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C O N T E N T S

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PRELIMINARY REPORT

The Evolution of Intellectual Capital Research – a Bibliometric Analysis of Highly-cited Papers

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ABSTRACT

This study presents and evaluates the development of research on intellectual capital (IC) using bibliometric analysis of highly cited research papers. It also uses social network analysis (SNA) to decipher the complex patterns of collaboration, influence, and knowledge diffusion in the field of IC research. Data for the SNA were extracted from the top 1% of highly cited papers identified through bibliometric analysis. The extracted data were processed using BibExcel, which allowed for the extraction of important metadata, statistical calculations, and an in-depth examination of the selected documents. Pajek, a network analysis tool, was used to visualize and understand the complex network of these influential articles. Our analysis shows the evolution of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study. The number of publications increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s. From the mid-2000s to the present, the field experienced almost exponential growth, peaking in 2022 with 796 publications. Analysis of the 103 most cited papers in intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors contributed to only one publication each. The co-authorship analysis unveils a decentralized structure characterized by several smaller research clusters embedded within the broader network. The results of this study enhance our comprehension of intellectual capital research by identifying influential authors, highly cited journals, and co-publication networks, thereby providing valuable insights into the field's dynamics.

Keywords: *intellectual capital, intangible assets, bibliometric analysis, social network analysis (SNA), human capital, structural capital, relational capital*

JEL Classification: O34

INTRODUCTION

In today's knowledge-based economy, intellectual capital (IC) is one of the most important factors in value creation. The competitiveness of developed countries is largely based on investments in IC, which is of particular importance for Serbia's economy, whose competitiveness is at a very low level.

The resource-based view of the firm looks at companies in terms of the resources they have. According to Barney (1991), not all resources that a firm possesses have the potential to create a sustainable competitive advantage, but only those that have the following four characteristics: (1) they must be valuable in the sense that they enable exploitation of opportunities and/or neutralization of environmental threats, (2) they must be rare among current and potential

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competitors, (3) they are difficult to imitate, and (4) there are no strategically equivalent substitutes that are valuable but, on the other hand, rare or difficult to imitate. As a result of considering the role and importance of a particular type of resource in achieving competitive advantage, the concept of IC was created (Janošević and Dženopoljac, 2013).

The purpose of this study is to present and evaluate the development of research on intellectual capital through the bibliometric analysis of highly cited articles. In addition to bibliometric analysis, this study employed social network analysis (SNA) to decipher the complex patterns of collaboration, influence, and knowledge diffusion in the field of intellectual capital research. The first part of the paper presents the relevant literature review, including the concept, definitions, importance, and classification of IC, as well as the development of IC research through the four phases. Then, the data (articles on IC) and methodology (bibliometric and social network analysis) are presented, followed by the presentation and discussion of the results. The main findings are summarized in the conclusion.

LITERATURE REVIEW/THEORETICAL BACKGROUND

The Concept and Importance of Intellectual Capital

The concept of intangible assets was first mentioned by Lawrence R. Dicksee in 1896 and IC by John Kenneth Galbraith in 1969. Although it was mentioned much earlier, the term IC did not become popular until 1991, when Tom Stewart published a paper titled "Brain Power: How Intellectual Capital is Becoming America's Most Valuable Asset" (Pedro, Leitão and Alves, 2018).

The term intangible assets is often used as a synonym for IC. However, some definitions in the literature distinguish between IC and intangible assets by considering IC to be a narrower term than intangible assets, i.e., they consider IC to be part of the company's intangible assets. It follows that IC consists of intangible assets that, in combination with tangible assets, contribute to the value creation of companies, regions or countries (Pedro, Leitão and Alves, 2018).

In the literature, there are many papers and studies from different disciplines that mention IC or intangible assets. There are also numerous definitions and classifications of IC and intangible assets. Some non-accounting authors define IC as the difference between the market value and the book value of the company, while accounting authors refer to this difference as goodwill, which is also used as a synonym for intangible assets (Choong, 2008). Goodwill can be internally or externally generated, although according to International Financial Reporting Standards (IFRS), in particular IFRS 3, only externally generated goodwill, i.e., goodwill acquired through purchase, can be recognized in the financial statements and subsequently amortized (IASB, 2008). Choong (2008) is of the opinion that IC or intangible assets cannot be equated with goodwill, as the concept of goodwill is too broad.

Although there is no unified definition of IC in the literature, most definitions state that IC is a non-monetary asset without physical substance that has value or can generate future benefits (Choong, 2008). Itami and Roehl (1987) define intangible assets as invisible assets that encompass a wide range of activities, such as technology, collected customer information, brand image, corporate reputation, and organizational culture.

Hall (1992, p. 136) considers intangible resources as “value drivers that transform productive resources into value-adding assets”. According to this author, intangible resources can be divided into assets and skills. Assets are resources that a company owns. They include intellectual property rights (patents, trademarks, copyrights and registered designs), contracts, trade secrets, and databases. Reputation is also an asset because it has the quality of belonging to a company, although it is not a property right, such as a copyright that can be bought or sold. Skills include the know-how of employees (but also the know-how of suppliers and consultants) and the culture of the company.

Smith and Parr (1994) state that intangible assets are an element of a firm that exists alongside working capital and tangible assets. It is an element that, along with working capital and tangible assets, enables a company to function and is often the factor that contributes most to a company's earning power.

According to Brooking (1997, p. 13), IC represents a "set of marketable assets, human capital, intellectual property, and infrastructure". Marketable assets are the potential of a company created in the market, such as brand, customer loyalty, repeat purchases, distribution channels, various agreements and contracts such as licenses, franchising and the like. Human capital consists of the collective experience of employees, their creativity, problem-solving ability, leadership skills, entrepreneurial skills, management skills, teamwork skills, and ability to work under pressure. Infrastructure includes technologies, methods and processes that enable the company to function, such as organizational culture, risk assessment methods, sales management methods, financial structure, market and customer databases and communication systems.

Edvinsson and Malone (1997) state that intangible assets are those assets that have no physical expression, but are essential for increasing the value of the company. Sveiby (1997) uses the term intangible value and states that IC has three dimensions: employee competencies, internal structure, and external structure. Nahapiet and Ghoshal (1998) use the term IC to consider the knowledge and learning capabilities of a social collective such as an organization, intellectual community, or professional association. According to Stewart (1998, p. 11), IC is a "collective brain power that includes knowledge, information, intellectual property, and experience that can be used to create wealth". Brennan and Connell (2000) state that IC can be viewed as a company's knowledge-based capital, which includes employees' knowledge and expertise, customers' trust in the company and its products, brand, franchise, information systems, administrative procedures, patents, trademarks, and business process efficiency.

According to Harrison and Sullivan (2000), in the first half of the 1990s, many companies were interested in making profits based on IC. For this reason, in January 1995, a meeting of eight companies actively involved in the process of creating value based on their intangible assets was held. On this occasion, the representatives of all eight companies agreed, among other things, on the definition of IC, which is that IC is "knowledge that can be converted into profit".

Lev (2001, p. 5) defines an intangible asset as a "right to future benefits that has no physical or financial expression". Financial assets, such as stocks or bonds, also have no physical expression but are not intangible assets because they represent the right to the company's assets, which can be tangible or intangible (Lev, 2005). Intangible assets can also be defined by their value drivers, such as research and development, advertising (brand support), capital expenditures, information systems, and technology deployment (Gu and Lev, 2001).

The Organization for Economic Cooperation and Development (OECD, 1999, p. 17) defines IC as the "economic value of two categories of intangible business assets: organizational (structural) capital and human capital". In this definition, structural capital includes assets such as software, distribution channels, and supply chains. Human capital includes human resources within the company as well as those outside the company, such as customers and suppliers. This definition also distinguishes between IC and intangible assets by treating IC as part of an intangible asset. For example, a company's reputation is an intangible asset, but not IC (Petty and Guthrie, 2000).

Funk (2003) links intangible assets to social responsibility, environmental responsibility, management credibility, innovation, brand, ability to attract talented employees, and research leadership. Pablos (2003) defines IC more comprehensively than other authors, explaining that IC is the difference between the market value and the book value of the company. It consists of knowledge-based resources that help to achieve a sustainable competitive advantage.

According to Rastogi (2003, p. 230), IC can be seen as the "holistic ability of an organization to coordinate, manage, and deploy its knowledge resources to create value in the future". Organizations are expected to face constant challenges and exploit opportunities to create value.

Therefore, IC can be understood as the company's comprehensive ability to respond to challenges and exploit opportunities to achieve its goals. The author further states that a company's ability to provide superior value to customers depends on the collective efforts of highly motivated, well-trained, capable, and creative employees who make up the company's human capital. Employee cooperation and motivation derive from the company's social capital, which includes shared values, a common vision, and a sense of trust and concern among employees. In turn, employees' skills, abilities, creativity, and knowledge are shaped by the firm's continuous efforts to create, develop, share, integrate, and leverage its knowledge resources, which this author refers to as the knowledge management function. Human capital, structural capital, and the knowledge management function are interrelated, and IC can be understood as the result of a continuous synergistic interaction of these three elements (Rastogi, 2003).

The International Accounting Standards Board (IASB) defines an intangible asset in its Standard 38 (International Accounting Standard - IAS 38) as a non-monetary asset without physical substance that is held by an entity for use in production, procurement of goods or services, rental to others, or use for administrative purposes (IASB, 2004). Intangible assets can comprise various activities that are expected to generate future benefits in the form of cash flows. These include investments in marketing, research and development, and human resources, but also the value created on the basis of the brand, copyrights, franchises, licenses, patents, trademarks, and so on. From an accounting perspective, most of these activities are treated as period costs, and only those items that can be quantitatively identified or that are externally generated can be capitalized on the balance sheet (Choong, 2008).

The Financial Accounting Standards Board (FASB) defines an intangible asset as the right to future benefits, where it is not short-term and financial in nature. Intangible assets also have no physical or financial expression (FASB, 2001).

Table 1 summarizes the definitions and most commonly cited synonyms for IC. Although definitions of IC differ, they all have in common that intangible resources are the category of assets with the greatest potential to create value (Janošević and Dženopoljac, 2013).

Table 1. Overview of definitions and the most frequently cited synonyms for IC

Authors	Term	Definition
Itami and Roehl (1987)	Invisible assets	Invisible assets include intangible assets that encompass a wide range of activities, such as technology, collected customer information, brand image, corporate reputation, and organizational culture.
Hall (1992)	Intangible assets	Intangible assets are "value drivers that convert productive resources into value-creating assets".
Smith and Parr (1994)	Intellectual property	Intangible assets are an element of a company that exists alongside working capital and tangible assets. It is an element that, along with working capital and tangible assets, enables a company to function and is often the factor that contributes most to a company's earning power.
Brooking (1997)	Intellectual capital	IC represents a set of marketable assets, human capital, intellectual property and infrastructure.
Edvinsson and Malone (1997)	Intellectual capital and intangible assets	Intangible assets are assets that have no physical expression but are essential for increasing the value of the company.
Sveiby (1997)	Immaterial values	IC has three dimensions: employee competencies, internal and external structure.
Nahapiet and Ghoshal (1998)	Intellectual capital	IC is considered to be the knowledge and learning capacity of a social collective such as an organization, an intellectual community, or a professional association.

Authors	Term	Definition
Stewart (1998)	Intellectual capital	IC is the collective brain power that includes knowledge, information, intellectual property, and experience that can be used to create wealth.
Brennan and Connell (2000)	Intellectual capital	IC can be considered the knowledge-based capital of a company.
Harrison and Sullivan (2000)	Intellectual capital	IC is "knowledge that can be turned into profit".
Lev (2001)	Intangibles	An intangible asset is a right to a future benefit that has no physical or financial expression.
Gu and Lev (2001)	Intangibles	Intangible assets are defined by their value drivers, such as research and development, advertising (brand support), capital expenditures, information systems, and technology deployment.
OECD (1999)	Intellectual capital	IC is the "economic value of two categories of intangible assets of the company: organizational (structural) capital and human capital".
Pablos (2003)	Intellectual capital	IC represents the difference between the market value and the book value of the company. It consists of knowledge-based resources that help to achieve a sustainable competitive advantage.
Rastogi (2003)	Intellectual capital	IC can be seen as the "holistic ability of an organization to coordinate, manage and deploy its knowledge resources to create value in the future".
International Accounting Standards Board (IASB, 2004)	Intangible assets	Intangible assets are non-monetary assets without physical substance that are held by the entity for the purpose of production, procurement of goods or services, rental to others, or use for administrative purposes.
Financial Accounting Standards Board (FASB, 2001)	Intangible assets	An intangible asset is a claim to a future benefit, where it is not short-term and financial in nature. Intangible assets also have no physical or financial expression.

Source: adapted from Choong (2008)

The importance of IC is demonstrated by the fact that in the United States, intellectual and informational processes create most of the value in companies that belong to service industries such as software, healthcare, communications, and education. These firms employ 79% of the labor force and generate 76% of the gross national product of the United States. In manufacturing, intellectual activities such as research and development, process and product design, logistics, marketing, market research, systems management, and technological innovation generate most of the value added (Quinn, Anderson and Finkelstein, 1996).

In a study that included 3,500 companies in the United States, the relationship between the market value and book value of these companies was observed over a 20-year period. At the beginning of the observation period, i.e., in 1978, the difference between the market value and the book value was not significant, as the book value was equal to 95% of the market value. However, 20 years later, the market value of the company was 2.2 times higher than the book value (Dess, Lumpkin, Eisner and McNamara, 2014). According to these authors, the difference between market value and book value is larger in knowledge-intensive companies than in companies that base their strategy on tangible assets. This difference becomes even greater in companies where knowledge and the management of a highly skilled workforce are key factors in product or service development, and material resources are less important factors.

Figure 1 shows the share of IC in the total assets of companies from the S&P 500 group. IC's share of total assets in 2015 is 84%, an increase of four percentage points compared to the period 10 years ago.

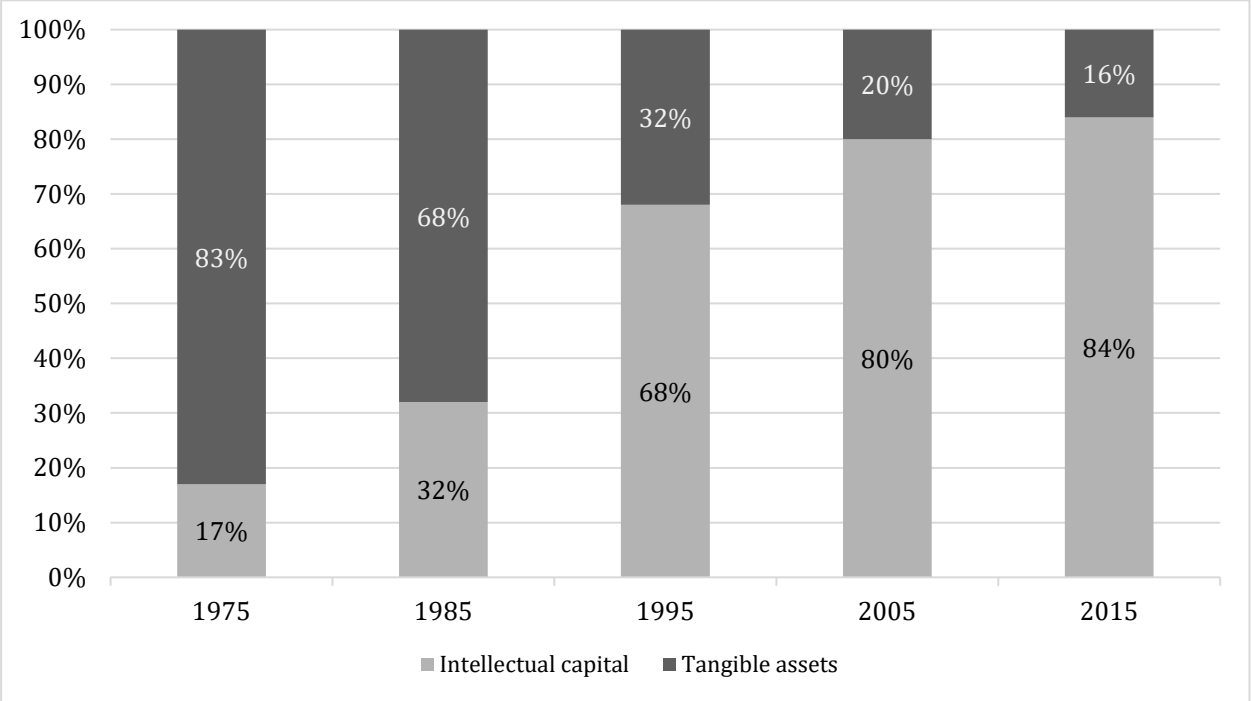

Figure 1. The share of IC in the total assets of companies

Source: Ocean Tomo (2017). Intangible asset market value study. Available at: http://www.oceantomo.com/intangible-asset-market-value-study/

In most OECD countries, investment in intangible assets is growing rapidly, and in some cases, it is approaching or even surpassing investment in tangible assets. It is estimated that annual investment in the United States ranges from $ 800 billion to $1 trillion, while the total value of intangible assets exceeds $5 trillion. Increasing competition on a global scale, ICT, new business models and the growing importance of the service sector are the reasons that lead to a greater importance of IC for companies, industries and economies (OECD, 2011).

Classification of Intellectual Capital

Similar to the definition of IC, there are a variety of attempts in the literature to determine the constituent elements of IC. Modern concepts divide IC into external elements associated with customers, internal elements, and human capital (Janošević and Dženopoljac, 2013).

Sveiby (1997) uses the term intangible value and explains that IC consists of employee competencies, internal and external structure. Employee competencies represent the ability to act in a variety of business situations. The internal structure includes patents, business models, information systems, management, organizational culture, and organization in its broadest sense. The internal structure is created by the employees and represents the ownership of the company. The external structure includes the capital of established and maintained relationships with stakeholders (customers, suppliers, investors, partners, community, etc.) (Krstić, 2009).

Brooking (1997) divides IC into human capital, marketable assets, intellectual property, and infrastructure. According to Roos and Roos (1997), IC includes human capital and structural capital. Edvinsson (1997) and Bontis (1998) state that IC consists of human capital, organizational capital, and customer capital. Stewart (1998) summarizes human capital, structural capital, and customer capital at IC. Petty and Guthrie (2000) accept the OECD's definition of IC, according to which IC is divided into human and organizational capital. Gu and Lev (2001) state that intangible

assets consist of research and development, advertising (brand support), capital expenditures, information systems, and technology deployment. Mouritsen, Larsen and Bukh (2001) divide IC into human capital, organizational capital, and customer capital.

Khalique, Bontis, Abdul Nassir bin Shaari and Hassan Md. Isa (2015) consider IC as a set of six components: human capital, social capital, customer capital, structural capital, technological capital, and spiritual capital. According to them, human capital consists of employees' competencies (education, professional skills, know-how, and experimental knowledge), attitudes (motivation, leadership, behavioral patterns), and mental agility (innovativeness, creativity, flexibility, and adaptability). Social capital includes honesty, ethics, and corporate responsibility. Customer capital consists of customer loyalty and satisfaction, networks, and brand equity. Structural capital consists of procedures, databases, systems, processes and routines. Technological capital consists of research and development and property rights, while spiritual capital consists of ethical values and an understanding of religion.

Although there are various subdivisions of IC, the one that divides IC into human capital, structural capital, and relational capital is the most commonly used in literature. This classification of IC is defined in the " Guidelines for managing and reporting on intangibles", i.e., the MERITUM guidelines (MERITUM, 2002). Table 2 provides an overview of the different classifications of IC.

Table 2. Overview of the different classifications of IC

Authors	Term	Classification
Sveiby (1997)	Immaterial values	Employee competencies, internal structure and external structure
Brooking (1997)	Intellectual capital	Human capital, marketable assets, intellectual property and infrastructure
Roos & Roos (1997)	Intellectual capital	Human capital and structural capital
Edvinsson (1997)	Intellectual capital	Human capital, organizational capital and customer capital
Bontis (1998)	Intellectual capital	Human capital and organizational capital and customer capital
Stewart (1998)	Intellectual capital	Human capital, structural capital and customer capital
OECD (1999)	Intellectual capital	Human capital and organizational capital
Gu & Lev (2001)	Intangible assets	R&D, information systems, advertising, capital expenditure, and technology deployment
Mouritsen, Larsen and Bukh (2001)	Intellectual capital	Human capital, organizational capital and customer capital
Khalique, Bontis, Abdul Nassir bin Shaari and Hassan Md. Isa (2015)	Intellectual capital	Human capital, customer capital, structural capital, social capital, technological capital and spiritual capital
MERITUM Guidelines (MERITUM, 2002)	Intellectual capital	Human capital, structural capital and relational capital

Source: adapted from Choong (2008)

Human capital includes the knowledge that employees take with them when they leave the company (Janošević and Dženopoljac, 2016). This includes their experience, commitment, skills, motivation, talent, experience, creativity, ability to acquire new knowledge, and enthusiasm. The knowledge embedded in human capital can be explicit and tacit. Explicit knowledge, such as

technical drawings or program codes, is codified and documented so that it can be easily transferred and reproduced. Tacit knowledge is in the minds of employees and is based on their experience and education. This knowledge can only be passed on with the consent and participation of the person who possesses it, and through the constant interaction of explicit and tacit knowledge, new knowledge can be created (Dess, Lumpkin, Eisner and McNamara, 2014).

Building human capital in a company requires three activities (Dess, Lumpkin, Eisner and McNamara 2014). The first step is to hire talented employees with the right skills, abilities, values and attitudes. According to these authors, companies can identify the best candidates based on their mindset, attitudes and social skills. This does not mean that specific knowledge is not important for performing the job; it is a necessary condition, but not a sufficient one.

Hiring the best people is no guarantee that their skills and abilities will remain relevant throughout their careers, so the second step is to develop human capital. In addition to the various types of training and development, companies should encourage employee involvement at all levels, monitor their development and provide them with feedback.

The final step in building human capital is to create a work environment and incentive system that allows the best people to stay with the company. Challenging work and a stimulating environment can create intrinsic motivation in employees and a desire to stay with the company. On the other hand, financial incentives in the form of salaries, bonuses, options or otherwise can mean different things to different people. For example, it can mean security, recognition, independence or a sense of freedom. Although money is an important factor in attracting and retaining human capital, most surveys indicate that it is not the most important reason why people take or leave a job.

These three activities are interrelated and can be considered like a table with three legs, in the sense that if one leg breaks, the table collapses. Poor selection of candidates at the recruitment stage makes it difficult to develop and retain staff. On the other hand, the inability of the company to retain good employees increases employment costs and prevents human capital development.

Structural capital is the knowledge that remains in the company when the working day is over (Janošević and Dženopoljac, 2016). It is used to transform tacit knowledge into explicit knowledge. These include management processes, procedures, business strategies, routines, organizational learning and culture, databases, software, copyrights, licenses, patents, etc. Human capital is transformed into structural capital through management systems and processes, which ensure the integration of employees toward common goals (Janošević, 2019). Certain elements of structural capital can be legally protected, becoming the company's intellectual property. However, the best way to preserve and protect IC is to develop dynamic capabilities. Dynamic capabilities represent the ability of a company to build and protect competitive advantages. They are based on knowledge, resources, competencies, complementary means and technologies, the ability to seize and exploit new opportunities, acquire new knowledge and reconfigure existing resources and capabilities (Dess, Lumpkin, Eisner and McNamara, 2014). Examples of dynamic capabilities are product development, strategic decision-making, alliance building and acquisitions (Dess, Lumpkin, Eisner and McNamara, 2014).

Relational capital includes all resources associated with the relationships the company has with external stakeholders such as customers, suppliers, creditors, investors, partners, and the like (Janošević and Dženopoljac, 2016). It consists of elements of human and structural capital that occur in relationships with external stakeholders. It also includes those stakeholders' perceptions of the company. It represents the ability of the company to acquire and use new knowledge from the environment with the aim of achieving a sustainable competitive advantage (Janošević, 2019). Some examples include the reputation of the company, business networks, ability to attract new customers, brand, distribution channels, market position, and the like.

In the process of value creation, the starting point is human capital. Structural capital is created by codifying the knowledge contained in human capital and incorporating it into procedures,

routines, management processes, business strategies, plans and organizational culture. Human and structural capital together lead to the creation of value that is estimated in the marketplace through good relationships with customers and other stakeholders. In later stages, the value created through relational capital can be reinvested in further improving human and structural capital, leading to renewed value creation (Janošević and Dženopoljac, 2016).

The Evolution of Intellectual Capital Research

According to Pedro, Leitão and Alves (2018), the development of IC research can be analyzed in four phases. The first phase lasted from the end of the 1980s to the end of the 1990s. The main focus of most authors in this phase was to raise awareness of the importance of recognizing and understanding the potential of IC to achieve and manage sustainable competitive advantage. Certain guidelines and standards were also created to reveal invisible values. The work that emerged during this phase points to the importance of IC and the need for its measurement without referring to specific empirical research (Petty and Guthrie, 2000).

The second phase lasted from 2000 to the end of 2003. The main focus and research directions were different approaches to measuring, managing and disclosing IC in empirical studies. Interdisciplinary studies were conducted to investigate how labor and capital markets respond to the potential of value creation through IC at the organizational level. In this phase, different classifications of IC were created, which made it possible to identify the three main components of IC. Although they are referred to differently in different publications, they all refer to (1) human competencies, i.e., the knowledge of employees, (2) structural capital, i.e., the knowledge embedded in the organization, and (3) relational capital, i.e., the knowledge contained in customers and other links with the external environment (Guthrie, Ricceri and Dumay, 2012).

The third phase began in 2004 and continues to this day. The publication of a special issue of the Journal of Intellectual Capital entitled "Intellectual capital at the crossroads - theory and research" is considered its beginning (Guthrie, Ricceri and Dumay, 2012). This phase focuses on the use of IC in the process of corporate governance. IC is critically examined from a practical perspective at the organizational level.

The fourth phase began in parallel with the third in 2004 and continues to this day. IC is considered in the context of national and regional ecosystems. The work that belongs to this phase points to the need for a change in approach to understand the drivers of wealth creation, with the aim of obtaining a more comprehensive view of national innovation capacity (Pedro, Leitão and Alves, 2018). Table 3 shows the evolution of IC research through these four phases.

Guthrie, Ricceri and Dumay (2012) studied intellectual capital accounting (ICA) as a research area in the period from late 1999 to late 2009. These authors define IC accounting as a management and accounting technology that aims to understand, measure and report on knowledge resources such as employee competencies, relationships with customers, brands, financial relationships and ICT (Guthrie, Ricceri and Dumay, 2012). IC Accounting differs from intangible asset accounting, which focuses only on the elements of IC that are recognized in the financial statements, such as a brand, patents or copyrights, and does not take into account the intangible assets that are not capitalized on the balance sheet but treated as an expense in certain periods.

Table 3. The evolution of IC research in four phases

Phase	Period	Research focus	Research direction
First phase: Development of the theoretical framework	From the end of the 1980s to the end of the 1990s	Organizational IC	IC as a determinant of competitive advantage
Second phase: Development supported by empirical research	From 2000 to the end of 2003	Organizational IC	Approaches to measuring, managing and disclosing IC in empirical studies; how markets respond to the value creation potential of IC; IC Classification
Third stage: Use of IC in the process of corporate governance	From 2004 until today	Organizational IC	The role of IC from the practical point of view and IC management
Fourth phase: Development focused on IC of cities, regions and countries	From 2004 until today	National and regional IC	IC of regional and national ecosystems

Source: adapted from Pedro, Leitão and Alves (2018)

After 1999, there was a slight, constant increase in the number of publications in the field of IC accounting. The authors state the increase in the number of pages in specialist journals rather than the acceptance of this field of research in generalist journals as the reason for this (Guthrie, Ricceri and Dumay, 2012). Of the total 423 papers included in this study, 345 papers were published in two journals that specialize in this field: The Journal of Intellectual Capital - JIC (297 papers), published since 2000, and the Journal of Human Resource Costing and Accounting - JHRCA (48 papers), published since 1996 (Guthrie, Ricceri and Dumay, 2012).

In most publications, IC is considered at the industry level. In less than a third of the papers, IC is considered at the organizational level, suggesting that most authors have tried to generalize their conclusions to all companies rather than analyzing a single company. Guthrie, Ricceri and Dumay (2012) believe that this top-down approach to evaluating IC offers little information about how IC is implemented in practice and that more research needs to be done at the organizational level to understand the complexity of IC and to make visible the links between its components and the value created for managers in the company.

The most common type of organizations that were the subject of the study are large, publicly listed companies. This can be explained by the higher availability of financial reports and other information needed for analysis than for other types of organizations. A significant number of such papers have examined the impact of disclosure of IC information on financial markets. A smaller number of papers examined small and medium-sized enterprises and an even smaller number considered the public sector and non-profit organizations.

As far as the regions covered in the study are concerned, almost half of the articles refer to continental Europe. This is followed by North America (17% of the works) and Australasia (17% of the works). In Continental Europe, most of the papers refer to the Scandinavian countries, and in North America, more papers refer to Canada than to the United States, although the United States has a significantly larger academic population than Canada. A significantly smaller number of articles deal with countries such as South Africa, Russia, India, China and Latin American countries, suggesting that developing countries will most likely be the subject of research in this area in the future (Guthrie, Ricceri and Dumay, 2012).

Looking at the research methods used in the observed period, more than half of the papers refer to empirical research. Empirical works are followed by normative studies, and the smallest number of papers refers to theoretical studies. Looking at the trend, one can see a gradual increase

in the number of empirical papers and a gradual decrease in the number of normative studies. The number of papers proposing new theoretical models is also decreasing, indicating that IC accounting is maturing as a scientific field (Guthrie, Ricceri and Dumay, 2012).

Since the 1990s, the number of researchers in this field of science has increased considerably. This is especially true for the countries where the first phase of the development of IC research began, such as the European countries, Canada and Australia. Recently, the number of researchers in China and India has also increased. However, many researchers in this field feel excluded from the broader accounting research community for two reasons (Guthrie, Ricceri and Dumay, 2012). The first reason is that journals in this field are not yet recognized in business school rankings. This means that the publication of articles in these journals does not contribute to the ranking of the business school where the professors who published these articles are employed. Another reason is that the editors of high-ranking accounting journals often have a bias against IC accounting as a scientific field. They often view IC as a financial accounting problem rather than a problem of understanding how IC is linked to the value creation process.

For this reason, according to Serenko and Bontis (2009), researchers from the IC field have two options. The first option is to submit their work to one of the specialized journals that offer the greatest visibility to the target audience. However, the reputation of these journals is currently not high, which may raise doubts among other colleagues about the quality of their work. Another option is to submit their work to a high-ranking journal that deals with broader topics. This way, the quality of their work will be recognized, but on the other hand, the work will not be sufficiently noticed in the research community from the IC field, where many researchers focus on specialized journals.

Pedro, Leitão and Alves (2018) examined empirical papers in the field of IC during the period 1960-2016, covering 777 papers from 253 journals with an impact factor higher than 0.25. The largest number of papers was published in the following four journals: Journal of Intellectual Capital (23%), International Journal of Learning and Intellectual Capital (7%), Knowledge Management Research and Practice (4%) and Management Decision (2%). According to these authors, the number of articles published each year was about the same until 2001, and the greatest increase in articles began in 2004, when the third phase of the development of IC began. The authors also noted that in the majority of the papers, IC is observed at the level of an organization. The first empirical research on IC at the national level was published in 1972, but it was only after 2004 that a significant number of papers observing IC at the regional or national level were published.

Of the total number of papers that were included in the research of Pedro, Leitão and Alves (2018), 188 empirical papers examined the relationship between IC and performance. The first empirical paper addressing the relationship between IC and performance was published in 2000, and after 2007, the number of such studies increased significantly, reaching record levels in 2015.

Empirical studies that have observed IC at the organizational level have mostly examined the relationship between IC and overall performance, with a substantial body of work examining the relationship between IC and innovation performance, profitability, productivity, organizational, corporate, and business performance. The most commonly used classification of IC is the three-part classification of human capital, structural (organizational or process) capital and relational (social or customer) capital.

In the papers where IC was observed at the regional level, the relationship between relational capital and overall performance was most frequently examined. The studies that analyzed IC at the national level considered the relationship between IC and economic growth, productivity growth and innovation performance. A three-part classification of IC was used, and the research most commonly included groups of countries (Pedro, Leitão and Alves, 2018).

A recent bibliometric analysis of intellectual capital (Quintero-Quintero, Blanco-Ariza and Garzón-Castrillón, 2021) indicated that research in this field has experienced a significant and

accelerating increase since 2015, suggesting ongoing growth. The primary contributors to this research trend are notably found in the USA, the UK, Spain, and several other countries highlighted in the statistical findings of the analyzed data sources. Examination of keywords revealed that diverse facets of intellectual capital have been explored and scrutinized over the past 74 years. The latest prominent studies revolve around the intersection of intellectual capital and knowledge management, followed by considerations of societies and institutions. To a lesser extent, there is also attention given to clusters related to competition, education, and universities.

DATA AND METHODOLOGY

The analysis was based on data retrieved from Scopus, a reputable scholarly database, accessed on October 09, 2023. The search was narrowed down to documents with the keyword "Intellectual Capital," focusing on titles, abstracts, and keywords.

The initial search yielded a total of 10,267 published papers in the field. A filtering criterion was applied to delve deeper into the significant contributions. Specifically, the top 1% of highly cited papers were selected for further analyses, ensuring a focus on the most impactful research in the domain of intellectual capital research.

In addition to the bibliometric analysis, this study employed Social Network Analysis (SNA) to unravel intricate patterns of collaboration, influence, and knowledge dissemination within the domain of intellectual capital research. SNA is a robust methodological framework used to understand the relationships and interactions among entities within a network. In the context of this study, SNA was instrumental in uncovering the collaborative dynamics among researchers and countries focusing on the highest-impact papers in the field of intellectual capital. By visualizing these networks, key insights into the structure of collaborations and the flow of knowledge were obtained.

Data for the SNA were extracted from the top 1% of highly cited papers identified through bibliometric analysis. Information about authors, their affiliations, co-authorships, and citation patterns was collected. Institutional collaborations and co-authorship networks were explored, shedding light on the collaborative landscape in the field. The extracted data was processed using BibExcel, a versatile bibliometric software. BibExcel enabled the extraction of essential metadata, statistical calculations, and in-depth exploration of the selected documents. To visualize and comprehend the complex network of these influential papers, Pajek, a network analysis tool, was employed. Pajek facilitated the creation of visual representations, aiding in the exploration of patterns, connections, and collaborations within the selected papers.

RESULTS AND DISCUSSION

Figure 2 shows the development of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study, demonstrating its central role in contemporary academic discourse. In the 1970s and 1980s, the number of papers published fluctuated between 1 and 8 per year, indicating a modest scholarly engagement with the topic. The 1990s and early 2000s saw exponential growth and a steady increase in the number of publications. The number increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s, underlining the considerable scholarly interest and acceptance of intellectual capital as an important field of research. The following years, especially from the mid-2000s until today, show an impressive development. The field experienced almost exponential growth, peaking in 2022 with 796 publications. This increase reflects a deepening of engagement, probably fueled by the growing recognition of the importance of intellectual capital in various disciplines.

The number of top 1% cited papers in the field of intellectual capital has shown fluctuations over the years. The notable peaks were in 2004 (10 papers) and 2005 (11 papers). In the following years, the number of top publications fluctuated between 1 and 9 per year.

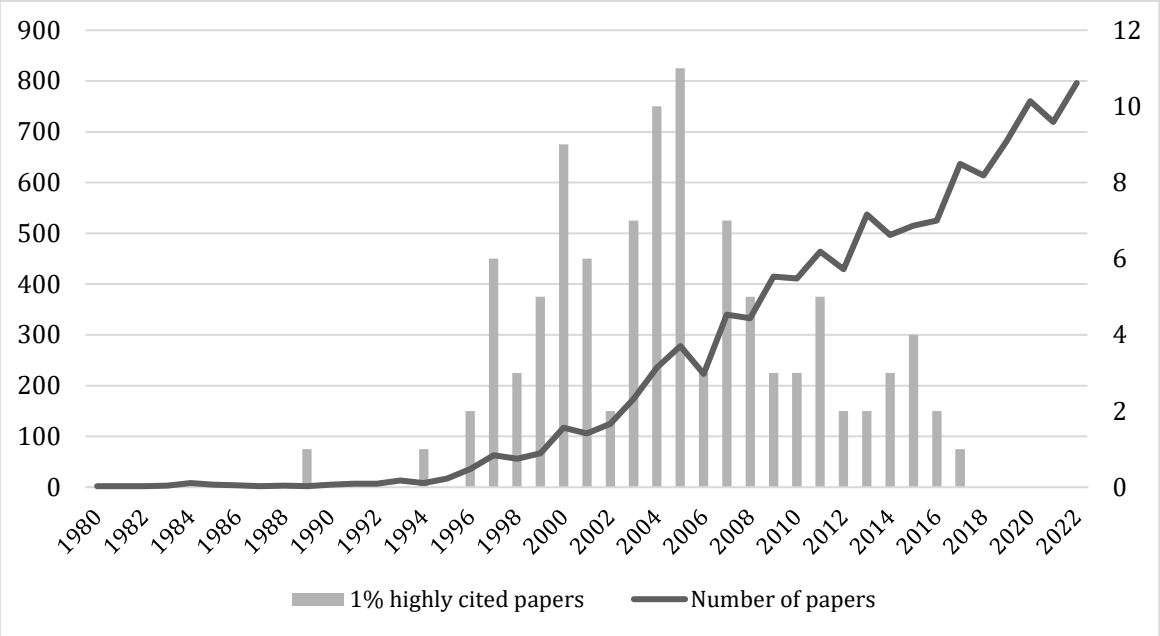

Figure 2. A comparative overview of published papers overall and 1% of highly cited papers in intellectual capital research over the period 1945-2022

Source: authors

Our analysis of the 103 most cited papers in the field of intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors (195 authors in total) contributed to only one publication each. Figure 3 shows the leading authors in the field of intellectual capital. In particular, researchers Bontis, N. and Guthrie, J. stand out as the most influential authors with papers that received the most citations in the field.

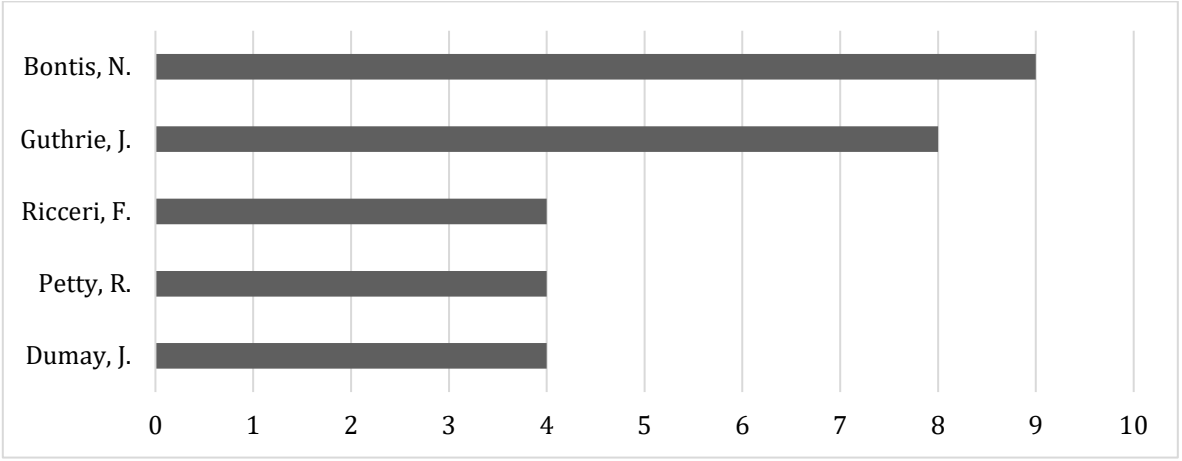

Figure 3. Authors with the highest number of top 1% cited papers in the field of intellectual capital research

Source: authors

In addition, our research found that a key journal, the 'Journal Intellectual Capital', is a focal point for the dissemination of significant research findings. This journal was the academic home for 23 of the 103 most cited papers, underlining its importance in shaping the discourse on intellectual capital (Figure 4).

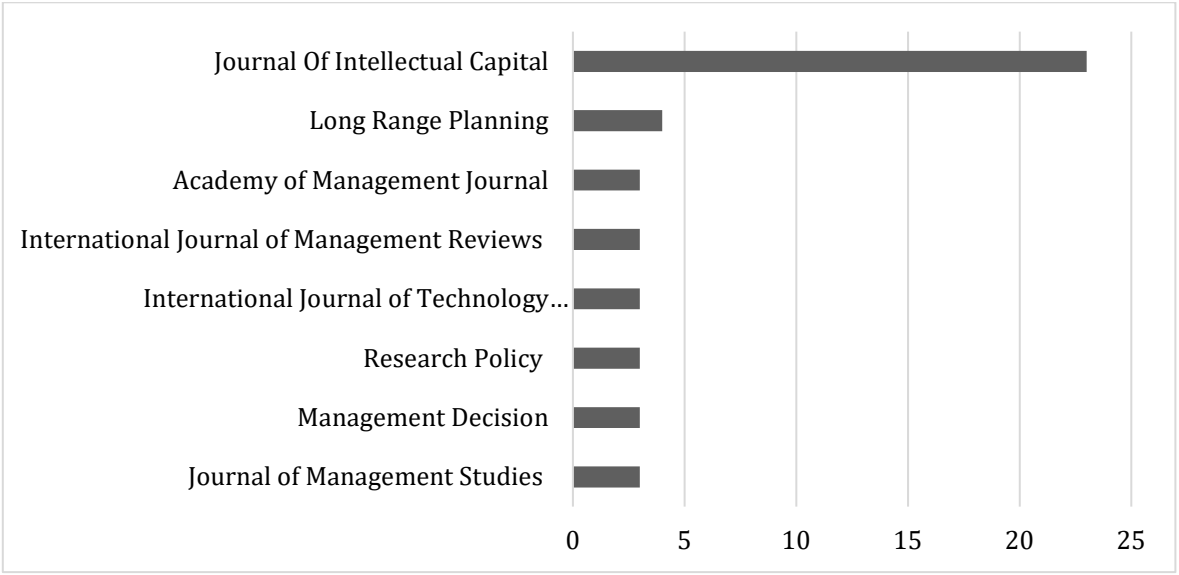

Figure 4. Source titles where the most highly cited papers were published
Source: authors

Figure 5 below illustrates the co-authorship relationships extracted from highly cited papers in the field of intellectual capital research, focusing on collaborations with at least four authors. A decentralized structure emerges, encompassing numerous smaller research clusters within the broader network. Our analysis identified nine different co-authorship networks with at least 4 authors, with the nodes representing individual authors and the connecting lines denoting the collaborative relationships between them. The size of the nodes corresponds to the authors' publication volume, while the thickness of the lines indicates the strength of the connections. Notably, the graph highlights two prominent clusters in particular: one with Bontis, N. and associated collaborations and another showing the interconnected networks of Guthrie, J., Petty, R. and Ricceri, F.

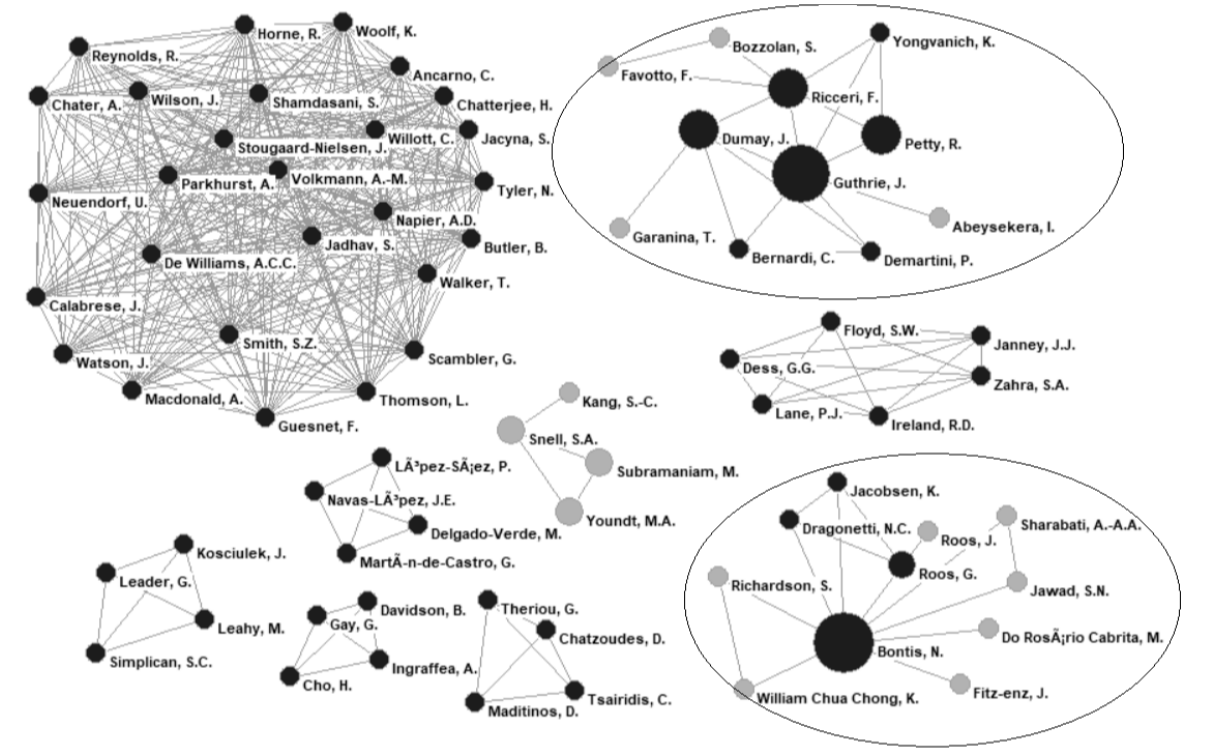

Figure 5. Co-authorship network of authors of the most cited papers in the field of Intellectual Capital Research

Source: authors

The authors of the most cited papers come from a total of 28 countries, with authors from 22 countries entering into international research collaboration. The research network consists of four different clusters, each characterized by a unique dynamic of collaboration. It is noteworthy that most of the highly cited articles are from the United States (39), with additional contributions from Canada (12), Australia (11) and the United Kingdom (10). The United States and Canada are the main players and play a central role throughout the network, highlighting their influential contributions to the field. In the second cluster, a compelling synergy emerges between Australian and Italian institutions, demonstrating close collaboration on joint research projects.

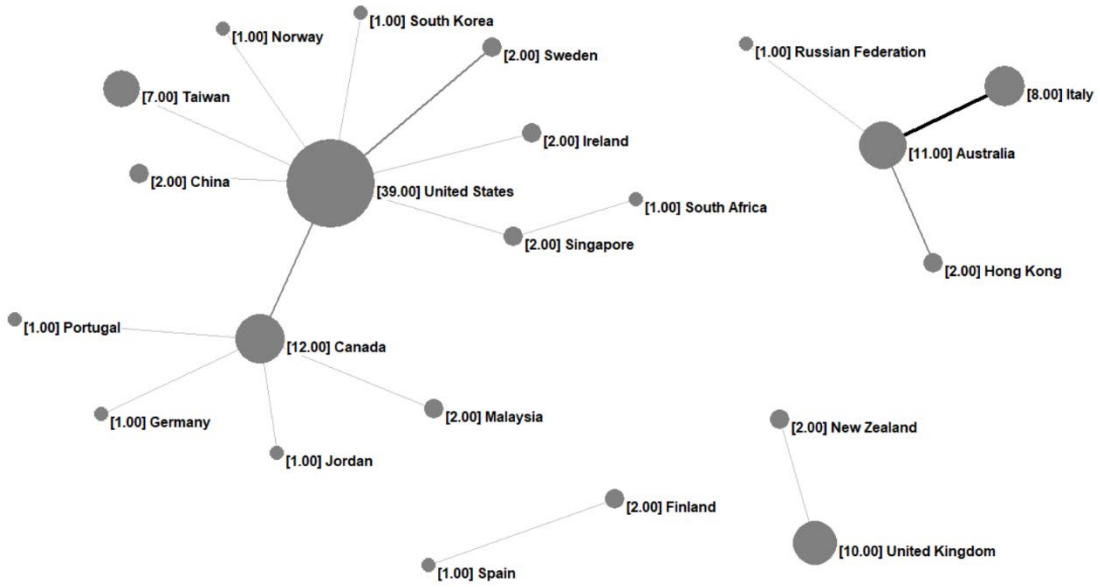

Figure 6. The network of co-authorship relations among 22 countries in producing the most-cited papers in the field of intellectual capital research

Source: authors

CONCLUSION

Intellectual capital is a cornerstone of value creation in the 21st-century economy. Organizations that recognize its importance and actively manage and develop their intellectual capital are better positioned to adapt, innovate, and succeed in an increasingly competitive business environment. A bibliometric analysis of intellectual capital research involves the quantitative examination of academic literature related to the subject of intellectual capital. It is a valuable tool for understanding the intellectual capital research landscape, recognizing influential research and authors, identifying emerging trends, and making informed decisions regarding research strategy, collaboration, and resource allocation. It plays a critical role in advancing the field and ensuring that research efforts are aligned with the evolving needs and challenges in the knowledge-based economy.

Our analysis shows the evolution of intellectual capital from a niche interest in the mid-20th century to a dynamically growing field of study. The 1990s and early 2000s saw exponential growth and a steady increase in the number of publications. The number increased from double digits in the early 1990s to over a hundred publications per year in the early 2000s, underscoring the considerable scholarly interest and acceptance of intellectual capital as an important area of research. The following years, especially from the mid-2000s to the present, show an impressive evolution. The field experienced an almost exponential growth, peaking in 2022 with 796 publications. These findings underline not only the remarkable expansion of the field, but also its continuing importance, reflecting the profound influence of intellectual capital on contemporary science and knowledge creation.

Analysis of the 103 most cited papers in the field of intellectual capital identified a total of 212 authors. Remarkably, 92% of these authors (195 authors in total) contributed to only one publication each. The results of our study on co-authorship relationships extracted from the most cited articles in the field of intellectual capital research reveal a decentralized structure that includes numerous smaller research clusters within the broader network. Nine distinct co-authorship networks with at least 4 authors were identified. Authors of the most cited articles come from a total of 28 countries, with authors from 22 countries engaging in international

research collaboration. The identification of 28 countries among those with highly cited intellectual capital publications indicates hotspots of research and expertise in this area. The concentration of highly cited intellectual capital research papers in only 28 countries shows that countries with well-established universities, research institutions and academic infrastructure are more likely to produce highly cited papers.

This paper sheds light on the development and global landscape of research on intellectual capital. It provides valuable insights into trends, collaborations and emerging hotspots that form the basis for future research. Although our approach aimed to identify and analyze the most influential research on intellectual capital through a rigorous selection process focusing on the 1% most cited papers, we must acknowledge certain limitations. One notable limitation is the potential bias due to the inherent temporal factor associated with the number of citations. The observed decline in citations for newer papers compared to earlier ones can be attributed in part to the limited time available for newer publications to accumulate citations. While focusing on the top 1% ensures a detailed examination of the most influential publications, it may miss valuable contributions from a larger pool of publications. A more comprehensive analysis that goes beyond the top 1% could provide a more holistic understanding of the field of intellectual capital research, including variations in topics, trends and impact across a broader range of publications. In addition, examining a larger number of research papers in future research would enable an investigation into how co-authorship networks have evolved over time, providing valuable insights into the changing dynamics of intellectual capital collaboration.

Our methodology relied primarily on quantitative measures, such as the number of citations. However, the lack of qualitative analysis, such as a detailed examination of abstracts or content, prevents us from providing insights into the specific nuances and thematic variations among the identified highly cited articles and may limit our understanding of the depth and focus of each publication. To address this limitation, future research efforts could incorporate qualitative analyses, such as reviewing abstracts, to provide a more nuanced perspective on the content and thematic relevance of the identified highly cited articles.

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ORIGINAL SCIENTIFIC PAPER

Inflation in the Eurozone, Converging and Diverging Countries

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ABSTRACT

The paper analyses the progress eurozone members made towards the convergence of inflation rates, which is a necessary condition for the effective implementation of the common monetary policy broadly appropriate for all members. It was expected that the common monetary policy would lead to the convergence of member states' economic performance, including inflation rates. The literature review shows that the majority of authors agree that a significant convergence process occurred before 1999, but no further progress was made after that. Our analysis indicates that inflation processes in member countries are diverse. Namely, monetary stability has been achieved in some countries, while inflation is more volatile in others. There is an insufficient correlation between inflation rates, the different transmission of shocks to inflation and different exposure to risks of rising energy and food prices. We conducted a unit root test on the series of inflation differentials for each country to determine which countries were in a process of absolute convergence. In the group of the first 12 members, we found evidence of convergence for the majority of countries, as there is no unit root. Thus, individual countries indeed made progress toward greater monetary stability (and the EMU level). We examined the standard deviations of the inflation differentials in the group of converging countries (separately for converging core and peripheral countries) and found no evidence that these groups of countries are becoming more homogeneous. In the group of new EMU members, we found evidence of convergence towards the EMU average for only four countries in the period of their membership, but not in the previous period.

Keywords: *eurozone, inflation convergence, inflation differentials, optimal currency area, common monetary policy*

JEL Classification: E31, E42, E58

INTRODUCTION

In 1999, the final phase of a unique project in Europe started. The European Central Bank took over responsibility for managing the monetary policy for (at that time) 11 European countries which gave up their currencies and independent interest rate and exchange rate policies in favor of the supranational central bank. In the following years, eight more countries joined, and one new member is expected in 2023. The economic and monetary union (EMU) of the European Union currently has 19 members and the issue that interests many researchers is whether these countries are sufficiently alike to share a common currency.

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However, the eurozone was not an optimal currency area from the very beginning. Some authors believe that the Maastricht convergence criteria are not firmly rooted in economic theory (theory of optimal currency area). Malović and Marinković (2013) particularly criticized the inflation convergence criterion as arbitrarily designed and in line with the aspirations of Germany. Maes (2004) stated that the Maastricht criteria were defined as a result of a compromise between the views of the old and the new theory of optimal currency area (OCA). Old OCA theory lists the conditions that must be satisfied for a country to enjoy the positive net benefits of membership in a monetary union in the long run. These criteria include the absence of greater asymmetry of shocks affecting given countries, a high degree of labor mobility and/or wage flexibility, a centralized fiscal policy that will provide transfers to low-performing countries (Mundell, 1961), high economic openness (McKinnon, 1963), higher diversification of production and consumption (Kenen, 1969), the similarity of inflation rates (Fleming, 1971), higher financial integration (Ingram, 1969) and political will (Mintz, 1970). According to the new OCA theory, the old theory underestimates the benefits of monetary integration, while there are alternative adjustment channels. For instance, although labor mobility in Europe is low, capital mobility is higher and rising. Furthermore, the need to increase the flexibility and adaptability of individual member countries in the monetary union could facilitate structural reforms to improve performance. A common currency can facilitate financial integration, the rise of trade and the harmonization of economic cycles (Emerson et al., 1992). A monetary union can increase the economic integration of members through integration of trade, financial integration, better symmetry of shocks and greater flexibility in labor and goods markets (De Grauwe & Mongelli, 2004).

Thus, it was expected that the environment of monetary union, common currency, and monetary policy focused on monetary stability as well as the necessary reforms would lead to higher integration of the members and convergence of their economic performance. Unfortunately, this did not occur. The EMU was separated into two parts – richer core countries (mostly from Northern Europe) and poorer peripheral countries (mostly from Southern Europe). The financial crisis that started at the end of 2008 revealed the structural weaknesses and polarization of the eurozone (Popović, 2013). Problematic peripheral members needed to undertake deflationary adjustment programs and reforms to restore competitiveness. Were these measures successful in shifting these countries on the path of the EMU in terms of bringing their performance closer to the economic results of the Northern members, so that differences between members narrowed? The enlargement of the monetary union began in 2007 when the first country from the former Eastern bloc joined, followed by others in the following years, after a painful process of transformation from a centrally planned economy and impressive structural reforms. But did that mean the enlargement of a suboptimal monetary union, which might bring higher adjustment costs? Were these new member countries ready and did they manage to adjust to the environment of a monetary union?

Concerning the issues mentioned above, this paper's main purpose is to reveal whether austerity measures and reforms were successful in combating inflation differentials within the EMU. In addition, the following questions arise: Is there a trend of convergence of inflation rates in peripheral countries towards the average EMU level? Do they tend to form a more homogeneous group of countries? If the performance of new members is of interest, have they managed to adjust to the environment of the monetary union? If the inflation rates of the new members are not converging towards the average EMU level, does the increasing proportion of "periphery" countries in the EMU mean that the number of countries for which the common monetary policy is not suitable is rising?"

Answering these questions is of great importance for the management of the common monetary policy. If member countries are very heterogeneous in an economic sense, they will have different needs regarding the common monetary policy, thus making it more difficult for the European Central Bank to manage monetary policy, and it will be less successful and will not suit all members. In addition, if member countries continuously have higher or lower inflation in

comparison to the EMU average, this will increase internal imbalances in the EMU. Persistent inflation differentials are largely the consequence of the differences in business cycles and heterogeneous market structures so that countries are faced with asymmetric shocks. This problem cannot be resolved with monetary policy (or exchange rate policies), but with structural reforms aimed at increasing the flexibility of the domestic economy and relative price and wage changes.

In this paper, we analyze the issue of the convergence of inflation rates. Inflation convergence is not only one of the accession criteria, but also an important criterion that facilitates successful membership in the monetary union. The main goal of the European Central Bank is to maintain price stability, and the ECB conducts its monetary policy with the aim of keeping the inflation rate below, but close to, 2% in the medium term. The ECB manages monetary policy at the average level and cannot adjust it to address the specific needs of individual countries. Thus, members need to be in a position in which the common monetary policy suits them, their inflation rates should be close to the average, the transmission of inflation shocks should not be significantly different and there should be no departures from the business cycles of other member countries (especially the largest economies). This is why, after analyzing the statistical characteristics of the inflation processes in member countries, we examine whether there is a tendency for each member country's inflation rate to converge toward the average EMU inflation rate. We cover the period from 1997 to March 2022, during which the largest efforts to attain monetary stability were made before joining the EMU. Furthermore, the period from 1999 to March 2022 is studied separately to determine whether the convergence achieved in previous years continued after the countries had satisfied Maastricht convergence criteria and joined the EMU. For the countries that entered later (new members), we analyze the convergence in the period after their accession to the EMU until March 2022, as well as the longer period that started 3 years before the individual accession year to capture the effects of preparation reforms. We test the hypothesis of absolute convergence of inflation rates for each member country towards the EMU average for different time periods. The majority of authors that have analyzed the issue of inflation convergence focused on the 12 original members, but it is interesting to study how ex-socialist countries perform in a monetary union environment and which problems they face. This is important information for prospective members which could enable them to avoid mistakes and traps, to decide what reforms are necessary and which path is better to follow.

Furthermore, the large heterogeneity of inflation processes among members complicates the management of the common monetary policy. This issue is especially important in the current period, bearing in mind that inflation rates and inflation differentials have been rising since mid-2021. This might cause further imbalances in the EMU.

LITERATURE REVIEW

There are various approaches to the issue of inflation convergence analysis. Authors have studied different time horizons and different samples of countries using different methods and indicators. Several authors have found that a convergence of inflation rates was in progress until the introduction of the euro, but this progress subsequently stalled. Popović (2013) focused on the first 12 members to determine whether postulates of the new optimal currency area theory were correct, such that the environment of the EMU and monetary policy oriented towards monetary stability indeed facilitated inflation convergence. She found that there was impressive progress during the 1980s and 1990s, but that progress stopped after the advent of the monetary union and that inflation differentials even rose with the outbreak of the financial crisis in 2008. Estrada et al. (2013) studied inflation convergence in euro-area countries and in several advanced economies outside the EMU. They concluded that there was a significant convergence process in progress before the establishment of the EMU in both groups of countries, which means that the EMU was not the critical factor behind the nominal convergence. For the period 1980–1997, Busetti et al. (2007) found evidence of absolute convergence and concluded that the exchange rate

mechanism facilitated nominal convergence. They also discovered some stability cluster clubs and divisions between low-inflation countries (Germany, France, Austria, Belgium and Finland) and higher-inflation countries (the Netherlands, Spain, Greece, Portugal and Ireland), so although the ECB indeed brought impressive monetary stability, some level of heterogeneity among countries remained. According to Consolo et al. (2021), differences in price levels increased in the EMU from 1999, i.e. prices of goods did not converge, and the dispersion of prices of services increased, reversing the preceding nominal convergence. Franks et al. (2018) also concluded that strong inflation convergence among the first 12 members stopped after the introduction of the euro, partially due to differences in their cyclical position. Some of the members had a larger increase in economic activity and inflation prior to the financial crisis. Small but persistent inflation differentials in peripheral countries, together with fixed exchange rates and very similar nominal interest rates hindered real convergence in these countries.

Some authors came to the opposite conclusion, discovering evidence of convergence in the period after the introduction of the euro. In the group of the first ten members (i.e., without Finland and Austria), Rutjes (2019) found evidence of absolute convergence since the advent of the EMU and that the European Central Bank was very successful in enabling price stability, which is an important issue for further enlargement of the EMU. However, he stressed that it does not mean that the eurozone is an optimal currency area. Broz and Kocenda (2017) discovered convergence of inflation rates in the European Union in the period 1999–2016, and that the inflation rate of new member countries appears to be in sync with old members' rates. According to Broz and Kocenda, monetary policy strategies oriented towards monetary stability were the most influential factor. They also concluded that the eurozone crisis facilitated stronger convergence among some countries, with inflation rates moving towards average levels, but for some EU members, there were diverging trends (Spain, Poland, Luxembourg and Slovenia). Colijn and Brzeski (2022) have a contrary opinion about the performance of the common monetary policy. In their view, in the early years the ECB managed monetary policy too loosely for those countries catching up, such as Ireland and Spain, which had higher inflation rates, leading to the creation of asset bubbles. After the financial crisis started, the common monetary policy was too loose for countries with high monetary stability, such as Germany, but too tight for peripheral countries which needed to undertake structural adjustment reforms.

A number of researchers focused on divisions in the EMU. Franks et al. (2018) stressed the problem of persistent inflation differentials in peripheral member states, especially Greece, Ireland, Portugal and Spain, which led to a decrease in their competitiveness, although these countries accomplished significant monetary stability (in comparison to their historical inflation rates). However, after the adoption of the euro, there was no further convergence progress, and cross-country variations of price levels did not significantly change in the EMU. Karanasos et al. (2016) analysed the convergence process for the first 12 members in the 1980–2013 period and discovered the existence of convergence clubs, while inflation differentials were stationary for some countries both before and after the advent of the euro. Brinke et al. (2015) stressed that there was a mistake in the design of the EMU, as the Maastricht convergence criteria were applied only as accession criteria, but not after the country had joined the EMU. Inflation and interest rate differentials were ignored in the expectation that they would diminish in the long run. This enabled some member states to have higher than average inflation rates continuously. Auray and Eyquem (2021) showed that partial inflation convergence, together with the common monetary policy and the ECB interest rate created a large positive demand shock in peripheral countries, creating pressure on the relative prices of goods and services produced there. The boom in consumption and investment led to current account deficits. Auray and Eyquem showed that if there was a full inflation convergence, the resulting imbalances would be significantly lower and there would be no sizeable rise in relative prices.

Bošković et al. (2013) found significant differences in the inflation process between core and periphery EMU member states. Differences between the peripheral members were found to be

statistically significant, while in the group of core EMU countries, there were no statistically significant differences in inflation rates. Wortmann and Stahl (2016) also focused on the core-periphery division, stressing that it poses problems in managing the common monetary policy as the ECB must decide which group of countries to direct its monetary policy towards since their needs significantly differ. Regling et al. (2010) stressed that this issue is very important for further enlargement of the EMU, as new entrants have lower economic performance and will increase the share of periphery countries in the monetary union. They also might face a longer catch-up process.

METHODOLOGY

To understand the characteristics of inflation processes in euro-area countries, we used the statistical indicators of mean, median and extreme values, as well as the indicators of dispersion – standard deviation and coefficient of variation (indicators of sigma convergence). These variables address several important issues: is inflation in a certain country "in line" with the average EMU rate, does it tend to exceed it or does it not reach it? What is the variability of the inflation rates – both for individual member states (over time) and for all the members in one period, i.e. how dispersed are the inflation rates? If, in the same period, some countries face very high or significantly higher inflation than average while some others have very low inflation rates, it complicates the management of the common monetary policy. The central bank should increase interest rates to curb rising demand and inflation in high-inflation countries, but that might create problems for countries with lower-than-average inflation. Demand and the inflation rate might drop further in low-inflation countries, creating problems in the real sector of the economy. Directing monetary policy more toward the needs of low-inflation countries will bring problems in the countries with higher inflation rates. It would decrease their real interest rate, further facilitating demand growth and a further rise in inflation. Such actions would lead to a divergence of business cycles in these two groups of countries and a divergence in real terms.

We also applied a unit root test to test the hypothesis of absolute convergence of inflation rates for each country towards the EMU average. Since we wanted to separately capture the influence of preparations for EMU membership and the influence of the monetary union environment, we conducted tests for different time periods – a longer period that started before the accession of a given country and a shorter period that began with the accession year.

Characteristics of Inflation in Member Countries

The observed 19 countries have diverse inflation rates. Table 1 presents the descriptive statistics of their inflation processes. For most of the countries, the average inflation rate is in line with the ECB target, except for Estonia, Lithuania, Luxembourg and Spain, which have higher than targeted inflation rates. Departures from the average eurozone rates are more significant, and only Ireland has the same average inflation rate as the EMU as a whole, while Belgium is the only country with the same median inflation rate as the euro area. Cyprus has the lowest level of average and median inflation, as this country suffered from a serious deflation for quite a long period of time. The eurozone reached a maximum inflation rate of 7.5% in March 2022 and almost all member states currently face inflation rates, which are at their highest level since their accession. The exception is Malta, which reached a maximum inflation rate the year it entered the EMU. The rise in energy and food prices in 2022 caused different rises in inflation rates, which shows that the member states transmit inflation shocks differently. In some countries, inflation entered the double-digit zone, with the highest rates in Lithuania at 15.6% and Latvia at 14.8%. The Netherlands was also faced with a very high level of inflation of 11.7%, while in Spain, Belgium and Slovakia the inflation rates were close to 10%. The eurozone experienced a minimal inflation rate of -0.6% on two occasions, a consequence of the financial and debt crisis in July 2009 and January 2015. Furthermore, a number of members suffered from significant deflation in the

second half of 2009, but there are differences. For instance, while Austria had negative inflation rates for only two months, Belgium faced deflation for 12 months. The rates were negative for a period of 6 months since mid-2009, and deflation repeated at the very end of 2014 and in the first quarter of 2015, then also for two months in 2020 as a consequence of the COVID crisis and related measures. Germany experienced deflation in 2020 when inflation reached the lowest level of -0.7, with negative rates also being recorded in mid-2009. The worst deflation was in Ireland, Greece and Cyprus, but in different time periods. Whereas Ireland suffered from severe deflation for almost the whole of 2009 (in which time the nadir of -2.9% was reached) and the whole of 2010, inflation in Greece was positive in 2009 and even high in 2010. Greece reached the lowest level of inflation at the end of 2013 and the very beginning of 2015 and struggled with deflation for almost three years from the beginning of 2013 until the end of 2015 and also for six months in 2016. Deflation repeated in 2020 and it was again very serious (-2.4% was the lowest rate) and long-lasting (14 months in a row). The corona crisis brought Ireland 11 months of negative inflation rates.

Table 1. Statistical characteristics of inflation in EMU member countries (period of membership)

	Mean, %	Median, %	Max, %	Min, %	SD, %	CV, %
EMU	1.7	1.9	7.5	-0.6	1.1	63.7
Core EMU members						
Austria	1.9	1.8	6.7	-0.4	0.9	50.3
Belgium	2.0	1.9	9.5	-1.7	1.5	73.2
Finland	1.6	1.4	5.8	-0.7	1.2	70.0
France	1.5	1.6	5.1	-0.8	0.9	61.4
Germany	1.6	1.5	7.6	-0.7	1.1	67.4
Luxembourg	2.2	2.3	7.9	-1.6	1.6	72.1
Netherlands	2.0	1.8	11.7	-0.7	1.5	73.4
Peripheral EMU members						
Ireland	1.7	1.7	6.9	-2.9	2.0	119.1
Italy	1.8	2.0	6.8	-1.0	1.2	69.4
Portugal	1.8	2.0	5.5	-1.8	1.5	83.0
Spain	2.1	2.4	9.8	-1.5	1.7	82.5
Greece	1.8	2.1	8.0	-2.9	2.1	119.0
New EMU members						
Slovenia	1.8	1.8	7.0	-1.4	1.9	105.5
Cyprus	1.1	0.8	6.2	-2.9	2.1	192.3
Malta	1.8	1.3	5.7	-0.5	1.3	74.6
Slovakia	1.8	1.7	9.5	-0.9	1.8	101.4
Estonia	2.7	2.9	14.8	-1.8	2.7	99.5
Latvia	1.8	1.8	11.2	-1.1	2.2	120.7
Lithuania	2.4	2.0	15.6	-1.5	3.1	125.6

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

SD-standard deviation

CV-coefficient of variation

The dispersion of the inflation rates, both in individual countries (over time) and among the member countries (in the same period), is very significant. For instance, in March 2022, while in Lithuania, the inflation rate was 15.6%, in Malta, it was "only" 4.6%, i.e., a difference of 11 percentage points. As early as the end of 2021, inflation differentials measured with this indicator were 9% or higher. Furthermore, in May 2010, the inflation rate in Greece was 5.3%, whereas in Ireland it was -1.9%. Significant differences existed even before the 2008 crisis, at the very

beginning of the EMU. For instance, in August 2000 inflation in Ireland was 5.7% and in Germany only 1%. It was rarely the case that the inflation differentials measured with this indicator were smaller than 2% and in no period were they below 1.5%. Although a shortcoming of this indicator is that it takes into account only extreme values, the results are worrying, showing disparities in the EMU which complicate the management of the common monetary policy and cause problems for countries that do not fit "into the average". The common monetary policy of the EMU is not suitable for all the member states and can even exacerbate their economic problems and divisions in the EMU. The European Central Bank was even accused of managing a more relaxed monetary policy during particular periods to help problematic peripheral countries that struggled with deflation, but obviously, such monetary policy was not sufficiently expansive for them. On the other hand, this caused not only problems with domestic savings, but also a rise in price bubbles and an undesirable increase in money supply in core countries (Wortmann & Stahl, 2016).

Analysis of the Inflation Convergence – Unit Root Test

To determine whether there are some stability clubs, where some countries indeed have inflation rates converging to the EMU average, we studied the stationarity characteristics of individual inflation differentials for each member country (Petrović & Matić, 2021; Rutjes, 2019; Busetti et al., 2007; Karanasos, 2016; Cuestas et al., 2016). We conducted the unit root test on the series of inflation differentials which were calculated as the difference between the inflation rate in a given country and the EMU average rate. The data on the monthly harmonized index of consumer prices were obtained from the ECB database (ECB, 2022). We used the inflation rate for country *i* and time period *t*:

$$\pi_{i,t} = \ln(HICP_{i,t}) - \ln(HICP)_{i,t-12} \quad (1)$$

where $\ln(HICP_{i,t})$ represents the natural logarithm of the price level (measured by the harmonized index of consumer prices) for country i and in period t (i.e. the inflation rate for the current period), and $\ln(HICP)_{i,t-12}$ represents the natural logarithm of the price level for country i one year earlier (i.e. the inflation rate for the same month one year earlier).

A series of inflation differentials was calculated by subtracting HICP for the eurozone in time period t (π_{tEMU}) from the inflation rate in country i and time period t ($\pi_{i,t}$):

$$d_{i,t} = \pi_{i,t} - \pi_{tEMU} \quad (2)$$

We conducted the unit root test (Augmented Dickey-Fuller test) without intercept to analyze the presence of absolute convergence. Absolute convergence means that inflation differentials tend to zero in the long term. This is a more desirable situation than relative convergence (when inflation differentials tend to some level different from zero in the long term), as it eases the common monetary policy. The existence of relative convergence means that only members that have similar characteristics converge, which might lead to polarization in the EMU (Busetti et al., 2007). The results are presented in Tables 2-6. Tables 2 and 3 present the test results for the core countries, Tables 4 and 5 for the peripheral countries and Table 6 for the new member countries, as we also wanted to determine whether there are differences between these 3 groups of countries. The first column in all the tables presents the results for the period that begins in 1997, and the second one for the period of membership (for each country, this period is different, beginning with their accession year). The third column in Table 6 presents the test results for the period that started 3 years before the accession of a given country in the EMU.

If there is a convergence of inflation rates of a given country, the inflation differentials will tend to zero. In this case, the series of inflation differentials will be stationary. The results that confirm the existence of a unit root at the 5% confidence level are highlighted in the tables.

Table 2. Absolute convergence of inflation rates in core eurozone countries – Unit root test of inflation differentials

Belgium		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.98015	0.0458	***-1.7065***	0.0833
Test critical values:	1% level	-2.57296		-2.57369	
	5% level	-1.94192		-1.94202	
	10% level	-1.61597		-1.6159	
Finland		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.74544	0.0061	-2.42209	0.0152
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
France		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***-0.3097***	0.5735	***-0.291***	0.5804
Test critical values:	1% level	-2.57267		-2.57334	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61593	
Germany		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.05216	0.0023	-3.04031	0.0024
Test critical values:	1% level	-2.57267		-2.57334	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61593	
Luxembourg		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.7488	0.006	-2.58305	0.0097
Test critical values:	1% level	-2.57296		-2.57369	
	5% level	-1.94192		-1.94202	
	10% level	-1.61597		-1.6159	
Netherlands		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.08549	0.0358	-2.074	0.0368
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
Austria		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.96995	0.0469	-1.95312	0.0488
Test critical values:	1% level	-2.57296		-2.57369	
	5% level	-1.94192		-1.94202	
	10% level	-1.61597		-1.6159	

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

Table 2 presents the results of the Augmented Dickey-Fuller test, which tests the null hypothesis that a time series has a unit root. The results show that there is no unit root in the series of inflation differentials for Germany, Austria, the Netherlands, Finland and Luxembourg at the 5% confidence level for both periods, i.e., the countries that have been in the process of absolute convergence of inflation rates towards the EMU average since 1997. We can determine whether these countries represent a "stability club", with converging inflation rates, from Table

3, which provides the results of testing the existence of a unit root in the series of inflation differentials within these five countries:

Table 3. Convergence of inflation rates in the group of five core eurozone countries – Unit root test of inflation differentials and standard deviations of inflation differentials

Inflation differentials		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.75436	0.0002	-3.46531	0.0006
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
Standard deviations of inflation differentials					
Augmented Dickey-Fuller test statistic		***-0.30578***	0.575	***-0.34218***	0.5612
Test critical values:	1% level	-2.57267		-2.57334	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61593	

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

The ADF τ statistics were found to be -3.75 (for the first period) and -3.47 (second period), which is below the critical value of τ^k (-1.94) at the 5% confidence level. In both periods, the p values are very low. Thus, the results show there is no unit root in the series of inflation differentials among the observed group of countries, and the inflation differentials have a decreasing tendency. To determine whether this tendency is actually a result of converging inflation rates or the consequence of inflation rates of a different sign (if some countries have positive inflation rates while others have negative rates at the same time, the inflation differentials will be lower), we conducted an additional ADF test for the series of standard deviations of the inflation rates. If the differences between the countries tend to decrease, there will be no unit root in the series. The existence of a unit root would show that the inflation rates among the observed group of countries are not mutually converging. The results obtained reveal the presence of a unit root; thus, the inflation rates in the group of five core countries are not less dispersed.

The series of inflation differentials for France (Table 2) has a unit root, while the ADF τ statistics were found to be -0.31 (for the first period) and -0.29 (second period), which is above the critical value of τ^k (-1.94) at the 5% confidence level. Both p values are very high, indicating a high probability of rejecting the correct null hypothesis. For Belgium, the obtained results show no unit root in the longer period, i.e., inflation convergence was in progress from 1997, but with the accession to the EMU this changed, as there is a unit root for the period of membership. The obtained value of the ADF τ statistics was found to be higher than that of τ^k (-1.94) at the 5% confidence level.

The results of the ADF test for the group of peripheral member countries are presented in Table 4.

Table 4. Absolute convergence of inflation rates in peripheral eurozone countries – Unit root test

Ireland		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***-1.93803***	0.0504	***-1.8649***	0.0594
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
Italy		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.1831	0.0015	-3.14977	0.0017
Test critical values:	1% level	-2.57269		-2.57337	
	5% level	-1.94189		-1.94198	
	10% level	-1.61599		-1.61593	
Portugal		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.05422	0.0023	-3.15867	0.0017
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
Spain		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.35793	0.018	-2.19967	0.0271
Test critical values:	1% level	-2.57264		-2.57331	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61594	
Greece		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.76364	0.0057	-1.96778	0.0472
Test critical values:	1% level	-2.57267		-2.57413	
	5% level	-1.94188		-1.94208	
	10% level	-1.616		-1.61586	

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

The augmented Dickey-Fuller test for the peripheral countries indicates the tendency of individual countries' inflation rates to converge towards the EMU average for both periods, except in the case of Ireland. We also tested the hypothesis that the inflation rates in the peripheral countries converge without including Ireland. The results are presented in Table 5:

Table 5. Convergence of inflation rates in the group of four peripheral eurozone countries – Unit root test

Inflation differentials		1.1997-3.2022		1.1999-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.26635	0.0228	-2.35683	0.0181
Test critical values:	1% level	-2.57267		-2.57334	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61593	
Standard deviations of inflation differentials					
Augmented Dickey-Fuller test statistic		***-1.79797***	0.0687	***-1.21813***	0.2046
Test critical values:	1% level	-2.57267		-2.57334	
	5% level	-1.94188		-1.94197	
	10% level	-1.616		-1.61593	

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

The results confirm that there is no unit root in the series of inflation differentials for both periods. However, testing the series of standard deviations of inflation rates showed opposite results. Thus, we can conclude that the inflation processes within this group of countries are also not becoming more homogeneous. There is no tendency to diminish the dispersion of the inflation rates, although for individual countries, there has been progress in inflation convergence.

Table 6. Absolute convergence of inflation rates in new eurozone countries – Unit root test

Slovenia		1.1997-3.2022		1.2007-3.2022		1.2004-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***0.77242***	0.8798	-3.12914	0.0019	***0.22643***	0.751
Test critical values:	1% level	-2.57293		-2.57773		-2.57618	
	5% level	-1.94192		-1.94258		-1.94237	
	10% level	-1.61597		-1.61554		-1.61568	
Cyprus		1.1997-3.2022		1.2008-3.2022		1.2006-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***-0.3552***	0.5564	-3.21001	0.0015	***-0.4817***	0.5062
Test critical values:	1% level	-2.57262		-2.57864		-2.57618	
	5% level	-1.94187		-1.94271		-1.94237	
	10% level	-1.616		-1.61546		-1.61568	
Malta		1.1997-3.2022		1.2008-3.2022		1.2006-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***-0.9989***	0.2849	-2.56877	0.0103	***-1.206***	0.2084
Test critical values:	1% level	-2.57262		-2.57864		-2.57618	
	5% level	-1.94187		-1.94271		-1.94237	
	10% level	-1.616		-1.61546		-1.61568	
Slovakia		1.1997-3.2022		1.2009-3.2022		1.2006-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***0.39574***	0.7973	-2.40124	0.0163	***0.962***	0.9107
Test critical values:	1% level	-2.57257		-2.57968		-2.57706	
	5% level	-1.94187		-1.94286		-1.94249	
	10% level	-1.616		-1.61537		-1.6156	
Estonia		1.1997-3.2022		1.2011-3.2022		1.2008-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***0.26132***	0.7612	***0.10102***	0.713	***0.47632***	0.8168
Test critical values:	1% level	-2.57272		-2.58233		-2.57888	
	5% level	-1.94189		-1.94323		-1.94275	
	10% level	-1.61599		-1.61513		-1.61544	

Latvia		1.1997-3.2022		1.2014-3.2022		1.2011-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***0.37863***	0.7929	***-0.4011***	0.5368	***2.37605***	0.9958
Test critical values:	1% level	-2.57257		-2.58877		-2.58208	
	5% level	-1.94187		-1.94414		-1.94319	
	10% level	-1.616		-1.61458		-1.61516	
Lithuania		1.1997-3.2022		1.2015-3.2022		1.2012-3.2022	
		t-Statistic	Prob.	t-Statistic	Prob.	t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		***0.66412***	0.8589	***1.06307***	0.9238	***5.39311***	1
Test critical values:	1% level	-2.57272		-2.59245		-2.5839	
	5% level	-1.94189		-1.94467		-1.94345	
	10% level	-1.61599		-1.61426		-1.615	

Source: authors' calculation based on data from ECB, Statistical Data Warehouse, https://sdw.ecb.europa.eu/browse.do?node=1496, 27.4.2022

The results in Table 6 confirm that the new members struggled with high inflation during the 1990s and early 2000s. All the individual series of inflation differentials since 1997 have a unit root. Furthermore, if we look at the results of the ADF test for the period that started 3 years before a given country's accession to the EMU, the conclusion is the same. To some extent, this was not expected, since, in the case of the old members, the highest efforts to reach monetary stability and to satisfy Maastricht criteria were made before joining the EMU. In this case, monetary stability did not precede accession. In some of the observed countries, inflation rates were very high in the period immediately before accession, and in others very low or negative. Over time, Slovenia, Cyprus, Malta and Slovakia managed to bring their inflation rates more in line with the EMU average rate. The ADF τ statistics for these countries were found to be below the critical value of τ^k (-1.94) at the 5% confidence level. The series of inflation differentials for Estonia, Latvia and Lithuania for the period of their membership have a unit root, which indicates the lack of convergence.

CONCLUSION

Inflation convergence is not only one of the criteria to join the EMU, but also a condition for successful membership of the monetary union. If an individual country has inflation rates that deviate significantly from the EMU average over a long period, this would be the result of structural factors which could not be addressed with the monetary policy. Such differences cause problems for the diverging country. A country with higher inflation will lose competitiveness since the exchange rate can no longer adjust to differences in inflation between the observed country and its main trading partners. It will lose markets and import more goods it previously produced, which will lead to an increase in the current account deficit. Financing this deficit would be a problem as the country earns less from its decreasing exports, so it will have to borrow, thus increasing debt. Its higher inflation will mean lower real interest rates, which will additionally facilitate borrowing and higher demand, thus raising the inflation rate further. This might lead to divergent business cycles and real divergence. If a country has significantly lower inflation than the EMU average, this might also harm its economy, while the common monetary policy could prolong economic stagnation or recession and make the environment of low inflation last longer, again leading to divergent business cycles and real divergence.

The above analysis has shown that EMU member countries have diverse inflation rates. Although in the majority of cases, the average and median inflation rates tend to be within the ECB target, they are not so close to the EMU average, showing larger inflation differentials. The indicators of sigma convergence reveal larger dispersion both for individual countries over time and between the member countries in the same period. Some countries managed to have stable prices, while for others inflation was much more volatile. Extreme values of inflation were reached

in different time periods, indicating an insufficient correlation between their inflation rates. In addition, the transmission of shocks to inflation differs; countries are differently exposed to rises in energy and food prices. While for some countries, we have an effect that fades after several months, for others the shock still influences inflation rates after a year, which facilitates divergence of inflation rates. This complicates the management of the common monetary policy, and it will not suit the needs and economic situation of all countries, bringing further problems for their economies.

A method often used to analyze the convergence of inflation rates is the unit root test. The logic behind it is simple: if inflation rates tend to approach each other, differences between them will diminish. This means that inflation differentials will have a decreasing tendency. They should tend towards zero and the dispersion around average inflation differentials should also tend to zero. We can conduct such an analysis to assess if a group of countries is becoming more homogeneous, i.e., their inflation processes are more alike, and we can also analyze the inflation differentials of each country. We have chosen the second approach in this paper – to test the hypothesis of absolute convergence of inflation rates of each country to the EMU average. We wanted to find out whether there are some stability clubs, such that some countries have inflation rates converging to the EMU average. In the group of core eurozone countries, only the series of inflation differentials for France has a unit root in both periods, and thus we cannot say that inflation in this country is converging to the EMU average. Although in Belgium inflation convergence was in progress from 1997 on, this changed with accession to the EMU. The results obtained for Germany, Austria, the Netherlands, Finland and Luxembourg at the 5% confidence level and for both periods show that these countries were in the process of absolute convergence of inflation rates towards the EMU average from 1997 on. However, although the ADF test for inflation differentials in this group shows the absence of a unit root, the test on the series of standard deviations appeared to have a unit root. This means that there is no statistically significant trend of decreasing differences in the inflation rates in this group of five countries. The results for the group of peripheral countries for both periods indicate the absolute convergence progress of Italy, Portugal, Spain and Greece towards the EMU average. In the case of Ireland, however, a unit root was found in the series of inflation differentials. As in the previous case, there is no statistically significant progress in decreasing the differences between the inflation rates of these four countries, thus indicating their inflation processes are not becoming more homogeneous. The results obtained for the group of new EMU members confirm problems with high inflation in the period preceding their accession. It was expected that they would achieve monetary stability immediately before membership, but the results show insufficient progress. However, results for Slovenia, Cyprus, Malta and Slovakia confirm the existence of absolute convergence in the period of their membership. For Estonia, Latvia and Lithuania, there was no convergence of inflation rates in any of the observed periods, and these countries are suffering from very high inflation at this time. Thus, it is questionable whether they were indeed ready for membership in the EMU. Perhaps it would have been better to wait until they had implemented the necessary reforms and achieved a sufficient level of convergence in their economic performance to be ready for the common monetary policy.

This issue is very important at the moment since inflation rates have been on an upward trend since mid-2021. The European Central Bank has still not increased its main refinancing rate to make money more expensive, but responded by curbing its provision of liquidity. It is not known whether this will be sufficient to cut inflation, which is steadily progressing towards the double-digit level. The ECB has explained that the rise in inflation is transient and that it will go back to lower levels in the second half of the year. Perhaps the ECB expects a very serious economic crisis and recession, which will decrease demand and, thus, inflation rates. Therefore, it perhaps fears that its increasing interest rates will hurt the economy the moment it faces economic problems due to the war in Ukraine and sanctions against Russia. But what will this situation mean for inflation rates in individual countries? Will they diverge even more as is currently going on? One of the most important costs of monetary union is associated with asymmetric shocks, and member

countries are currently facing this problem. What the EMU is likely to face is a period of stagflation, i.e. the simultaneous occurrence of inflation and stagnation or even recession. In such circumstances, the ECB will be faced with a choice: inflation or the economy. Since its main objective is to control inflation, and economic progress in an environment of high inflation is not possible, it will probably choose to curb high inflation at the price of having an economic recession. How will individual countries cope? If they are not sufficiently alike, we could expect that they will be impacted differently by ECB measures and the current economic and inflation shocks, which might fuel divergence in the EMU, complicating the management of the common monetary policy even further.

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ORIGINAL SCIENTIFIC PAPER

Causality Between Exchange Rates, Economic Growth and Inflation in Indonesia

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ABSTRACT

The primary objective of this study is to examine the causal relationships among exchange rates, economic growth, and inflation in Indonesia. The data used in this research is secondary data with time series data for the period 2000 to 2019, obtained from the Bank Indonesia, Indonesia Central Bureau of Statistics, and World Bank. The method used in this research is Granger Causality. The outcomes of the analysis reveal a bidirectional causal relationship between economic growth and the exchange rate in the short term, as well as between inflation and the exchange rate. An appreciation of a country's exchange rate of one percent has an impact on changes in the overall price of goods, while an increase in the inflation rate causes a depreciation of the exchange rate. The relationship between inflation and economic growth shows that there is a one-way causal relationship, namely that inflation affects economic growth but not vice versa. These findings have significant policy implications, indicating that the Indonesian government needs to prioritize efforts to control inflation to support sustainable economic growth. Therefore, it is necessary to implement appropriate monetary and fiscal policies to maintain price stability and encourage balanced economic growth in Indonesia.

Keywords: e*xchange rate, economic growth, granger causality, inflation*

JEL Classification: E31, F31, F43

INTRODUCTION

The predominant challenge faced by nearly every country globally is the challenge of sustaining economic stability (Altbach, 2013). A successful government is characterized by its ability to address various issues within a nation. The government's objective to foster sustainability and prosperity for its citizens underpins economic development (Kline & Moretti, 2014). Initiatives aimed at attaining economic growth involve the maintenance of exchange rate stability and the regulation of inflation rates, both on regional and national scales (Mijiyawa, 2015).

The presence of economic stability and growth is a prerequisite for a nation's well-being (Acemoglu and Restrepo, 2018). As noted by Özokcu and Özdemir (2017), economic growth constitutes a key element in sustaining economic development and ensuring equitable societal services (Sari et al., 2023). Economic stability is instrumental in fostering the smooth and planned progression of economic growth and development, aligning with governmental objectives. Consequently, the meticulous and effective pursuit of both development and economic growth is imperative.

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As per Medvedev (2016), a factor capable of disrupting economic stability and impeding economic growth is a sustained increase in overall commodity prices. The Gross Domestic Product (GDP) data serves as an indicator to assess a country's economic status during a specific period (Kummu et al., 2018). The GDP value provides insight into how efficiently a country manages its available resources. According to a consensus among economists, a low inflation rate has a positive impact on the economy by enhancing national income and fostering work enthusiasm. Conversely, during periods of severe inflation, an escalating inflation rate poses a critical challenge for steering economic growth toward improvement (Mohseni & Jouzaryan, 2016). Improper inflation rates can result in adverse consequences, such as the depreciation of currency value, leading to a reduction in purchasing power, particularly for individuals with fixed incomes. Maintaining a low and stable inflation rate is considered a catalyst for stimulating economic growth.

The primary factor contributing to the elevated inflation rate of 77.63 percent in 1998 was the devaluation of the rupiah against foreign currencies, particularly the United States dollar (Pratama & Rizal, 2019). The decline in the rupiah's value in comparison to other currencies can influence the surge in export values, subsequently affecting both economic growth and inflation. Fluctuations in the exchange rate can also impact investment and international trade. The rise in import costs resulting from these conditions contributes to the overall high inflation rate. Foreign entities may be enticed by the relatively lower prices of domestic goods, leading to an increase in demand and gradual price hikes, thereby causing inflation (Bala & Chin, 2018).

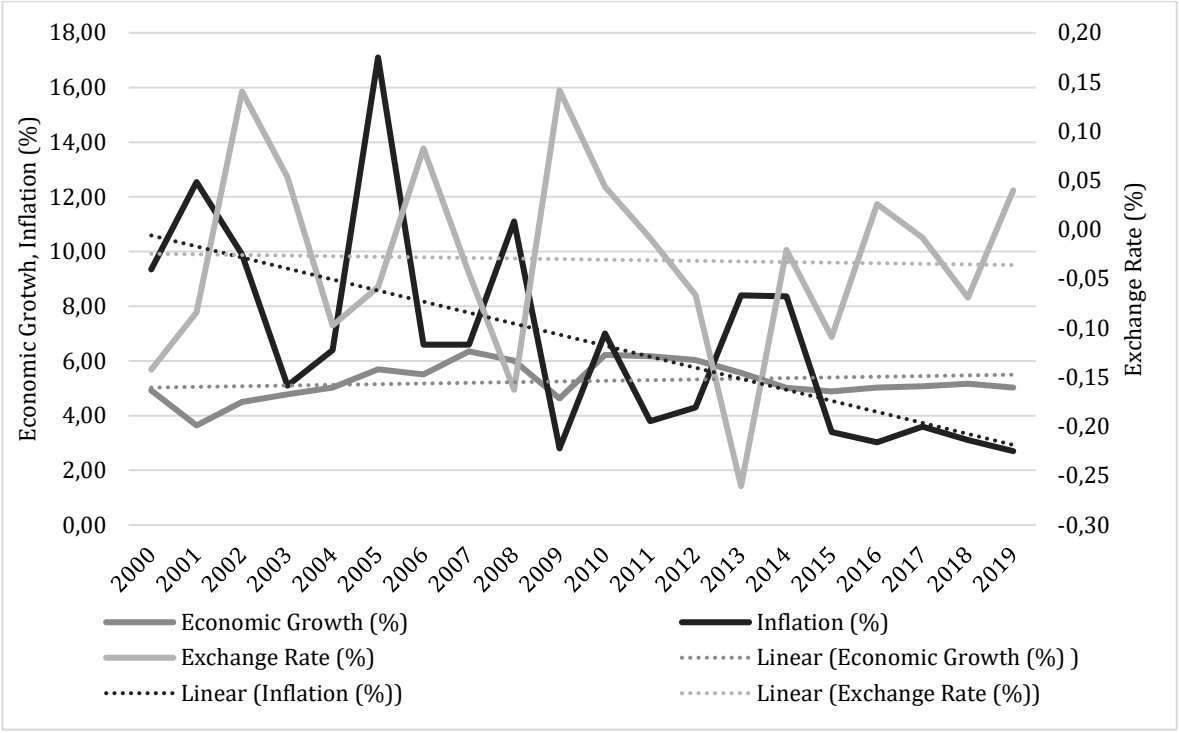

Figure 1. Exchange Rate (USD/IDR), Inflation, and Economic Growth in Indonesia
Source: Central Bureau of Statistics and Bank Indonesia (2021)

As illustrated in Figure 1, Indonesia witnessed a slowdown in economic growth, dropping from 5.56 percent to 5.02 percent between 2013 and 2014. This deceleration was linked to various economic sectors facing declines, notably exports, driven by diminished demand from key trade partners and falling prices of export commodities tied to natural resources (Resosudarmo & Abdurohman, 2018). Another noteworthy event in 2014 was the substantial appreciation of the

USD against the IDR, reaching Rp12,440/US$ with a 2.1 percent increase. The depreciation of the rupiah was instigated by the recovering U.S. economy, leading the United States Central Bank (the Fed) to consider interest rate hikes, resulting in capital outflows from developing nations, Indonesia being one of them. Furthermore, the economic slowdown in China played a role in the depreciation of the rupiah exchange rate, contributing to reduced exports of commodities from Indonesia.

The depreciation of the exchange rate was accompanied by inflation, which remained at 8.36 percent. Although this inflation rate is relatively high, it is slightly lower than the 8.38 percent recorded in 2013. The significant factors contributing to this elevated inflation rate include a 1.04 percent increase in fuel oil prices, reflecting the volatile nature of commodity prices throughout the 2014 period (Julitawaty, 2015). Other contributing factors encompassed electricity tariffs (0.64 percent), inner-city transportation (0.63 percent), red chili prices (0.43 percent), targeted prices (0.38 percent), and household fuel (0.37 percent).

Several previous studies and theories say that exchange rates, inflation, and economic growth have a causal relationship. The study by Loukil (2017) concluded that there is a unidirectional causal relationship between inflation and the exchange rate in Tunisia. Lado's (2015) research found that there is a two-way causality between inflation and exchange rates in South Sudan. Amoah et al. (2015) show the existence of a unidirectional causality relationship between the growth rate of GDP and the exchange rate and a two-way causal relationship between the Inflation rate and the Exchange Rate, and also between the Inflation rate and GDP. Results of Granger's Causality in research Chaudhry et al. (2012) show that economic growth and exchange rates affect each other bidirectionally. Based on previous research and theories, it is suggested that exchange rates, inflation, and economic growth in Indonesia are believed to be interrelated in a casual manner. This shows that this research topic is important to discuss, especially in Indonesia.

The primary objective of this study is to investigate and elucidate the interplay among exchange rates, economic growth, and inflation in Indonesia. Employing a descriptive approach with a quantitative framework, specifically the Granger Causality method, the research aims to discern potential causal relationships among exchange rates, economic growth, and inflation in Indonesia. In a changing global economy, a deep understanding of the causality relationships between these key variables is imperative for developing effective and responsive economic policies. The success of economic stability, the management of inflation rates, and the achievement of sustainable economic growth are key foundations in navigating the challenges faced by developing countries such as Indonesia. Understanding the causation between exchange rates and economic growth, along with inflation's role as an intermediary, involves a complexity of dynamics that need to be revealed through careful analysis. The recency of the analysis of this phenomenon becomes important to enrich the economic literature with deeper insights and nuances that can make a significant contribution to current economic thinking. In addition, this research has the potential to provide new insights related to the specific challenges faced by the Indonesian economy, and these findings not only serve as a reference source for the government and policymakers, but also stimulate further research in this area, thus contributing continuously to the development of economic literature and a broader understanding of regional economic dynamics. The Granger Causality approach was chosen because it allows researchers to evaluate the direction and strength of causality within a time frame and then provides a more detailed understanding of the dynamics of interactions between these variables.

The rest of the research is structured as outlined below. Section 2 delves into the literature review, while Section 3 investigates the data and methodology. The dynamics of variables, empirical findings, and subsequent discussion are presented in Section 4. Section 5 concludes the study and provides policy implications for the country of Indonesia.

LITERATURE REVIEW

Economic expansion can be characterized as the advancement of endeavors within the economy that lead to a rise in the quantity of goods and services generated within the community (Hidayat et al., 2023). Along with the development of economic literature, earlier theories made important contributions to understanding the causality relationship between exchange rate variables, inflation, and economic growth. For example, the Purchasing Power Parity Theory emphasizes that changes in exchange rates will be reflected in relative price changes and can, therefore, affect the inflation rate. In line with this view, the Mundell-Fleming Model highlights the impact of monetary as well as fiscal policy on exchange rate balance and inflation (Bouakez & Eyquem, 2015). From the perspective of economic growth, Solow-Swan theory also highlights the role of investment and capital accumulation on the long-run growth of a country, while Keynesian theory focuses attention on the effect of the inflation rate on consumption and investment levels (Van Wyk & Kapingura, 2021). Research of Bouchetara and Bendahmane, (2017) focuses on in-depth reviews of the complex relationship between exchange rates and inflation, emphasizing the role of government intervention and monetary policy in achieving economic stability.

The investigations conducted by Srithilat et al. (2018) and Yien, et al. (2017) delved into the intricate dynamics of the interplay among inflation, real exchange rates, and currency substitution within Southeast Asian economies, employing the VECM and Granger Causality analysis on panel data. The empirical outcomes from both studies consistently indicate the presence of cointegration panels, signifying an enduring relationship between inflation, real exchange rates, and currency substitution. Furthermore, they concur on the observation that escalating inflation rates and the devaluation of domestic currency positively impact currency substitution in the protracted duration. Additionally, the Granger Causality analysis at a concise temporal scale discloses the mutual influence between inflation and currency substitution, along with the unidirectional relationship from exchange rates to currency substitution within the Southeast Asian context.

On a contrasting note, the investigation conducted by Deka and Dube (2021) explores the prolonged and immediate interactions involving inflation, exchange rates, and the utilization of renewable energy in Mexico within the 1990-2019 timeframe, employing the ARDL boundary test methodology. The study's outcomes reveal a reciprocal causality relationship between inflation and exchange rates over an extended period.

Aligned with this perspective, Ayodeji and Adeyemi (2018) conducted a study investigating the repercussions of Monetary Policy on Economic Growth in Nigeria, employing the Engle-Granger and Granger Causality methodologies. The findings of the cointegration analysis reveal a persistent causal connection between monetary policy and long-term economic growth in Nigeria. Nevertheless, the outcomes of the Granger causality test indicate that while there is a positive impact of money supply and exchange rate on economic growth, this influence does not attain statistical significance.

In an alternative domain, the study conducted by Uddin et al. (2014) delves into the Causality between Exchange Rate and Economic Growth in Bangladesh, employing the Granger Causality regression approach. The empirical findings demonstrate a positive and substantial bidirectional association between exchange rates and economic growth. Similarly, the investigation by Ali et al. (2015), scrutinizing the impact of inflation, interest rates, and money supply on exchange rate volatility in Pakistan, utilizes the Granger Causality method to explore both short and long-term relationships. The outcomes indicate a sustained relationship in the long run, where increments in the money supply and escalating interest rates contribute to an augmented inflation rate, subsequently intensifying exchange rate volatility.

Thus, the integration of these theories is able to provide a comprehensive framework for understanding the dynamic relationship between exchange rates, inflation and economic growth, which is the basis for this research in exploring new dimensions and highlighting the

characteristics of the Indonesian economy. This research is able to fill the knowledge gap regarding the causality between exchange rates, economic growth and inflation. Unlike previous research, the main focus of this research is Indonesia as a research subject, using a Granger Causality approach and combining qualitative and quantitative analysis. The aim is to deepen understanding of the complex dynamics of these variables and provide a more contextual contribution to the economic factors influencing the country. Based on previous research and theories, this research hypothesis states that there is a causal relationship between the exchange rate, economic growth and inflation in Indonesia.

DATA AND METHODOLOGY

The analytical tool utilized for this examination is the Econometric Views (EViews) version 8.0 application. The dataset employed in this study comprises secondary data, specifically the most recent macroeconomic data for Indonesia, encompassing exchange rates, economic growth, and inflation. These data sources include publications from Bank Indonesia, the Indonesian Central Bureau of Statistics, and the World Bank, spanning 2000 to 2019.

In this research, the cause-and-effect relationship was measured using the Granger causality method. The causality test serves as a diagnostic tool for gauging the intensity of the connection between two or more variables. Additionally, it elucidates the directionality of the relationship between the independent variable and the dependent variable (Maziarz, 2015). The initial step in examining Granger causality involves conducting a test for stationarity. This stationarity examination is executed by assessing unit roots through a unit root test. Unstable data will exhibit units of roots, while stable data will not possess units of roots. The widely employed unit root test model in numerous investigations is the Augmented Dickey-Fuller (ADF) test model. The formula for the ADF test is articulated as follows:

$$\Delta Y = \beta 1 + \beta 2 + \delta Yt - 1 + \sum_{i=1}^{m} \alpha i \Delta Yt - 1 + \varepsilon t \quad (1)$$

Information:

Y= Observed variable; ΔYt= Yt – Yt-1**;** ΔYt-1= Yt - Yt-1; T= Time trend. So, the form of the ADF test formula for the exchange rate, economic growth and inflation variables is as follows:

$$\Delta ERt = \beta 1 + \beta 2t + \delta ERt - 1 + \sum_{i=1}^{m} \alpha i \Delta ERt - 1 + \varepsilon t \quad (2)$$

$$\Delta EGt = \beta 1 + \beta 2t + \delta ERt - 1 + \sum_{i=1}^{m} \alpha i \Delta ERt - 1 + \varepsilon t \quad (3)$$

$$\Delta INFt = \beta 1 + \beta 2t + \delta INFt - 1 + \sum_{i=1}^{m} \alpha i \Delta INFt - 1 + \varepsilon t \quad (4)$$

To find out whether the data is stationary or not, compare the ADF statistical values (δYt -1) with the critical value of the MacKinnon distribution. If the statistical ADF value is greater than the critical value of the MacKinnon distribution, then the data is said to be stationary.

The formula employed to conduct the Granger Causality test is represented by the following equation:

$$ERt = \sum_{i=1}^{m} a_{11} ER_{t-i} + \sum_{j=1}^{m} a_{12} GE_{t-j} + \sum_{k=1}^{m} a_{13} INF_{t-k} + e_{ER} \quad (5)$$

$$GEt = \sum_{j=1}^{m} a_{21} GE_{t-k} + \sum_{k=1}^{m} a_{22} INF_{t-k} + \sum_{i=1}^{m} a_{23} ER_{t-i} + e_{GE} \quad (6)$$

$$INFt = \sum_{k=1}^{m} a_{31} INF_{t-k} + \sum_{i=1}^{m} a_{31} ER_{t-i} + \sum_{j=1}^{m} a_{33} GE_{t-j} + e_{INF} \ldots \quad (7)$$

Information:

INF = Inflation; ER= Exchange rate; GE = Economic Growth; M= Amount of Lag; t= Time; e= Disruptor variable.

RESULTS AND DISCUSSION

Variable Movement Analysis

Variable Movement Analysis of Exchange Rate in Indonesia

The USD to IDR exchange rate displayed notable fluctuations from 2000 to 2019, as illustrated in Figure 2. Examining the data, it becomes evident that the rupiah experienced its most significant appreciation against the USD in 2009, reaching a peak of 14.16 percent—the highest observed figure within the 2000-2019 timeframe. This noteworthy strengthening can be attributed to the economic downturn in the United States starting in 2007, prompting the Federal Reserve (Fed) to implement substantial interest rate cuts, reaching a historic low of 0.0 percent to 0.25 percent in early 2009 (Cukierman, 2013). Additionally, the Fed injected significant liquidity into the market to stimulate economic activity, contributing to the depreciation of the USD against the IDR in the 2009 period. In contrast, the most significant depreciation of the rupiah occurred in 2013, registering a decline of -26.05 percent.

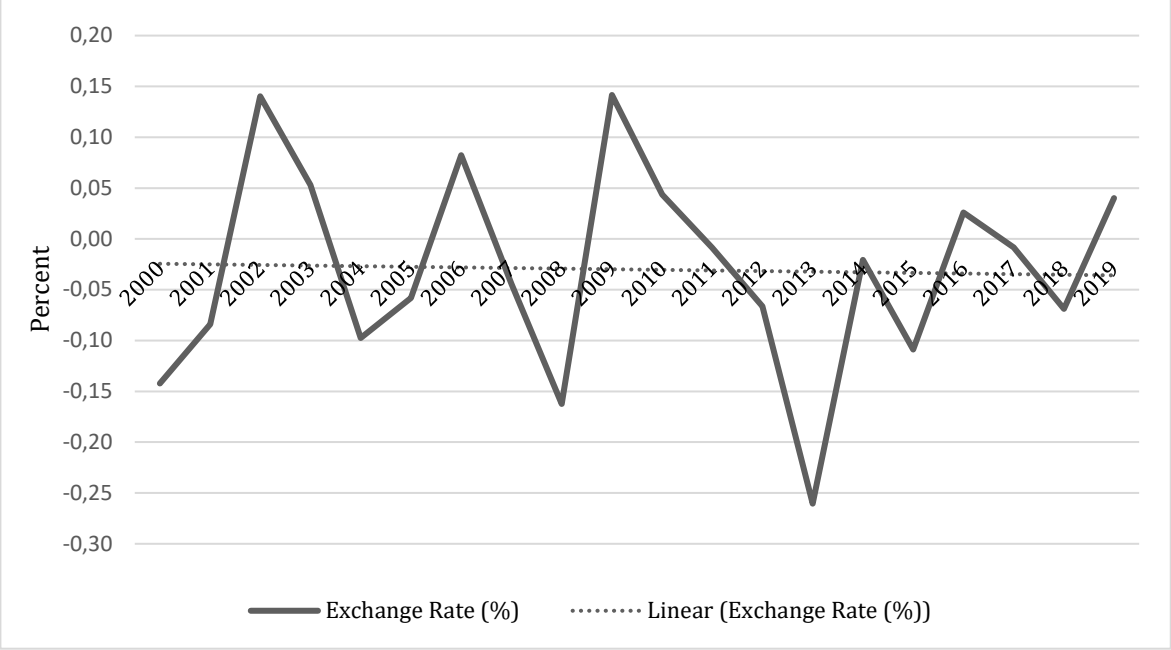

Figure 2. Rupiah Exchange Rate Movement against USD

Source: Bank Indonesia, 2020

The factor that can cause the depreciation of the rupiah exchange rate is the high current account deficit due to the trade balance (Purwono et al., 2018). This trade balance deficit was mainly caused by the increasing need for imported goods, such as fuel oil, which is an important commodity for the Indonesian economy. In this case, demand for foreign currency, especially the

United States dollar (USD), increased significantly. As a result of this, there was a high increase in demand for foreign currency to meet import needs, which ultimately led to a decline in the rupiah exchange rate against foreign currencies. In situations where the exchange rate experiences significant fluctuations, companies are forced to adjust product prices, which are reflected in changes in import costs (Auboin & Ruta, 2013). This creates uncertainty in the prices of goods and services, which in turn can trigger instability in the financial sector.

Variable Movement Analysis of Economic Growth in Indonesia

Economic growth is the augmentation of a country's capacity to produce goods and services within its economic pursuits. The success of economic development is discerned through sustained and stable growth. Figure 3 illustrates the annual variations in Indonesia's economic growth from 2000 to 2019, marked by alternating periods of expansion and contraction. The varying economic growth rates during this period can be attributed to several other economic factors. The data illustrated in the chart highlights a peak in Indonesia's economic growth rate in 2007, reaching 6.35 percent. This surge can be correlated with relatively stable global economic conditions and high economic growth in developed countries during that year (Antonakakis et al. 2015). Given Indonesia's status as an open economy, it is inherently linked to the global economic landscape. The notable growth in Indonesia's industrial sector in 2007 was propelled by government policies incentivizing investments in the industrial sector and the recovery of the manufacturing sector following the crisis of 1997-1998 (Szirmai & Verspagen, 2015).

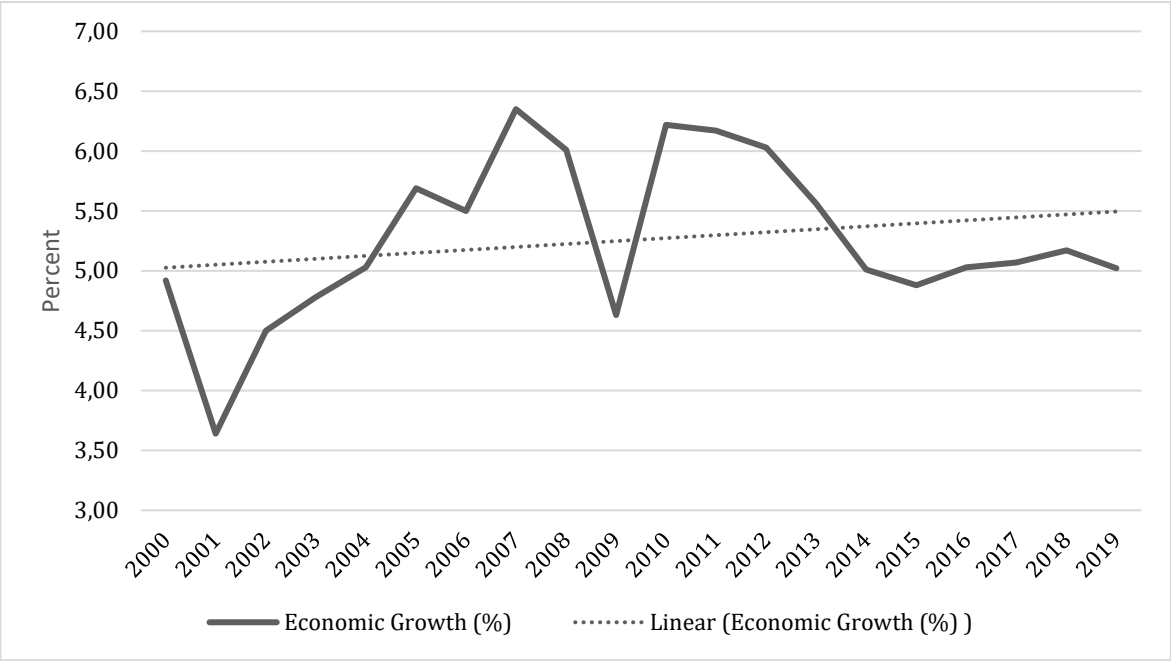

Figure 3. Economic Growth Movement in Indonesia

Source: World Bank, 2020

The decline in economic growth that occurred in 2009 was 4.63 percent, compared to the previous year's growth. This reflects the magnitude of the impact of the global economic crisis that hit the world from 2008 to 2009. The global economic crisis triggered by the collapse of the American financial market in 2008 caused a wave of falling asset prices, a decline in consumer purchasing power, and global economic uncertainty (Eaton, et al., 2016). The negative impact of this crisis extends to various sectors of the Indonesian economy, including international trade, investment and the financial sector, which are closely related to economic growth. This condition

caused a significant slowdown in economic growth and caused growth to reach its lowest point throughout the 2000-2019 period. However, after 2009, Indonesia's economic growth experienced an improvement and began to stabilize. This improvement was caused by a number of factors, including efforts to recover the global economy after the 2008-2009 crisis, fiscal and monetary policies implemented by the Indonesian government, as well as the growth of certain sectors in the economy. The stability of economic growth in this period reflects the resilience and adaptability of the Indonesian economy in facing global economic challenges. Even though the journey of economic growth has experienced ups and downs, this shows the ability of the Indonesian economy to recover and develop again after facing significant economic pressure in 2009.

Variable Movement Analysis of Inflation in Indonesia

Inflation is an economic condition characterized by a continuous and sustainable increase in prices in a country's economy (Hansen, 2016; Gilchrist et al., 2017). Inflation occurs due to economic turmoil within the country (Asmadina et al., 2021). This phenomenon occurs as a result of an increase in the amount of money and goods circulating in the economy. An overall increase in prices can affect people's purchasing power and have a significant impact on a country's economic stability. Changes in the inflation rate in Indonesia during the 2000-2019 period can be seen in Figure 4. In 2005, the inflation rate was the highest throughout the period in Indonesia during the research conditions, reaching 17.11 percent. This figure shows a significant increase compared to the previous year's inflation rate in 2004, namely 6.4 percent. The sharp increase in 2005 could be caused by several economic factors, such as fluctuations in international commodity prices, changes in domestic demand, monetary and fiscal policies, and global conditions.

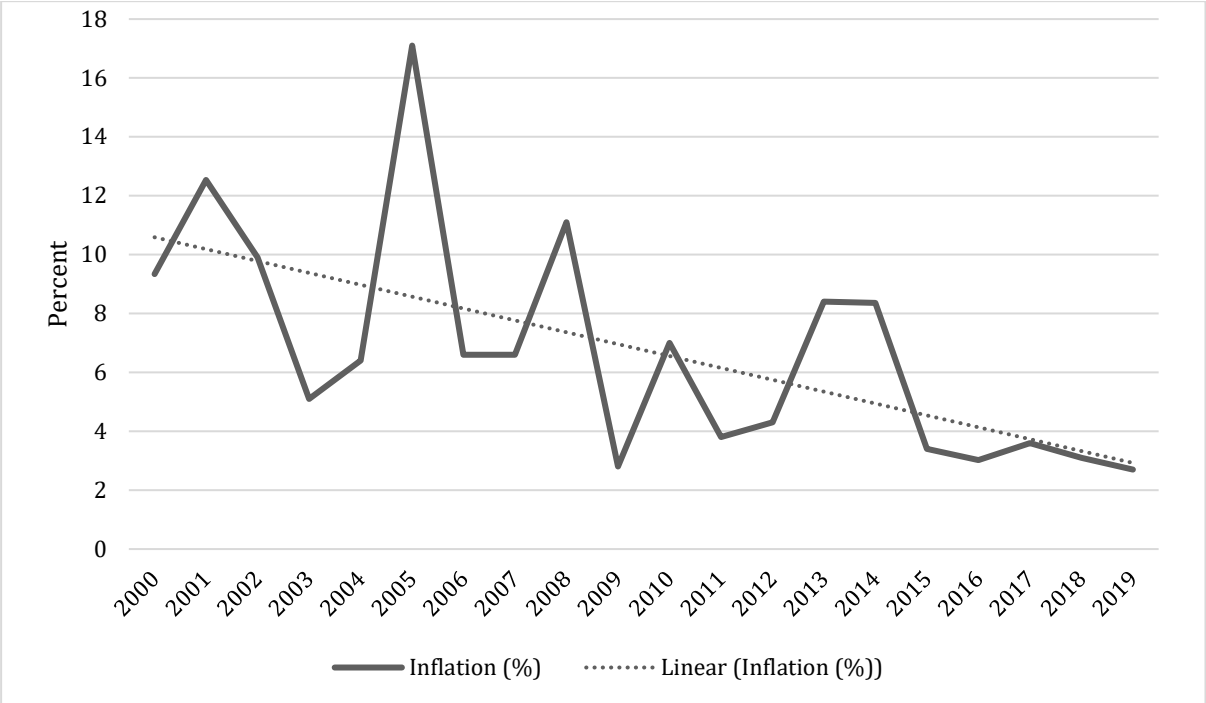

Figure 4. Inflation Movement in Indonesia

Source: Indonesian Central Bureau of Statistics, 2020

The development of inflation in Indonesia in the 2000-2019 period reflects an effective response to economic factors that influence changes in price levels. After experiencing a significant increase in inflation in 2005, Indonesia succeeded in reducing the inflation rate in

2006, and this achievement continued in 2007 with an inflation rate of 6.6 percent. These results indicate that there are effective inflation control efforts in Indonesia. Indonesia's lowest inflation rate throughout the research period occurred in 2019, at 2.70 percent. This decline was caused by relatively controlled prices of high-value goods. For example, rice prices, which often trigger high inflation in Indonesia, could be managed well that year because of sufficient rice supplies. The low inflation rate is the result of appropriate policies in managing the supply and price of rice, as well as other factors that support controlling inflation (Putra et al., 2021). This reflects the ability of the government and economic authorities to face inflation challenges and maintain price stability in the country. Furthermore, the decline in the inflation rate in 2019 is concrete evidence that economic policies and supply management of strategic goods such as rice can have a significant impact on price stability. These results reflect the Indonesian government's serious efforts to keep inflation within acceptable limits, which in turn supports economic stability and sustainable growth. Thus, the development of inflation in Indonesia during the 2000-2019 period shows the importance of appropriate and efficient policies in efforts to maintain price stability in the economy.

Variable Movement Analysis

Descriptive Statistics

Descriptive statistical analysis is used as an initial approach to detailing and presenting the basic characteristics of the exchange rate, inflation and economic growth variables studied in Indonesia. Descriptive statistical results can be seen in Table 1.

Table 1. Descriptive Statistics

	ER	EG	INF
Mean	-0.030182	5.260500	6.758000
Median	-0.032414	5.050000	6.500000
Maximum	0.141553	6.350000	17.10000
Minimum	-0.260496	3.640000	2.700000
Std. Dev.	0.100861	0.679980	3.835814
Skewness	-0.212805	-0.221178	1.046127
Kurtosis	2.858567	2.887588	3.661293
Jarque-Bera	0.167623	0.173596	4.012361
Probability	0.919605	0.916862	0.134501
Sum	-0.603634	105.2100	135.1600
Sum Sq. Dev.	0.193285	8.785095	279.5559
Observations	20	20	20

Source: *Author's Estimation, 2021*

Descriptive statistical results show that the highest exchange rate was in 2002 with a value of 0.14, while the lowest point was in 2013 with a value of -0.26. In contrast, economic growth reached its highest peak in 2007 with a value of 6.35, and its lowest value in 2001 with a value of 3.64. The inflation rate reached its maximum value in 2005 at 17.1, while the lowest value in 2019 was 2.7. It also found that the variability of exchange rate data and economic growth was relatively low, while the inflation rate showed significant variations. The distribution of exchange rate data and economic growth tends to be symmetrical, while the inflation rate shows positive skewness, which indicates a long tail on the positive side of the distribution.

Unit Root Test

The initial stage before estimating a time series model involves conducting a unit root test. This examination is crucial to prevent spurious regression, which could lead to inaccuracies in the estimated results if a unit root is present in the variable under consideration.

Table 2. Unit Root Test

Variable	Significant Levels	Level		Information
		Critical Value	ADF-test	
ER	1%	-3.831511	-4.458487	Stationary
	5%	-3.029970		
	10%	-2.655194		
EG	1%	-3.831511	-2.431088	Non-Stationary
	5%	-3.029970		
	10%	-2.655194		
INF	1%	-3.831511	-3.260474	Non-Stationary
	5%	-3.029970		
	10%	-2.655194		

Source: Author's Estimation, 2021

The outcomes of the stationarity tests at the significant levels of 1%, 5%, and 10% for each variable indicate that nearly all the research variables employed are non-stationary at these levels. In other words, almost all the variables utilized in this study are non-stationary. As mentioned earlier, having non-stationary data for research variables can lead to inaccurate regression results or spurious regression. Henceforth, the subsequent step in the analysis involves conducting a unit root test at the first difference level. The results from this initial difference test are detailed in Table 3:

Table 3. Unit Root Test

Variable	Significant Levels	Level		Information
		Critical value	ADF-test	
ER	1%	-3.857386	-5.749681	Stationary
	5%	-3.040391		
	10%	-2.660551		
EG	1%	-3.857386	-6.137360	Stationary
	5%	-3.040391		
	10%	-2.660551		
INF	1%	-3.886751	-6.503407	Stationary
	5%	-3.052169		
	10%	-2.666593		

Source: Author's Estimation, 2021

The results of the first difference test, as presented in Table 3, indicate that all observed variables in the research have been confirmed as stationary with a consistent level of confidence. This is substantiated by the ADF test results surpassing the critical value in the first difference. The test clarifies that all variables considered in this study have achieved stationarity to a comparable extent.

Lag Length Criteria

The criteria for determining the lag length, also known as the optimal lag test, seek to identify the suitable lag duration for this research following the confirmation of stationary data through unit root testing. The determination of the most suitable lag is performed through an examination of three information criterion functions: Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Criterion (HQ). The results of the optimal lag assessment are delineated in Table 3.

Table 4. Lag Length Criteria

	LogL	LR	FPE	AIC	SC	HQ
0	-128.6397	ON	451.8473	14.62663	14.77503	14.64709
1	**-110.3605**	**28.43430***	**164.7784***	**13.59561***	**14.18919***	**13.67746***
2	-107.0265	4.074840	344.1741	14.22517	15.26394	14.36840

Source: Author's Estimation, 2021

The outcomes of the optimal lag testing (refer to Table 4) indicate that the AIC, SC, and HQ values presented in the output are chosen based on their minimal values, marked with the most asterisks, signifying the optimal lag under these conditions. The results spanning from lag 0 to lag 2 reveal the smallest AIC, SC, and HQ values. Specifically, for lag 1, the AIC has a value of 13.59561, SC has a value of 14.18919, and HQ has a value of 13.67746. Thus, it can be deduced that the optimal lag is at lag 1, as indicated by the smallest values across AIC, SC, and HQ outputs in the table. Consequently, this study will proceed with testing up to the 1st lag.

Granger Causality Test Results

The purpose of the causality test is to examine the interdependence among the research variables. A variable is considered to have a significant impact on other variables if the probability is < 0.05 confidence level, with a lag length of 1 in this test. The outcomes of the Granger causality test are displayed in Table 5.

Table 5. Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
EG does not Granger Cause ER	19	3.65462	0.0447
ER does not Granger Cause EG		11.0658	0.0043
INF does not Granger Cause ER	19	3.79198	0.0330
ER does not Granger Cause INF		10.8079	0.0121
INF does not Granger Cause EG	19	3.55836	0.0496
EG does not Granger Cause INF		0.18651	0.6716

Source: Author's Estimation, 2021

Based on the outcomes derived from the Granger causality test conducted over the research duration from 2000 to 2019, as presented in Table 5, it is evident that among the variables—exchange rates, economic growth, and inflation—there is bidirectional causality between all of them. However, a unidirectional causality is observed, specifically from inflation variables to exchange rates.

Turning our attention to the outcomes of the inflation variable test (INF), it becomes evident that inflation (INF) exerts a significant and positive impact on the exchange rate (ER), substantiated by an F-statistical value of 3.79198 and a probability of 0.0330, residing below the 0.05 threshold. In a reciprocal manner, the exchange rate variable (ER) significantly and positively influences inflation (INF), supported by an F-statistical value of 10.8079 and a probability of 0.0121, also falling beneath the alpha value of 0.05. Consequently, a bidirectional causality is established between inflation (INF) and exchange rate (ER), with the probability associated with each variable positioned below the 0.05 alpha level.

Turning to the relationship between the inflation variable (INF) and economic growth (EG), it is observed that inflation (INF) significantly and positively impacts economic growth (EG), demonstrated by an F-statistical value of 3.55836 and a probability of 0.0496, which is less than 0.05. However, the economic growth variable (EG) does not exhibit a statistically significant impact on inflation (INF), with an F-statistic of 0.18651 and a probability of 0.6716, exceeding the 0.05 threshold. Consequently, the results for the inflation and economic growth variables indicate a unidirectional causality relationship, with inflation significantly affecting economic growth.

Discussion

Causality Analysis of Exchange Rate and Economic Growth

The examination of the economic growth variables in conjunction with the exchange rate reveals a reciprocal association between the two. As a nation experiences economic expansion, there is an amplified demand for its currency, subsequently leading to an appreciation of the exchange rate (Bresser-Pereira & Nakano, 2020). This surge in demand stems from the increased need for the country's currency to facilitate transactions related to the augmented production of goods and services. Conversely, an elevated exchange rate can exert an impact on a country's economic growth trajectory (Guzman, et al., 2018). The heightened exchange rates render the country's goods and services more expensive in the global market, resulting in a decline in exports and an upswing in imports (Dogru, et al., 2019). This phenomenon has the potential to decelerate economic growth, given that exports constitute a pivotal factor propelling economic expansion. Furthermore, when a country's interest rates surpass those of other nations, investments within that country become more appealing, fostering an increased demand for the country's currency and consequently leading to exchange rate appreciation (Khalfaoui & Derbali, 2021). However, the concomitant escalation of exchange rates can render exports more costly and diminish competitiveness on the global stage, potentially impeding economic growth. Consequently, a bidirectional relationship exists between economic growth and exchange rates, where alterations in one variable can significantly influence the other.

Causality Analysis of Inflation and Exchange Rate

Based on the Granger causality results, it is evident that there is a positive and significant two-way causality relationship between the inflation variables and the exchange rate. This phenomenon is in line with previous findings, as observed by Deka and Dube (2021). This means that there is a causal relationship between inflation and the exchange rate. When a country's inflation rate increases, people's purchasing power generally decreases because they have to spend more money on the same goods and services (Khan, et al., 2019). As a result, demand for imported goods tends to increase because prices are relatively lower in the currency of a country experiencing inflation. This can cause an increase in the need for foreign currency and a weakening of the country's currency exchange rate. However, on the contrary, if the inflation rate is lower, it results in an appreciation of the exchange rate because people's purchasing power is relatively higher, and foreign investors are more interested in investing in countries where

inflation is under control (Bouraoui & Phisuthtiwatcharavong, 2015). This is one of the mechanisms underlying the positive causal relationship between inflation and the exchange rate.

Exchange rate depreciation refers to a scenario wherein a country's currency loses value in comparison to foreign currencies, thereby exerting a significant impact on domestic inflation (Ramasamy & Abar, 2015). This is caused by an increase in the cost of importing goods and services. When the rupiah exchange rate depreciates, the price of imported goods in the local currency will increase because one unit of the local currency will buy less foreign currency, such as dollars. As a result, domestic producers and consumers will face higher costs for imported goods, which could lead to an increase in the prices of goods and services in Indonesia. In addition, exchange rate appreciation, which is an increase in the value of a country's currency against foreign currencies, can also have a significant effect on inflation. In a situation of appreciation, the price of imported goods becomes lower in local currency since one unit of local currency will buy more foreign currency. The impact is a decrease in the price of imported goods, which can reduce domestic inflationary pressures (Islam, 2013). With lower prices of imported goods, domestic consumers tend to acquire imported goods at a lower cost, which can hinder the increase in prices of goods and services in the domestic economy.

Causality Analysis of Economic Growth and Inflation

The results of the subsequent causality evaluation reveal a statistically significant positive influence of inflation variables on economic growth. Conversely, the outcomes of the Granger causality test for economic growth variables on inflation suggest the absence of a unidirectional relationship between economic growth and inflation. In the Indonesian context spanning 2000-2019, there is no unilateral association between economic growth variables and inflation, primarily attributed to the inflation shock experienced in 2008. The prevailing notion suggests that inflation is not primarily shaped by real sectors, such as economic growth, but rather by monetary variables, exemplified by the continuous increase in the money supply in Indonesia during 2007 (1,649,622 billion rupiahs) and 2008 (1,895,838 billion rupiahs). This aligns with the findings of Adaramola and Dada (2020).

The correlation between economic growth and inflation is intricate, characterized by a nuanced interplay rather than a straightforward unidirectional causality. This relationship is contingent upon a myriad of factors that influence both economic growth and inflation, including factors of production, governmental policies, and the dynamics of market demand and supply. Economic growth has the potential to stimulate heightened production and productivity, thereby augmenting the abundance of goods and services within the economy (Myovella et al., 2020). Nevertheless, the constrained availability of production factors, such as labor and raw materials, can impose limitations on the economy's capacity to sustainably escalate production. In cases where production factors remain constrained, sustained economic growth may result in increased demand and pricing of goods, subsequently instigating inflation (Oreiro et al., 2020). Governmental monetary and fiscal policies play pivotal roles in influencing both the inflation rate and economic growth. A stringent monetary policy accompanied by elevated interest rates can quell inflation but concurrently impede economic growth (Abuselidze, 2019). Conversely, an expansive fiscal policy and substantial spending can foster economic growth but may also incite inflation. Therefore, a judicious balance in government policies is imperative, striving to control inflation while propelling economic growth forward. The upsurge in demand can stem from heightened consumption or increased investment, thereby contributing to economic growth (Shahbaz et al., 2020). However, if the surge in demand lacks a commensurate increase in supply, the prices of goods and services may ascend, precipitating inflationary pressures.

CONCLUSION

The study's findings suggest a bidirectional causal relationship between economic growth and exchange rate variables in the short term. Correspondingly, akin outcomes are observed in the association between inflation and exchange rates, displaying a bidirectional causal relationship. A 1 percent increase in a country's exchange rate induces a shift in the overall price of goods, whereas an escalation in inflation leads to the depreciation of the exchange rate. In contrast, the connection between inflation and economic growth variables demonstrates a unidirectional causal relationship; specifically, inflation has a causal effect on economic growth. This implies that the surge in overall prices impacting the income of the Indonesian populace does not necessarily translate into a reciprocal impact on the upswing in economic growth, marked by an increase in people's income, within the 2000-2019 period in Indonesia.

The Indonesian government needs to pay attention to the two-way causal relationship between economic growth and the exchange rate. In line with efforts to increase economic growth, the government needs to take careful steps in managing the rupiah exchange rate, considering that changes in the exchange rate can have a significant impact on the overall price of domestic goods. The government also needs to consider measures that can control inflation, considering the existence of a two-way causal relationship between inflation and the exchange rate. An increase in the overall price of an item can affect the exchange rate and vice versa. Therefore, Bank Indonesia and the government need to work together to ensure price and exchange rate stability, as well as mitigate risks that may arise due to exchange rate fluctuations. The relationship between inflation and economic growth is unidirectional; that is, inflation affects economic growth. The Indonesian government can focus on efforts to control inflation to support sustainable economic growth. The Indonesian government can also take appropriate monetary and fiscal policies to maintain price stability and encourage balanced economic growth.

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ORIGINAL SCIENTIFIC PAPER

Enterprises' Emissions Intensity and Financial Performance in Serbia: The Case Study of Wastewater

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ABSTRACT

Untreated industrial and municipal wastewater is the key factor that leads to water pollution in Serbia. The aim of the paper is to examine the impact of environmental performance (using eco-intensity indicators) of enterprises on their profitability in the period 2011-2020 in Serbia in the area of wastewater. Apart from using the panel data technique in the paper, the Generalized Method of Moments (GMM) is also used to estimate the parameters in the model. The results demonstrate that if the eco-intensity indicator increases, the profitability of an enterprise increases significantly, whereas the profitability of an enterprise decreases with the increase in the size of an enterprise. According to the results of the evaluated model, the capital intensity variable has no influence on the profitability of an enterprise. Additionally, it has been determined that the coefficient with the eco-intensity indicator is quite large, indicating the poor eco-efficiency of Serbian enterprises in the area of wastewater.

Keywords: *eco-intensity, enterprise profitability, wastewater, GMM, Serbia*

JEL Classification: C23, L25, Q25, Q53

INTRODUCTION

The concept of eco-efficiency was first defined by Schaltegger and Sturm (1989), whereby the indicator is a mixture of economic and environmental efficiency. Eco-efficiency refers to the ability to create more products or services with fewer resources and less damage to the environment (Chen et al., 2022a). Eco-efficiency is a type of management whose task is to seek environmental improvement that brings parallel economic benefits. It focuses on business opportunities and enables enterprises to become more environmentally responsible and profitable (Revollar et al., 2021).

Daud et al. (2023) maintain that eco-efficiency can be measured in two ways. The first way is to use the economic value-added quotient and several measures of environmental impact (the higher the quotient, the more profound effect the surrounding has on the environment). Another way is the inverse relationship, also known as eco-intensity, which is a measure of the environment divided by the economic value (the lower the value of this indicator, the better eco-efficiency is).

Industrial and communal wastewater discharged directly into the watercourses, without prior treatment, is the biggest water polluter in the Republic of Serbia, bearing in mind that industrial

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wastewater can be highly dangerous due to its toxic substances (Ekologika, 2023). Approximately 50% of the pollution discharged into the rivers originates from industrial plants, and only 13% of the municipal wastewater is treated before being discharged (Zelena Zemlja, 2023). Mitrović (2021) states that industrial plants, municipal wastewater coming from settlements, and agriculture are the main sources of pollution of the rivers and other water resources in Serbia because of using artificial fertilizers and other chemical compounds. In Serbia, only 10% of wastewater is treated, while the other 90% is discharged into the rivers (Dalmacija, 2022). The public company Elektroprivreda Srbije (JP EPS) is the major generator of industrial wastewater in Serbia. According to the data of the Serbian Environmental Protection Agency, JP EPS annually discharges over 95% of the total industrial wastewater in Serbia (Ekologika, 2023). Dalmacija (2022) states that the biggest water polluters in Serbia are the three cities that do not have treatment plants: Belgrade, Novi Sad, and Niš.

The Water Act (2018) regulates the protection of water pollution in the Republic of Serbia. "Water protection, in compliance with the law, is a set of measures and activities that protect and improve the quality of surface water and groundwater, including the protection from the effects of cross-border pollution, in order to:

1) preserve the life and health of people;
2) reduce pollution and prevent further deterioration of the water condition;
3) provide harmless and unhindered use of water for various purposes;
4) protect aquatic and coastal ecosystems and achieve the environmental quality standard in accordance with the regulation governing environmental protection and environmental goals." (Water Act, 2018, Article 92).

The Water Act regulates the prevention of the deterioration of water quality and the environment, determines the physicochemical parameters and emission limit values of polluting substances, as well as the methods and conditions for discharging polluting substances and the application of emission limit values. Moreover, the law defines the water protection plan against pollution.

In the Republic of Serbia, not all planning documents in terms of water management have been adopted, indicating that not all activities have been undertaken to conduct effective wastewater management planning. "The Water Council has not been established and the National Water Conference in the revised period has not undertaken any activities to monitor the implementation of the Water Management Strategy and has not made any proposals for improving public participation in the process of planning, decision-making, and controlling the process of implementation" (Ekologika, 2023). The main problem is that a large number of cities in Serbia do not have wastewater treatment systems (Mitrović, 2021). Mitrović (2021) states that Serbia has taken on the obligation of building all municipal wastewater treatment plants for settlements with more than two thousand inhabitants by 2040.

The paper analyses the link between eco-intensity and the profitability of enterprises, taking into account that eco-intensity is based on the total emissions released into the waters in Serbia. The data are collected on an annual basis, and the period analyzed is from 2011 to 2020. The methodology which is used is the econometric technique (data panel technique), and the method for evaluating the parameters is the Generalised Method of Moments (GMM). The eco-intensity indicator is calculated as the quotient of the total water emissions and total revenues of enterprises, while Return on Assets (ROA) is used to measure their profitability. To the best of the author's knowledge, this research can be considered a pioneering one because, so far, no similar research has ever been done in the field of wastewater for Serbia.

The hypotheses on which the research is based are as follows:

1. The eco-intensity indicator has a significant impact on a company's profitability in the field of wastewater in Serbia.

2. The size of a company significantly affects a company's profitability.

In addition to the introduction, the paper presents an overview of the literature (Section 2). In Section 3, the data and methodology used are described. Section 4 includes results and discussion, while Section 5 provides concluding remarks.

THEORETICAL BACKGROUND

Most of the literature refers to wastewater-based eco-efficiency research in China (Zhu et al., 2022; Zhou et al., 2020; Yu et al., 2016; Wang and Peng, 2021; Wang et al., 2022 ; Shi et al., 2021; Liu et al., 2022; Li et al., 2020; Huang et al., 2021; Hou et al., 2019; Chen et al., 2022b, etc.). There are few studies that analyze this indicator for some other countries. For example, Cecchini et al. (2023) consider the eco-efficiency of the beef cattle sector in Italy, Aoki-Suzuki et al. (2023) evaluate the eco-efficiency of the materials produced in Japan, while Chappin et al. (2007) analyze the eco-efficiency in the case of wastewater treatment, waste and energy efficiency in the Dutch paper and board industry. Furthermore, achieving eco-efficiency for the 10 most polluted countries using green technology and natural resource rents is studied by Chen et al. (2022a). Gómez et al. (2018) and Molinos-Senante et al. (2016) measure the eco-efficiency of the wastewater treatment plants in Spain. The evaluation of the eco-efficiency of the wastewater in Spain is examined by Mocholi-Arce et al. (2020). Maziotis et al. (2023) study the dynamic eco-efficiency of the water utilities in Chile. Sala-Garrido et al. (2021) assess the eco-efficiency of the water companies in England and Wales.

Chakraborty and Mukhopadhyay (2012) research water pollution in India using Input-Output Analysis, while Gani and Scrimgeour (2014) explore the impact of the governance of the water pollution levels for all industrial activities in OECD countries. Hernández-Chover et al. (2018) consider the efficiency of the wastewater treatment plants for 217 regions of Valencia.

Hou et al. (2019) state that there is literature examining the eco-efficiency of urbanization, agricultural production, wastewater treatment plants, biogas production, national economic sectors, energy use, etc.

Daud et al. (2023) claim that several studies have analyzed the relationship between eco-efficiency and financial performance in the last two decades and got varied results. Some of these studies have shown that better financial performance is achieved when companies integrate environmental efficiency into their business operations.

In the literature examining this area, two methodologies are predominantly used: parametric (econometric) and non-parametric (linear programming) techniques. Sala-Garrido et al. (2021) and Hou et al. (2019) emphasize that the most common model for evaluating the efficiency of various production activities is, in particular, the non-parametric technique, the Data Envelopment Analysis (DEA).

Chen et al. (2022b), Shi et al. (2021), Sala-Garrido et al. (2021), Gómez et al. (2018), Li et al. (2020), and Molinos-Senante et al. (2016) have used the DEA model in their analyses, while the econometric model GMM has been used in the following studies: Hou et al. (2019), Zhu et al. (2022); Zhou et al. (2020); Wang and Peng (2021), Brahmana and Kontesa (2021), Ahmad et al. (2021), etc.

Radonjić and Ostojić (2023) state that the situation in Serbia regarding wastewater management is terrible. Moreover, the Draft Law on Amendments to the Law on Fees for the Use of Public Goods is in the parliamentary procedure. According to this draft, Article 78, the fee for the discharge of insufficiently purified wastewater is reduced by 1000 times.

DATA AND METHODOLOGY

The data used in the paper are the environmental data from the national PRTR register (SEPA, 2022), having analyzed the total water emissions for 96 companies in Serbia. The financial data

for these 96 companies are for the period 2011-2020. Therefore, there are a total of 960 observations. The financial data are taken from the annual financial statements of the companies published in the Register of Financial Statements of the Serbian Business Registers Agency (SBRA).

Four variables are used in the paper: the eco-intensity indicator (EI), the indicator that measures a company's profitability, i.e., Return on Assets (ROA); and the other two variables are the size of an enterprise (SIZE) and capital intensity (CI). The eco-intensity indicator is calculated as the quotient of total water emissions and total revenues for each company. The profitability indicator of a company or ROA is calculated as the quotient of a company's net financial result and the value of a company's business assets. The variable SIZE is defined as the natural logarithm of the total assets, while the variable CI is calculated as the quotient of the total assets of a company and the operating revenue of a company (Table 1).

Table 1. Description of the variables

Variable	Abbreviation	Calculation
Eco-intensity	EI	Total water emissions/Total revenues
Return on Assets	ROA	Net financial result/Operating assets value
Size of an enterprise	SIZE	ln(SIZE)
Capital intensity	CI	Total assets/Operating revenue

Source: Authors' own elaboration based on SEPA and SBRA data

Dynamic panel regression and Generalized Method of Moments (GMM) are used for the analysis, similar to Stevanović et al. (2023). However, Stevanović et al. (2023) consider total air emissions, unlike this paper, which takes into account water emissions. The difference is also in the number of the sample and the structure of companies, and in the number of variables as well. The following model is evaluated:

$$\mathrm{ROA}_{it} = \mathrm{C} + \lambda_1 ROA_{it-1} + \lambda_2 \mathrm{EI}_{it} + \lambda_3 \mathrm{SIZE}_{it} + \lambda_4 \mathrm{CI}_{it} + \varepsilon_{it} \qquad (1)$$

where *i* refers to an enterprise, and *t* to the period, while ε represents the error term, and λ_1,..., λ_4 are the parameters along with the described variables that need to be evaluated, and C is a constant.

RESULTS AND DISCUSSION

The heteroscedasticity test was conducted using Breusch and Pagan (1980) (Table 2). We start from the null hypothesis that there is homoscedasticity in residuals. The value of the Breusch-Pagan LM test is 7346.907 (0.000), which can be interpreted as the presence of heteroscedasticity. However, the GMM method is preferred when this kind of problem arises. As the number of companies (N=96) in our case is greater than the analyzed period (T=10), it is necessary to perform the Pesaran (2004) test to examine Cross-Section Dependence (Table 2). The null hypothesis in this case is that there is no cross-section dependence (correlation). According to the data for the p-value, which is about 6% for the Pesaran CSD test, it is possible to conclude that the disturbances have no cross-sectional dependence. It is also necessary to mention the fact that the GMM estimator is consistent under the null hypothesis of cross-sectional independence.

Table 2. Heteroscedasticity and Cross-Section Dependence tests

ROA	Statistics	Probability
Breusch-Pagan LM test	7346.907	0.000
Pesaran CSD test	1.886	0.059

Source: Authors' calculation

Table 3 presents the results of correlation analysis to test the problem of multicollinearity between the independent variables. All correlation coefficients between the variables are statistically insignificant, and it is possible to draw the conclusion that there is no problem with multicollinearity among the variables.

Table 3. The Correlation Matrix

	ROA	EI	SIZE	CI
ROA	1.000			
EI	0.001 [0.029] (0.977)	1.000		
SIZE	0.009 [0.281] (0.779)	0.036 [1.103] (0.270)	1.000	
CI	-0.004 [-0.125] (0.900)	-0.004 [-0.113] (0.910)	0.007 [0.207] (0.836)	1.000

Note: t-Statistics (in brackets); Probabilities (in parenthesis)

Source: Authors' calculation.

From Table 4, it can be concluded that all the independent variables in the model are statistically significant at the 1% confidence level. Moreover, when the EI variable increases, there is a significant increase in the ROA variable as well. This result matches the result of Sudha (2020), unlike the result of Kamande and Lokina (2013), who cannot find a relationship between eco-efficiency and profitability. The first hypothesis of this paper is confirmed due to the result that the eco-intensity indicator has a significant impact on the profitability of an enterprise in the field of wastewater in Serbia.

Nevertheless, when the SIZE variable increases, the ROA variable decreases. This result coincides with the result obtained by Guenster et al. (2011), whereas it contradicts the result of Galindo-Manrique et al. (2021) who found no relationship between SIZE and profitability. Since the result shows that SIZE has a significant effect on the profitability of an enterprise, the second hypothesis of this paper has been confirmed.

Daud et al. (2023) state that the lower the value of EI, the better eco-efficiency is. However, Table 4 displays a particularly high value, indicating the poor eco-efficiency of the Serbian companies in the area of wastewater.

Table 4. Regression analysis: Dependent variable is ROA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROA(-1)	0.021	6.44E-05	-328.721	0.000
EI	461.091	1.883	244.828	0.000
SIZE	-31.053	0.501	-61.931	0.000
CI	0.000	3.98E-05	5.850	0.000
J-statistic	41.822			0.199
AR(1)	-1.068214			0.2854

Note: Panel Generalized Method of Moments has been used.

Source: Authors' calculation

Hansen's test or J-statistics is not statistically significant according to the results in Table 4, and it can be concluded that the model is correctly evaluated. Additionally, the value for the Arellano and Bond (1991) test for first-order autocorrelation in the residuals is also not statistically significant, meaning that there is no serial correlation in the residuals of the estimated model.

CONCLUSION

The paper studies the relationship between eco-intensity and the profitability of the enterprises in Serbia for the period 2011-2020. Eco-intensity is based on the total emissions released into the waters, and this indicator is calculated as the quotient of the total emissions into the waters and the total revenues of the enterprises. Return on Assets (ROA) was used to measure the profitability of the enterprises. A panel data technique was used to examine the relationship between eco-intensity and the profitability of the enterprises in Serbia, and the Generalized Method of Moments (GMM) was used to estimate the parameters.

Our results indicate that in the examined regression equation, all the coefficients of the independent variables of the model are statistically significant at the 1% confidence level. Additionally, if the eco-intensity indicator increases, then the profitability of an enterprise increases significantly, while the profitability of an enterprise decreases with the increase in the size of an enterprise. According to the results of the evaluated model, the CI variable has no influence on the company's profitability (ROA). It is impossible to reject both hypotheses presented in the paper. The results of the paper coincide with the results of Sudha (2020) and Guenster et al. (2011), while they contradict the results of Kamande and Lokina (2013) and Galindo-Manrique et al. (2021).

The main limitations of this paper are that the analysis is based only on the Serbian companies that are polluters from the PRTR register during the analyzed period and that the paper considers their emission of polluting substances into the water. On the other hand, the paper is a pioneering work since it examines the wastewater in Serbia, and to the best of the authors' knowledge, there have been no similar studies so far.

Future research could include a different time period, sectorial analysis and other econometric methodology, whereby the EI indicator could be measured based on the emissions of pollutants into the air, water, soil or other measures of the quality of the natural resources in Serbia. Future research could also include the relationship between eco-intensity and the profitability of an enterprise based on wastewater in other countries or the relationship between eco-intensity and revenue of selected Balkan countries.

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ORIGINAL SCIENTIFIC PAPER

Causality between Greenfield Investments, Regulatory Quality, and Economic Growth: Are the Western Balkans different?

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ABSTRACT
The study aims to examine the causality link between Greenfield Investments, Regulatory Quality, and Economic Growth by using seven Western Balkan countries between 2003 and 2022. Johansen cointegration tests, the VECM model, and multiple empirical unit root tests are the foundation of the empirical analysis. The study's findings indicate that, in the short run, GFI-led growth in Albania and North Macedonia is supported. In the long run, the analysis backs the growth driven by GFI in Serbia and Montenegro and the growth driven by regulatory quality in Albania, Bosnia and Herzegovina, North Macedonia, Serbia, Montenegro, and Bulgaria. The findings support the growth driven by regulatory quality in most Western Balkan countries, reassuring national policymakers that encouraging improvements in regulatory quality and GFI inflows is warranted and will ultimately spur economic growth.

Keywords: *greenfield foreign investments, regulatory quality, growth, VECM model, Western Balkans*

JEL Classification: F65, Q56, O16

INTRODUCTION

Although European countries in transition have similar political and economic orientations and serve EU members, foreign investors are not interested in investing in new areas. One of the main economic goals of European transition countries is to stimulate economic growth. The former socialist, now transition economies, have gone through different stages when it comes to perceiving the role of foreign direct investment (FDI) in the process of transforming their economies. In Central and Eastern Europe, where significant changes in the socio-economic structure of ownership and production relations are taking place, the importance of FDI flows is great. Consequently, it makes sense that governments enact laws that establish favorable economic and stable legal conditions, as well as high levels of assurance and safeguards for foreign investors. FDI serves as the cornerstone of the new international economic order and is one of the key elements that affect the internationalization and globalization of world trade and production (Ganić, 2021). For some researchers and scholars, the relationship between Greenfield foreign investments (GFI), the effectiveness of the regulatory system, and economic growth is a key topic. Bertrand (2004) defines green space investment as one of many non-resident investors creating service facilities from scratch. GFI increases production capacity and creates new jobs

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and facilities in the country. It also has a positive effect on activity levels. Additionally, the introduction of GFI and production methods and technologies can encourage companies to increase production to meet the needs of the market (UNCTAD, 2014).

The literature, however, presents conflicting evidence regarding the effects of GFI on both short-term and long-term economic growth. Although FDI has a large positive impact on growth rates in developing nations according to certain theoretical and empirical studies, other research suggests that these benefits might not be absolute. According to some empirical studies, institutional and regulatory quality can influence economic growth.

Hence, this research aims to respond to the the research question: Is there a Granger causality effect between GFI, regulatory quality and economic growth in the Western Balkans? When examining the research question, the following hypothesis will be subjected to testing:

H_o: There is a Granger causality effect between GFI, regulatory quality and economic growth in the Western Balkans.

Based on the findings, the research will identify strategies for luring international investors in and bolstering the nation's finances. Most empirical research that addresses the economic effects of FDI inflows used econometric models that examine total FDI flows without making a distinction between Greenfield and Brownfield investments. However, depending on the industry that draws the foreign investment, these two forms of FDI may have distinct economic effects. Because there is a dearth of pertinent research and theoretical concerns in the literature, this study focuses on the causal relationship between GFI, regulatory quality, and economic growth (Bayaret al. 2020). This study adds to the body of literature by emphasizing the causality between GFI, regulatory quality, and economic growth, as well as the significance of early detection. The importance of this research analysis lies in the fact that it provides decision-making guidelines for policymakers and practitioners regarding greenfield investments, improving the quality of regulation and assessing their impact on economic growth in the Western Balkans. The contribution of this research is visible in the investigation of Western Balkan countries as transition regions based on the use of GFI and regulatory quality in causality with economic growth. Additionally, panel analysis using the VECM model and the results of the Granger causality test demonstrated the contribution of research, ultimately confirming that higher GFI inflows and better regulator quality can be factors of economic growth. In fact, the findings of this study have consequences for those who formulate economic policy in addition to adding to the body of scientific knowledge. Accordingly, national policymakers should consider improving the circumstances for GFI inflows since the research has demonstrated that it can spur economic growth in the Western Balkans when combined with improved regulatory quality.

LITERATURE REVIEW

Numerous studies demonstrate how FDI inflows generally help developing market economies flourish. The relationship between greenfield investment, regulatory quality, and economic growth has been extensively studied; nevertheless, the lack of agreement between studies suggests that more research is necessary. The various countries, time periods, and econometric techniques employed in these studies could account for the lack of consensus. There is a wealth of studies on emerging and wealthy nations alike that make use of primary and secondary data. Mathematical equations are widely used in this research. Nevertheless, a few studies that engage with empirical research have limits. Empirical research delves deeply into several facets associated with various problems (Qiu & Wang, 2011). Most people agree that the partial equilibrium model applies to both host and foreign nations. This model considers variables including fixed costs, market size, competition, and cost differentials. The four elements hold significant importance when it comes to green-field investments and merger and acquisition procedures. Multinational corporations aim to maximize efficiency by capitalizing on several aspects, such as cultural norms, institutional setups, economic laws and systems, and market

configurations. This is achieved by centralizing production in specific regions to cater to a variety of markets. (Dunning, 1993). The OLI theory is applied to provide a response to the questions of where, when, and why FDI will occur. As per Dunning's (1993) OLI theory, companies choose to engage in FDI if they satisfy three essential criteria: (1) they must possess net ownership advantages over rival firms from other nations; (2) it must be advantageous to retain those advantages internally rather than selling them to foreign firms via the market; and (3) there must be a locational advantage in utilizing ownership advantages in a foreign location as opposed to the home country.

This theory holds that the likelihood of domestic governments acting in this way is a positive consequence, ceteris paribus, of the quantity of unique ownership-specific advantages that MNEs possess and their capacity to complement or integrate these assets with local knowledge and resources. This likelihood increases when a nation's location-specific assets become more appealing to foreign investors and when MNEs compete for the resources, skills, or markets of the host nation (Dunning, 2000). Greenfield FDI creates new institutions in the host nations, increases production potential, and hence enhances employment by bringing in new labor prospects. For example, the study done by Peric and Filipovic (2021) examined the link between FDI and labor indicators in 17 transition countries. The findings of the study indicate that wages, salaries, and the employment rate are all positively and significantly impacted by foreign direct investment (FDI); the effect on income inequality is less evident.

Furthermore, the introduction of Greenfield FDI utilizing cutting-edge technologies and sophisticated production techniques may inspire local businesses to increase their productivity (UNCTAD, 2014).

Antonietti&Mondolo (2023) investigated the short-term impact of FDI inflows on the institutional quality of recipient countries. Until then, this issue has not been thoroughly explored in the context of high-quality domestic institutions as attractive factors for FDI. The research covered 102 countries over a 25-year period, providing insight into the dynamics of the relationship between FDI and institutional quality in the short term. The authors found that FDI inflows in transition economies can be explained by Granger causality associated with greater political stability and lower quality of regulation and rule of law. Their research suggests that this may be the result of 'diminishing returns to institutional quality', particularly in situations where transition economies are already experiencing significant increases in regulatory quality and the rule of law.

One recent study done by Raza, Shaf & Arif (2019) studied the links between FDI, capital, labor and five key factors of institutional quality in the context of economic expansion of OECD member countries in the period from 1996 to 2013. The study finds a two-way causal relationship between FDI and regulatory quality (REQ) when it comes to economic expansion. Additionally, it demonstrates the unidirectional causal relationship between voice and accountability (VAC), political stability (POS), economic growth, government effectiveness (GOE), and corruption controls. These results imply that FDI and regulatory quality have a reciprocal influence, but that the relationships between economic growth and other variables—such as political stability, voice and accountability, and government efficacy—are unidirectional. In their study, Daude and Stein (2007) examined the connection between FDI and institutional quality, concluding that the two factors were significantly positively correlated. Their research shows that the decrease in FDI inflows is caused by several factors, including unstable governments, unpredictable laws, onerous regulations and policies, and a lack of commitment. Kandil (2009) also studied the association between institutional quality, FDI and economic expansion in the MENA region. His research indicates that there is an association between the WGI indicators and economic growth. However, Kandil (2009) concludes that institutional quality has a negative impact on economic growth and FDI in these countries. Similarly, Hraiba et al. (2019) found an inverse relationship between government effectiveness and FDI outflows in North Africa and the Mideast region after the Arab Spring.

Several studies done by Masron& Abdullah (2010), Buchanan et al. (2012), Ahmed &Ahmed (2014), Economou et al. (2016), Yerrabati& Hawkes (2016), Kayani &Ganić (2021), Ganić (2022) confirmed the connection between institutional quality and FDI.

The host nation's economic growth can benefit from greenfield investments in a number of ways. First, GFI has the potential to greatly expand the nation's capital resources for output by building new facilities. Second, the establishment of these new facilities promotes the nation's economic growth by increasing the number of companies operating there and by generating new job opportunities. As a result, greenfield investments can boost local businesses' productivity, which raises the nation's general level of productivity (Ahmed, et al 2023).

Some recent empirical studies have highlighted a positive relationship between GFI and GDP. For example, this has been done by Gopalanet al. (2018) in developing Asian countries, Wang &Wong (2009) in 84 countries, Harms & Méon, (2018) in 127 countries across the world, Luu (2016) in emerging countries, Neto et al. (2010) in 53 countries, Bayar (2017) in Central European countries. On the contrary, some empirical studies refute the association between GFI and economic growth, not finding a significant relationship thereof (Eren & Zhuang, 2015 in 12 EU member countries, Calderon et al., 2004 in 72 developing and developed countries).

DATA AND METHODOLOGY

For the seven Western Balkan countries, the panel model used in this study utilizes three variables: GFDI, REQ and GDPPC. The study's data is limited to the time frame for which UNCTAD collected annual data (GFI in million $), from 2003 to 2020. The data related to GFI, economic growth and regulatory quality are derived from the UNCTAD, World Development Indicators (WDI) database managed by the World Bank, and from the Worldwide Governance Indicators (WGI), respectively. The study uses the WGI indicators developed by Kraay and Kaufmann (2010) to gauge the quality of regulations. The perception of the government's capacity to create and carry out laws and regulations that promote and strengthen market-oriented tactics and private sector growth is known as regulatory quality. The quality of regulation and its relevance is a crucial factor in evaluating the attractiveness of a country for investment. Investor risk and uncertainty are reduced by quality laws, which establish a stable corporate environment. This component evaluates how supportive the regulatory environment is of private sector efforts and how business-friendly it is. Low regulatory quality can make doing business more challenging, discourage investment, and impede economic growth. High regulatory quality, on the other hand, shows the existence of transparent, equitable, and consistent regulations that support economic activities. This view is crucial for luring in foreign capital, promoting entrepreneurship, and fostering a competitive economic climate. The variable of gross domestic product (GDP) per capita is used as a proxy for economic growth, given the fact that it is most often used in the literature as the main indicator for measuring economic development. Since GDP per capita is a measure of GDP relative to the population of a country, it is seen to be a useful indication of economic growth. This statistic makes it possible to evaluate the average economic performance per resident, which offers a clearer picture of the nation's economic conditions and level of living.

The methodology of this article follows three stages in the field of econometrics. Checking whether a unit root exists in the panel data is the first step in the process. A panel cointegration test is used in the second stage to investigate the long-term cointegration connection between the variables following the determination of the unit roots. Once cointegration has been established, the next step uses the Granger causality test to investigate the causal relationship between the variables.

A variety of empirical tests are used in the methodological approach to investigate the causality and link between exports, foreign direct investment, and economic growth. Time series stationarity is tested using unit fit tests (ADF - Fisher Chi-square, PP Fisher Chi-square, Levin et al. LLC - 2002, and Im et al., 2003 tests). Johansen's cointegration test is employed to assess the

empirical model. Furthermore, we employed a modified Wald test and the multivariate Granger causality test within the autoregressive model's vector framework to investigate the direction of the short- and long-term causal components.

The long-term cointegration of greenfield foreign investments, regulatory quality, and economic growth in the Western Balkans was examined using Johansen's cointegration test. Cointegration suggests that variables may be related, but it does not specify which way the link is causative. Vector autoregression (VAR) after first differencing may be misspecified owing to loss of long-run information if non-stationary variables are cointegrated. However, the VECM model can overcome this problem (Engle & Granger, 1987). Furthermore, the VECM model provides improved results than the traditional Granger causality test by accurately identifying the origin of causality and enabling the differentiation of long-term and short-term correlations in a series (Dritsakis & Stamatiou, 2018).

Three versions of the VECM model were employed to investigate the relationship between Greenfield foreign investments, regulatory quality, and economic growth:

$$\Delta LNGFI_{it} = c_{1i} + \sum_{i=1}^{k} \alpha_{1ik} \Delta LNGFI_{it-k} + \sum_{i=1}^{k} \beta_{1ik} \Delta REQ_{it-k} + \sum_{i=1}^{k} \gamma_{1ik} \Delta LNGDP_{it-k} + \\ + \varepsilon_{1t} \quad (1)$$

$$\Delta REQ_{it} = c_{2i} + \sum_{i=1}^{k} \alpha_{2ik} \Delta LNGFI_{it-k} + \sum_{i=1}^{k} \beta_{2ik} \Delta REQ_{it-k} + \sum_{i=1}^{k} \gamma_{2ik} \Delta LNGDP_{it-k} + \\ + \varepsilon_{2t} \quad (2)$$

$$\Delta LNGDP_{it} = c_{3i} + \sum_{i=1}^{k} \alpha_{3ik} \Delta LNGFI_{it-k} + \sum_{i=1}^{k} \beta_{3ik} \Delta REQ_{it-k} + \sum_{i=1}^{k} \gamma_{3ik} \Delta LNGDP_{it-k} + \\ \varepsilon_{it} \quad (3)$$

The study utilizes a model with a dynamic error correction representation, in which Δ stands for the first difference operator, k represents the lag duration, and ε_{it} denotes serially uncorrelated error terms, i, t- identify a country and time period, respectively; LNGDPC refers to log of the real gross product per capita of a country i in year t; REQ is a proxy for regulation quality of a country i in year t , and $LNGFI$ is log of greenfield foreign investment of a country i in year t.

RESULTS AND DISCUSSION

The study uses the panel cointegration test to investigate potential long-term correlations between the variables based on the panel unit root test results, which show the non-stationarity of the data series at that level. Granger (1981) showed that a series is considered cointegrated when stationary after the first differentiation, while its linear combination becomes already stationary without additional differentiation. This suggests that there is a long-term relationship among variables. ADF - Fisher Chi-square, Chi-square, Levin et al. LLC -2002; and Im et al. –IPS, 2003 tests were used to determine the sequence in which the variables in our models were integrated, and the findings are shown in Table 1. It can be said that the findings are consistent with economic science theory. The first differences of the three variables are stationary since they are all integrated - I(1).

Table 1. Panel Unit root tests

Intercept and trend								
Variable	**I(1) First difference**				**I (0)**			
	ADF - Fisher	**PP - Fisher**	**LLC**	**IPS**	**ADF - Fisher**	**PP - Fisher**	**LLC**	**IPS**
LNGFI	27.57**	36.90***	-2.90***	-2.45***	27.5***	36.90***	-4.63***	-5.48***
LNGDP	25.96**	39.31***	-2.242**	-2.25**	43.54***	57.45***	-7.37***	-4.40***
REQ	36.70***	84.08***	-6.240***	-3.64***	73.43***	129.82***	-7.27***	-7.80***
Intercept								
	I (0)				**I(1) First difference**			
	ADF - Fisher	**PP - Fisher**	**LLC**	**IPS**	**ADF - Fisher**	**PP - Fisher**	**LLC**	**IPS**
LNGFI	30.90***	47.42***	2.67***	-2.83***	27.57**	36.90***	-2.90***	-2.45***
LNGDP	6.108	14.66	-1.37*	1.42	34.25***	71.88***	-3.78***	-3.25***
REQ	39.61***	78.26***	-6.27***	-3. 97***	87.63***	20.51***	-9.41***	-8.86***

Source: Author's research

This research paper applies the Johansen & Juselius (1990) procedure for testing cointegration between the variables under investigation. The largest eigenvalue test (λmax-test) and the eigenvalue matrix trace test (λtrace-test) results can be used to determine the number of cointegration vectors. The null hypothesis of the trace test is rejected based on the data presented in Table 2, which shows that there is no cointegration relationship between the variables as indicated by the greatest eigenvalue. The Johansen cointegration test shows that GFI, regulatory quality, and economic growth may all be recognized as having long-term cointegration. It is decided to embrace the alternative hypothesis, which affirms cointegration.

Table 2. Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)				
Hypothesized	**Fisher Stat.***		**Fisher Stat.***	
No. of CE(s)	(from trace test)	Prob.	(from max-eigen test)	Prob.
None*	53.77	0.0000	44.13	0.0001
At most 1*	22.98	0.0607	21.90	0.0507
At most 2	17.92	0.2103	17.92	0.2103

Source: Author's research

The paired Granger Causality test findings for seven Western Balkan countries are shown in Table 3. It sets each variable against every other variable and shows the corresponding estimates of short- and long-term causality.

Table 3. Short run and long run Granger causality test results

	ALB	B&H	NMAC	MNG	SRB	ROM	BUG
	Short-run Granger causality (Wald test)						
Δ(LNGDP)⇒ Δ (REQ)	0.584617	0.00139	1.118050	0.82515	0.010440	1.031361	3.99356**
Δ(REQ)⇒ Δ (LNGDP)	1.083577	4.8338	2.581393	0.80461	1.864126	0.007017	0.872904
Δ(LNGFI)⇒ Δ (REQ)	6.328283**	1.13793	3.26112*	7.475***	0.554686	1.333142	0.078679
Δ(REQ)⇒ Δ (LNGFI)	13.841***	5.9123**	2.244580	33.321***	1.695490	0.147196	12.07950***
Δ(LNGDP)⇒ Δ (LNGFI)	0.56395	0.883227	6.24839**	0.462383	2.253371	0.000113	1.10E-06
Δ(LNGFI)⇒ Δ (LNGDP)	6.9284***	0.19433	5.662125*	0.167097	2.126441	0.312090	0.221869
Long -run Granger causality ((F-statistics)							
LNGDP does not Granger Cause LNGFI	1.10405	3.20506*	1.86066	0.26949	0.03522	2.18125	4.13915**
LNGFI does not Granger Cause LNGDP	0.47409	0.23901	1.32263	3.52877**	5.51504**	1.97956	1.39921
REQ does not Granger Cause LNGFI	0.25499	2.67689	0.36637	0.89688	1.39221	1.19687	1.86704
LNGFI does not Granger Cause REQ	2.66121	0.21343	0.60775	1.42932	1.19865	0.14291	0.16436
REQ does not Granger Cause LNGDP	27.0722***	4.51981**	3.02275*	8.46903***	3.86747**	1.66988	6.38466**
LNGDP does not Granger Cause REQ	1.67338	0.98858	2.36939	0.98385	2.83297*	1.24002	0.74492

Source: Author's research

The findings shown in Table 3 indicate a strong unidirectional causal link in the long run, ranging from LNGFI to LNGDP in Montenegro and Serbia at 1% significance, and from LNGDP to LNGFI in Albania at 5% significance, and in Bosnia and Herzegovina at 10%. Also, regulatory quality unidirectionally Granger causes LNGDP in the long run in all countries except Romania. For example, the relationships are significant at 1% in Albania and Montenegro, at 5% in Bosnia, Serbia and Bulgaria, and at 10% in North Macedonia. In the short run, there exists a significant causal link between LNGDP and regulatory quality, only in Bulgaria at 5% significance, while LNGFI Granger causes REQ in Montenegro and Albania at 1% and 10%, respectively. In four countries: Albania, Bosnia and Herzegovina, North Macedonia and Bulgaria, the study finds the causal relationship between REQ and LNGFI at 1% and 5% significance. In Albania and Montenegro, there is two-way causality in the short run between LNGFI and REQ. Unlike other relationships in the long run, the link between regulatory quality and green foreign direct investment does not appear to play a major explanatory function for seven Western Balkan countries.

CONCLUSION

In the context of the Western Balkan nations, this research aimed to elucidate the current interrelationships between GFI, regulatory quality, and economic growth. We used the VECM model to accomplish this. The interpretation of the study indicates that the data we collected are statistically significant and dependable. These findings offer hints that may be crucial for developing relevant policies in this field.

The study finds two bidirectional causalities between GFI and regulatory quality (Albania and Montenegro), economic growth and GFI (North Macedonia) and four unidirectional causalities, from economic growth to regulatory quality (Bulgaria), from GFI to regulatory quality (North

Macedonia), from regulatory quality to economic growth (Bosnia and Herzegovina, Montenegro and Bulgaria), and from Greenfield investment to economic growth (Albania), in the short run.

In the long run, the results obtained per country indicate that only one bidirectional causality exists between regulatory quality and economic growth (Serbia), and three unidirectional causalities, from economic growth to GFI (Bosnia and Herzegovina, and Bulgaria), from GFI to economic growth (Montenegro and Serbia), and from regulatory quality to economic growth (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, and Bulgaria).

No significant causality was found between regulatory quality and GFI, and vice versa in the long run. The study's findings indicate that, in the short run, GFI-led growth in Albania and North Macedonia is supported. In the long run, the analysis backs the growth driven by the GFI in Serbia and Montenegro and the growth driven by regulatory quality in Albania, Bosnia and Herzegovina, North Macedonia, Serbia, Montenegro, and Bulgaria. Poor regulation quality can discourage investment, make doing business more difficult, and limit economic progress. The study helps to understand how much effort governments are putting into creating a far better and more alluring environment for foreign investors in the Western Balkans through responsible and high-quality regulation.

The findings indicate that policymakers in the Western Balkans should concentrate on measures that entice GFI into new production. Governments should enact sensible macroeconomic policies, strengthen regulations, and draw in more investment to support economic growth and job creation. The standard of regulation is a crucial factor in growth and FDI. Setting a high standard of regulation is essential in the short run since it can play a significant role in the Western Balkans' economic development. Also, policymakers in the Western Balkans should focus more on strengthening and implementing fair, transparent and consistent rules that promote economic growth.

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ORIGINAL SCIENTIFIC PAPER

Partisan Conflict and Uncertainties Spillover in the United States

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ABSTRACT

Given the increasing political polarization in the United States, especially on cogent issues of climate change, health policy, immigration, and recently the handling of the Coronavirus pandemic, the current study divulged further on the link between policy divides and partisan conflict. In the context, we employed the Diebold and Yilmaz index model to examine the potential spillover effect among partisan conflict (PC), economic policy uncertainty (EPU), fiscal policy (FP), and monetary policy (MP) over the period from January 1996 to June 2020 for the case of the United States. Importantly, the result posits a total spillover index (interconnectedness) of 30.04% among the examined variables, thus showing that shock transmission exists among these variables. In addition, the EPU transmits the largest share of shock (56.78%) to PC, FP, and MP, thus illustrating that the EPU is the only net giver of potential shock but with a net spillover of (+) 12.325%. Moreover, with the largest spillover index of 84.569%, PC directly contributes the largest shock to the EPU (6.691%), which is followed by a direct 4.608% to fiscal policy and a lower shock of 0.526% to monetary policy. Apart from making a significant contribution to the existing literature on partisan conflict in the United States, this study further highlighted the grey area to pursuing more inclusive democratic discourse and dialogue among the country's social, cultural, and political representations.

Keywords: *partisan conflict, monetary policy, fiscal policy, economic policy uncertainty, spillover Index, United States*

JEL Classification: E51, E52, H30

INTRODUCTION

Partisan conflict refers to the discord or disagreement between political parties or factions within a political system. This conflict can manifest in various forms, including differences in policy preferences, ideological positions, and strategies for governance. Partisan conflict often arises from competing interests and values held by different political groups, leading to disagreements over issues such as taxation, healthcare, immigration, and social welfare policies. In democratic systems, partisan conflict is inherent to the political process, as it reflects the diversity of perspectives and interests within society. However, excessive or polarized partisan conflict can impede effective governance, hinder policymaking, and contribute to gridlock or

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dysfunction in political institutions. Moreover, heightened partisan conflict may erode public trust in government and undermine social cohesion (Akadiri & Alola, 2022; Akadiri, 2018; Balcilar et al., 2017).

Partisan conflict can occur at various levels of government, including the national, state, and local levels, and may involve different branches of government, such as the executive, legislative, and judicial branches. Additionally, partisan conflict can be exacerbated by factors such as electoral competition, media polarization, and socioeconomic divisions within society. Efforts to address partisan conflict often involve fostering dialogue, compromise, and consensus-building among political actors. Strategies for mitigating partisan conflict may include promoting bipartisanship, encouraging civil discourse, and enhancing transparency and accountability in the political process. Ultimately, managing partisan conflict is essential for maintaining a functioning democracy and advancing the common good (Akadiri & Alola, 2022; Balcilar et al., 2019).

Considering the growing political polarization among Republicans and Democrats in the United States, there has been an increasing concern regarding the economic policy uncertainties associated with fiscal and monetary policy imbalances. As the world integrates into one global village, the interconnectedness among economies creates changes in economic and political outlooks, which in one way or another also create tension (either directly or indirectly) and a perception of economic and political instabilities. Thus, increasing economic policy uncertainties and heightened partisan conflict trigger fiscal (Azzimonti, 2018a, b) and monetary (see Balcilar, Demirer, Gupta and Eyden, 2017) imbalances resulting in reduced investment (see Azzimonti (2018b), and impacting both money and financial markets (Pastor and Veronesi, 2012; Gupta et al 2018), respectively. It is believed that economic policy uncertainty in the United States, China, and the United Kingdom, among others, coupled with monetary policy, fiscal policy and other forms of government regulations, immensely influence the world economic and financial downturn and the steady recovery that followed.

Economic policy uncertainties, if not properly managed, could influence investment decisions negatively and increase financial market volatility, while heightened partisan conflict, on the other hand, would halt investment decisions (fiscal policy), lead to increased economic policy uncertainty and lower financial volatility (monetary policy). This argument is in line with the findings of Gupta et al. (2018), where they concluded that, heightened partisan conflict lowers stock market volatility in the United States. Pastor and Veronesi`s (2012) study resonates with this result that lower economic policy uncertainty reduces financial market volatility and vice versa. Furthermore, Bechtel and Fuss (2008) reveal that political polarization reduces policy uncertainties by reducing the possibility of any policy variations. In addition, Azzimonti (2018b) is of the opinion that heightened partisan conflict reduces policy uncertainty. According to Azzimonti (2018b), a reduction in economic policy uncertainty can be achieved if and only if such an economic situation or condition remains stable, a consequence of polarization among political parties. Thus, the interactions between economic policy uncertainty and partisan conflict have significant impacts on both the fiscal and monetary policies of any nation, most especially in the United States.

This study aims to examine the interactions and interconnectedness in terms of spillover impacts among economic policy uncertainty, monetary policy, fiscal policy, and partisan conflict in the United States over the periods January 1996 to June 2020 (a constraint on data availability) in the United States by employing the Diebold and Yilmaz (2012) approach. The choice of the United States for the current study is based on the fact that, over time, the nation has been experiencing heightened political polarization, thus exerting a grievous impact on the overall well-being of the nation (see Balcilar et al. 2019; Azzimonti, 2018b). In turn, the situation creates uncertainty in the country's economic policy, thus eroding and delaying immediate responses to fiscal and monetary policy issues. Policy suggestions from this study would assist the government and policymakers (especially economies with high partisan conflicts and economic policy

uncertainty) in coming up with workable policies that would facilitate social, political and economic stability for all-inclusive economic growth.

The contribution of this study is as follows (i), this study appears to be the first empirical study that focuses on the interconnectedness between economic policy, partisan conflict, and monetary and fiscal policy, especially for the United States, as most of the study rather focuses on the interaction between the variables under investigate and other macroeconomic variables (see Boushey & McGrath, 2020; Balcilar et al 2017; Balcilar, Saint, Gupta and Miller, 2019; Saint Akadiri & Alola, 2019; Cheng, Chiu, Hankins & Stone, 2018) (ii), Results show an aggregate spillover of 30.04%, with the highest shock coming from the EPU (a net giver of spillover shock). Also, the uncertainty resulting from monetary policy, fiscal policy and partisan conflict is received from the spillover effect from the EPU, thus making monetary policy, fiscal policy, and partisan conflict net receivers of spillover shocks. Importantly, with the largest spillover effect of 84.569%, the uncertainty resulting from partisan conflict directly contributes the largest shock of 6.691% to EPU, followed by a 4.608% direct shock contribution to fiscal policy and a lower shock of 0.526% to monetary policy. From a policy standpoint, we are of the opinion that the government of the United States will have to deliberately do more to douse the lingering trend of democratic polarization in the country. Thus, a new approach, such as the adoption of a more inclusive dialogue among political and social representations, could effectively moderate or pacify the current political atmosphere in the United States, resulting from the deep political dichotomy between the Democratic and Republican parties.

The study outline is scheduled as follows: Section two discusses the data and methodology adopted for empirical analysis. Section three presents and discusses results, while section 4 concludes the study with attendant policy suggestions.

DATA AND METHOD

Data

This study uses the United States' categorical data (that include the economic policy uncertainty (EPU), monetary policy (MP), and fiscal policy (FP)) from the economic policy uncertainty (2019). The index of partisan conflict (PC) was retrieved from the Federal Reserve Bank of Philadelphia (2020). In addition, the monthly dataset employed covers the period from January 1996 to June 2020. Following Wang et al. (2016) and Antonakakis et al. (2018), we define the volatility as the absolute return $V_t = |lnPC_t - lnPC_{t-1}|$. In addition to the graphical presentation of the examined series (see Figure 1), the statistical property of each series is presented in Table 1,

Table 1. Volatility summary statistics

	EPU	FP	MP	PC
Mean	0.202	0.268	0.414	0.115
Median	0.158	0.235	0.348	0.091
Maximum	1.198	1.252	1.767	0.939
Minimum	0.0009	0.001	0.004	0.0002
Std. deviation	0.172	0.214	0.329	0.112
Skewness	1.926	1.174	1.211	2.867
Kurtosis	9.111	4.681	4.592	17.186
Jarque-Bera	637.308*	101.944*	102.616*	2858.640*
ADF	-16.583*	-14.297*	-16.345*	-6.402*

*Notes: * denotes significance at the 1% level.*

The ADF statistics reported in the last row of Table 1 show that the series under investigation are integrated of order 1, and none of the series are of order II. The coefficients are greater than 2, implying statistical significance at 0.01 percent.

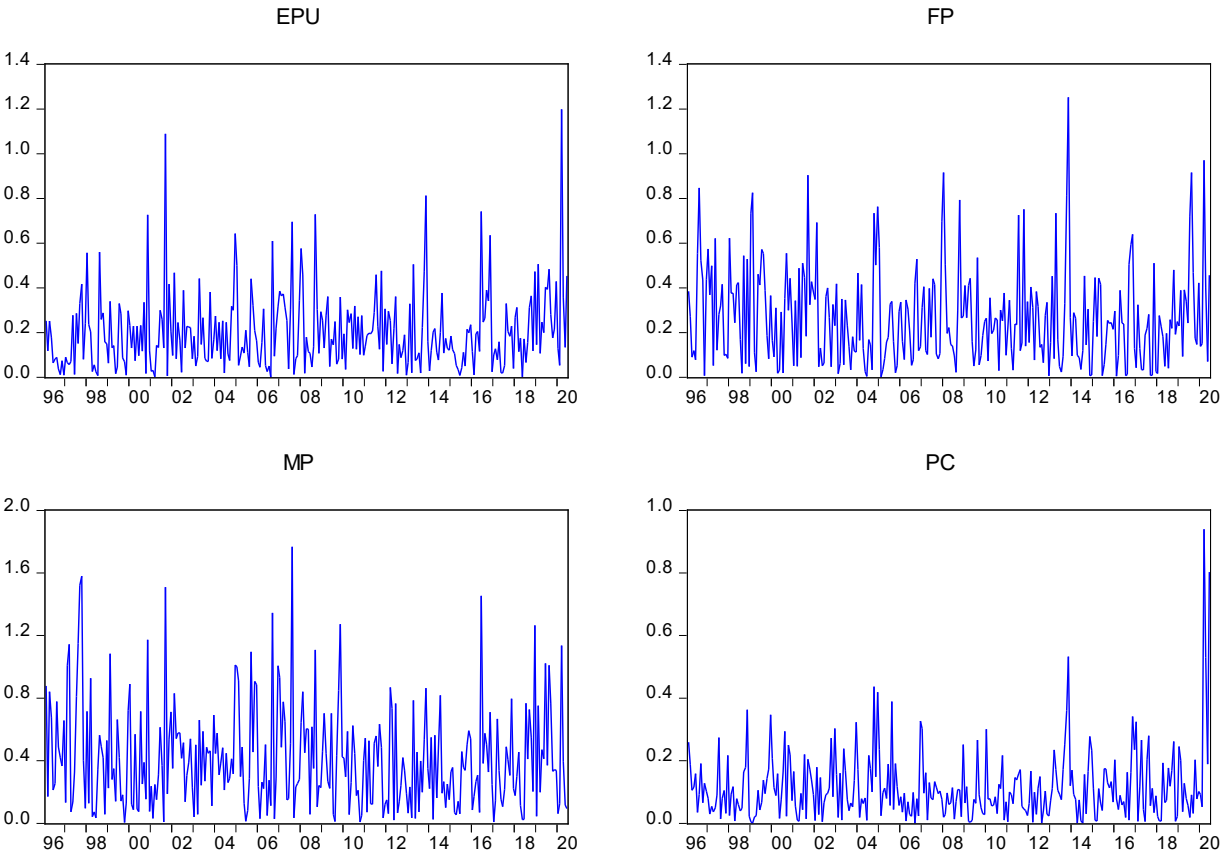


Figure 1. Variables volatilities (absolute returns).

Methodology

By considering the appropriateness of the Diebold and Yilmaz (2012) methodology in this study, we consider a stationary VAR (p) model:

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

where Y_t is a vector of size N and ε_t is a vector of independently and identically distributed disturbances. Then, Y_t can be expressed as a moving average representation VMA (∞):

$$Y_t = \sum_{i=0}^{\infty} \Theta_i \varepsilon_{t-i} \qquad (2)$$

where Θ_i is a coefficient matrix of size $N \times N$. In this line, the h-step ahead forecast error variance decompositions are defined as:

$$\Psi_{ij}(h) = \frac{\sigma_{ij}^{-1} \sum_{h=0}^{h-1} (e_i' \Theta_h \Sigma e_j)^2}{\sum_{h=0}^{h-1} (e_i' \Theta_h \Sigma \Theta_h' e_j)} \qquad (3)$$

where σ_{ij} is the standard derivation of the error term for the *j*th equation, Σ is the variance matrix for the error vector ε and, e_i and e_j are the selection vectors with one for the *i*th and *j*th elements, respectively, and zeros otherwise.

To calculate the spillover index, Diebold and Yilmaz (2012) normalize each entry of the variance decomposition matrix by the row sum:

$$\widetilde{\Psi}_{ij}(h) = \frac{\Psi_{ij}(h)}{\sum_{j=1}^{N} \Psi_{ij}(h)} \quad (4)$$

In addition, they introduced the ***total volatility spillover*** index to measure the contribution of the spillovers of the volatility on the system's forecast error variance.

$$S(h) = \frac{\sum_{i,j=1}^{N} \widetilde{\Psi}_{ij}(h)}{\substack{i \neq j \\ N}} \quad (5)$$

However, the ***directional volatility spillovers*** received by market *i* from all other markets *j* is measured by:

$$S_{i.}(h) = \frac{\sum_{j=1}^{N} \widetilde{\Psi}_{ij}(h)}{\substack{i \neq j \\ N}} \quad (6)$$

Similarly, the ***directional volatility spillovers*** transmitted by market *i* to all other markets *j* is measured by:

$$S_{.i}(h) = \frac{\sum_{j=1}^{N} \widetilde{\Psi}_{ji}(h)}{\substack{i \neq j \\ N}} \quad (7)$$

Consequently, the ***net volatility spillover*** from market *i* to all other markets *j* is defined by:

$$S_i(h) = S_{.i}(h) - S_{i.}(h) \quad (8)$$

Finally, the ***net pairwise volatility*** spillover between market *i* and market *j* is defined by:

$$S_{ij}(h) = \frac{\widetilde{\Psi}_{ji}(h) - \widetilde{\Psi}_{ij}(h)}{N} \quad (9)$$

RESULT AND DISCUSSION

By employing the Diebold and Yilmaz (2012) approach to examine the volatility spillover effect among the United States' partisan conflict (resulting from the intrigues associated with American politics), fiscal policy, monetary policy, and economic policy uncertainties, the implied result is indicated in Table 2. Importantly, the study revealed that the total spillover, which explains the extent of interconnectedness among the examined variables, is 30.04%. This value is significant enough to show that shock transmission exists among these variables, as further indicated in Figure 2. In specific, it is revealed that EPU transmits the largest share of shock (56.78%) to other variables, thus suggesting that EPU is the only net giver of potential shock, with a net spillover of (+) 12.325%. While fiscal policy, monetary policy, and partisan conflict are vulnerable to receiving a share of shock from EPU, partisan conflict received the second largest (-3.607%) after monetary policy.

Table 2. Volatility Spillover Result

	EPU	FP	MP	PC	From others
EPU	**55.546**	18.255	19.508	6.691	44.454
FP	22.496	**69.225**	3.671	4.608	30.775
MP	24.626	4.352	**70.497**	0.526	29.503
PC	9.658	5.311	0.462	**84.569**	15.431
Contribution To others	56.780	27.918	23.642	11.825	120.164
Directional including own	112.325	97.143	94.138	96.393	Total spillover index
Net spillovers	12.325	-2.857	-5.862	-3.607	(30.041%)

***Note**: EPU, FP, MP and PC are, respectively, the economic policy uncertainty, fiscal policy, monetary policy, and partisan conflict. While the bold indicate*

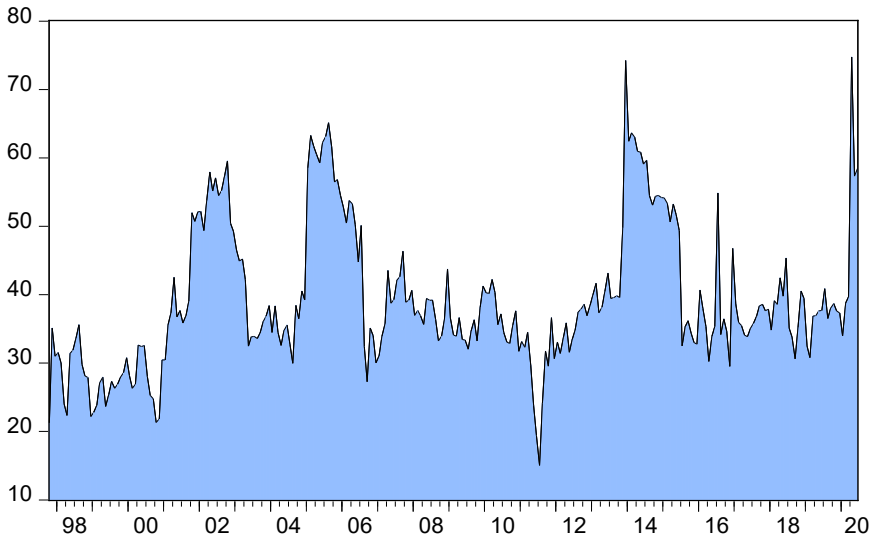


Figure 2. Total volatility spillovers.

Considering that partisan conflict is a net receiver of shock with the largest spillover effect (84.569%) in this context, PC directly contributes the largest shock to the EPU (6.691%), followed by 4.608% directly to fiscal policy and a lower shock of 0.526% to monetary policy. The implication is that the United States' economic policy and fiscal policy are quite vulnerable to a shock that arises from the volatility of the country's democratic polarity vis-à-vis the increasing trend of political partisanship. This new evidence affirms the position of Azzimonti (2018, 2019), who found a negative relationship between the PC and investment (as a fiscal policy) in the United States. In regard to the nexus of PC, EPU, and monetary policy, a related study by Cheng et al. (2018) found that political uncertainty shocks (arising from partisanship) lower financial market volatility and also exert an asymmetric effect on aggregate corporate cash holdings vis-à-vis monetary policy.

Moreover, Figures 3-6 further provided diagnostic evidence in support of the results. For instance, PC exhibits the least volume of directional spillover volatility from and to others, as obviously reflected in the depletion associated with the volume/size of PC in Figures 3 and 4. Similarly, evidence of the net spillover effect and pairwise spillover connected are respectively indicated in Figures 5 and 6. In addition to the contribution of Gupta et al. (2019) on the nexus of political uncertainty (partisan conflict), fiscal policy and asset prices, PC has increasingly been linked with related dynamics (Cheng et al., 2016; Balcilar et al., 2019; Boushey & McGrath, 2020; Saint Akadiri & Alola, 2020).

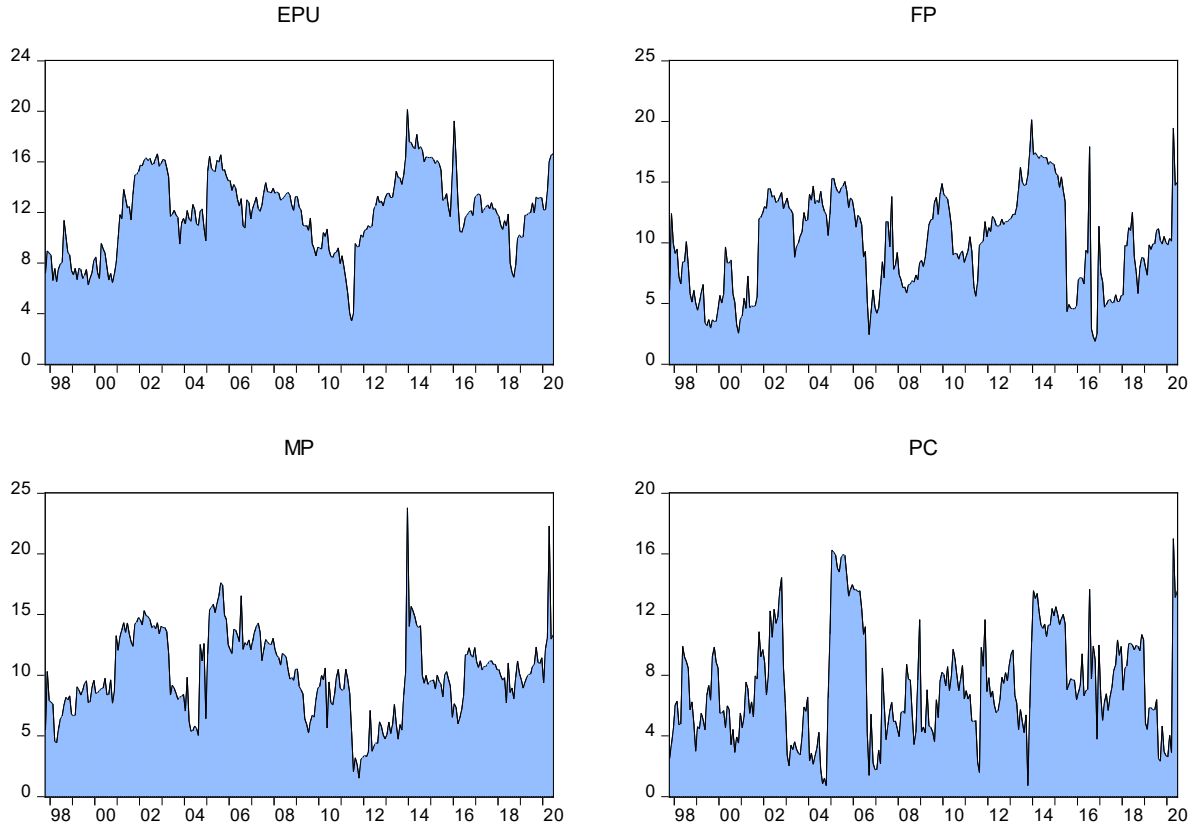


Figure 3. Directional volatility spillovers from others.

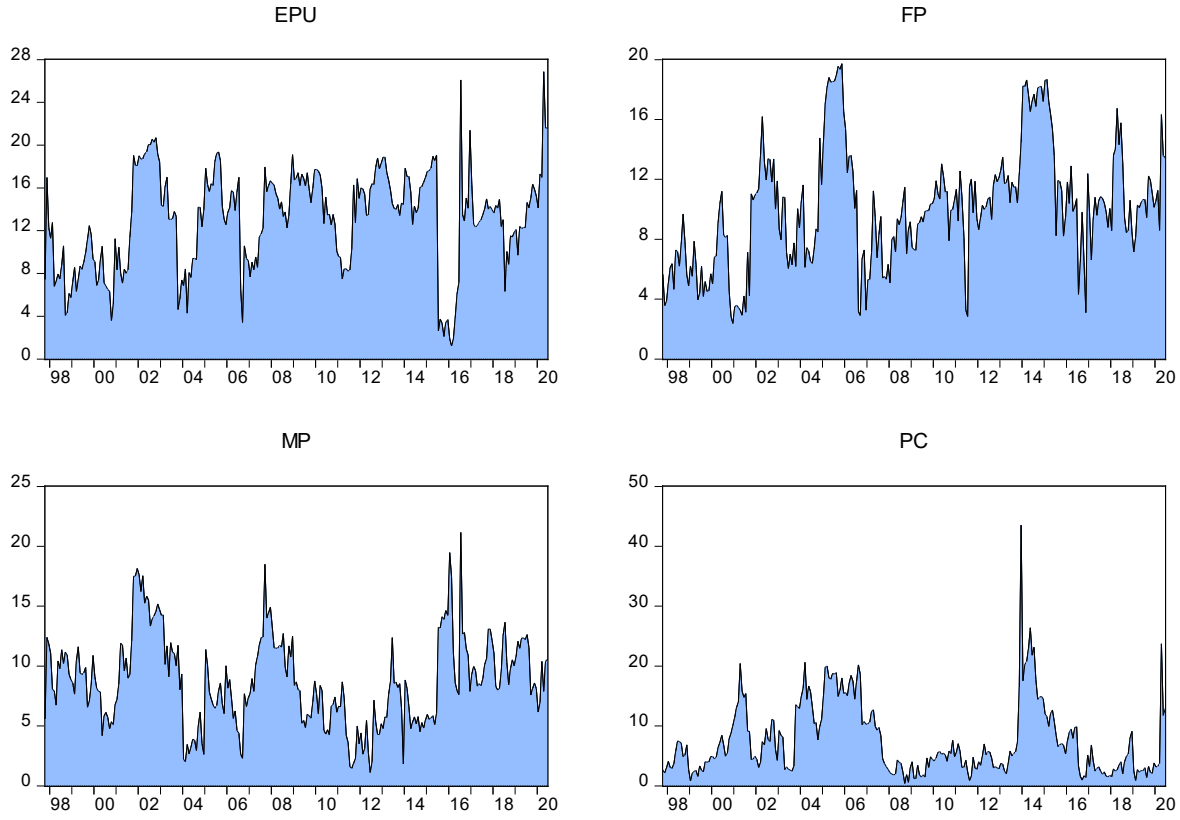


Figure 4. Directional volatility spillovers to others.

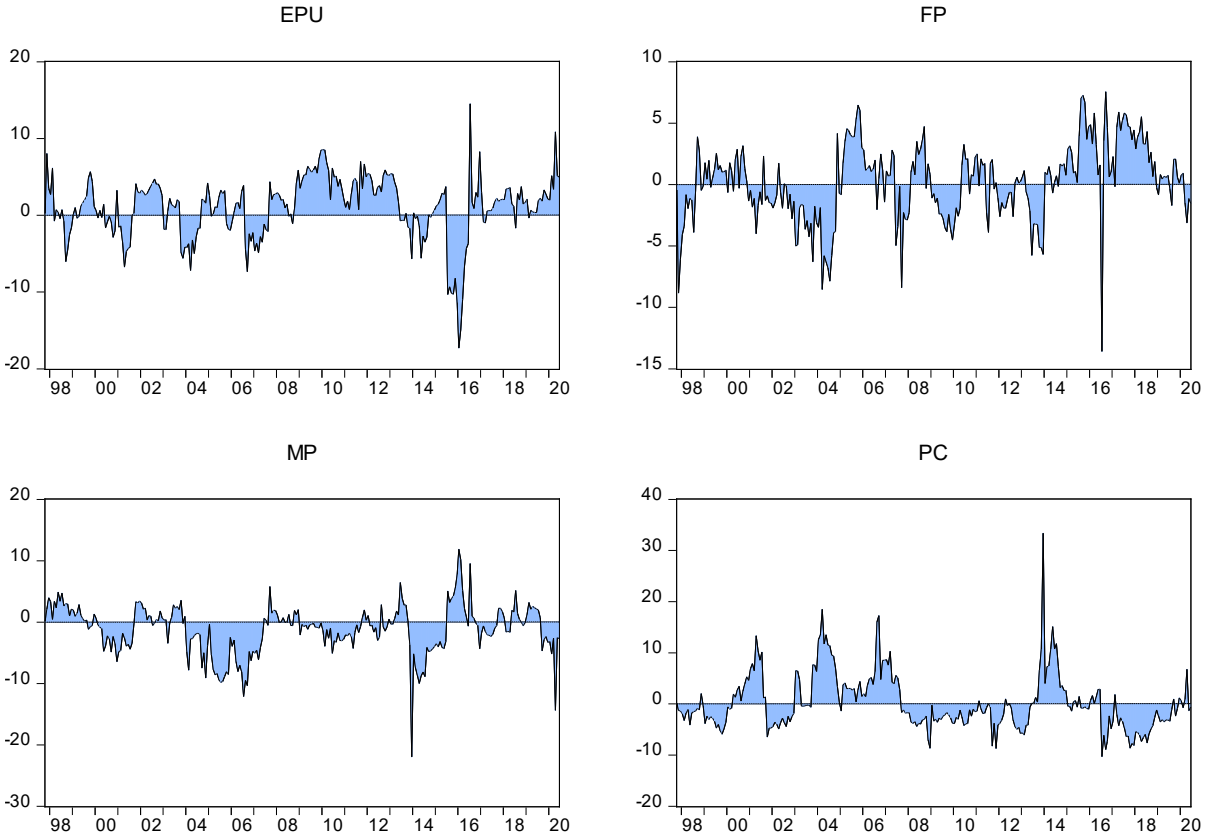
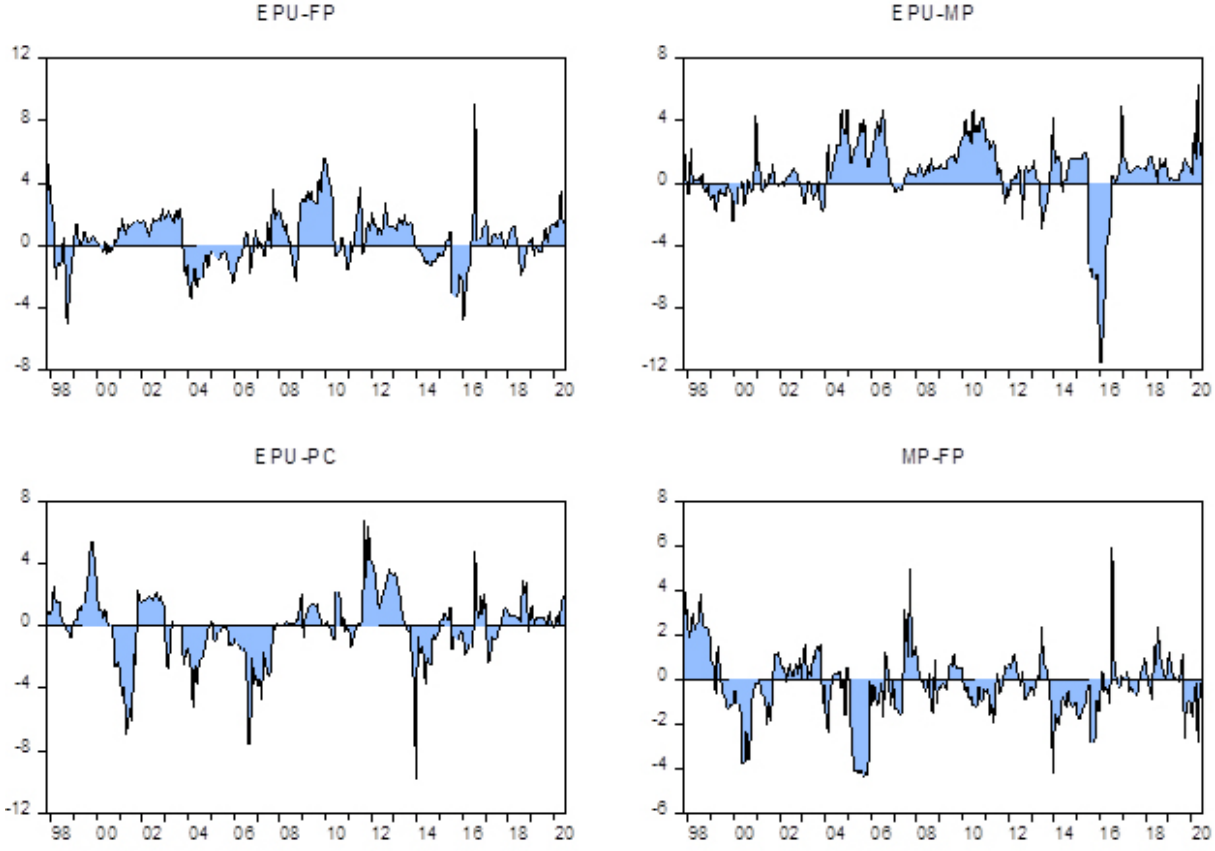


Figure 5. Net volatility spillovers.



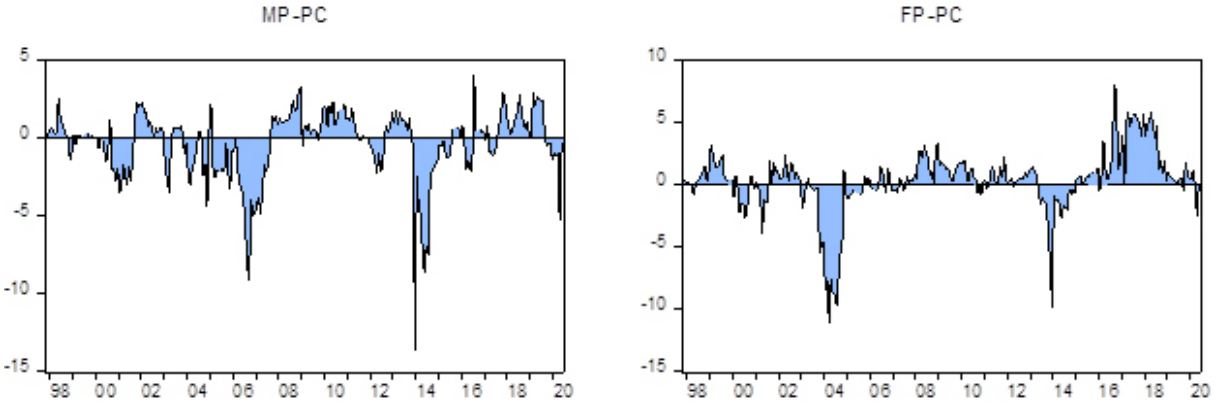


Figure 6. Net pairwise volatility spillovers.

CONCLUSION/POLICY SUGGESTION

In recent times, the polarization of the democratic process in the United States has consistently heightened the trend of partisanship in the country, thus affecting a broad range of socioeconomic and financial forces. This study employed the Diebold and Yilmaz (2012) approach to examine the interconnectedness among economic policy uncertainty, monetary policy, fiscal policy, and partisan conflict in the United States over the period of January 1996 to June 2020. In this context, the study revealed a total spillover of 30.04%, with the highest shock coming from the EPU (a net giver of spillover shock). In addition, the uncertainty resulting from monetary policy, fiscal policy and partisan conflict are received from the spillover effect from the EPU, thus making monetary policy, fiscal policy, and partisan conflict net receivers of spillover shocks. Importantly, with the largest spillover effect of 84.569%, the uncertainty resulting from partisan conflict directly contributes the largest shock of 6.691% to EPU, followed by a 4.608% direct shock contribution to fiscal policy and a lower shock of 0.526% to monetary policy.

Based on policy inference, the government of the United States will have to deliberately do more to douse the lingering trend of democratic polarization in the country. Thus, a new approach, such as the adoption of a more inclusive dialogue among political and social representations, could effectively moderate or pacify the current political atmosphere in the United States, resulting from the deep political dichotomy between the Democratic and Republican parties. Given the significant impact of partisan conflict on economic policy uncertainty, policymakers should prioritize efforts to reduce polarization and foster more inclusive dialogue among political and social representatives. This could involve initiatives to bridge divides between political parties, encourage bipartisan cooperation, and engage diverse stakeholders in the policymaking process. Policymakers should also focus on addressing the underlying factors driving partisan conflict, such as ideological polarization, electoral competition, and institutional dysfunction. This may require reforms aimed at promoting transparency, accountability, and fairness in the political system, as well as efforts to counteract media polarization and mitigate the influence of special interests.

Considering the interconnectedness among economic policy uncertainty, monetary policy, fiscal policy, and partisan conflict, policymakers should prioritize efforts to enhance coordination and coherence across these policy domains. This could involve adopting a more integrated approach to policymaking, improving communication and collaboration between relevant government agencies, and ensuring consistency and alignment in policy objectives and strategies. Policymakers should also focus on building resilience to economic policy uncertainty and mitigating its adverse effects on the economy. This may involve implementing measures to enhance transparency and predictability in policy decision-making, providing clear guidance to

businesses and households, and strengthening institutions and mechanisms for managing and responding to economic shocks.

One potential limitation of this study is its focus on the United States, which may limit the generalizability of its findings to other countries or contexts with different political systems, institutions, and dynamics of partisan conflict. Reliance on data from January 1996 to June 2020 may also present limitations in capturing more recent developments or changes in the political landscape that could impact the relationship between economic policy uncertainty, monetary policy, fiscal policy, and partisan conflict. Additionally, while the study provides valuable insights into the interconnectedness among these variables and their implications for policy, it may overlook other factors that could influence partisan conflict and its effects on economic policy uncertainty. For example, the study does not take into consideration the underlying causes of partisan conflict or consider potential interactions with broader societal trends, such as media polarization, social movements, or demographic shifts. Furthermore, reliance on the Diebold and Yilmaz (2012) approach for analyzing spillover effects may have limitations in capturing the full complexity of the relationships among the variables under investigation.

Future research could explore alternative methodologies or incorporate additional variables to provide a more comprehensive understanding of the dynamics of partisan conflict and its implications for economic policy. Additionally, studies could explore the role of non-governmental actors, such as interest groups, grassroots organizations, and civil society, in shaping partisan dynamics and influencing economic policy outcomes. Moreover, comparative studies across different countries or regions could provide insights into the factors driving variation in partisan conflict and its consequences for economic policymaking.

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