.1493***	-.818**
	(.4171)	(.4006)	(.4161)	(.4002)	(.4101)	(.3957)	(.409)	(.3955)
FAGE * FIN	.0024	.0018	.0022	.0017	.0024	.0017	.0023	.0016
	(.0018)	(.0017)	(.0018)	(.0017)	(.0018)	(.0017)	(.0018)	(.0017)
FSIZE * FIN	.0332	.1285***	.0314	.1279***	.0116	.1217**	.0107	.1217**
	(.0307)	(.0483)	(.0306)	(.0482)	(.0255)	(.0483)	(.0255)	(.0483)
CEOD * FIN	-.0199	-.0194	-.0256	-.0247	-.0561	-.0574	-.0605	-.0615
	(.1273)	(.1195)	(.127)	(.1195)	(.1228)	(.116)	(.1225)	(.116)
BSIZE * FIN	.0059	.0041	.005	.0032	.0035	.0062	.0031	.0057
	(.0313)	(.0294)	(.0312)	(.0294)	(.0308)	(.0291)	(.0307)	(.0291)
BMEET * FIN	.0325*	.0339*	.0314	.0329*	.0138	.0148	.0131	.014
	(.0196)	(.0184)	(.0196)	(.0184)	(.0196)	(.0185)	(.0196)	(.0185)
BNEXEC * FIN	-.8833	.3524	-.8278	.4089				
	(.7668)	(.784)	(.765)	(.7835)				
BINDEP * FIN					-.1048	.7108	-.0771	.7332
					(.5737)	(.5614)	(.5723)	(.5615)
BGDIV * FIN	-.6932	-.8827	-.6597	-.8538	-.3534	-.4697	-.3341	-.453
	(.6767)	(.6379)	(.6753)	(.6375)	(.6308)	(.5982)	(.6293)	(.5983)
C	2.1435***	2.134***	2.1693***	2.1274***	2.1297***	2.0584***	2.1706***	2.0672***
	(.0149)	(.1499)	(.0797)	(.1689)	(.0146)	(.0975)	(.0798)	(.1242)
Effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects
R-squared	.0518	.1719	.0518	.1719	.0481	.1591	.0481	.1591
Observations	3785	3785	3785	3785	3992	3992	3992	3992

Note: Significance level: *** p<.01, ** p<.05, * p<.1. Standard errors are displayed in brackets.

Source: author's own computation using Stata 18 software.

Table no. 6 – Empirical results on the determinants of firm value during the Covid-19 pandemic crisis

Variable	Models							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
LEV * COVID	.2692*	.2048	.2695*	.21	.2257	.1801	.227	.1862
	(.154)	(.1467)	(.1527)	(.1457)	(.1538)	(.1467)	(.1526)	(.1459)
TANG * COVID	-.2865*	-.2766*	-.2676	-.2583	-.3056*	-.3035*	-.2859*	-.2836*
	(.1688)	(.1603)	(.1673)	(.1593)	(.169)	(.1608)	(.1675)	(.1599)
LIQ * COVID	.1559***	.1596***	.1577***	.1616***	.1604***	.1745***	.1612***	.1751***
	(.0435)	(.0417)	(.0432)	(.0415)	(.0434)	(.0418)	(.0431)	(.0416)
ETR * COVID	-.9274***	-.6822**	-.9793***	-.7392***	-.9434***	-.6134**	-.9979***	-.6772**
	(.2996)	(.2872)	(.2978)	(.2861)	(.3001)	(.2893)	(.2984)	(.2885)
FAGE * COVID	.0015	.0007	.0014	.0007	.0013	.0008	.0012	.0007
	(.0012)	(.0012)	(.0012)	(.0012)	(.0012)	(.0012)	(.0012)	(.0012)
FSIZE * COVID	.1026***	.2036***	.1045***	.2025***	.0525***	.2055***	.0562***	.2036***
	(.0207)	(.0389)	(.0206)	(.0387)	(.0192)	(.039)	(.0191)	(.0388)
CEOD * COVID	-.0917	-.1283*	-.1015	-.1368**	-.1071	-.1691**	-.1149	-.1747**
	(.0722)	(.0694)	(.0717)	(.069)	(.0727)	(.07)	(.0721)	(.0697)
BSIZE * COVID	-.0737***	-.0807***	-.0751***	-.0818***	-.0821***	-.088***	-.0836***	-.0892***
	(.0209)	(.0201)	(.0208)	(.02)	(.0209)	(.02)	(.0208)	(.02)
BMEET *	.0482***	.0481***	.047***	.0468***	.0454***	.0463***	.0443***	.045***
COVID	(.0115)	(.0114)	(.0115)	(.0113)	(.0116)	(.0114)	(.0116)	(.0114)
BNEXEC *	-1.6125***	-.5512	-1.6282***	-.5951				
COVID	(.5295)	(.553)	(.5258)	(.5504)				
BINDEP *					.0168	.9643**	-.0521	.8682*
COVID					(.4501)	(.4559)	(.447)	(.4542)
BGDIV * COVID	-.9594**	-.7347	-.9562**	-.7362	-1.1468**	-.9492**	-1.1304**	-.9383**
	(.4683)	(.4552)	(.4646)	(.4527)	(.4675)	(.4552)	(.4642)	(.4532)
C	1.9681***	2.133***	1.9863***	2.1288***	1.9631***	2.0612***	1.9935***	2.0714***
	(.0159)	(.1489)	(.0799)	(.1676)	(.0155)	(.0967)	(.0795)	(.1231)
Effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects	Cross-section fixed effects	Cross-section and period fixed effects	Cross-section random effects	Cross-section random effects with period fixed effects
R-squared	.0883	.1837	.0883	.1836	.0806	.1735	.0806	.1735
Observations	3785	3785	3785	3785	3992	3992	3992	3992

Note: Significance level: *** p<.01, ** p<.05, * p<.1. Standard errors are displayed in brackets.
Source: author's own computation using Stata 18 software.

It can be observed that the financial leverage and the liquidity had a negative effect on the S&P 500 companies value during the global financial crisis, contrary to the Covid-19 pandemic period when the impact of the financial leverage and the liquidity on the firm value was positive. The effective tax rate had a negative influence on the companies value both during the financial crisis and the pandemic crisis, whereas asset tangibility, CEO duality, board size, the number of non-executive members on the board and the proportion of the females on the board negatively affected Tobin's Q only during the Covid-19 crisis. Regarding the firm size and the board meetings, these factorial variables positively impacted the firm value during financial and pandemic crises. Moreover, during the pandemic crisis, the board independence had a positive impact on the enterprise value.

5. CONCLUSIONS

The study investigated the determinants of the firm value, on a database consisting of 442 non-financial companies included in the Standard & Poor's 500 index, over a period of 20 years, from 2004 to 2023. Given that the analyzed period spans two crises – the global financial crisis and the Covid-19 pandemic crisis – two new factorial variables were proposed to capture the impact each of these crises had on the S&P 500 companies. Reviewing the international specialized literature, several independent variables were identified that could influence the firm value. In addition to the factorial variables proposed by the specialized literature, to enhance the robustness of the research, there were included in the empirical models other new variables considered to have an impact on the company value, such as the effective tax rate and the proportion of the non-executive members on the board. There were estimated unbalanced panel data multiple regression models, with cross-section fixed effects, with cross-section and period fixed effects, with cross-section random effects, and with cross-section random effects with period fixed effects.

The research results indicated a positive or negative impact of the independent variables on the firm value, 7 out of 10 research hypotheses being validated. On the one hand, the company value is positively influenced by the financial leverage (Su *et al.*, 2017; Saona *et al.*, 2020; Cho *et al.*, 2021; Sisodia *et al.*, 2021; Benjamin *et al.*, 2022; Cid *et al.*, 2022; Hutauruk, 2024; Mishra *et al.*, 2024; Tan *et al.*, 2024), asset tangibility (Saona *et al.*, 2020; Benjamin *et al.*, 2022), liquidity (Hutauruk, 2024), firm size (Sudiyatno *et al.*, 2020; Sisodia *et al.*, 2021; Caixe *et al.*, 2024; Huang, 2024; Hutauruk, 2024; Intara & Suwansin, 2024), board meetings, board independence (Saona *et al.*, 2020; Huang & Xiong, 2023; Mishra *et al.*, 2024; Wu & Song, 2024; An *et al.*, 2025), and the Covid-19 pandemic crisis, and, on the other hand, factors such as firm age, CEO duality (Lee *et al.*, 2015; Intara & Suwansin, 2024), board size (Chen & Yoon, 2023; Huang, 2024; Mishra *et al.*, 2024), board gender diversity, and the global financial crisis have a negative impact on the value of the non-financial companies included in the S&P 500 index.

To capture the factors affecting the S&P 500 companies value during the global financial crisis and the Covid-19 pandemic crisis, there were constructed interaction variables between each dummy variable showing the crisis and the other independent variables. The empirical results indicated that to increase the firm value during the global financial crisis, companies had to reduce their debt financing and increase the company size and the number of board meetings. During the Covid-19 pandemic crisis, to increase the enterprise value, companies resorted to debt financing, decreased the proportion of tangible assets in total assets, increased the liquidity and firm size, reduced the number of board members and increased the number of board meetings.

In conclusion, the empirical research results provide substantial information regarding the factors that could positively or negatively affect the company value, but also offer valuable information, both to shareholders and to potential investors who are interested in purchasing shares of the companies that are part of the S&P 500 index.

ORCID

Alexandra Ioana Vintilă https://orcid.org/0009-0003-5363-0807

References

An, H., Ran, C., & Gao, Y. (2025). Does ESG information disclosure increase firm value? The mediation role of financing constraints in China. *Research in International Business and Finance, 73*, 1-21. http://dx.doi.org/10.1016/j.ribaf.2024.102584

Belo, F., Gala, V. D., Salomao, J., & Vitorino, M. A. (2022). Decomposing firm value. *Journal of Financial Economics, 143*(2), 619-639. http://dx.doi.org/10.1016/j.jfineco.2021.08.007

Benjamin, S. J., Biswas, P. K. M., Marathamuthu, M. S., & Arunachalam, M. (2022). Social Media Sentiments and Firm Value. *Applied Economics, 54*(26), 2983-2997. http://dx.doi.org/10.1080/00036846.2021.2001421

Caixe, D. F., Pavan, P. C. P., Maganini, N. D., & Sheng, H. H. (2024). Foreign Institutional Ownership and Firm Value: Evidence of "Locust Foreign Capital" in Brazil. *Emerging Markets Finance & Trade, 60*(2), 310-327. http://dx.doi.org/10.1080/1540496X.2023.2218967

Chen, H., & Yoon, S. S. (2023). Does brain gain enhance firm value? Evidence from China. *Asia Pacific Business Review, 29*(3), 501-522. http://dx.doi.org/10.1080/13602381.2021.1976369

Cho, K., Kim, H. J., Mun, S., & Han, S. H. (2021). Do confident CEOs increase firm value under competitive pressure? *Applied Economics Letters, 28*(17), 1491-1498. http://dx.doi.org/10.1080/13504851.2020.1827133

Choi, D., James, K. L., Okafor, C. E., Cho, E., & Bhuyan, M. N. H. (2022). The effect of executives' education and compensation on firm value: Evidence from China. *Applied Economics, 54*(50), 5763-5781. http://dx.doi.org/10.1080/00036846.2022.2053053

Cid, C., San Martín, P., & Saona, P. (2022). Founding-family-controlled firms, intergenerational succession, and firm value. *Ekonomska Istrazivanja, 35*(1), 3138-3167. http://dx.doi.org/10.1080/1331677X.2021.1986673

Diantimala, Y., Syahnur, S., Mulyany, R., & Faisal, F. (2021). Firm size sensitivity on the correlation between financing choice and firm value. *Cogent Business & Management, 8*(1), 1-19. http://dx.doi.org/10.1080/23311975.2021.1926404

Hardiningsih, P., Srimindarti, C., Anggana Lisiantara, G., & Kartika, A. (2024). How does environmental, social, governance disclosure and political connection performance affect firm value? An empirical study in Singapore. *Cogent Business & Management, 11*(1), 1-18. http://dx.doi.org/10.1080/23311975.2024.2377764

Huang, Q., & Xiong, M. (2023). Does managerial ability increase or decrease firm value? *Applied Economics Letters, 30*(13), 1717-1722. http://dx.doi.org/10.1080/13504851.2022.2081658

Huang, W. (2024). Female board representation and firm value: International evidence. *Finance Research Letters, 68*, 1-8. http://dx.doi.org/10.1016/j.frl.2024.105998

Hutauruk, M. R. (2024). The effect of R&D expenditures on firm value with firm size moderation in an Indonesia palm oil company. *Cogent Business & Management, 11*(1), 1-24. http://dx.doi.org/10.1080/23311975.2024.2317448

Intara, P., Sangwichitr, K., & Sattayarak, O. (2024). Earnings quality and firm value: Does corporate governance matter? *Cogent Business & Management, 11*(1), 1-17. http://dx.doi.org/10.1080/23311975.2024.2386158

Intara, P., & Suwansin, N. (2024). Intangible assets, firm value, and performance: Does intangible-intensive matter? *Cogent Economics & Finance, 12*(1), 1-20. http://dx.doi.org/10.1080/23322039.2024.2375341

Lee, J., Park, J., & Park, S. (2015). Revisiting CEO power and firm value. *Applied Economics Letters, 22*(8), 597-602. http://dx.doi.org/10.1080/13504851.2014.962216

Liow, K. H. (2010). Firm value, growth, profitability and capital structure of listed real estate companies: An international perspective. *Journal of Property Research, 27*(2), 119-146. http://dx.doi.org/10.1080/09599916.2010.500459

Mishra, G., Patro, A., & Tiwari, A. K. (2024). Does climate governance moderate the relationship between ESG reporting and firm value? Empirical evidence from India. *International Review of Economics & Finance, 91*, 920-941. http://dx.doi.org/10.1016/j.iref.2024.01.059

Panaretou, A. (2014). Corporate risk management and firm value: Evidence from the UK market. *European Journal of Finance, 20*(12), 1161-1186. http://dx.doi.org/10.1080/1351847X.2013.766625

Saona, P., Muro, L., San Martín, P., & Cid, C. (2020). Ibero-American corporate ownership and boards of directors: Implementation and impact on firm value in Chile and Spain. *Ekonomska Istrazivanja, 33*(1), 2138-2170. http://dx.doi.org/10.1080/1331677X.2019.1694558

Silva, J. R., Silva, A. F., & Chan, B. L. (2019). Enterprise Risk Management and Firm Value: Evidence from Brazil. *Emerging Markets Finance & Trade, 55*(3), 687-703. http://dx.doi.org/10.1080/1540496X.2018.1460723

Sisodia, G., Jadiyappa, N., & Joseph, A. (2021). The relationship between human capital and firm value: Evidence from Indian firms. *Cogent Economics & Finance, 9*(1), 1-15. http://dx.doi.org/10.1080/23322039.2021.1954317

Su, K., Li, L., & Wan, R. (2017). Ultimate ownership, risk-taking and firm value: Evidence from China. *Asia Pacific Business Review, 23*(1), 10-26. http://dx.doi.org/10.1080/13602381.2016.1152021

Sudiyatno, B., Puspitasari, E., Suwarti, T., & Asyif, M. (2020). Determinants of Firm Value and Profitability: Evidence from Indonesia. *The Journal of Asian Finance, Economics and Business, 7*(11), 769-778. http://dx.doi.org/10.13106/jafeb.2020.vol7.no11.769

Tan, W., Cai, Y., Luo, H., Zhou, M., & Shen, M. (2024). ESG, technological innovation and firm value: Evidence from china. *International Review of Financial Analysis, 96*, 1-14. http://dx.doi.org/10.1016/j.irfa.2024.103546

Thakur, B. P. S., Kannadhasan, M., Charan, P., & Gupta, C. P. (2021). Corruption and Firm Value: Evidence from Emerging Market Economies. *Emerging Markets Finance & Trade, 57*(4), 1182-1197. http://dx.doi.org/10.1080/1540496X.2019.1613643

Wu, H., & Song, Y. (2024). Does performance of carbon neutrality affect firm value? *Finance Research Letters, 63*, 1-7. http://dx.doi.org/10.1016/j.frl.2024.105383

Scientific Annals of Economics and Business
71 (4), 2024, 641-662
DOI: 10.47743/saeb-2024-0028

Income-Based Economic Determinants of Life Expectancy in Four Groups of Countries Classified by their Levels of Income

Ismael M. Abdulrahman[*], **Sarah Ahmed Chawsheen** [**]

Abstract: This study seeks to determine the role of per capita value added in the main sectors of; agriculture, industry, services, plus per capita GDP, on life expectancy at birth in the four groups of countries classified internationally by; high income, upper middle income, lower middle income, and low-income countries, during the period 1990-2022. Panel data analysis adopted for each group countries, where CS-ARDL approach is used to measure the effect of the independent variables (sector's value-added per capita income) on the dependent variable (life expectancy at birth). The findings indicate that the per capita values provided by the sectors of industry and services are important factors in increasing life expectancy in high-income countries. Whereas, increases in per capita GDP would significantly extend life expectancy in countries ranging from upper-middle to lower-middle and low-incomes.

Keywords: life expectancy at birth; agriculture; industry; services; per capita GDP; CS-ARDL.

JEL classification: E10; C33; I15.

[*] Department of Business Administration, Soran Technical College, Erbil Polytechnic University, Iraq; e-mail: *ismael.abdullrahman@epu.edu.iq*.

[**] Department of Economics, College of Administration and Economic, Salahaddin University, Iraq; e-mail: *sarah.chawsheen@su.edu.krd* (corresponding author).

Article history: Received 9 August 2024 | Accepted 29 October 2024 | Published online 19 December 2024

To cite this article: Abdulrahman, I. M., Chawsheen, S. A. (2024). Income-Based Economic Determinants of Life Expectancy in Four Groups of Countries Classified by their Levels of Income. *Scientific Annals of Economics and Business*, 71(4), 641-662. https://doi.org/10.47743/saeb-2024-0028.

1. INTRODUCTION

Human life expectancy at birth (LEB) is the expected average number of years living at a given age (at birth). Life expectancy has upsurged in the four groups of countries classified by the world bank according to income as; low income, lower middle income, upper middle income, and high income, from 49.7 to 62.5, 59 to 66.9, 67.6 to 74.7, and 75.3 to 79.9, respectively, during the period under study 1990-2022 (WB, 2024). These figures tell that there are discrepancies among the four groups life expectancy, approximately more than 15 years between low-income and high-income countries. This gap, and the factors behind the high level of life expectancy in high-income countries, have prompted researchers in various scientific fields to investigate its reasons.

Investigating the factors affecting life expectancy has received great importance from different fields of study. The factors were classified under: economic, social, political, and environmental (Aigheyisi, 2020). This study examines the impact of the primary components of the economy on life expectancy by considering the value added per capita in agriculture, forestry, and fisheries, the value added per capita in industry, and the value contributed per capita in services, in addition to GDP per capita. Any difference in the added value of these sectors demonstrates structural changes that happened over the inquiry period, whereas per capita GDP reflects economic growth. The added value in any of these areas refers to a feature of life that contributes to expanding life expectancy, whether the rise is in the proper direction to support health and the environment, or, on the contrary, it affects the direction of rising life expectancy. Considering the average per capita GDP reveals the individual's ability to access sufficient and healthy food, obtain life-sustaining goods, good health, and educational and recreational services.

The main economic sectors are the sectors that provide the population with necessary and luxury goods and services. Access to adequate food is an essential goal for achieving well-being and human development. The United Nations has set access to food and eliminating poverty among the main sustainable development goals, as the agricultural sector is the one that accomplishes this mission (Herforth, 2015). Achieving progress in the sector of agriculture in many countries is an important step in achieving economic development, reducing poverty and hunger, and thus liberation from the restrictions of poor and backward agriculture (Alexandratos, 1999). On the other hand, agriculture is one of the entities responsible for secreting large quantities of gases and harmful substances to the environment that negatively affect the quality of life and life expectancy (FAO, 2024).

Industrialization transforms the production process from labor-intensive production to capital-intensive production, and this transformation creates a major leap in the quantity and quality of production. As a result, the potential of getting goods and services grows significantly, thereby improving people's well-being (Szreter, 2004). Successive industrial revolutions provided great assistance to the prosperity of agriculture through the development of modern agricultural methods, providing sufficient food for the growing population. In addition, industrial development has created a revolution in the field of transportation, delivery of goods, provision of services, and energy (Liu *et al.*, 2020). The industrial sector also provides many job opportunities with higher wages, which helps increase income (Helper *et al.*, 2012). On the other hand, industry is responsible for causing harm to the environment by releasing many gases and wastes into the air, soil and water, which has serious consequences for health (Sardar *et al.*, 2013).

In regard to services, it is the sector that includes numerous offerings, such as medical services that have significant impacts on life expectancy (Tackie *et al.*, 2022). Also, educational services contribute to increasing people's interest in health (Hahn and Truman, 2015), in addition to other entertainment services that may support life expectancy. Without a doubt, services sector consumes materials and energy to accomplish its works, which may also have negative effects on the environment. For example, health sector is responsible for 4.6% of greenhouse gas (MacNeill *et al.*, 2020).

In addition to mentioning the importance of measuring the impact of the main above-mentioned sectors, per capita GDP was added to the independent variables under study, because per capita GDP largely reflects the level of well-being and social welfare that affect the life expectancy (Boo *et al.*, 2016).

As mentioned previously, there is a number of researches that has dealt with the factors determining life expectancy, some of which have focused on socio-economic factors, some of which have dealt with political and security factors, and Others have focused on health and environmental issues. Some of these studies were related to a specific country, others to a specific region, or a group of countries, such as developed and developing countries, and even brought together almost all countries of the world in one research. This study examines the impact of four economic factors on life expectancy at birth (LEB) for four-classified groups of countries by income around the world, selected depending on data available by the WB (2024). Therefore, this study attempts to answer the following questions:

1- Do increases in per capita value added in the sectors of agriculture, industry, and services lead to increased life expectancy at birth, and does this impact differ among the four groups of countries?

2- How would per capita GDP affect life expectancy at birth within the four groups of countries?

2. LITERATURE OVERVIEW

WB (2024) has defined life expectancy as "The average number of years that a newborn could expect to live, if he or she were to pass through life exposed to the sex and age-specific death rates prevailing at the time of his or her birth, for a specific year, in a given country, territory, or geographic area". Ortiz-Ospina and Roser (2017) defines life expectancy as, the number of years a group of people is expected to live.

The relationship between the agricultural sector and life expectancy is broad and includes: food security and proper nutrition, contribution to comprehensive economic development, negative and positive impacts of agriculture on the environment, as well as migration from the countryside to the city. Agricultural researchers presented both effects positive and negative, on life expectancy. On the one hand, it offers food and raw resources. On the other hand, it causes the release of certain gases that affect global warming and the atmosphere over a long period of time, as reported by Aigheyisi (2020) and Kabir (2008). While, in the short run, this is contradictory to the findings of Saidmamatov *et al.* (2024) and Aigheyisi (2020). According to Saidmamatov *et al.* (2024) agricultural production had a positive and significant connotation with life expectancy, and access to healthy and sufficient food contributors to a better and longer livelihood. Also, Pramita (2017) discovered that agriculture, forestry, and fisheries contribute significantly to economic growth, which influences life expectancy by increasing income and enhancing nutrition and health services.

Therefore, in this study the authors enter the per capita value added in the sector of agriculture, fisheries, and forestry, as one main factor that influence life expectancy.

Even though agriculture utilizes natural resources, the way these resources are used has an impact on people's quality of life and life expectancies. According to Cavusoglu and Gimba (2021) there is a positive relationship between food production and life expectancy in the long-term in Sub-Saharan Africa countries. The study of Aigheyisi (2020) exposed increases in agricultural output have a short-term advantageous effect on life expectancy since they allow for the acquisition of additional nutrients and the enhancement of the diet. However, the long-term outcomes were reversed, since this enhancement might have an adverse effect on life expectancy if calories and cholesterol are consumed excessively. In this context Madreimov and Li (2019) discovered an inverted U-shaped link between natural resource consumption and life expectancy, implying when greater natural resources are used, life expectancy declines. Lin *et al.* (2012)) calculated nutrition contributes 2.79% - 5.14% to life expectancy gains in less developed countries during 1970-2004. Kabir (2008) found a significant negative impact of undernourished on life expectancy in developing countries with high life expectancy.

Fish and other aquatic creatures help to increase global food production and eliminate hunger, both of which are essential aims of the UN's Sustainable Development aims (SDGs 2 and 3). Fish consumption account for almost 20% of the average per capita animal protein intake for approximately three million people. Furthermore, fish contain omega-3, which is necessary for the prevention of many illnesses, helping to increase life expectancy (Siregar, 2021). Therefore, sustainable fisheries management is critical for maintaining food security, which has a favorable influence on life expectancy (Mainguy *et al.*, 2023).

Forests play a crucial role in conserving ecosystems by storing carbon and moderating global warming. They also provide beauty and environmental benefits for human health. Ciocanel and Pavelescu (2015) discovered increasing forest area by ten units might reduce the frequency of mortality by 1297 people. Also, Kerdprasop and Kerdprasop (2017) observed a significant relationship between forest acreage and GDP growth in the Mekong Pool, which had a positive impact on long life.

Industry is another vital and important sector that has a wide-ranging impact on many aspects of life, including: contributing to the population's food supply through the agricultural developments, contributing to the development of health care by building advanced infrastructure for health services and providing medicines, and connecting regions with roads, transportation, and communication. In addition, industrialization brings about urbanization and technical progress. Thus, industrialization may have a positive effect on life expectancy. On the other hand, increased industrial activities result in pollution in the air, water and soil, which has negative consequences on life expectancy. Fuel consumption on the other hand is the main driver of industrialization, where Hendrawaty *et al.* (2022) discovered that a 1% increase in fuel use reduces life expectancy by 0.15% in Asian countries. Pathirathne and Sooriyarachchi (2019) argued technological progress and increased urbanization have a negative impact on life expectancy, due to increases in pollution.

Jafrin *et al.* (2021) discovered that a growth in urban population has a negative and substantial influence on life expectancy at birth in five nations out of eight in the South Asian Association for Regional Cooperation (SAARC). But Kabir (2008) didn't find the impact of urbanization on life expectancy in developing countries, and the use of internet and mobile phone have not had any significant impacts on life expectancy at birth.

The sector of services provides a wide range of impact on life expectancy, which may be classified into several different groups, the most important of which are health, education, and recreation services. This sector provides; 1- Effective health care that lowers mortality rates, increase life expectancy; 2- A healthy workforce enhances productivity, which eventually raises production and per capita income. 3- Education is regarded as a necessary public service that provides the opportunity to earn a higher income and a greater interest in health, so contributing to a longer life expectancy. 4- Entertainment, hospitality, tourism, and recreational services all assist in creating a comfortable and happy lifestyle, which may help to extend life expectancy.

Radmehr and Adebayo (2022) employed the approaches of FMOLS, DOLS, and FE-OLS of long-run estimators. They observed an increasing in health expenditures by 1% lead to increase in life expectancy in the Mediterranean countries by 0.018%, 0.025%, and 0.057%, respectively, other factors been constant. Also, Owumi and Eboh (2021) discovered that $1% increase in the domestic general government health expenditure would lead to 6% increase in life expectancy, $1% increase in out-of-pocket health expenditure would lead to 63% enhancement in life expectancy, and 1% increase in external health spending as a percentage of existing health care spending will result in an 11%-year increase in average life expectancy at birth in Nigeria. However, other scholars such as Rahman *et al.* (2018) found that overall health spending does not boost life expectancy in SAARC-ASEAN countries. In addition, Rahman *et al*. (2022) discovered no short-term causal relationship between health spending and life expectancy in most of examined countries.

The results of 13 studies conducted on eight different groups indicated that recreational and regular physical activity increases life expectancy by 0.4 to 6.9 years. It also reduces the risk of death among physically active people by 20% to 30% compared to those who are inactive (Reimers *et al.*, 2012). Mueller *et al.* (2019) examined the relationship between county-level spending on parks and recreation activities and all-cause mortality in the United States between the years 1980 and 2010. The study shows parks and recreational activities had a favorable influence on all-cause death rates, including female-specific mortality rates. According to their estimated models for female and overall all-cause age-standardized mortality, when all other factors were equal, a $100 increase in per capita parks and recreation operational expenditures, in 2010 dollars, was associated with an average 3.9% decrease in mortality rate, or 3.4 deaths per 100,000 persons. Esfahani *et al.* (2018) found a significant positive relationship between public sports participation and life expectancy. Also, recreational activities support the social life of the elderly and improve their well-being and life satisfaction, improves their physical health and increases their resistance to diseases (Zhang *et al.*, 2021).

Concerning the relationship between education and life expectancy, Joshi *et al.* (2017) emphasize the positive role of education in life expectancy. Literacy had a significant impact on increasing life expectancy in less developed countries, where the impact ranged between 23.7-38.1 during 1970-2004. Lin *et al.* (2012) and Jafrin *et al.* (2021) found the average number of years of schooling positively impacts the life expectancy in five SAARC nations. Also, Kabir (2008) found a negative relationship between adult illiteracy and life expectancy in the developing countries that had longer life expectancy. Also, lack of access to health and education services is one of the reasons leading to low life expectancy in low-income countries (Aigheyisi, 2020).

In general, rich countries have a higher life expectancy than poor countries (Freeman *et al.*, 2020). The influence of per capita GDP on life expectancy varies by country, with some having a positive effect and others having a negative effect. For example, out of six Asian nations, the effect of per capita GDP was significant only in two countries: Japan and Bangladesh, with negative and positive impacts, respectively (Summoogum and Fah, 2016). Gürler and Özsoy (2019) discovered that a unit increase in income per capita leads to an increase of nearly 0.05 units in life expectancy at birth for 56 developing countries, this means that nearly 8.108 USD increase in per capita income, for 56 developing countries, causes nearly 3.27 years increase in life expectancy on average.

Increases in per capita GDP improve access to health and education services, as well as beneficial nutrition. According to the WB (2024) extending life expectancy (WHO, 2024)by 10% leads to economic growth of 0.3% to 0.4% (Colantonio *et al.*, 2010). Cervellati and Sunde (2005) proposed a large empirical evidence to support that a high level of economic development is associated with a higher level of life expectancy. Radmehr and Adebayo (2022) adopted the econometric methods of FMOLS, DOLS, and FE-OLS estimators, and found that a 1% improvement in economic performance contributed to raise life expectancy by 0.13%, 0.17%, and 0.15%, respectively, other factors remained unchanged. Also, Saidmamatov *et al.* (2024) found a direct and significant relationship between per capita GDP and life expectancy, with each 1% rise in per capita GDP result in a 0.014% increase in lifespan in five Central Asian countries. Therefore, per capita GDP may have a significant impact on happiness and life satisfaction, that eventually affect life expectancy, similar to Boo *et al.* (2016) confirmed a direct and significant relationship between the size of income with both happiness and life satisfaction.

3. DATA SCOPE AND METHODOLOGY

This study relied on the WB (2024) classification of the countries, according to income, into four groups countries (2024):

- High income, includes 48 countries.
- Upper middle income, includes 44 countries.
- Lower middle income, includes 41 countries
- Low income, includes 16 countries.

The time span of this study is 33 years starting from year 1990 to 2022. And the studied variables notations are:

- Life expectancy at birth, total years denoted by (L_E), dependent variable.
- Agriculture, forestry, and fishing, annual per capita value added in constant 2015 US$, (AFF).
- Industry including construction, annual per capita value added in constant 2015 US$, (IND).
- Services annual per capita value added in constant 2015 US$, (SER).
- Annual GDP per capita in constant 2015 US$, (GDP_PC).

STATA17 software was adopted for the empirical analysis.

Frequently panel data units or countries will be affected by common factors result in cross section dependency across the units (countries). In order to avoid the biasness impacts of slope heterogeneity, and the endogeneity problem between the variables, which lead to inconsistent estimates using conventional panel regression estimates, also, to develop long-

term and short-term impacts, this study adopts Common Correlated Effects (CCE) approach, known by Cross Section Autoregressive Distributed Lags (CS-ARDL).

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The average of life expectancy was 76.8 years in high income countries. While in group of upper middle-income countries the average of life expectancy was 70.3 years. This average reduced to 63.9 years in group of lower middle-income countries. Also, the average reduced further in group of lower income countries to 55.3 years, see Table no. 1.

Table no. 1 – The Descriptive statistics

Countries	Variable	Mean	Std. dev.	Min	Max	Obs.
High income	Countries	-	-	1	48	1584
	Year	-	-	1990	2022	1584
	L_E	76.8058	4.168465	62.415	84.56	1536
	AFF	571.897	460.7976	16.7886	3781.528	1484
	IND	7508.6	5796.316	648.9524	44437.46	1478
	SER	18903.3	14560.69	970.6112	89538.94	1477
	GDP_PC	29473.9	20105.43	2386.057	112417.9	1546
Upper middle income	Countries	-	-	1	44	1452
	Year	-	-	1990	2022	1452
	L_E	70.334	5.151	50.632	80.116	1408
	AFF	427.154	198.747	92.67	1288.37	1422
	IND	1526.097	972.939	212.53	7156.735	1419
	SER	3198.222	1711.672	262.808	9061.698	1402
	GDP_PC	5604.936	2603.624	791.647	14200.27	1437
Lower middle income	Countries	-	-	1	41	1353
	Year	-	-	1990	2022	1353
	L_E	63.93726	7.854374	41.957	79.729	1312
	AFF	280.0389	143.3071	39.18747	865.9799	1333
	IND	501.2045	383.2536	42.92058	2127.698	1332
	SER	1015.895	906.5837	99.73121	6661.377	1300
	GDP_PC	1934.743	1291.454	353.9566	9037.086	1348
Low income	Countries	-	-	1	16	528
	Year	-	-	1990	2022	528
	L_E	55.39514	6.731896	14.098	67.545	512
	AFF	222.0811	165.6891	62.8988	947.8558	507
	IND	158.2017	208.4829	16.13141	1349.249	493
	SER	314.7578	270.3306	47.6915	1601.468	488
	GDP_PC	703.0122	513.6541	190.35	2547.64	528

Source: researchers' calculations

The average of per capita value added for the sector of agriculture, forestry, and fishing, had the highest figure 571.897$, in high income countries. Concerning the upper middle countries recorded 427.154$, while lower middle countries witnessed 280.0389$. As for low-income countries record was the lowest figure 222.0811$.

Concerning per capita value added for the sector of industry including construction, recorded 7508.6$ in high income countries, while in upper middle-income countries 1526.097$, then this figure reduced to almost to less than a quarter of this figure in upper middle countries to reach 1526.097$, in lower middle-income countries recorded more reduction 501.2045$, while low-income countries evidenced minimum industry per capita valued added with the mean of 158.2017$.

The highest average of per capita value added in the sector of services was 18903.3$ in high income countries. This statistic reduced to 3198.222$ in upper middle-income countries, then reduced further to 1015.895$ in lower middle-income countries, while it recorded its lowest figure 314.7578$ in low-income countries.

Observing the average of GDP per capita in high income countries was quite high 29473.9$, then it lowered to 5604.936$, 1934.743$, and 703.0122$, in upper middle-income countries, lower middle-income countries, low-income countries, respectively.

4.2 Cross-Sectional Dependence Test

As commonly understood, a panel dataset consists of N countries or groups and T time (years, months…etc.), where a linear panel data model would take the following formula:

$$Yit = \alpha i + \beta Xit + Uit \quad (1)$$

for i=1, …, N, and t=1, …, T

Xit is a k×1 vector of regressors, β is a k×1 parameters to be estimated, αi is individual time invariant nuisance parameters. Uit is the model residuals, assumed independent and identically distributed (iid) across sections and over periods under the null hypothesis. And, correlated across units under the alternative hypothesis, but the assumption of no serial correlation remains.

In panel data usually the residuals are correlated due to common factors between the countries or across sections. To assess the existence of cross section dependence (CSD) between a panel data (Pesaran, 2004) CD test is employed in this study.

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}.\sum_{j=i+1}^{N}\rho ij\right) \quad (2)$$

Where ρ_{ij} is the pairwise correlation of the residuals. $\hat{U}_{it}$ is the estimated U_{it} in (1)

$$\rho ij = \rho ji = \frac{\sum_{t=1}^{T}\hat{U}it\,\hat{U}jt}{\left(\sum_{t=1}^{T}\hat{U}it^2\right)^{1/2}\left(\sum_{t=1}^{T}\hat{U}jt^2\right)^{1/2}} \quad (3)$$

***H0**: Cov (uit, ujt) = 0, for all t, i ≠ j, or the panels are cross sectionally independent.*

***H1**: Cov (uit, ujt) ≠ 0, for all t, i ≠ j, or the panels are cross sectionally dependent.*

The results of CD test are illustrated in Table no. 2.

Table no. 2 – CD Test for the Four Groups Countries

Countries	CSD Test	L_E	AFF	IND	SER	GDP_PC
High income	Pesaran CD	179.261	6.213	56.026	148.757	137.898
	P-value	0.000	0.000	0.000	0.000	0.000
Upper middle income	Pesaran CD	118.9	29.45	76.48	140.84	126.5
	P-value	0.000	0.000	0.000	0.000	0.000
Lower middle income	Pesaran CD	120.22	38.39	37.91	125.46	96.43
	P-value	0.000	0.000	0.000	0.000	0.000
Low income	Pesaran CD	52.42	-1.43	11.39	13.56	12.39
	P-value	0.000	0.154	0.000	0.000	0.000

Notes: Under the null hypothesis of cross-section independence, CD ~ N (0,1) P-values close to zero indicate data are correlated across panel groups.

Source: researchers' calculations

Notice that all variables are cross sectionally dependent for each panel countries. As the CD tests p-values are less than 0.05, therefore, we reject the H0, and accept ***H1***, except for variable AFF in low-income countries, we accept ***H0***.

4.3 Series Stationarity (Unit Root) Test

Following the CD test results in Table no. 2, to examine the series stationarity (non-existence of unit root), the second-generation unit root test of Pesaran (2007) is used, which is known as Cross Sectional Augmented Dicky Fuller (CADF) test, the hypotheses are as the following:

H0: *the variable is non-stationary (the series contains a unit root),*

H1: *the variable is stationary (the series doesn't contain a unit root).*

Retrieving from Westerlund *et al.* (2015) the CADF statistic is:

$$\text{CADF}i = \frac{y'i,-1M_X\Delta y_i}{\sigma\epsilon,i\sqrt{y'i,-1M_X y_{i,-1}}} \tag{4}$$

where:

$M_X = I_{T-1} - x(x'x)^{-1}x',\ x = (\Delta\bar{y}, \bar{y} - 1),\ \Delta y_i = \left(\Delta yi, 2, \dots, \Delta y_{i,T}\right)',\ y_{i,-1} = \left(y_{i,1}, \dots, y_{i,T-1}\right)'$,

$\Delta\bar{y} = N^{-1}\sum_{i=1}^{N}\Delta\, y_i$ with a similar definition of $\bar{y} - 1$, and $\sigma^2\epsilon, i = T^{-1}(\Delta y_i)'^{M_X}\Delta y_i$.

Table no. 3 – Series Unit Root Test CADF

Countries	variable	Constant		constant and trend		Stationary
		CADF	p-value	CADF	p-value	at
High income	L_E	-2.1680	0.0020	-2.1880	0.8850	I(0)
	AFF	-2.4770	0.0070	-1.397	0.0810	I(0)
	IND	-9.7720	0.0000	-7.641	0.0000	I(1)
	SER	-8.8370	0.0000	-6.3470	0.0000	I(1)
	GDP_PC	-9.4830	0.0000	-6.978	0.0000	I(1)
Upper middle income	L_E	-2.267	0.0000	-2.642	0.0110	I(0)
	AFF	-16.382	0.0000	-14.661	0.0000	I(1)
	IND	-4.061	0.0000	-1.0210	0.1540	I(0)
	SER	-1.978	0.0240	2.934	0.9980	I(0)
	GDP_PC	-3.885	0.0000	1.139	0.8730	I(0)
Lower middle income	L_E	-2.246	0.0011	-2.185	0.8700	I(0)
	AFF	-16.365	0.0000	-14.640	0.0000	I(1)
	IND	-1.710	0.0440	-0.5290	0.2980	I(0)
	SER	-8.421	0.0000	-7.2610	0.0000	I(1)
	GDP_PC	-7.374	0.0000	-6.087	0.0000	I(1)
Low income	L_E	-2.6230	0.0000	-2.0310	0.9200	I(0)
	AFF *	0.3205	0.6257	-4.0853	0.0000	I(0)
	IND	1.6520	0.9510	-2.9230	0.0020	I(0)
	SER	-5.7520	0.0000	-6.1090	0.0000	I(1)
	GDP_PC	-3.6020	0.0000	-4.2000	0.0000	I(1)

Note: * Im–Pesaran–Shin (IPS) unit-root test for AFF due to the variable cross section independence as show in Table no. 2. The statistic of Z-t-tilde-bar is considered for CADF test, as the series has some gaps with one year lag.

Source: researchers' calculations

The results in Table no. 3 show that the series are stationary at the original level I(0) and first difference I(1). As their CADF statistics P-values are less than 0.05, therefore we reject H0 and accept H1, so we conclude that the series under investigation is stationary in the long run and doesn't contain a unit root for each (i) country (group).

4.4 Testing Model Slope Heterogeneity

The general form of this study's Four panel models high income countries (M1), upper middle-income countries (M2), lower middle-income countries (M3), and low-income countries (M4), for each group of countries is:

$$L\_E_{it} = \alpha_i + \beta_{1i}AFF_{it} + \beta_{2i}IND_{it} + \beta_{3i}SER_{it} + \beta_{4i}GDP\_PC_{it} + U_{it} \quad (5)$$

In this study Pesaran and Yamagata (2008) test of a model slope heterogeneity is adopted for testing the following hypothesis:

***H0**: slope coefficients are homogenous.*

***H1**: slope coefficients are heterogenous.*

or

***H0**: $\beta_{1i} = \beta_1$, $\beta_{2i} = \beta_2$, $\beta_{3i} = \beta_3$, $\beta_{4i} = \beta_4$, for i= 1, 2, …, N*

***H1**: $\beta_{1i} \neq \beta_1$, $\beta_{2i} \neq \beta_2$, $\beta_{3i} \neq \beta_3$, $\beta_{4i} \neq \beta_4$, for some i.*

Table no. 4 – Panel Model Slope Heterogeneity Test

Statistics	M1 High income countries		M2 Upper middle-income countries		M3 Lower middle-income countries		M4 Low-income countries	
	Statistics	P-value	Statistics	P-value	Statistics	P-value	Statistics	P-value
Delta	44.019	0.000	35.572	0.000	39.935	0.000	21.638	0.000
adj. Delta	49.245	0.000	39.629	0.000	44.508	0.000	24.325	0.000

Source: researchers' calculations

Results in Table no. 4 indicate that the slopes of the specified models aren't homogenous for each of M1, M2, M3, and M4. As Delta and adjusted Delta statistics p-values are less than 0.05 for all four models. Therefore, we reject H0, and infer that the slops are heterogenous for each model.

4.5 CS-ARDL Approach

Cross-sectionally augmented autoregressive distributed lags model (CS-ARDL) of Chudik and Pesaran (2015), and Chudik *et al.* (2016) was developed in this research, both long-term and short-term assessments were estimated. In comparison to the mean group (MG), pooled mean group (PMG), common correlated effect mean-group (CCEMG), and augmented mean group (AMG), CS-ARDL require far less time and effort (Wang *et al.*, 2021). Based on another definition, this method solves seemingly undiscovered issues of endogeneity, non-stationarity, mixed-order integration, slope heterogeneity SH, and cross section dependency CSD (Chudik *et al.*, 2016).

The CS-ARDL derived from panel ARDL approach of Pesaran *et al.* (1999), where the dynamic panel model with heterogeneous slopes and an unobserved common factor (f_t) and a heterogeneous factor loading (γ_i) is:

$$y_{i,t} = \lambda_i\, y_{i,t-1} + \beta_i\, x_{i,t} + u_{i,t} \tag{6}$$

where

$u_{i,t} = \gamma`_i\, ft + e_{i,t}$

$\beta MG = 1/N \sum_{i=1}^{N} \beta i$, $\lambda MG = 1/N \sum_{i=1}^{N} \lambda i$, i = 1, ..., N, and t = 1, ..., T (Pesaran et al. 1999).

A more extended description of equation (6) with additional lags of the dependent and independent variable in the form of an ARDL (py, px) model is:

$$y_{i,t} = \sum_{j=1}^{p_y} \lambda_{j,i} y_{i,t-j} + \sum_{i=0}^{p_x} \beta_i x_{i,t-i} + u_{i,t} \tag{7}$$

where

p_y and p_x is the lag length of y and x.

The long run coefficient of β and the mean group coefficient are:

$$\theta_i = \frac{\sum_{i=0}^{p_x} \beta_{i,i}}{1 - \sum_{j=1}^{p_y} \lambda_{j,i}}, \quad \hat{\theta}MG = \frac{1}{N}\sum i = 1^N \widehat{\theta_i}$$

Chudik *et al.* (2016) proposed the cross-sectionally augmented ARDL (CS-ARDL) estimator as:

$$y_{i,t} = \sum_{l=1}^{p_y} \lambda_{l,i} y_{i,t-l} + \sum_{l=0}^{p_x} \beta_i x_{i,t-l} + \sum_{l=0}^{p_T} \gamma'_i \bar{z}t - l + ei, t \quad (8)$$

where the mean group estimates:

$$\hat{\theta}CS - ARDL, i = \frac{\sum_{l=0}^{p_x} \widehat{\beta} i}{1 - \sum_{l=1}^{p_y} \widehat{\lambda_{l,\iota}}} \quad , \quad \theta \hat{} MG = \sum_{i=1}^{N} \widehat{\theta_i}$$

And the Error Correction Model (ECM) transformation:

$$\Delta y_{i,t} = \phi_i \left[y_{i,t-1} - \theta_i x_{i,t} \right] - \sum_{l=1}^{p_y - 1} \lambda_{l,i} \Delta y_{i,t-l} - \sum_{l=1}^{p_x} \beta_i \Delta_l x_{i,t} + \sum_{l=0}^{p_T} \gamma_{i,l} \Delta \bar{z} i, t + ui, t \quad (9)$$

where:

$$\Delta l = t - t - l, \ \Delta x_{i,t} = x_{i,t} - x_{i,t-1}$$

$$\varphi \hat{} \, i \ = \ - (1 \ - \sum_{l=1}^{py} \lambda \hat{} \, l, i \ ) \ , \ \theta_i = \frac{\sum_{l=0}^{p_x} \beta_{l,i}}{\phi \hat{} \, _i} \ , \theta \hat{} MG = \sum_{i=1}^{N} \widehat{\theta_i}$$

where φˆ i is the error correction term (ECT), also known as the speed of adjustment, refers to the pace at which the model corrects itself in the long run, given a short run disequilibrium. Ideally, we anticipate the ECT to be statistically significant and range between -1 and 0, ensuring that the system returns to equilibrium.

4.6 The Estimated Models

The general formula for our four estimated models is as the following:

$$L\_E_{it} = \beta_0 + \beta_1 L\_E_{it-1} + \beta_2 AFF_{it} + \beta_3 IND_{it} + \beta_4 SER_{it} + \beta_5 GDP\_PC_{it} + U_{it} \quad (10)$$

where β's are the estimated coefficients, L_E_{it-1} is lag dependent variable (life expectancy at birth), AFF_{it}, IND_{it}, SER_{it}, and GDP_PC_{it}, are the independent variables described previously at time t related to country i. Table no. 5 shows the estimated model for each group contraries denoted by M1, M2, M3, and M4.

Table no. 5 – The Estimated Models of Life Expectancy in Four Groups of Countries

CS-ARDL Model	M1			M2			M3			M4		
	Coef.	St. Err.	Z. Sta.	Coef.	St. Err.	Z. Sta.	Coef.	St. Err.	Z. Sta.	Coef.	St. Err.	Z. Sta.
Long-run Models												
AFF	-0. 02834	0.029	-0.960 (0.335)	-0. 00243	0.005	-0.500 (0.619)	-0.0352	0.0207	-1.70 (0.090)	-0.0642	0.0331	-1.9400 (0.0520)
IND	0. 00147	0.001	2.920 (0.004)	-0. 00572	0.003	-1.870 (0.061)	-0.0203	0.0113	-1.80 (0.072)	-0.0647	0.0302	-2.1500 (0.0320)
SER	0. 00131	0.000	2.670 (0.008)	-0. 00266	0.002	-1.740 (0.081)	-0.0205	0.0116	-1.75 (0.079)	-0.0639	0.0321	-1.9900 (0.0460)
GDP_PC	-0. 00132	0.000	-3.470 (0.001)	0. 00228	0.001	1.570 (0.117)	0.02199	0.0109647	2.01 (0.045)	0.0653	0.0286	2.28 (0.0220)
Constant	23.4625	59.2896	0.40 (0.692)	304.5222	266.211	1.14 (0.253)	-5.2477	25.1868	-0.21 (0.835)	7.5720	8.4464	0.9 (0.3700)
ECT	-0.956	0.081	-11.810 (0.000)	-0.839	0.080	-10.500 (0.000)	-0.4613	0.07481	-6.17 (0.000)	-0.7456	0.0891	-8.3700 (0.0000)
Short-run Models												
Lag L_E	0.04368	0.081	0.540 (0.590)	0.161	0.080	2.020 (0.043)	0.5386	0.07481	7.20 (0.000)	0.2544	0.0891	2.86 (0.0040)
AFF	-0. 000085	0.001	-0.090 (0.932)	0.00170	0.002	0.700 (0.482)	-0.0106	0.0061	-1.71 (0.087)	-0.0435	0.0212	-2.0500 (0.0400)
IND	0. 00075	0.000	2.740 (0.006)	-0. 00133	0.001	-0.980 (0.328)	-0.0105	0.0059	-1.76 (0.078)	-0.0560	0.0287	-1.9500 (0.0510)
SER	0. 00096	0.000	3.740 (0.000)	-0. 00114	0.001	-0.810 (0.420)	-0.0086	0.00537	-1.62 (0.10)	-0.0463	0.0204	-2.2700 (0.0230)
GDP_PC	-0. 00075	0.000	-3.500 (0.000)	0. 00120	0.001	0.940 (0.347)	0.0096	0.0052	1.83 (0.067)	0.0503	0.0204	2.47 (0.0140)
Constant	-1.0666	13.07207	-0.08 (0.935)	14.41935	32.95571	0.44 (0.662)	-16.6277	20.9009	-0.80 (0.426)	4.4391	7.2402	0.61 (0.5400)
Trend	-	-	-	.0669479	.0765283	0.87 (0.382)	-	-	-	-	-	-
Statistics												
Obs.	1310			1293			1211			450		
groups	48			44			40			16		
Avg. Obs. per group (T)	27			29			30			28		
cross-sectional lags	2			2			1			1		
R-squared	0.54			0.16			0.37			0.37		
R-squared (MG)	0.98			0.99			0.97			0.96		
Residuals CSD test	0.36 (0.7203)			1.51 (0.1321)			5.63 (0.0000)			-0.14 (0.8896)		

Note: P-values are between parentheses.
Source: researchers' calculations

5. COINTEGRATION TEST

The presence of long-run cointegration among panels is one of reliability checks for the estimated models, therefore, we employed the first-generation cointegration test of Neal (2014), and the second generation cointegration test of Westerlund *et al.* (2015), which assumes cross-sectional independence among the panels. The hypothesis being tested are:

H0*: panels aren't cointegrated.*

H1*: panels are cointegrated.*

Table no. 6 – Panel Cointegration Test

Test	M1 High income		M2 Upper middle income		M3 Lower middle income		M4 Low income	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
Westerlund	0.7183 (0.2363)	-1.3911 (0.0821)	-1.0671 (0.1430)	2.2702 (0.0116)	1.7966 (0.0362)	4.1196 (0.0000)	-0.6289 (0.2647)	0.2371 (0.4063)
Pedroni: Modified Phillips	1.7165 (0.0430)	1.9182 (0.0275)	4.1191 (0.0000)	4.3527 (0.0000)	2.9814 (0.0014)	2.3008 (0.0107)	1.3884 (0.0825)	2.5158 (0.0059)
Perron t Phillips–Perron t	-2.7241 (0.0032)	-2.3904 (0.0084)	2.2150 (0.0134)	2.2123 (0.0135)	-0.9748 (0.1648)	-2.5596 (0.0052)	-1.8687 (0.0308)	2.2039 (0.0138)
Augmented Dickey–Fuller t	-1.1726 (0.1205)	-1.8921 (0.0292)	2.6864 (0.0036)	2.3300 (0.0099)	0.0590 (0.4765)	-1.6221 (0.0524)	-0.5079 (0.3058)	3.3931 (0.0003)

Source: researchers' calculations

The results in Table no. 6 indicated long run cointegration among the series (variables) for each estimated model, as the calculated p-values are less than 0.05, generally with constant and trend. Therefore, we reject the ***H0*** and accept ***H1*** and conclude all countries (panels) for each estimated model are cointegrated (Neal, 2014).

6. THE ECONOMIC INTERPRETATION OF THE RESULTS

6.1 High income countries

The results of M1 in Table no. 5 show the existence of a positive relationship between an individual's yearly share of services, and life expectancy, at 1% significance level, in countries with high incomes. Therefore, as SER increases by $100, L_E will extend in the long run and the short run by 0.131, and 0.096 years, respectively, ceteris paribus. This might be attributed to an increase in health, education, water, and sewage services. This finding is compatible with economic theory, as well as the findings of Joshi *et al.* (2017); Esfahani *et al.* (2018); Radmehr and Adebayo (2022).

The results revealed a direct relationship between the individual's share of the value added in the sector of industry including construction, and the expected life span. So, as IND increases by $100, L_E will extend by 0.147, and 0.075 years, in long run and short run, respectively, ceteris paribus. Because in high income countries, the positive effects of

industrial development are greater due to persistent improvements in the production process, transportation and communication.

Commonly an increase in the individual's share of GDP is expected to increase people's ability to access goods and services, which contributes to an increase in life expectancy. But the results of M1 are showing the opposite, thus as GDP_PC increases by $100, L_E will decrease by 0.132, and 0.075 years, in long run and short run, respectively, ceteris paribus. According to Freeman et al. (2020) similar result was appeared in Japan, which is the opposite with most studies of previous generations. Similarly, an inverse relationship was observed between the per capita share of AFF, and L_E, but with insignificant impact, because the associated P-value of the AFF coefficient is exceeding 10% significance level.

A one-year lag of L_E, represented as (L_Et-1), has a positive and weak impact on the current value of L_E. Therefore, if L_Et-1 extended by one year, L_E rises by 0.0436 years, assuming all other variables remain constant.

The coefficient of error correction term (ECT) is the rate which disequilibrium among variables adjusts back to their long-run equilibrium by a shock within a certain period of time. The value of ECT=-0.956, significant at the 1% level and has a negative sign, indicating that all estimated variables are cointegrated across time. This statistic indicates that 95.6% of the disequilibrium among variables has been adjusted to their long-run equilibrium during the current year at a convergence rate of 95.6%. However, for 100% adjustments to occur, 1/0.956 =1.046, or one year, four days, and six hours would be required. This means the value of life expectancy will be equal in both short and long periods within one year.

6.2 Upper Middle-Income Countries

The estimated model M2 of upper middle-income countries shows significant inverse relationship between each of IND, SER, and L_E in the long timeframe at 10% significant level. Therefore, as IND increases by $100, L_E will reduce by 0.57 years in the long run, ceteris paribus. Regarding SER, if it increases by $100, L_E will decrease by 0.26 years in the long run, ceteris paribus. These results are telling that both industry and services are contributing negatively to environmental pollution, urban migration and urban sprawl. the increased adverse effects, due to the misuse of economic resources as the disadvantages of these sectors are way more than their advantages on the expected lifetime, as the process of progress and change was a long-term process. As per Azodi *et al*. (2019) the negative relationship between services and life expectancy in this group is attributed to several reasons, including: the shortcomings in the provision of public health services, as the inefficient allocation of public funds hinders the provision of health services, which reduces life expectancy despite increased spending. Additionally, unequal income distribution lowers life expectancy. According to Wilkinson (2018) growing economic inequality has a negative influence on health and psychological well-being, reducing life expectancy. The indirect relationship is also in line with the findings of Pathirathne and Sooriyarachchi (2019). Moreover, increased spending has the potential to affect the ecosystem, resulting in reduced life expectancy (Fahlevi *et al*., 2023; Vladimirskaya and Kolosnitsyna, 2023).

There is a week (insignificant at 10% level) positive relationship between the individual share of agricultural value added and expected life in the short term, but it has changed in the long term. This inverse relationship can be attributed to the use of toxic pesticides and chemical fertilizers, which cause pollution as it will have a negative impact on the expect age.

The impacts in long and short run time frames showed that GDP_PC has a positive relationship with L_E, as an increase in the individual's share of national product leads to an increase in life expectancy. As an outcome, when GDP_PC increases by $100, L_E extends by 0.226 and 0.12 years in the long and short terms, respectively, assuming that all other factors remain constant. Although this result is consistent with the economic theory and the results of most previous studies but the effect is insignificant as the associated p-values are bigger than 10% significance level in both long- and short-time frames.

A one-year lag of L_E, denoted as (L_Et-1), has a notable and positive influence on the present value of L_E at the 5% level. As a result, if L_Et-1 expands by one year, L_E rises by 0.161 years, providing all other variables stay constant.

The error correction coefficient of M2 is (-0.839), which is significant at the 1% level, and has a negative sign, implying that all estimated variables are cointegrated across time. Inferring the current year witnessed an 83.9% convergence rate in bringing variables back to their long-run equilibrium. We may conclude that the model achieves equilibrium with a 100% convergence rate within 1.19 years, that is, one year, one month, and nine days, meaning that the value of life expectancy will be 100% identical in both the short and long periods after 1.19 years.

6.3 Lower Middle-Income Countries

Observing M3 in Table no. 5 which is the estimated model for lower middle-income countries, the short- and long-term consequences of comparison are largely similar to those in high-middle income countries, however M3 shows the increase in the share of the individual services, industry and agriculture will lead to a significant reduction in life expectancy, at 10% significance level. The long run findings show as each of AFF, IND, and SER increases disjointedly by $100, L_E decreases by 3.52, 2.03, and 2.05 years, respectively, ceteris paribus. While the short run impact for these three variables showed reduction in the L_E by 1.06, 1.05, and 0.86 years, respectively. This negative impact may be attributed to lack of expertise and improper use of the available resources. As Madreimov and Li (2019) explained the relationship between the use of natural resources and life expectancy is in the form of an inverted U shape, and given that these countries are experiencing high population growth, the increase in the use of natural resources in these sectors (services, industry, agriculture) may have negative consequences over the environment and individual health, reducing life expectancy. Some industries, particularly those in developing nations, have a detrimental influence on the environment by increasing greenhouse gas emissions, which leads to increased sickness and mortality and, eventually, a decrease in life expectancy (Siddique and Kiani, 2020; Aslam *et al.*, 2023).

Per capita GDP has a significant positive impact on life expectancy at 5% significance level, which is greater than that of the upper middle income group countries. Thus, in the long term, M3 shows that when GDP_PC increases by $100, L_E increases by 2.19 years, assuming every other factor remains constant. In the short run, L_E would increase by 0.96 years for every $100 increase in GDP_PC, if all other factors remained constant. These outcomes align with the economic theory and the results of the majority of previous studies.

The effect of a one-year lag of L_E, i.e. (L_Et-1) on the current value of L_E is significant and positive at the 1% level. As a result, if L_Et-1 expanded by one year, L_E increases by 0.5386 years, assuming all other factors remain constant.

M3 error correction coefficient (-0.4613) is significant at the 1% level and has a minus sign, indicating the current year witnessed an 46.13% convergence rate in bringing variables back to their long-run equilibrium. Therefore, life expectancy model for group of lower middle-income countries reaches to equilibrium by a 100% convergence rate within 2.16 years.

6.4 Low Income Countries

M4 in Table no. 5 illustrates significant negative impact of per capita value added in the sectors of agriculture, industry, and services at 5% significance level. These consequences are more potent in both periods, when compared to the rest estimated models M1, M2, and M3, because growth in these economic sectors is usually slower while the negative consequences exceed the positive ones. The long run results show as each of the variables AFF, IND, and SER increases disjointedly by $100, then L_E reduces by 6.42, 6.47, and 6.39 years, respectively, ceteris paribus. Considering the short run results, we observe L_E reduces by 4.35, 5.60, and 4.64 years for $100 increase to these variables, ceteris paribus.

It is worth noting health services in this category countries have issues because they only provide certain treatments, and this fragmentation makes it difficult to provide comprehensive care, such as care for chronic diseases such as vascular and heart disease, so increasing health spending does not result in an increase in life expectancy (Reddy, 2001; Dudley and Garner, 2011). Also, inadequate sanitary infrastructure may impede the effectiveness of water purification processes, resulting in the spread of various illnesses and a decrease in life expectancy.

Per capita GDP has a greater positive impact on life expectancy in low-income countries comparing with the other three groups of countries. The results show a $100 increase in GDP_PC increases L_E by 0.65 years, if all remaining variables remain constant in the long run. accordingly, if GDP_PC increases by $100, then L_E extends by 5.03 years, all other factors being constant in the short run. This outcome is compatible with economic theory, because any rise in personal income in these nations will have a large influence on the provision of fundamental requirements of life, hence contributing to enhance life expectancy.

The effect of one year lag of L_E (L_Et-1) is significant and positive on the present value of L_E at 1% significant level. Therefore, if L_Et-1 increased by one year then L_E increased by 2.54 years, ceteris paribus.

The error correction coefficient is (-0.7456), which is significant at 1% level, showing the current year had a 74.56% convergence rate in adjusting the variables to their long-term equilibrium. Thus, to establish long-term equilibrium with a 100% convergence rate, low-income countries would take 1.34 years, or one year, three months, and four days.

7. CONCLUSIONS

As a result of measuring the impact of each of annual per capita value added in the sectors of agriculture fisheries and forestry, industry including construction, services and per capita GDP in constant 2015 US$ on life expectancy at birth, only the group of high-income countries experiences increases in life expectancy with increments in individual share of industry and services, unlike the other groups. Concerning the groups of upper middle income, lower middle income, and low-income countries, only the factor of per capita GDP increases

life expectancy, this result is parallel to Cervellati and Sunde (2005); Gürler and Özsoy (2019); Radmehr and Adebayo (2022). While the remaining variables individual share in agriculture, industry, and services, decrease life expectancy.

The negative impact of per capita value added in the sectors of agriculture, industry and services, and the positive impact of the individual's share of the national product have witnessed a greater magnitude in the group of lower income countries.

The findings of the per capita value added in the sectors of agriculture, industry, and services in the higher, lower, and low-income countries, revealed negative relationships, which contradict with the economic theory. Reasons were provided for these contradictions and comparable outcomes from earlier studies, such as Cervellati and Sunde (2005); Pathirathne and Sooriyarachchi (2019); Radmehr and Adebayo (2022). The findings indicate to inefficiency in the management of these countries' resources, such as the presence of political, financial, and administrative corruption, income inequalities, and the agricultural, services, and industrial production being directed for export or for products that may harm health and life expectancy, such as global warming, tobacco, eco-pollution, noises, harmful radiations …etc.

In summary, the results showed that per capita GDP is a crucial component that is rising in scale as we move from upper-middle-income to lower-middle-income and low-income countries with regard of life expectancy. While per capita value added generated by the sectors of industry and services is an essential component in extending life expectancy in high-income countries. The speed of adjustment to reach long term equilibrium as a result of one shook in the short term is faster in high income countries comparing to the other groups of countries.

8. LIMITATIONS AND RECOMMENDATIONS

Due to the lack of complete data for a long period of time, we were forced to choose the period (1990-2022), but structural changes in economic sectors require a longer time. On the other hand, the data were intermittent for some countries in the four groups, so we removed a number of countries from the measurement, which may affect the measurement results. Therefore, we suggest that researchers, if more data would be available, repeat the research for a longer period of time and include other countries that were not studied in this research. In this study, the independent variables used are a set of parts, for example, the per capita share of added value in the agricultural sector, which includes agriculture, forestry and fisheries, as well as for industry and services. Researchers can divide these variables into smaller variables and then measure their impact on life expectancy.

We recommend other variables, such as culture, social values, working environment, political, security, and international relations stability, may have an influence on life expectancy at birth, plus those under inquiry. Thus, including such factors into future studies may result in more richer findings.

We advocate the authorities particularly in developing countries to reconsider their political and administrative plans, and seek to establish the foundations that are suitable to preserve public funds and direct them in the right direction, including: health spending to areas related to people's lives and maintaining their health, establishing an educational system with a tangible return, developing skills that meet the needs of the labor market, paying attention to agriculture and construction. And directing their efforts towards reaching

sustainable development goals that suit the demands of the current generation while conserving resources for future generations.

ORCID

Ismael M. Abdulrahman http://orcid.org/0009-0009-4810-1277
Sarah Ahmed Chawsheen http://orcid.org/0009-0000-8264-5512

References

Aigheyisi, O. S. (2020). Determinants of Life Expectancy in Nigeria: Does Agricultural Productivity Matter? *Determinants of Life Expectancy in Nigeria: Does Agricultural Productivity Matter, 1*(2), 194-210. http://dx.doi.org/10.59568/KIJHUS-2020-1-2-14

Alexandratos, N. (1999). World food and agriculture: outlook for the medium and longer term. *Proceedings of the National Academy of Sciences, 96*(11), 5908-5914. http://dx.doi.org/10.1073/pnas.96.11.5908

Aslam, M., Ahmad, A., Ali, F., & Akhtar, A. (2023). Nexus between industrialization and greenhouse gas emissions: Impacts on infant mortality in Lower-Middle-Income countries. *Journal of Asian Development Studies, 12*(4), 817-831. http://dx.doi.org/10.62345/jads.2023.12.4.65

Azodi, T., Javad Razmi, S. M., Naji Meidani, A. A., & Ali Falahi, M. (2019). The effect of public and private health expenditures on life expectancy in different countries: Using panel data model. *International Journal of Business and Economic Sciences Applied Research, 12*(1), 64-69.

Boo, M. C., Yen, S. H., & Lim, H. E. (2016). A Note on Happiness and Life Satisfaction in Malaysia. *Malaysian Journal of Economic Studies, 53*(2), 261-277.

Cavusoglu, B., & Gimba, O. J. (2021). Life expectancy in Sub-Sahara Africa: An examination of long-run and short-run effects. *Asian Development Policy Review, 9*(1), 57-68. http://dx.doi.org/10.18488/journal.107.2021.91.57.68

Cervellati, M., & Sunde, U. (2005). Human capital formation, life expectancy, and the process of development. *The American Economic Review, 95*(5), 1653-1672. http://dx.doi.org/10.1257/000282805775014380

Chudik, A., Mohaddes, K., Pesaran, M. H., & Raissi, M. (2016). Long-run effects in large heterogeneous panel data models with cross-sectionally correlated errors *Essays in Honor of man Ullah* (pp. 85-135): Emerald Group Publishing Limited. http://dx.doi.org/10.1108/S0731-905320160000036013

Chudik, A., & Pesaran, M. H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. *Journal of Econometrics, 188*(2), 393-420. http://dx.doi.org/10.1016/j.jeconom.2015.03.007

Ciocanel, A. B., & Pavelescu, F. M. (2015). The influence of the forest on the population health. *Procedia Economics and Finance, 32*, 745-754. http://dx.doi.org/10.1016/s2212-5671(15)01457-4

Colantonio, E., Marianacci, R., & Mattoscio, N. (2010). On human capital and economic development: Some results for Africa. *Procedia: Social and Behavioral Sciences, 9*, 266-272. http://dx.doi.org/10.1016/j.sbspro.2010.12.148

Dudley, L., & Garner, P. (2011). Strategies for integrating primary health services in low- and middle-income countries at the point of delivery. *The Cochrane Library, 2019*(8). http://dx.doi.org/10.1002/14651858.cd003318.pub3

Esfahani, G., Yektayar, M., Yarahmadi, Y., & Mohammadpour, B. (2018). The relationship between participating in public sports and life expectancy in the staff of Kurdistan University of Medical Sciences, Sanandaj, Iran. *Chronic Diseases Journal, 4*(2), 56-60. http://dx.doi.org/10.22122/cdj.v4i2.221

Fahlevi, M., Ahmad, M., Balbaa, M. E., Wu, T., & Aljuaid, M. (2023). The efficiency of petroleum and government health services to benefit life expectancy during the inefficiencies of hydroelectricity consumption. *Environmental and Sustainability Indicators, 19*, 100289. http://dx.doi.org/10.1016/j.indic.2023.100289

FAO. (2024). Food and Agriculture Organization of the United Nations. Retrieved from https://www.fao.org/home/en

Freeman, T., Gesesew, H. A., Bambra, C., Giugliani, E. R. J., Popay, J., Sanders, D., . . . Baum, F. (2020). Why do some countries do better or worse in life expectancy relative to income? An analysis of Brazil, Ethiopia, and the United States of America. *International Journal for Equity in Health, 19*, 202. http://dx.doi.org/10.1186/s12939-020-01315-z

Group, W. B. (2024). World Development Indicators.

Gürler, M., & Özsoy, Ö. (2019). Exploring the relationship between life expectancy at birth and economic growth in 56 developing countries. *Journal of Global Health Reports, 3*. http://dx.doi.org/10.29392/joghr.3.e2019001

Hahn, R. A., & Truman, B. I. (2015). Education improves public health and promotes health equity. *International journal of health services, 45*(4), 657-678. http://dx.doi.org/10.1177/0020731415585986

Helper, S., Krueger, T., & Wial, H. (2012). Why does manufacturing matter? Which manufacturing matters? A policy framework. *SSRN*. http://dx.doi.org/10.2139/ssrn.3798089

Hendrawaty, E., Shaari, M. S., Kesumah, F. S. D., & Ridzuan, A. R. (2022). Economic growth, financial development, energy consumption and life expectancy: fresh evidence from ASEAN countries. *Economic Growth, Financial Development, Energy Consumption and Life Expectancy: Fresh Evidence from ASEAN Countries, 12*(2), 444-448.

Herforth, A. (2015). Access to Adequate Nutritious Food: New Indicators to Track Progress and Inform Action', in David E. Sahn (ed.) *The Fight Against Hunger and Malnutrition: The Role of Food, Agriculture, and Targeted Policies* (pp. 139–162): Oxford. http://dx.doi.org/10.1093/acprof:oso/9780198733201.003.0007

Jafrin, N., Masud, M. M., SEIF, A. N. M., Mahi, M., & Khanam, M. (2021). A panel data estimation of the determinants of life expectancy in selected SAARC countries. *Operations Research and Decisions, 31*(4), 69-87. http://dx.doi.org/10.37190/ord210404

Joshi, P. K., Pirastu, N., Kentistou, K. A., Fischer, K., Hofer, E., Schraut, K. E., . . . Wilson, J. F. (2017). Genome-wide meta-analysis associates HLA-DQA1/DRB1 and LPA and lifestyle factors with human longevity. *Nature Communications, 8*(1), 910. http://dx.doi.org/10.1038/s41467-017-00934-5

Kabir, M. (2008). Determinants of Life Expectancy in Developing Countries. *Journal of Developing Areas, 41*(2), 185-204. http://dx.doi.org/10.1353/jda.2008.0013

Kerdprasop, N., & Kerdprasop, K. (2017). *Association of economic and environmental factors to life expectancy of people in the Mekong basin.* Paper presented at the 12th IEEE Conference on Industrial Electronics and Applications (ICIEA).

Lin, R., Chen, Y., Chien, L., & Chan, C. (2012). Political and social determinants of life expectancy in less developed countries: A longitudinal study. *BMC Public Health, 12*(1), 85. http://dx.doi.org/10.1186/1471-2458-12-85

Liu, Y., Ma, X., Shu, L., Hancke, G. P., & Abu-Mahfouz, A. M. (2020). From Industry 4.0 to agriculture 4.0: Current status, enabling technologies, and research challenges. *IEEE Transactions on Industrial Informatics, 17*(6), 4322-4334. http://dx.doi.org/10.1109/tii.2020.3003910

MacNeill, A. J., Hopf, H., Khanuja, A., Alizamir, S., Bilec, M., Eckelman, M. J., . . . Sherman, J. D. (2020). Transforming the Medical Device Industry: Road map to a Circular economy. *Health Affairs (Project Hope), 39*(12), 2088-2097. http://dx.doi.org/10.1377/hlthaff.2020.01118

Madreimov, T., & Li, L. (2019). Natural-resource dependence and life expectancy: A nonlinear relationship. *Sustainable Development (Bradford), 27*(4), 681-691. http://dx.doi.org/10.1002/sd.1932

Mainguy, J., Bélanger, M., Valiquette, E., Bernatchez, S., L'Italien, L., Millar, R. B., & De Andrade Moral, R. (2023). Estimating fish mortality rates from catch curves: A plea for the abandonment of Ricker (1975)'s linear regression method. *Journal of Fish Biology, 104*(1), 4-10. http://dx.doi.org/10.1111/jfb.15577

Mueller, J. T., Park, S. Y., & Mowen, A. J. (2019). The relationship between parks and recreation per capita spending and mortality from 1980 to 2010: A fixed effects model. *Preventive Medicine Reports, 14*, 100827. http://dx.doi.org/10.1016/j.pmedr.2019.100827

Neal, T. (2014). Panel Cointegration Analysis with "xtpedroni". *The Stata Journal, 14*(3), 684-692. http://dx.doi.org/10.1177/1536867X1401400312

Ortiz-Ospina, E., & Roser, M. (2017). "Life Expectancy"–What does this actually mean? *Our World In Data*. Retrieved from https://ourworldindata.org/life-expectancy-how-is-it-calculated-and-how-should-it-be-interpreted

Owumi, B. E., & Eboh, A. (2021). An assessment of the contribution of healthcare expenditure to life expectancy at birth in Nigeria. *Journal of Public Health, 30*, 1-9. http://dx.doi.org/10.1007/s10389-021-01546-6

Pathirathne, L., & Sooriyarachchi, M. R. (2019). Factors Affecting Life Expectancy: A Global Perspective. *Environ Prot Sustainable Dev, 5*(1), 14-21.

Pesaran, M. H. (2004). General Diagnostic Tests for Cross Section Dependence in Panels. *Empirical Economics, 1240*(1).

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*(2), 265-312. http://dx.doi.org/10.1002/jae.951

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association, 94*(446), 621-634. http://dx.doi.org/10.1080/01621459.1999.10474156

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics, 142*(1), 50-93. http://dx.doi.org/10.1016/j.jeconom.2007.05.010

Pramita, M. (2017). *Role of agricultre, forestry, and fishiaries sectors in the economy Central Lampung District.* University of Lampung, Indonesia. Retrieved from http://digilib.unila.ac.id/25938/14/3.%20TESIS%20TANPA%20BAB%20PEMBAHASAN.pdf

Radmehr, M., & Adebayo, T. S. (2022). Does health expenditure matter for life expectancy in Mediterranean countries? *Environmental Science and Pollution Research International, 29*(40), 60314-60326. http://dx.doi.org/10.1007/s11356-022-19992-4

Rahman, M. M., Khanam, R., & Rahman, M. (2018). Health care expenditure and health outcome nexus: New evidence from the SAARC-ASEAN region. *Globalization and Health, 14*(1), 1-11. http://dx.doi.org/10.1186/s12992-018-0430-1

Rahman, M. M., Rana, R., & Khanam, R. (2022). Determinants of life expectancy in most polluted countries: Exploring the effect of environmental degradation. *PLoS One, 17*(1), 985-986. http://dx.doi.org/10.1371/journal.pone.0262802

Reddy, K. S. (2001). Neglecting cardiovascular disease is unaffordable. (Round table discussion). *Bulletin of the World Health Organization, 79*(10), 984.

Reimers, C. D., Knapp, G., & Reimers, A. K. (2012). Does physical activity increase life expectancy? A review of the literature. *Journal of Aging Research, 2012*, 1-9. http://dx.doi.org/10.1155/2012/243958

Saidmamatov, O., Saidmamatov, O., Sobirov, Y., Marty, P., Ruzmetov, D., Berdiyorov, T., . . . Day, J. (2024). Nexus between Life Expectancy, CO2 Emissions, Economic Development, Water, and Agriculture in Aral Sea Basin: Empirical Assessment. *Sustainability (Basel), 16*(7), 2647. http://dx.doi.org/10.3390/su16072647

Sardar, K., Shafaqat, A., Samra, H., Sana, A., Samar, F., Muhammad, B. S., . . . Hafiz, M. T. (2013). Heavy Metals Contamination and what are the Impacts on Living Organisms. *Greener Journal of Environment Management and Public Safety, 2*(4), 172-179. http://dx.doi.org/10.15580/gjemps.2013.4.060413652

Siddique, H. M. A., & Kiani, A. K. (2020). Industrial pollution and human health: Evidence from middle-income countries. *Environmental Science and Pollution Research International, 27*(11), 12439-12448. http://dx.doi.org/10.1007/s11356-020-07657-z

Siregar, D. I. (2021). Prediction of Life Expectancy at Birth, Total (years) By Analyzing Capture fisheries production (metric tons) And Industry (including construction), value added (current US$) In Italy 1990??? 2016. *Journal of Hypertension, 10*(5), 1-8. http://dx.doi.org/10.37421/2167-1095.2021.10.284

Summoogum, J. P., & Fah, B. C. Y. (2016). A comparative study analysing the demographic and economic factors affecting life expectancy among developed and developing countries in Asia. *Asian Development Policy Review, 4*(4), 100-110. http://dx.doi.org/10.18488/journal.107/2016.4.4/107.4.100.110

Szreter, S. (2004). Industrialization and health. *British Medical Bulletin, 69*, 75-86. http://dx.doi.org/10.1093/bmb/ldh005

Tackie, E. A., Chen, H., Ahakwa, I., & Atingabili, S. (2022). Exploring the Dynamic Nexus Among Economic Growth, Industrialization, Medical Technology, and Healthcare Expenditure: A PMG-ARDL Panel Data Analysis on Income-Level Classification Along West African Economies. *Frontiers in Public Health, 10*, 903399. http://dx.doi.org/10.3389/fpubh.2022.903399

Vladimirskaya, A. A., & Kolosnitsyna, M. G. (2023). Factors in Life Expectancy: A Cross-Country Analysis. *Voprosy Statistiki, 30*(1), 70-89. http://dx.doi.org/10.34023/2313-6383-2023-30-1-70-89

Wang, J., Zhang, S., & Zhang, Q. (2021). The relationship of renewable energy consumption to financial development and economic growth in China. *Renewable Energy, 170*, 897-904. http://dx.doi.org/10.1016/j.renene.2021.02.038

WB. (2024). World Bank Group-Intrernational Development, Poverty and Sustainability. Retrieved from https://www.worldbank.org/ext/en/home

Westerlund, J., Hosseinkouchack, M., & Solberger, M. (2015). The Local Power of the CADF and CIPS Panel Unit Root Tests. *Econometric Reviews, 35*(5), 845-870. http://dx.doi.org/10.1080/07474938.2014.977077

WHO. (2024). Life expectancy at birth (years). Retrieved from https://www.who.int/data/gho/indicator-metadata-registry/imr-details/65

Wilkinson, R. G. (2018). The impact of income inequality on life expectancy *In Locating health*: Routledge. http://dx.doi.org/10.4324/9781351166409-2

Zhang, C., Qing, N., & Zhang, S. (2021). The impact of leisure activities on the mental health of older adults: The mediating effect of social support and perceived stress. *Journal of Healthcare Engineering, 2021*, 1-11. http://dx.doi.org/10.1155/2021/6264447