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Articles

Book Review

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RELATIONSHIP BETWEEN CRYPTO CURRENCIES AND CLIMATE CHANGE

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ABSTRACT

Since the emergence of cryptocurrencies in 2008 to the present day, the volatility of bitcoin prices has generated a surge of interest among investors, as it provides an opportunity to profit from excessive price increases. Industry observers refer to it as a "growing energy problem" as bitcoin mining consumes more energy than most countries in recent times. This research study examines the causality relationship between the cryptocurrencies involved in Bitcoin mining and the amount of carbon emissions that lead to climate change. In the research study, the total energy consumption estimates and the predicted trend global CO_2 emission values of Bitcoin and Ethereum cryptocurrencies are discussed. The data used in the research study are the daily time-series data over the period 05.20.2017 - 04.08.2022. The analysis was conducted by performing the Toda-Yamamoto causality test. A bilateral causal relationship was found between Bitcoin and CO_2 emissions; whereas no significant connection existed between Ethereum and CO_2 emissions. In conclusion, the high energy consumption of cryptocurrencies and the resulting CO_2 emissions pose significant environmental challenges, bringing the sustainability of cryptocurrencies into question. In this context, efforts to increase the share of renewable energy in energy consumption of cryptocurrencies need to be accelerated. Additionally, this study will contribute to the development of theoretical foundations in this field.

JEL Classification: Q540, Q430, Q560

Keywords: Climate change, Bitcoin, Ethereum, Toda-Yamamoto Causality Analysis

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1. INTRODUCTION

Global climate change is a long-term change in the temperature and weather patterns of our world. These changes are not only natural but also arise from human activities affecting worldwide climate change (Trenberth, 2018). Human activities have caused the atmosphere to become filled with carbon dioxide and other heat-trapping substances (Hao et al., 2008). This temperature rise has caused melting of glaciers, rising sea levels, forest fires, floods and excessive precipitation (Kompas, Pham, and Che, 2018). In addition to such natural events, factors such as agriculture, energy use and public health negatively affect our lives (Tol, 2009). In fact, climate change is a long-term problem affecting all areas of human life. For example, as global warming increases following climate change, assets and substructure will be destroyed, productivity will decrease, and mass migrations and security threats will emerge. This situation will create many problems worldwide (Wade, 2016). This study explores the relationship between cryptocurrency production and climate change.

Before introducing how cryptocurrency mining affects the environment through energy consumption, some background on climate change is presented. Geographical features have changed several times around the world, from the existence of humanity until today. Periodically, the natural balance between the elements of the earth has been disturbed for various reasons. Depending on these deteriorations, there have been great climate changes. Especially since the beginning of the "Industrial Revolution", the amount of greenhouse gases in the atmosphere has increased. Since then, pollution and global temperature has been increasing, leading to climate change. Thus, the negative effects of climate change are gradually manifesting themselves. The human-induced impact of climate change has continued to increase in recent years.

The common view of climate scientists is that the climate change that will continue in the future will arise from global warming caused by the increase in greenhouse gas emissions in the atmosphere. If immediate steps are not taken to slow down acceleration of global warming, the Earth will experience unimaginable disruptions in every aspect of human life by 2050. Since the Industrial Revolution, the average surface temperature has risen by 0.8 °C due to past and ongoing human-induced greenhouse gas emissions caused by burning fossil fuels. Environmentalists warn that global warming would accelerate by

1.5°C by 2050, and catastrophic consequences of climate change may occur if no measures are taken to combat climate change within the next decade (Taskinsoy, 2019). To prevent such a disaster, the objectives of the "Paris Agreement" regarding climate change must be implemented within the given timeframe. Besides, new solutions are needed to get climate change under control. Emerging technologies such as blockchain have been developing new methods to prevent climate change. Blockchain is not only the technology utilized for cryptocurrency units but also serves as an independent instrument that can be used for various purposes.

Blockchain technology has become indispensable, particularly for financial systems, maintaining its popularity in recent years. Cryptocurrencies that have been developed using "Blockchain technology" provide users with various advantages such as being available for investment, being used as a medium of exchange, and having ease of storage. Many types of cryptocurrencies serve different purposes such as online payment, exchange in internet games and so forth. The uses of cryptocurrencies are increasing day by day. The most basic feature of cryptocurrencies is that they are not issued and managed by a central mechanism. The level of blockchain technology usage has been increasing considerably since 2018. The use of cryptocurrency units, which are products of developing technology, has raised energy consumption problems. People in the cryptocurrency system use a high amount of electrical energy to mine and distribute the currency. A high amount of energy consumption will increase costs. The returns of the processors in the system may decrease in parallel with this situation because they need to have a larger capacity operating system in order to do more scraping, and this comes across as an extra cost. On the other hand, in order to meet the increasing demand for cryptocurrencies over time, more excavation is made and thus energy consumption increases.

Considering Bitcoin's share in global electricity consumption, the importance of this consumption share is quite remarkable. Various studies have estimated the consumption that cannot be calculated clearly. Bitcoin production is carried out in the computer environment and by the processors making complex calculations. Increased value of Bitcoin in the last few years has led to more users producing Bitcoin. Cryptocurrencies result in huge demand for energy systems, but it is also thought to increase carbon emissions that affect global warming. In other words, cryptocurrency mining utilizes a significant amount of energy by including new blocks in the chain. Therefore, due to the amount of CO_2 emissions released to the natural environment, both the global ecosystem and human life are being endangered. These

developments raised concerns regarding their environmental impacts. Such concerns, which have been frequently expressed recently, draw attention to the environmental impacts of cryptocurrencies and enhanced energy consumption.

As of 2021, governments, firms, media commentators, and economists have expressed their concerns regarding the environmental impacts of cryptocurrencies (Stoll, Klaaßen, and Gallersdörfer, 2019; De Vries, 2018). Some researchers have argued that cryptocurrencies, especially the very old Bitcoin, served as "economic batteries" in sustainable energy markets, and therefore, assumed importance (Bitcoin Clean Energy Initiative, 2021; Carter, 2020; Bendiksen and Gibbons, 2019). Bitcoin, "on the other hand, is defined as a decentralized inter-account electronic cash system that provides online payment without the intervention of any bank, government, or central authority" (Nakamoto, 2008). Although Bitcoin emerged in 2008, it is being preferred by investors due to its excessive price increase. The value of Bitcoin fluctuated between US$500 and US$1.200.000.000 over the period January-September 2021, generating more than 50% of the market cap of all cryptocurrencies combined (CoinMarketCap, 2021). There is a growing reaction to environmental issues for other cryptocurrencies, especially Bitcoin, whose value is increasing for investors (Cambridge Center for Alternative Finance, 2021). Industry observers have stated that it would have emerged with a "growing energy problem" as cryptocurrency networks consumed more electricity than most countries (De Vries, 2018). In support of this situation, the total annual energy cost of Bitcoin mining alone as of the year 2014 was calculated as equal to the total annual energy consumption of Ireland. In February 2021, research studies conducted by Cambridge University asserted that the annual energy consumption of bitcoin mining was approximately 121 terawatts per hour (https://www.bbc.com/ news/technology-56012952). According to these results, if cryptocurrencies were countries, they would be among the countries that consume the most energy in the world. It is aimed that society would be completely cash-free in the future, and therefore, although cryptocurrencies would gain value after a point, their ecological impacts that would lead to an environmental crisis should not be ignored (Walsh, 2021).

Predictions of the carbon footprint of cryptocurrencies are attracting enormous attention in both academic and public discussions. Nevertheless, cross-country comparison shows that crypto networks tend to concentrate more on emissions (Howson, 2019; Stoll et al., 2019). Binding relative measures on carbon emissions regarding cryptocurrencies, however, still do not constitute an important portion of

the discussion. The financial aspect of cryptocurrencies, in general, has been researched in favor of investors. Nonetheless, in the case of merely dealing with cryptocurrencies financially and ignoring carbon emissions, misleading results would be obtained in terms of investment and portfolios.

Besides, criticism of the negative impact of cryptocurrencies on the climate is increasing today. Recently, Roeck and Drennen (2022), Badea and Mungiu-Pupazan (2021), Jiang et al. (2021) focused on the carbon dioxide emissions of cryptocurrency mining. Roeck and Drennen (2022) explored the environmental impact of bitcoin mining in New York. They used global warming, smoke generation, acidification, and pollutant emissions as environmental variables. The research revealed that Bitcoin mining not only hinders national climate measures, but also threatens local programs related to climate change. Panah et al. (2022) emphasized integrating regulatory practices into markets to reduce greenhouse gas emissions globally. They suggested reducing greenhouse gas emissions by investing in green hydrogen production in research. The idea that cryptocurrency mining would become profitable by doing this was discussed. At the same time, a crypto tax should be levied by correlating hydrogen costs with the bitcoin market. Erdogan, Ahmed, and Sarkodie (2022) investigated the asymmetric relationship between cryptocurrency demand and environmental sustainability/ Their findings suggest that demand for cryptocurrencies such as “Bitcoin (BTC), Ethereum (ETH) or Ripple (XRP)” results in environmental degradation. Badea and Mungiu-Pupazan (2021) conducted a comprehensive analysis covering energy consumption and carbon dioxide emissions with bitcoin data mining to reduce its negative impact on climate and environment. Their research highlights how energy is used in bitcoin transactions and bitcoin is used intensively by investors, although it harms the environment.

At the same time, although there are accusations about bitcoin usage, its use rate is increasing in many countries and it has gained credibility as a currency. In their research, Othman and Dob (2022) explored the relationship between bitcoin data mining and energy use and global carbon emissions between 2012-2021. The research findings show that before 2013, bitcoin mining was correlated between energy use and the global carbon emission index at different frequencies and time periods. After 2013, it shows that there is no relationship between bitcoin mining and energy consumption and the global carbon emission index. De Vries (2021) reveals that as bitcoin prices rise, the environmetal damage increases. It was determined that there was a high level of energy consumption as a result of the Bitcoin price breaking a

record at the beginning of 2021. Hence it could result in a carbon footprint comparable to London. Accordingly, the causal relationship between Bitcoin and Ethereum and carbon dioxide (CO_2) emissions are to be examined in this research study. The research study concentrates on the causal relationship between climate change and the Bitcoin and Ethereum digital currencies presented by technology.

2. LITERATURE REVIEW

Almost all of the money used in the world has started to be digitalized. Especially with the pandemic, electronic payment methods have replaced paper payment methods. Many countries will become cashless societies in future. In the last two decades, certain alternative methods have been on the rise as all traditional money and banking transactions have shifted to the electronic field. These various forms of digital currencies or cryptocurrencies are online assets unlike our traditional notions of money. The first and best known of these is Bitcoin. Thousands of cryptocurrencies exist such as LiteCoin, NameCoin, PeerCoin and Ethereum, with new ones appearing every day (Walsh, 2021). As the cryptocurrency market continues to evolve, it will create some important problems in the future as well as its expected benefits. In particular, the energy use of bitcoin mining has increased to 4.8 Terrawatt hour (Twh) 73.12 Twh in the last two years. The energy footprint per Bitcoin transaction is estimated at 619 Kwt, which equates to the average US household's electricity consumption for 20.92 days. Considering its energy usage, bitcoin in its current form can be considered as an expensive and inefficient transmission mechanism. In addition, most bitcoin mining is located in China. The main fuel for these networks, the energy for each operation comes from coal-fired power stations (Corbet, Lucey, and Yarovaya, 2021). Cryptocurrency mining is getting more complex as the network of encrypted assets continues to grow. Bitcoin data mining machines will need more energy to operate and generate computing power requirements (Yan, Mirza, and Umar, 2022). In this situation, the concern regarding environmental damage caused by cryptocurrency mining is not surprising (Huynh, Hille, and Nasir, 2020).

At the same time, the “Cambridge Bitcoin Electricity Consumption Index (CBECI)” estimated Bitcoin's energy consumption to be around 100 TWh per year. It is more complicated to calculate the carbon footprint, which is required to know the power resources used by the total miner network, while calculating the energy consumption can

be determined without error. Bitcoin also uses data models to make estimates of energy consumption in carbon footprint calculations, and estimates are made from this model to measure fossil fuel use of the mining network. These calculated estimates, however, contradict industry reports that claim to use data directly from data miners and arrive at very low estimates (Rennie, 2022).

The concept of "social licence" emerges in relation to Bitcoin and energy. This concept explains that strategies to own and maintain reputation capital are associated with the actions of people seeking legitimacy. In fact, this concept causes a loss of reputation by the public, mostly because disasters such as chemical spills threaten business activities (Moffat et. al., 2016). Like legitimacy, social licence acknowledges that social arrangements can come first (Jenkins, 2018; Gehman, Lefsrud, and Fast, 2017).

As of today, the frequently expressed concern about cryptocurrencies includes the environmental impacts associated with increased energy consumption and mining pollution. Upon considering the studies in this field, it is seen that such a concern is frequently raised along with the uncertainty it has created. Egiyi and Ofoegbu (2020) emphasized that although the impacts of Bitcoin are difficult to predict within the near future, it is predictable that the acceleration of its adoption could generate enough emissions for its electricity demand to produce emissions resulting in more than 2°C of global warming in a few decades. Nonetheless, they suggested that objectives are required to reduce demand for power to avoid potential demoralizing consequences of further cryptocurrency development. Browne (2021) stated that bitcoin mining can generate up to 36.95 megatonnes of CO_2 emissions per year. This rate is equivalent to New Zealand's per capita carbon footprint and more.

Undoubtedly, Bitcoin requires a large amount of energy as it has a significant market share (Corbet et al., 2019). Dilek and Furuncu (2019) studied Bitcoin mining and blockchain technology. The high amount of energy consumed by Bitcoin and its environmental aspects were discussed. With the increase in Bitcoin mining, the energy consumed has increased, and accelerated effects such as global warming and climate change, leading to environmental and social consequences. Krause and Tolaymat (2018) raised the question of the relationship between cryptocurrency mining and environmental damage. The current literature, research results have shown that people need more energy every year for bitcoin mining. For example, while 1005 kWh of electricity was used in January 2016, 60,461 kWH electricity was used

in June 2018 (Krause and Tolaymat, 2018). Although there are existing studies on energy consumption and economics (Dey and Tareque, 2019), an in-depth understanding of the relationship between the mechanism of cryptocurrencies and the amount of energy is a fascinating subject. Greenberg and Bugden (2019) examined the energy consumption of US local communities from using crypto mining. The results obtained covered the following: (1) the effect of covariates between energy supplies and prices, (2) uncertainty in socioeconomic benefits, (3) illegal cryptocurrencies, (4) environmental problems resulting from increased electricity use, and (5) separation from the national heritage and the community economic identity.

Mohsin (2021) noted that concerns existed about the long-term impacts of widespread cryptocurrency usage. He emphasized that these included the increased CO_2 emissions due to energy consumption in cryptocurrency mining. Goodkind, Jones and Berrens (2020) estimated the economic losses of air pollution emissions and related human deaths as well as climate impacts of cryptocurrency mining per coin both in the USA and China, and found that the value of every US$1 worth of Bitcoin generated in 2018 accounted for US$0.49 and US$0.37 worth of health and climate damage in the USA and China, respectively. Gallersdörfer, Klaaßen, and Stoll (2020) made predictions about currency units, regardless of the uncertainty in assessing the demand for energy and associated greenhouse gas emissions of cryptocurrencies. Based on the underlying algorithms and suitable mining devices, they concluded that Bitcoin accounted for two-thirds of the total energy consumption, whereas the remaining cryptocurrencies accounted for one-third. Also, it was emphasized that understudied currencies would add about 50% to the energy impact of Bitcoin, which alone could cause a significant level of environmental damage.

Wang et al. (2022) developed a new index of cryptocurrency environmental attention to address the concerns regarding sustainable growth in cryptocurrency markets. It was determined that the index had a significantly positive relationship with the “volatility index (VIX)”, Brent crude oil, and Bitcoin. Moreover the advanced index had a significant negative relationship with global economic policy uncertainty and global temperature uncertainty. Furthermore, the index had a significant and positive relationship with industrial production in the short run, but a significant and negative relationship in the long-run. Zhang et al. (2023) explored the environmental impacts of Cryptocurrency energy consumption on climate change. They highlighted the need to foster technological advances in developing

energy efficient decentralized finance consensus algorithms to transform the cryptocurrency market into a climate-friendly one. The results will provide policy implications, emphasizing the importance of decarbonizing the cryptocurrency ecosystem in addressing environmental concerns. In addition, according to Truby et al. (2022), the Art industry wanted to draw attention to the impact of NFT operations on climate change. It has commercialized and popularized non-fungible tokens (NFTs), as NFT transactions rapidly grew to about US$10 billion in the third quarter of 2021. The surge in NFT transactions has drawn the attention of the art market to the carbon emissions from the verification of transactions on proof-of-work blockchains that support NFT transactions. Along with the CO2-related deaths attributable to NFT transactions, social pressure from the art market has helped advance the shift from deliberately polluting proof-of-work blockchains to more sustainable consensus protocols. Many popular types of blockchains, however, have resisted pressure to reduce their environmental impact, including Bitcoin, whose 2021 annual emissions will produce emissions responsible for future deaths. Recent global policy interventions have used legal and financial tools to reduce the carbon impact of some or all blockchain types. By associating the damage caused by proof-of-work blockchains with climate change and human deaths, they examined recent policy interventions designed to motivate miners' energy efficiency to reduce environmental damage and effect change in blockchain consensus protocols.

In the present study, we focused on the causality relationship between the increase in global CO_2 emission values that cause climate change and the total energy consumption of the cryptocurrencies Bitcoin and Ethereum. The hypothesis of our study is:

H0: Total energy consumption of Bitcoin and Ethereum is not the cause of the increase in $C0_2$ emissions.

H1: Total energy consumption of Bitcoin and Ethereum is the cause of the increase in $C0_2$ emissions.

3. METHODOLOGY, DATASET, AND ANALYSIS

In this part, a brief description of the methodology used in the research study is made and the dataset and analysis phases are introduced in compliance with the study objective.

3.1 METHODOLOGY

In the research study, the relationship between Bitcoin and Ethereum and carbon dioxide (CO_2) emissions is investigated by performing the Toda-Yamamoto causality test. The omission of the stationarity of the series or the existence of a cointegration relationship in the analysis accounts for the preference for the Toda-Yamamoto test. In the conventional Granger (1969) causality test, on the other hand, it is necessary to ensure that the series is stationary and contains a cointegration relationship (Mecik and Koyuncu, 2020). Additionally, in our study, only causal analysis has been preferred. This is because regression analysis entails the dependency of one variable on another. However, this dependency does not imply causality. No matter how strong, a statistical relationship may not inherently indicate causality. Causality is established through theoretical examination. In our study, we focused on the causal relationship. We constructed a model based on the premise that the increase in global CO_2 emissions, caused by climate change, may be related to the total energy consumption of cryptocurrencies such as Bitcoin and Ethereum.

The fact that the series is stationary/cointegrated to the same degree according to the Toda-Yamamoto causality test does not hamper the test validity. This situation is not valid in the Granger causality test and may cause data loss by rendering the series stationary by taking the first difference.

In order to perform the Toda-Yamamoto causality test, the Vector Autoregressive (VAR) model is established first. The lag length (k) is determined with the established VAR model. Then, the highest degree of cointegration (d_{max}), is included in the obtained lag length (Mecik and Koyuncu, 2020). Here, unit root tests are performed to determine the stationarity degrees of the series (Ata and Yucel, 2003). The Dickey-Fuller (1979) (DF) test is one of the most widely used and oldest unit root tests. The DF test is based on the assumption that the error terms are statistically independent and have constant variance. The Augmented Dickey-Fuller (ADF) was proposed in 1981 for avoiding the autocorrelation problem that can be encountered in error terms upon performing the DF tests (Izolluoglu, 2019). The ADF is performed as the unit root test in the analysis part of the research study.

3.2 DATASET AND ANALYSIS

Recently, research studies suggesting that Bitcoin mining increases carbon emissions along with energy use have been attracting attention.

This situation accompanies the negative impacts of climate change (Iklim, 2018). In this context, this research study aims at investigating the causal relationship between the cryptocurrencies involved in Bitcoin mining and the level of carbon emissions that cause climate change. The total energy consumption predictions for Bitcoin and Ethereum, as well as the predicted trend of global CO_2 emission values, are discussed. The data used in the research study are the daily time-series data obtained over the period 20.05.2017- 04.08.2022. The beginning date of the obtained data is determined as 20.05.2017 since the earliest data on cryptocurrencies and carbon emissions that are the topics of the research have been simultaneously accessed on this date. CO_2 emission values are obtained from the Global Monitoring Laboratory (NOAA) (gml.noaa.gov). The latest predictions of the total energy consumption of the networks of Bitcoin and Ethereum are obtained from the website called digiconomist, which presents the data under the titles of "Bitcoin Energy Consumption Index" and "Ethereum Energy Consumption Index" (https://digiconomist.net/). During the analysis phase, Bitcoin is denoted by "BIT", Ethereum by "ETH", and carbon dioxide emission values by "CO_2". Toda-Yamamoto's (1995) Causality Test is preferred for analysis. Firstly, the ADF unit root tests are performed to determine the highest stationarity levels (d_{max}) of the data. Then, the optimal lag lengths are determined. Using the obtained information, the Toda-Yamamoto causality analysis is conducted. According to the analysis results, the relationships among the variables are determined. In this regard, the analysis results are presented as next. Before analysis, descriptive statistics for the variables are given in Table 1.

TABLE 1
Descriptive Statistics of Variables

	CO_2	BIT	ETH
Mean	411.0472	81.5866	25.0844
Standard Error	0.0818	1.1769	0.7121
Median	411.1900	73.1215	10.6450
Mode	405.2800	73.1215	11.7130
Standard Deviation	3.4483	49.6379	30.0360
Sample Variance	11.8910	2463.9202	902.1615
Kurtosis	-1.2135	0.9246	2.1265
Skewness	-0.0127	1.2653	1.8416
Count		1779	

4. RESULTS

4.1 UNIT ROOT TESTS

The existence of unit roots for the variables is determined by performing the ADF unit root tests. The hypotheses for the ADF unit root tests are as follows:

H0: Series is not stationary.

H1: Series is stationary.

In Tables 2, 3, and 4 presented below, the degrees of stationarity (d_{max}) of the series are examined. In Table 2, the stationarity of the variables is examined. ADF Unit root test is used to calculate the stationarity of the variables. "CO_2", "BIT" and "ETH" values are not stable at the level. The analysis is continued in order to determine the stationarity levels of the variables. Variables are reanalyzed by taking the 1st degree difference with the ADF unit root test.

Table 3 shows the ADF unit root test results. The stationarity of the variables at the 1st difference is determined. According to the results, "BIT" and "ETC" variables are stationary at the first difference.

The analysis is continued in order to determine the stability level of the "*CO_2*" variable.

The results of the second-order stationarity test of the "CO_2" variable are shown in Table 4. Looking at the ADF unit root test results, the "CO_2" variable became stationary at the second difference.

As can be seen from the tables above, according to the ADF unit root test results, the "*BIT*" and "*ETH*" series are stationary at the first difference. Again, according to the unit root test results, the "CO_2" series is determined as stationary at the second difference.

4.1.1 DETERMINATION OF LAG LENGTH

The optimal lag length in the VAR model is tested at the 5% significance level. The optimal lag length (k) indicated by the majority of the information criteria is chosen for the model. The test results for determining the optimal lag lengths by the VAR model are shown in Table 5.

As can be seen from Table 5, the optimal lag length is determined to be 8 according to the VAR model.

TABLE 2
ADF Unit Root Tests (At Level)

At Level	Constant		Constant with Trend		Non-Constant without Trend	
Variables	t-statistic	Prob. value	t-statistic	Prob. Value	t-statistic	Prob. Value
$C0_2$	0.3089	0.9788	-2.5343	0.3113	2.3354	0.9957
BIT	1.7042	0.9997	0.1317	0.9976	4.0888	1.0000
ETH	2.4863	1.0000	-0.8475	0.9998	3.4362	0.9990
Critical values at 1%, 5%, and 10% levels, respectively.	-3.43, -2.86, -2.56		-3.96, -3.41, -3.12		-2.56, -1.94, -1.61	

TABLE 3
ADF Unit Root Tests (1st Difference)

1st Difference	Constant		Constant with Trend		Non-Constant without Trend	
Variables	t-statistic	Prob. value	t-statistic	Prob. Value	t-statistic	Prob. Value
$C0_2$	-2.2262	0.1971	-2.2063	0.4852	0.6924	0.8650
BIT	12.6653	0.0000	-12.8272	0.0000	-12.0483	0.0000
ETH	-6.1405	0.000	-6.8688	0.0000	-5.6093	0.0000
Critical values at 1%, 5%, and 10% levels, respectively.	-3.43, -2.86, -2.56		-3.96, -3,41, -3,12		-2,56, -1,94, -1,61.	

TABLE 4
ADF Unit Root Tests (2nd Difference)

2nd Difference	Constant		Constant with Trend		Non-Constant without Trend	
Variables	t-statistic	Prob. value	t-statistic	Prob. Value	t-statistic	Prob. Value
$C0_2$	-19.6349	0.0000	-19.6365	0.0000	-19.6124	0.0000
BIT	-	-	-	-	-	-
ETH	-	-	-	-	-	-
Critical values at 1%, 5%, and 10% levels, respectively	-3.43, -2.86, -2.56		-3.96, -3,41, -3,12		-2,56, -1,94, -1,61	

TABLE 5
Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-19215.740	NA	535095.0	21.70383	21.7131	21.7073
1	6446.155	51207.870	1.40e-07	-7.2661	-7.2290	-7.2524
2	7387.081	1874.415	4.90e-08	-8.3185	-8.2535	-8.2945
3	7647.169	517.238	3.69e-08	-8.6021	-8.5093	-8.5678
4	7776.068	255.905	3.22e-08	-8.7375	-8.6168	-8.6929
5	7804.813	56.970	3.15e-08	-8.7598	-8.6113	-8.7049
6	7853.011	95.363	3.01e-08	-8.8041	-8.6277*	-8.7389
7	7879.075	51.480	2.96e-08	-8.8233	-8.6191	-8.7479
8	7903.566	48.289*	2.90e-08*	-8.8408*	-8.6088	-8.7551*

* Optimal lag length of the Information Criteria

4.1.2 TODA-YAMAMOTO CAUSALITY ANALYSIS

The causal relationship among the series in the analysis is investigated bilaterally. To this end, the Toda-Yamamoto causality test is performed along with the established models. Subsequently, the optimal lag length (k) is determined as eight. As a result of the analysis, the maximum stationarity level is determined as two. The hypotheses established to investigate the relationship among the variables are as follows:

H0: Independent variable does not cause the dependent variable.

H1: Independent variable causes dependent variable.

The results of the Toda-Yamamoto causality analysis conducted to determine the possible causal relationships between the CO_2 emission values and the energy consumption values of Bitcoin and Ethereum are presented in the following Table 6.

TABLE 6
Test Results

Hypothesis Models Dependent Variable - Independent Variable	$k+d_{max}$	Chi-Sq.Test Statistic	P-value	RESULTS
CO_2-BIT	10	14.0424	0.0807**	Related
BIT-CO_2	10	13.4884	0.0961**	Related
CO_2- ETH	10	10.1998	0.2513	Not related
ETH-CO_2	10	10.9429	0.2050	Not related
BIT-ETH	10	111.3593	0.0000*	Related
EHT-BIT	10	45.3443	0.0000*	Related

Probability values are statistically significant at the 1%* and 10%** significance levels. The optimal lag length is indicated by the majority of the information criteria. d_{max} = the maximum stationarity level according to the ADF unit root test results, k = VAR lag length.

Upon considering Table 6, the Chi-square test statistic p-probability values are determined by two analysis results in which the H_0 hypothesis is rejected at the 1% level, and two analysis results in which the H_0 hypothesis is rejected at the 10% level. As a result of the analysis, a bilateral causal relationship is found between Bitcoin and

CO_2 emissions at the 10% significance level. With this obtained result, it is possible to claim that Bitcoin and CO_2 emissions cause each other. Correspondingly, a bilateral causal relationship is detected between Bitcoin and Ethereum at the 1% significance level. With this obtained result, it is possible to claim that Bitcoin and Ethereum cause each other. As a result of the analysis, however, no statistically significant causality relationship is detected between CO_2 emissions and Ethereum.

5. CONCLUSION

In this study, the extent of the relationship between cryptocurrencies and carbon emissions is investigated. Based on recent frequently expressed concerns, the findings of this study support this relationship. According to the analysis results, a bilateral causal relationship is found between Bitcoin and CO_2 emissions. A bilateral causal relationship is detected between Bitcoin and Ethereum, whereas no causal relationship is found between Ethereum and CO_2 emissions. Nonetheless, detecting a causal relationship running from Ethereum to Bitcoin would indirectly lead to a causal relationship from Ethereum to CO_2 emissions, since a causal relationship exists from Bitcoin to CO_2 emissions. The results of this study concerning the causal relationship running from Bitcoin (and indirectly from Ethereum) to CO_2 emissions align with the results of similar studies in the literature. For instance; Goodkind et al. (2020) mentioned the environmental impacts of cryptocurrencies by emphasizing that each US$1 worth of Bitcoin value generated in the increasing Bitcoin market accounts for US$0.49 and US$0.37 worth of health and climate damage in the USA and China, respectively. Similarly, Gallersdörfer et al. (2020), who yielded similar results, reported that cryptocurrency energy consumption could generate negative environmental impact. Wang et al. (2022) developed a new index of cryptocurrency environmental attention toward the sustainability concerns of the growth of cryptocurrency markets. They observed that the index had a significantly positive relationship with Bitcoin, whereas it has a significantly negative relationship with global temperature uncertainty.

It is thought that there may be studies conducted in compliance with the increasing concerns with the environmental pollution that cryptocurrencies may cause along with energy consumption in the findings of a causal relationship running from CO_2 emission to Bitcoin. In the presence of such a remarkable concern, efforts are being made to fulfill the energy needs in mining activities using renewable energy resources instead of fossil fuels. In this context, the Bitcoin Mining

Council is promoting renewable energy usage to mitigate the environmental damage during cryptocurrency production. Moreover, it is stated that cryptocurrency miners increase the volume of renewable energy usage, and this rate is over 70% (Yenilenebilir Enerji Kripto", 2021). Within these improvements, while the share of renewable energy consumption of cryptocurrencies in total energy consumption is quite crucial, the amount of energy consumed by cryptocurrencies in the total energy consumption that causes CO_2 emission is also critically important.

As a result, the high energy consumption of cryptocurrencies, which has great potential, and the CO_2 emission pollution problems question sustainability of cryptocurrencies. Furthermore, it is expected that more studies on the environmental impacts of Blockchain technology would be conducted, and it would be possible to benefit from taking measures concentrated on sustainable development. In this regard, efforts should accelerate to increase the share of renewable energy usage in the energy consumed by cryptocurrencies.

This research study contributes to formation of the theoretical infrastructure in the relevant field. Considering the results of the research study, ideas are offered to policymakers to highlight cryptocurrency projects or technologies that reduce energy consumption or provide renewable energy usage. In the long term, the extent to which the adverse impacts of cryptocurrencies which are crucial investment instruments in the financial market would be reflected in the prices of cryptocurrencies is critical. Although it is observed that more research studies are needed in this field, such research studies would guide policymakers, researchers, environmentalists, and investors.

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HOW CORPORATE SOCIAL RESPONSIBILITY AFFECTS ORGANIZATIONAL SUSTAINABLE PERFORMANCE: THE MEDIATION ROLE OF GREEN INNOVATION AND GREEN HUMAN RESOURCE MANAGEMENT

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ABSTRACT

A company or business organization can achieve sustainable performance only when it is able to carry out organizational processes, functions, or operations so that the business or organization's activities do not damage environmental quality. Therefore, business or organizational transactions must be carried out with the aim of producing better social interactions with stakeholders such as suppliers, consumers, the general public, and the authorities. This research aims at exploring the direct relationship between Corporate Social Responsibility (CSR) and Organizational Sustainable Performance by involving the role of Green Human Resource Management (GHRM) and Green Innovation (GI) as mediating variables. Further, this study was conducted by using a literature review as a methodology in order to address the gap on these issues. The result of this study views an organization as a collection of human, physical, and organizational resources. These resources are valuable and incomparable for the green practice. Thus, they are a major source of sustained competitive advantage and sustainable performance. While for sustainable, three important ideas can be applied, i.e., considering the needs of future generations, institution matters, and new ways of thinking and perceiving. Finally, this study is expected to become a foundation for promoting sustainable performance of organizations that helps organizations to achieve competitive advantage by cultivating environmental awareness as part of their organizational strategy, which is also known as green management. Furthermore, this study provides new insights or knowledge for further research by developing a novel research model as a basis for further empirical research.

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1. INTRODUCTION

In the last stage of the industrial era, globalization has led to interdependence between nations and regions along with global problem. As “the necessary revolution”, individual, organization and government realize its effects are unsustainable. Interest in sustainable development around the world has emerged in many forms. However, the important revolution now starting is not just related to the ecological issues. The wrong dichotomy between ecological and environmental and social imbalance leads to ignoring that poor people suffer from environmental stresses in terms of food, water and basic necessities. For example, food and water can be a conflict as a social disruption in certain regions. China and India are on a collision course over water sources from the Himalayas in western China and northern India resulted in water-starved regions; continued growth in water usage will worsen matters (Senge, 2009). Sustainable organizational achievement is the dominant approach in today's world, with a trend toward increased profitability, healthy social and environmental conditions, recent economic disasters, and also green actions (Zhao et al., 2022; Zhao et al., 2021). Over the past few years, the need for sustainable environmental management has increased tremendously, and green management has emerged as an important organizational tool (Úbeda-García et al., 2022). The United Nations Sustainable Development Goals adopted by all member states in 2015 are the '2030 Agenda for Sustainable Development' (17 GOALS and Sustainable Development) which emphasizes the importance of addressing current problems in a sustainable way and not hindering future generations from meeting their own needs. As a result, current issues of poverty, health, education, inequality, and economic progress goals must be addressed so that countries find ways to deal with climate change and preserve the natural ecosystems (Ren, Tang, and Jackson, 2018). For example, the Singapore Environment Council ordered the recall of their products from all stores in Singapore. This incident highlights the strong effect of compliance with environmental issues on organizational economic performance of (Yusliza et al., 2019).

Sustainable and environmental issues are rapidly emerging as one of the most important topics for strategic business decisions, management, manufacturing, and product development. Awareness is a result of high demands on the natural environment which has been reflected in the innovative and environmentally conscious products offered to consumers (Saeed et al., 2019). Meanwhile, recognition of a direct relationship between CSR and corporate performance has shifted interest among authors recently (Úbeda-García et al., 2021). As we know, CSR makes them responsible to nature and society, which they affirm and seek resources for their business success (Shahzad et al., 2020). The concept of CSR, however, is not very popular and is still in the early stages of adoption, specifically in developing countries (Abbas, 2020).

Furthermore, the need to build a sustainable environment has given rise to the concept of Green Human Resources (GHR). Under these conditions, organizations focused on providing a green work environment must fulfill social responsibility to support the importance of a green environment of workers in society (Yasin, Huseynova, and Atif, 2023). We can identify the negative impact of a corporation's irresponsible action on the stakeholders that influence the workers deviant on the environment. For example, a study by Abbasi, Amran, and Sahar (2024) examined the impact of corporate environmental irresponsibility (CEI) on the workplace deviant behaviors (WDB) of Generation Z and Millennials by using moral outrage as mediation. In this term, Generation Z is the youngest generation in the labor market. The finding confirmed that CEI has a positive impact on the WDB of both generations. However, they revealed that sustainable performance by Generation Z is higher than in their predecessor generation; they found significant evidence related to the critical role of generational groups in understanding the emotional and behavioral actions of workers to CEI. Therefore, they confirmed that harming the environment will decrease organizational performance because of deviant worker behavior. Workplace deviant behaviors are rooted in motives. It can be the result of corporate environmental irresponsibility. They claimed that negative violation of expectation automatically will direct negative behaviors from the workers. It provides a new perspective for the executive management that it is crucial to eliminate social irresponsibility, especially from the new generation's lens such as generation Z. Therefore, green initiative can be realized by implementing Human Resource Management (HRM) practices that emphasize the environmental aspects of an organization's business operations – a concept known as GHRM

(Yusliza et al., 2019). The relevance between HRM significantly influences the perspective of CSR, is developed, and implemented; similarly, how companies approach social responsibility has implications for the treatment of workers (Úbeda-García et al., 2021). However, to the best of our knowledge, the prior literature fails to provide a clear link (if any) between CSR and GHRM which, if established, could provide practitioners with steps and guidance on how organizations can enhance their CSR through the adoption of GHRM practices, or vice versa. This can provide a better understanding of how implementing CSR can lead to more effective implementation of GHRM practices, which this research will explore (Yusliza et al., 2019).

At the same time, in an effort to achieve corporate sustainability, companies must prepare for Green Innovation (GI) by acquiring the required capabilities and resources (Zhang et al., 2020). The concept of GI is driven by external legal requirements as well as internal company conditions, such as organizational culture and available resources. Singh et al. (2020) confirmed that environmental performance depends on the quality of green processes and green product innovation. In addition, the results of research by Shah et al. (2021) showed that leaders and managers in organizations should regard GI as a strategic resource and utilize it to achieve corporate environmental management goals so that it can work well for GI environmental performance. However, until now, although it functions as a determinant of environmental strategy, the concept of GI has received little attention (Shahzad et al., 2020).

Furthermore, research on the relationship between CSR and GI has yet to show consistency (Wan, Jin, and Ji, 2023). Although we know that green human resource management (GHRM) is very important for enhancing a company's GI capability, this relationship has rarely been explored or tested empirically in the literature (Song, Yu, and Xu, 2021). Meanwhile, Chaudhary (2020) also conducted a study aimed at identifying the impact of GHRM practices on environmentally friendly behavior related to employee duties and volunteers. However, the results obtained still do not provide certainty. The study found that gender and environmental values fail to moderate GHRM and Organizational Identification. This finding corroborates the results reported by Dumont, Shen, and Deng (2017), where individual green values fail to moderate the effect of GHRM practices on green behavior in employee roles. It is surprising to note that the employee's task-related and extra-role-related behaviors are equally affected by an organization's GHRM practices. On the other

hand, the study by Khan et al. (2023) confirmed the importance of gender quality in implementing GHR practices to empower green work attitude and behavior. They examined the Green HRM, organizational identification and sustainable development supported by social identity theory. Specifically, this study examined the moderating effect of gender to the top management team operating in telecom sector firms in Pakistan. The finding revealed that GHR has a positive and significant influence on organizational identification and green worker behavior through moderating effect of gender. They postulated that when employees or workers view positive support from an organization through GHR practices such as training and practice, this will result in a green work attitude and behavior. Next, policymakers and managers have to implement GHR practices to increase gender equality. Green practices are critical for the organization or business to anticipate the negative environmental impact. They also pressure the organization or business to implement GHR practices and organizational identification for long-term performance. Another study by Kraus, Rehman, and García (2020) revealed that CSR does not have a significant direct effect on environmental performance, but is positively correlated with environmental strategy and GI, which again improves environmental performance, that is, significantly mediates between CSR and environmental performance. Chaudhary's findings (2020) found the indirect effect of GHRM on employee performance that is also supported by the findings of Saeed et al. (2019) where the relationship between GHRM practices and employee pro-environmental behavior is mediated by a pro-environmental psychological climate. These findings suggested that the adoption of GHRM practices by organizations makes employees identify strongly with them and display performance behaviors that benefit the organization. Therefore, this study presents original contributions to the following body of knowledge:

a. CSR and OSP studies are limited (e.g., Hang et al., 2022; Mbanyele et al., 2022; Malik et al., 2021; Zhao et al., 2021; Kraus et al., 2020).
b. There is still a lack of studies examining the role of GI (e.g., Padilla-Lozano and Collazzo, 2022; Muisyo et al., 2021; Shahzad et al., 2020; Singh et al., 2020; Sobaih, Hasanein, and Elshaer, 2020) and GHRM (e.g., Al-Swidi et al., 2022; Haldorai, Kim, and Garcia, 2022; Lu et al., 2022; Úbeda-García et al., 2021) as a mediator.

c. Some studies explore the relationship between CSR and sustainable performance using GHRM and/or GI as mediators. This study finds only the first empirical study by Zhou, Tiruneh, and Legese (2024) examining these relationships using environmental performance as the dependent variable. The study by Khan et al. (2023) examined sustainable performance by using the same aspects as this study; however, they investigated the role of organizational identification as a mediating factor on the link between GHR and sustainable performance. Thus, this study makes a new attempt that identifies the link between CSR and OSP (i.e., economic, social, and environmental aspects) which is broader than environmental performance.

Therefore, an effort to fill the gap mentioned previously is by identifying a direct relationship between CSR on Sustainable Organizational Performance by involving the role of GHRM and GI as a mediating variable for this research.

2. LITERATURE REVIEW

2.1 CORPORATE SOCIAL RESPONSIBILITY (CSR)

Most advanced organizations nowadays are adopting eco-friendly business practices and highlighting CSR activities to achieve Sustainable targets. For example, the success of Sun Pharmaceuticals Industries Ltd., an eco-friendly company registered in the healthcare sector in India, which linked its organizational activities to stringent GHRM activities starting from recruitment, selection, performance appraisal, orientation, training, and development as well as employee relations improvement in the workplace. The company gives top priority to investment in CSR to achieve Sustainable environment through green practices such as reducing the use of paperwork, collecting car facilities, using more natural sunlight during the day instead of electricity, working from home facilities, tree planting camps, teleconferences, and conducting annual 'Going Green' surveys (Suri and Banerji, 2016).

CSR for the last six decades has been interpreted as compensation for environmental pollution. Such compensation in most cases cannot compensate for the damage companies do to the natural environment (Wan et al., 2023). Specifically, there are several dimensions or elements of CSR as follows namely environmental,

economic, social (Sezen and Cankaya, 2013), community CSR, customer CSR, employee CSR (Úbeda-García et al., 2021), CSR confirmation, and CSR differentiation (Wan et al., 2023). Furthermore, experts propose CSR components, namely formal CSR tools, environmental-related CSR, workplace-related CSR, community-related CSR, market-related CSR (e.g., Padilla-Lozano and Collazzo, 2022), philanthropic, ethical, legal, and economical (Shahzad et al., 2020). Therefore, the practice of environmental protection and prevention of environmental pollution emerged as a result of environmental problems recently when humans realized that natural resources were limited which accelerated business-conscious action on environmental problems because they have the greatest responsibility for environmental pollution (Khanam, Sultana, and Mushtaq, 2023).

2.2 GREEN HUMAN RESOURCE MANAGEMENT (GHRM)

The current trend indicates that GHRM has promoted important key business strategies for organizations where the concept of the Human Resources Department provides an active role in greening the organization (Ahmad, 2015). Therefore, these initiatives have involved implementing effective environmentally friendly Human Resource (HR) practices, among other things, that are capable of producing higher efficiency, greater cost reductions, and increased employee retention and full engagement (Yusliza et al., 2019). The increasing awareness of companies or organizations and regulations concerning environmental Sustainability has led organizations to adopt the GHRM concept with the goal of producing effective Environmental Management (EM) within the organization (Ren et al., 2018).

Indeed, GHRM includes unique characteristics, and the concept of the Green Human Resource subsystem is different from the conventional HRM subsystem (Fayyazi et al., 2015). In this regard, Chams and García-Blandón (2019) postulated the following antecedents of Sustainable Human Resource Management (SHRM):

a. Environmentally Friendly Behavior (GB)

   Literature review reveals that individual characteristics, attributes, and behaviors are important drivers of sustained performance. Individuals are considered facilitators of organizational metamorphosis into more socially responsible and environmentally oriented entities.

b. Green Competency (GC)
Experts have conducted both qualitative and quantitative studies addressing GC and assessing its impact on SHRM.

c. Green Value (GV)
Apart from GB and GC, the convergence of individual and organizational values and the suitability of leadership traits with the work environment are predictors of SHRM. Leadership style has been identified in the literature that shows the type initiates of sustainable development. Further, it assists in SHRM implementation.

Indeed, GHRM is built on organizations engaging in practices related to environmental protection and maintaining ecological balance. Therefore, GHRM is an important approach to promoting sustainable organizational development. Although the literature on GHRM effects is growing, little is known about the mechanisms and boundary conditions that may facilitate the relationship between GHRM and green outcomes (Abualigah et al., 2022). Saeed et al. (2019) and Zaid, Jaaron, and Bon (2018) found that GHRM practice has a positive impact on employee pro-environmental behavior, and environmental psychological capital has a mediating role in this link. In this case, GHRM practices are expected to increase the employee's ability to generate creative ideas and solutions for green practices. In other words, GHRM practices, such as green training and development and green performance appraisal, should increase employees' dedication to their green work and maintain their absorption in carrying out environmental tasks (Abualigah et al., 2022).

Meanwhile, top management commitment and a culture of sustainability play a critical moderating role in improving environmental management practices and developing resource pools (green human capital) in companies (Padilla-Lozano and Collazzo, 2022). In this case, the interaction of Green Human Resource practices and the attitude of top managers will lead to more effective adoption of environmental practices which will ultimately enhance the company's green human capital (Song et al., 2021). Therefore, the main objective of GHRM is to make employees aware of environmental management namely what actions are required, how they function, and how to help the environment. This practice motivates employees and builds a sense of pride for being part of the program go green (Ahmad, 2015). Specifically, this study attempts to identify several GHRM elements as in Table 1.

TABLE 1
Components of Green Human Resource Management (GHRM)

Components	Author/Year
Green Training and Development	Wen et al. (2022), Amjad et al. (2021), Muisyo and Qin, 2021), Malik et al. (2021), Úbeda-García et al. (2021), Amrutha and Geetha et al. (2020), Chaudhary (2020), Al-Romeedy (2019), Yusliza et al. (2019), Zaid et al. (2018), Ahmad, S. (2015)
Green Performance	Yusliza et al. (2019), Ahmad (2015)
Green Performance Assessment	Wen et al. (2022), Amjad et al. (2021), Chaudhary (2020), Al-Romeedy (2019), Yusliza et al. (2019)
Green Awards and Recognition	Jamal et al. (2021), Malik et al. (2021), Amjad et al. (2021), Amrutha and Geetha et al. (2020), Chaudhary (2020), Malik et al. (2020), Al-Romeedy (2019), Yusliza et al. (2019), Ahmad, S. (2015)
Preservation of Knowledge Capital	Padilla-Lozano and Collazzo (2022)
Green Ability	Muisyo and Qin (2021), Chaudhary (2020), Singh et al. (2020), Sobaih et al. (2020)
Green Motivation	Úbeda-García et al. (2021), Sobaih et al. (2020), Singh et al. (2020)
Green Opportunity	Muisyo and Qin (2021), Singh et al. (2020)
Green Jobs Analysis and Description	Wen et al. (2022), Malik et al. (2020), Al-Romeedy (2019), Yusliza et al. (2019)
Green Recruitment	Al-Romeedy (2019), Chaudhary (2020); Muisyo and Qin, (2021), Malik et al. (2020), Wen et al. (2022), Wen et al. (2022), Úbeda-García et al. (2021), Yusliza et al. (2019), Ahmad, (2015), Jamal et al. (2021), Malik et al. (2021)

TABLE 1 *(continued)*

Components	Author/Year
Green Selection	Wen et al. (2022), Jamal et al. (2021), Malik et al. (2021), Muisyo and Qin (2021), Úbeda-García et al. (2021), Chaudhary (2020), Malik et al. (2020), Yusliza et al. (2019), Al-Romeedy (2019)
Green Induction	Al-Romeedy (2019)
Green HRM Practice	Amrutha and Geetha et al. (2020), Al-Romeedy (2019)
Green Employee Acquisition	Amrutha and Geetha et al. (2020), Al-Romeedy (2019)
Green Employee Assessment	Amrutha and Geetha et al. (2020)
Green Engagement	Jamal et al. (2021), Úbeda-García et al. (2021), Amrutha and Geetha et al. (2020), Chaudhary (2020), Zaid et al. (2018)
Green Health and Safety	Amrutha and Geetha et al. (2020)
Green Discipline Management	Amrutha and Geetha et al. (2020)
Green Initiative	Muisyo and Qin (2021)
Green Performance Evaluation	Malik et al. (2021), Malik et al (2020)
Green Skills Development	Úbeda-García et al. (2021)
Environmental Beliefs	Zhu et al. (2021)
Green Organization Identity	Zhu et al. (2021)
Green Recruitment	Zaid et al. (2018)
Green Performance Management and Compensation	Zaid et al. (2018)
Green Employee Relations	Ahmad (2015)
Green Environment Training	Malik et al. (2020)

Source: Compiled by Authors (2024)

Finally, this study tries to generalize the elements of GRHM Practices into seven types as follows:

a. Green recruitment and selection
   Involve recruiting and selecting candidates with green awareness through tests intended to ensure that employees have a positive attitude towards environmental issues, supplemented by questions related to environmental beliefs, values, and knowledge (Úbeda-García et al., 2021).
b. Green recruitment
   A system that focuses on the importance of the environment and makes it a key element in the organization. Recruitment for candidates with the concept of green thinking will facilitate the recruitment of professionals who are aware of sustainable processes and are familiar with foundations e.g. recycling, conservation, and creating a more logical world (Ahmad, 2015).
c. Green performance assessment (GPA)
   In understanding whether adopting and promoting green behavior by employees is considered one of the main performance indicators and is measured during the performance appraisal process (Mishra, 2017).
d. Green Training and Development
   One of the reasons for providing employee training and development is to implement positive practices toward the environment that can be used as a signal to prospective employees about how they will potentially be treated (Yusliza et al., 2019).
e. Green Reward and Compensation
   The main process of HRM activities is where employees are rewarded for their performance. This HR practice is the most powerful method of linking individual interests to organizational interests. Incentives and rewards can maximally influence employee attention at work and motivate them to exert maximum effort to achieve organizational goals (Ahmad, 2015).
f. Green Employee Relations
   An aspect of HRM that is concerned with building friendly employer-employee relationships that facilitate employee motivation and morale and increase productivity. Employee relations involve employee participation and empowerment activities that help prevent and resolve problems arising in the workplace that may affect work so that positive employee

relations are an intangible and long-lasting asset as well as a source of competitive advantage for any organization (Ahmad, 2015).

g. Green Initiative for HR

Many issues related to GHRM must be considered by the Human Resource Department before implementing green initiatives and all of them cannot be contained in one document. Because of space limitations, this study focuses briefly only on some of the key green initiatives for the development of HR departments as follows:

- Green Buildings
  Organizations worldwide are increasingly choosing green buildings as their workplaces and offices as alternatives to traditional offices. This phenomenon is quite trend-setting because green buildings meet certain criteria useful for reducing the exploitation of natural resources used in their construction (Ahmad, 2015).
- Paperless Office
  Statistics show that paper wastage is one of the top workplace concerns. In this regard, efforts are made to understand the role of Human Resource in providing soft copies of internal documentation (including plans and policies) to facilitate paper reduction, paper recycling, and so forth (Mishra, 2017).
- Energy conservation
  The organization also develops the extensive use of energy-starred light bulbs and lamps which undoubtedly consume at least two-thirds less energy than ordinary ones (Ahmad, 2015).
- Recycling and Waste Disposal
  Recycling is a methodology for processing used materials (waste) into new and useful products. Recycling reduces the use of raw materials that should be used to produce new products. Thus, this practice saves energy and reduces the amount of waste that goes into the trash, resulting in a cleaner environment and fresher air (Ahmad, 2015).

As mentioned by Chaudhary (2020), employees are expected to display more green behavior when their environmental values match the organizational green values. Since GHRM reflects organizational environmental values, it is proposed that employees'

environmental values will influence the nature of the relationship between GHRM and employees' green behavior in such a way that the relationship will be stronger when environmental values are high and vice versa.

2.3 GREEN INNOVATION (GI)

Green innovation (GI) can be defined as the development of new or better products, processes, or technologies that simultaneously present economic and environmental advantages (Lian, Xu, and Zhu, 2022). In other words, green human capital is a company's unique asset, and employees with unique green knowledge and skills can create and enhance opportunities for GI (Song et al., 2021). Therefore, a "green" innovation culture is seen as employee beliefs and behaviors related to improving the natural environment. The strong foundation in Environmental Management (EM) research is that extraordinary results can be achieved not only by overhauling production processes, products, or raw materials but also by implementing corporate culture so that companies have an adequate attachment to sustainable development (Muisyo and Qin, 2021). Furthermore, Sobaih et al. (2020) suggested that the GI component can be divided into three categories, namely product, service, and procedure innovation. Meanwhile, Zhang et al. (2020) suggested that they are green process innovation, green product innovation, and green managerial. However, this study identified that in general experts propose GI into two aspects, namely green product innovation and green process innovation (e.g., Padilla-Lozano and Collazzo, 2022; Muisyo and Qin, 2021; Singh et al., 2020; Song et al., 2020; Xie, Huo, and Zou, 2019). Furthermore, the study by Xie et al. (2019) also identified that green product innovation mediates the relationship between green process innovation and firm financial performance and that a firm's green image moderates the relationship between green product innovation and financial performance. The result of the study, however, revealed that the effect of the moderating variable, i.e., green subsidies on the link between green product innovation and firm financial performance was not supported.

Therefore, it acts as an antecedent of the green process innovation, i.e., by presenting new insights into the configuration for intangible assets. The findings of the study showed that, in the context of green, there are three aspects, i.e., intellectual capital, individually and interactively that support development of process innovation for

the performance. Of the three, human capital appears to have the strongest influence on process innovation performance. Employee knowledge and experience will facilitate the development and dissemination of knowledge in the organization, hence improving the innovation performance process (Jirakraisiri, Badir, and Frank, 2021). It is conceivable that exploitative GI and exploratory GI can be linked to environmental performance in their own way. Besides, the types of GI may be different in how they influence their action in a mediating role. It is hoped that future research will further differentiate between the various types of GI. In addition, it is also important to carry out further analysis of the company's environmental strategy and its efficacy (Rehman et al., 2021).

2.4 ORGANIZATIONAL SUSTAINABLE PERFORMANCE (OSP)

Global trends have increasingly reflected growing societal concern for the environment, prompting organizations and businesses to adopt environmentally friendly practices to maintain performance and competitiveness. The objective of the company or organization is not only to maximize profit but also it aims to provide sustainability by adopting sustainable growth and the highest performance (Hang et al., 2022). Therefore, it needs for organizations to focus on systematic methods when they implement the concept of green performance management. One way is that adopting green performance management standards is a priority for some types of organizations. Green performance management creates green performance indicators to define a set of green criteria for all members in performance appraisal, covering topics such as environmental incidents, environmental responsibility, carbon emission reduction, and communicating environmental issues and policies (Saeed et al., 2019). Furthermore, to achieve organizational environmental performance, several variables can generally be used to support direct and indirect relationships to organizational sustainable performance as shown in Table 2.

TABLE 2
Direct and Indirect Relationship with Organizational Sustainable Performance (OSP)

Author/Year	Direct effect	Indirect Effects	Findings
Amjad et al. (2021)	GHRM practices namely training and development, performance appraisal, and reward compensation on organizational sustainability	The mediating effect of environmental performance and employee performance	Significant effects of GHRM practices on organizational sustainability. This study also supports the hypothesized role model of mediating environmental performance and employee performance between GHRM practices and organizational sustainability
Jamal et al. 2021	GHRM practices, i.e. green recruitment and selection, green salary and rewards, and green engagement in organizational sustainability	-	GHRM practices have no significant effect on company sustainability
Malik et al. (2020)	GHRM Practices (green job analysis and description, green recruitment and selection, green environment training, green performance evaluation, green rewards) and Green Intellectual Capital	-	The two dimensions of the practices of GHRM (green recruitment and selection, and green rewards) and green intellectual capital (green human capital, green structural capital, and green relational capital) have a positive effect on corporate sustainability. Meanwhile, no significant relationship was found between green performance evaluation and green training on sustainable performance.
Malik et al. (2021)	GHRM Practices: Green recruitment and selection, green training, green performance evaluation, green awards, and Corporate Social Responsible GHRM and corporate ability Organizational Citizenship Behavior (OCBE) and Sustainable Performance	Mediating Effects of Organizational Citizenship Behavior	Organizational citizenship behavior on the environment significantly mediates the link between CSR and the practices of GHRM. In addition, there is a significant positive impact of CSR on sustainable performance. Meanwhile, OCBE has a positive effect on sustainable performance.
Sezen and Cankaya (2013)	Green Manufacturing and Eco-innovation on Sustainable Performance	-	Applications of Green Manufacturing influence significantly environmental and social performance show. In addition, environmentally friendly process innovation has a significant positive impact on corporate sustainability. However, green product innovation did not significantly influence any of the three types of performance.

TABLE 2 *(continued)*

Author/Year	Direct/Immediate effect	Indirect Effects	Findings
Ganapathy et al. (2014)	Eco-Innovation on Sustainable Performance	-	Invention demonstrated that training on environmental-related practices can address innovation and social aspects in the Indian manufacturing sector context.
Imran, Alraja, and Khashab (2021)	GHRM and Big Data on Sustainable Performance	The mediating effect of GI	GHRM and Big Data have a positive and significant effect on GI. In addition, GI influences the sustainable performance
Le (2022)	Corporate Green Strategy and Sustainable Corporate Performance	Mediating the role of CSR and GI	There is an integration of three green elements namely green strategy, green corporate social responsibility, and GI to improve environmental performance. Meanwhile, there is also a significant mediating effect of CSR and GI.
Shahzad et al. (2020)	The CSR dimension has an impact on sustainable development that is environmentally sound and subsequently GI	Environmental Sustainable Development Mediating Effects	All CSR dimensions were found to be significantly positive toward environmentally sustainable development. Furthermore, environmentally sound sustainable development positively enhances GI.
Yasin et al. (2023)	Environmentally friendly HRM in employer branding	The mediating effect of corporate ES and corporate social sustainability.	GHRM has a positive effect on corporate sustainability. Furthermore, CSR has a positive influence on corporate branding. The results also support the effect of mediating role corporate ES on the link between GHRM and CSR
Wen et al. (2022)	GHRM Practices and Environmental Sustainable (ES)	The mediating role of CSR	Practices of Green HRM have a significant and positive effect on ES. Furthermore, the second hypothesis is not supported (CRS has any positive impact on ES through green HRM practices). In addition to the direct impact, the indirect impact of the influence of green HRM practices on CSR is positive and significant. Finally, the authors define green HRM as the practice of influencing ES through the partial mediation of CSR.
Zhao et al (2022)	Analyzing the role of GHRM and CSR mechanisms in order to achieve the sustainable performance of the organization	Performance Organizational Sustainable mediates the relationship between GHRM and OP Perceived Organizational Support (PO) mediates the relationship between CSR and OP	The findings from the study show the significance of all hypotheses proposed and validate the study model.

Source: Compiled by Authors (2024)

Based on the description in Table 2, it is known that in general, there is a significant influence of certain variables (e.g., GHRM, Green Intellectual Capital, CSR, Eco-Innovation, and others) on the Sustainable performance of an organization. However, this study also found contradictory findings that did not show a significant relationship between GRHM and corporate sustainability, as shown in the research by Jamal et al. (2021). An earlier study by Sezen and Cankaya (2013) found that green product innovation was not found to have a significant effect on any of the three types of performance. Likewise, research by Malik et al. (2020) also revealed that only two GHRM dimensions have a significant effect on business sustainability. These findings indicate insufficient resources, lack of knowledge about training, and traditional task completion methods might be the reasons for the insignificant relationship. Thereby, when companies are faced with environmental problems, green performance appraisals can provide feedback to employees about their environmental contributions, motivating them to achieve the environmental knowledge and skills needed to build green human capital. In addition, compensation practices related to environmental management are effective in generating employee commitment to, and efforts on behalf of, environmental management, thus enhancing the company's green human capital. In other words, with increasing environmental pressures, companies can acquire and maintain green human capital by adopting Green Human Resource practices (Song et al., 2021).

2.5 THE RELATIONSHIP BETWEEN CSR AND OSP: THE MEDIATING ROLE OF GI AND GHRM

Business trends around the world have changed rapidly because of the competitive environment. Companies are not enough to gain profits and gain a competitive advantage but are also being sued and must be responsible for environmental impacts (Kraus et al., 2020). Meanwhile, CSR differentiation is assessing the level of relationship with certain stakeholders and emphasizing the further strengthening of already established core competitive advantages. This categorization contributes to the analysis of the problem in terms of CSR connotations. Moreover, although research has focused more attention on the concept of the CSR-HRM nexus, a more comprehensive examination is needed of the link between these two constructs. It has not been carried out, especially concerning the potential relationship between GHRM and CSR. Such efforts seem to us highly relevant and it is necessary to bear in mind that several significant interfaces exist

between GHRM and CSR which have not been explored adequately or systematically. With regard to HR practices, instrumental CSR-HRM research has primarily considered CSR as a means of enhancing these practices to the extent that they contribute to organizational goals and economic performance. For example, the concept of CSR is considered a way to improve recruiting practices to attract the best talent, motivate employees and upgrade their commitment to organizational goals (Úbeda-García et al., 2021).

Specifically, considering the various types of strategic targets for CSR compatibility and CSR differentiation, the effect of the GI concept may also differ. Thereby, additional studies are needed to increase the development of knowledge concerning the link between various types of CSR and GI (Wan et al., 2023). Although many companies or organizations implement GI for sustainable development, it looks like not all are successful.

In particular, Zhang et al. (2020) emphasized that the application of GI relies on three aspects:

a. Technology Readiness

It refers to the characteristics associated with a technology that will be adopted by a company as an important asset for GI.

In this term, technological readiness can be categorized into 2 elements:

- Technology Compatibility: as a necessary condition, when a concept of GI demands resources that are not available or comes about changes that are not in accordance with its strategic objectives, implementation will be very difficult.
- Relative Advantage

  The relative advantage in terms of utilizing GI technology for corporate sustainability is a condition that sufficiently facilitates implementation efforts.

b. Organizational Readiness

It refers to the characteristics of a company that are important in the implementation of GI which can be divided into:

- Innovation Capability: in this sense, it is a necessary condition for GI at the organizational level.
- Environmental concern: it is a sufficient condition for employees to fully engage and commit to the implementation of GI activities.

c. Environmental Readiness

It refers to external pressures that drive companies to pursue GI. Institutional theory suggests that external pressures motivate

organizations to develop performance measures for Sustainable benchmarking.

- Policy orientation: it lays the bottom line for GI; policy orientation serves as a necessary condition of the environment.
- Market Orientation: it can be considered as an aspect of sufficient environmental readiness conditions.

Furthermore, Zhang et al. (2020) argued that in order to carry out GI namely green managerial innovation, green process innovation, and green product innovation successfully, companies need to meet the necessary and sufficient conditions from the technological, organizational, and environmental dimensions. First, they must ensure that they build a green culture, adopt compatible technologies and comply with environmental policies. Therefore, to reduce environmental pollution and get sustainable development, companies or organizations need to promote vigorously the concept of green creativity among the workers (Al-Ghazali and Afsar, 2021).

These opinions, however, have raised a fundamental question for the organization or business, i.e., how can a corporate implement GHRM and GI still survive in the marketplace. For this case, Senge (2009) shared the essential idea of green management for creating a more sustainable future as the necessary revolution for the organization or business, i.e., seeing systems, collaborating across boundaries, and shifting from problem-solving to creating. Specifically, in determining crucial problem as the necessary revolution for sustainability, there are three important ideas for creating a sustainable future as the new paths:

a. Have to consider the needs of future generation.
   The terminology of sustainability is widely applied to show the need to live in the present but does not jeopardize the future that demands corporation to take into account the demands of the next or future generation such as our children, families, society, and business. Thus, it is not just referring to the present demands.
b. Institutions matter
   Besides the actions of individuals, the world is also created by networks of business and governmental and non-governmental institutions that influence the product of our business. The changes needed in future years thus require fundamental shifts on the function of the institution-individually and also collectively.

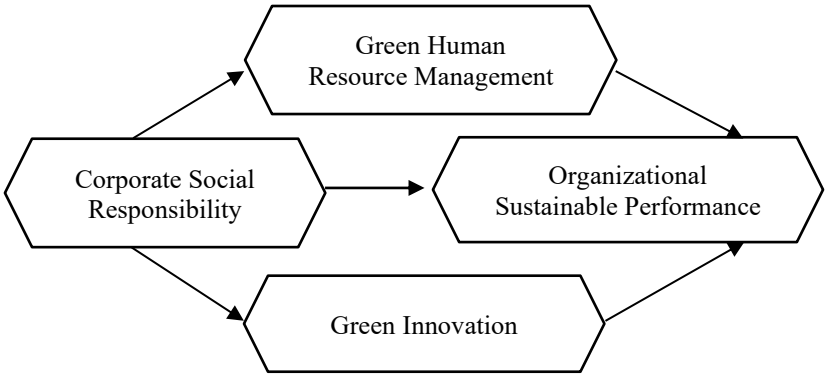
c. New ways of thinking and perceiving
All change can be a real when there are new ways of thinking and perceiving. The way of institution operating is a direct outcome of how we operate-how people think and also interact. Thereby, we cannot find solutionswith the same kind of thinking.

Therefore, it is urgent radically to move the three ideas of sustainable as suggested previously when corporation are ready to face turbulence in achieving sustainable organizational performance by using the green management method through implementing CSR, GHRM and GI.

3. METHODOLOGY

To answer the gaps presented in this study that will be able to contribute to the issue of Sustainable of organizational performance, then this study adopts the literature review method as a basis for further empirical studies. Further, there are 95% of articles ranging from 2020-2023 used as information sources based on Google Scholar, SCOPUS, ProQuest, Sage Journals, and other information sources. Then, this study proposes a literature review study that functions as a basis for further empirical research that creates a new research model in order to identify the main role of GHRM and GI as a mediating variable in the relationship between CSR and OSP. Therefore, this study categorizes research subjects based on direct and indirect relationships since this research uses mediating variables on the relationship between CSR and OSP (see Figure 1).

FIGURE 1
Research Model



4. CONCLUSION AND IMPLICATION

Top management can demonstrate their commitment to the environment by incorporating it into their mission and making it part of business goals and priorities, thereby demonstrating their full support for environmental sustainability. Top managers and ownership groups can prioritize environmental issues when establishing operational strategies and practices. Therefore, they can develop clear written policies that communicate their commitment, thereby providing the necessary leadership and resources to maintain the environmental standards required in the organization. Their environmental commitment must not only be communicated to employees but also to their suppliers, contractors, and subcontractors, as well as their customers. Thus, top management can link their commitment to CSR, GHRM, and GI and to complete environmental initiatives introduced by the organization. They must play an important role in increasing active involvement of organizations in OSP practices (Haldorai et al., 2022).

This study presents implications from practical as well as theoretical aspects. First, based on the practical aspect, this study will become a foundation for promoting sustainable performance of organizations which helps organizations achieve competitive advantage by cultivating environmental awareness as a part of their organizational strategy which is also known as green management. Second, from a theoretical aspect, this study provides new insights or knowledge for further research by developing a new research model as a basis for subsequent empirical research. This research also has limitations that only identify the role of mediating variables to support OSP success. Thus, this research suggests further research to explore other variables that can act as a moderator to empower organizational sustainable performance.

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MOOD AND EMOTION EFFECT ON AUDITOR JUDGMENT AND DECISION-MAKING: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This study analyzes the trends, progress, and opportunities for future research on the relationship between emotions, moods, and auditors' judgment and decision-making (JDM). We included 24 articles from the Scopus database through a systematic review process using the framework of Hoque (2014) in our literature review. Bibliometric analysis shows interesting developments in the topics of mood, emotion, and auditors' JDM. In particular, the results highlight the evolution of publications in top accounting journals, theoretical development, research context and setting, methods used, and statistical analysis tools. The findings also map the study areas covering five main topics: risk and probability assessment, risk decisions, ethical assessment, conflict resolution, and commitment to professional decisions. In general, previous studies show that emotions and mood can influence auditor judgment when assessing the risk and probability task, affect conservatism, ethical judgment, conflict resolution strategies, and commitment to the profession. One limitation is that the number of articles is small because the related studies are underexplored. Nevertheless, this study contributes to mood and emotion research on auditor JDM by discussing research trends, highlighting current study progress, and identifying future research gaps. We highlight opportunities for further exploration in this field.

JEL Classification: M41, M42

Keywords**:** Auditor, Judgment and Decision-Making, Mood, Emotion, Systematic Literature Review

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1. INTRODUCTION

During the audit process, auditors may experience many things that can affect their mood and emotions. Meanwhile, psychological research shows that emotions and moods influence individual judgments (Finucane et al., 2000). Given that most of an auditor's work involves professional judgment, understanding the impact of moods and emotions on auditing is crucial (Bhattacharjee and Moreno, 2013). This topic is very important but underexplored, so much further research still needs to be done.

A previous study by Bhattacharjee and Moreno (2013) summarized six studies regarding mood, emotions, and auditing. They confirm that mood and emotions are very important in the audit process because they can influence the auditor. Their review, however, only focused on identifying the types of emotions associated with audit assignments, such as client liking, negative feelings, and mood, without examining the impact of these emotions on auditors' Judgment and Decision Making or JDM. Apart from that, another study by Geng and Kalargiros (2022) only focused on experimental studies and did not have a comprehensive literature review.

The preceding discussion shows that no systematic literature review specifically documents the relationship between mood, emotions and auditors' JDM. Our study aims at filling this gap by conducting a systematic literature review. Specifically, this research:

a. Analyzed the trending topics, theories, research settings, methods, and data analysis techniques related to the relationship between mood, emotion, and the auditor's JDM.
b. Analyzed the future research opportunities related to the relationship between mood, emotion, and auditor's JDM.

This study contributes to auditor JDM research in several ways.

First, we conducted a bibliographical analysis of previous studies related to mood, emotion, and auditors' JDM topics. This analysis will help us obtain an overview of the distribution of studies on this topic and identify still unexplored areas. The bibliographical analysis we conducted included journal and publication quality, topics, theories, research settings, methods, and data analysis techniques. Second, we synthesized the previous studies and grouped them into five main topics in the auditor's JDM area: risk and probability judgment, risk decision, ethical judgment, conflict

decision, and commitment to professional decision. Finally, we identified specific gaps and provided recommendations for future research questions on each of these topics.

The remainder of this paper is organized as follows. The next section discusses the methodology used in this systematic literature review. Section 3 shows the bibliometric analyses used in current studies, including the distribution of article frequency based on journal category, publication quality, topic, theory, research setting, research method, and data analysis techniques. Section 4 discusses the current progress of previous research in five auditors' JDM topics: risk and probability judgment, risk decision, ethical judgment, conflict decision, and commitment to professional decision. This section also provides suggestions for future research. The final section presents the conclusions of this literature review.

2. METHODS

This research uses a systematic literature review approach, aiming to provide a comprehensive basis for future research and summarize existing problems (Khalique et al., 2020; Petticrew and Roberts, 2006). This approach is a suitable method for providing a critical review of the literature to identify, organize, and analyze existing research (Gholami et al., 2021). Various terminologies for literature reviews have been used in previous studies (example: traditional review, critical review, research synthesis and meta-analysis, systematic literature review, and structured literature review), but they share the core characteristics of collecting, evaluating, and presenting research evidence (Arksey and O'Malley, 2005). Massaro, Dumay, and Guthrie (2016) suggest that systematic reviews and structured literature reviews follow a more rigorous set of rules compared to other types of literature reviews. These reviews offer a thorough and comprehensive map of the research landscape (Denyer and Tranfield, 2006). They differ from rapid reviews, traditional literature reviews, or narrative reviews, which are more subjective and rely heavily on the researcher's expertise. Because of this reliance, these types of reviews are sometimes referred to as critical reviews. The differences between various literature review terms are illustrated in Figure 1. Our study follows a systematic literature review methodology to provide a comprehensive and unbiased picture of the relationship between mood, emotions, and auditors' JDM.

FIGURE 1
The Differences Between Literature Reviews

This literature review was carried out following the Hoque (2014) framework with modification. Each systematic step is shown in Figure 2. To do so, we first set the topic to be reviewed as the relationship between mood, emotion, and the auditor's JDM. Second, we determined the objectives and research questions of the study. This study analyzes trends, progress, and future research opportunities related to auditors' JDM topics. The research questions in this study were:

a. What are the trending topics, theories, research settings, methods, and data analysis techniques related to the relationship between mood, emotion, and the auditor's JDM?
b. What are the future research opportunities related to the relationship between mood, emotion, and auditor's JDM?

After determining the research questions, we entered the third stage by searching for related articles in the Scopus database. The Scopus database has been widely used for literature review studies (e.g., Anggraini and Sholihin, 2023; Casino, Dasaklis, and Patsakis, 2019). This database is considered reputable by regulators in several developing countries, such as Indonesia, Malaysia, and Taiwan. Thus, relying on the development of a study using the Scopus database is acceptable. The search was based on titles, abstracts, and keywords containing "mood" OR "emotion" OR "feeling" AND "auditor." The keywords were selected based on their frequent usage in article abstracts within this topic area. Additionally, these keywords have been used in previous review studies (e.g., Bhattacharjee and Moreno, 2002, 2013; Geng and Kalargiros, 2022) hence ensuring consistency and relevance in our literature review. The search period covers all years up to 2022, as this research was conducted in early 2023. The overall search code used in the database is as follows: (TITLE-ABS-KEY (mood) OR TITLE-ABS-KEY (emotion*) OR TITLE-ABS-KEY (feeling) AND TITLE-ABS-KEY (auditor)) AND PUBYEAR < 2023. A search using these keywords yielded 146 articles. Searches were then filtered for management, accounting, economics, social, and decision science areas, and limited to journal articles. This search strategy resulted in a total of 86 articles.

The fourth stage involved selecting articles obtained in the previous search. Several criteria are applied in this process, namely, accessibility, universality, publication quality, and relevance. Accessibility refers to the ease with which an article can be accessed online. All 86 articles can be accessed by the authors. Universality is an article that uses the international language, English. Two articles

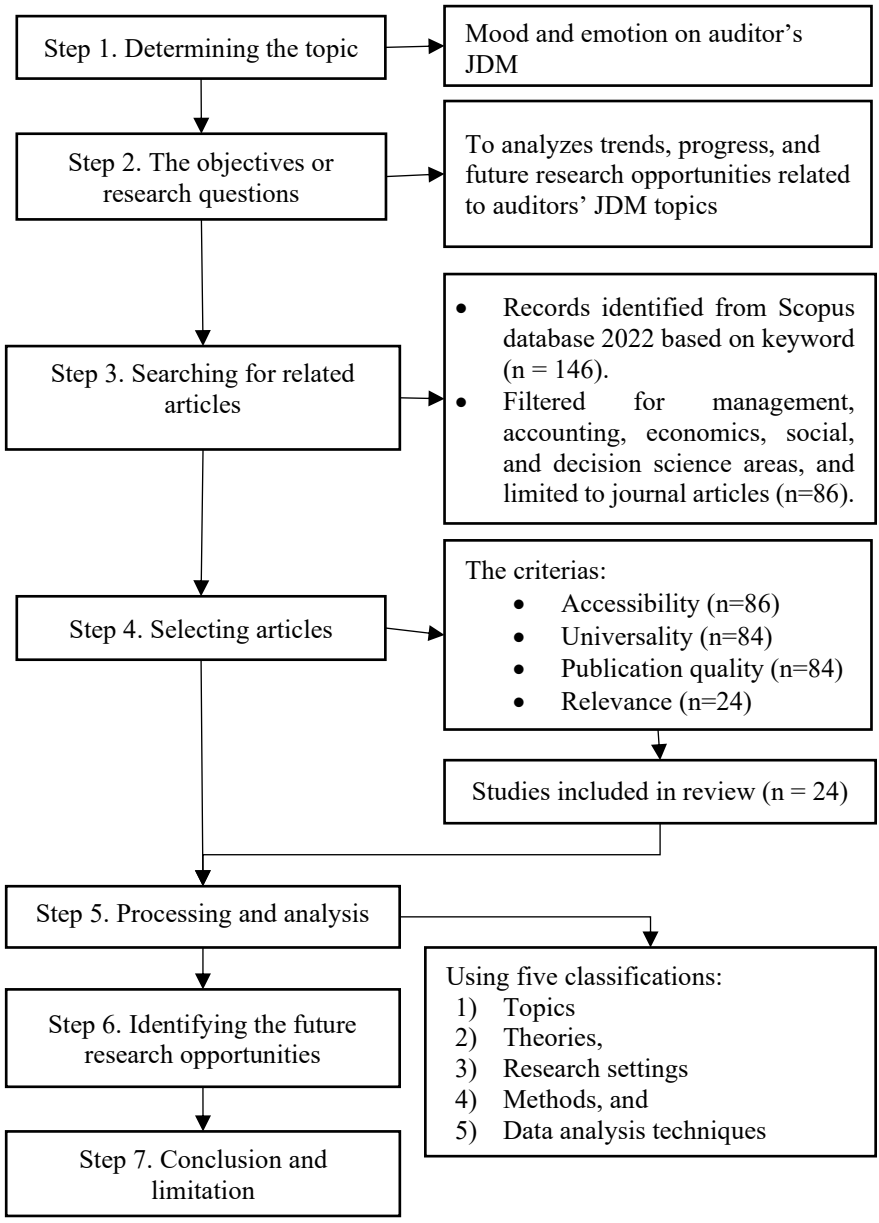
were not in English, so they were excluded. Publication quality refers to articles published in journals indexed globally and registered in the Scimago Journal Ranking. The articles included in the review fell into quartiles one to four, and all articles met these criteria. The relevance category indicates that the article contains at least one of the keywords in the title, abstract, or keywords. This stage resulted in 40 articles. Finally, we ensured that the article content appropriately discussed the relationship between one of the keywords—mood, emotion, or feeling—and auditors' JDM by examining the full text of each article. Sixteen articles were excluded, resulting in 24 articles being included in the review stage. The number of articles may seem small; however, efforts to add more articles can be challenging. This indicates that this topic is less explored. Therefore, despite the seemingly small number (24), it is expected to be accepted. Indeed, from this systematic literature review, it is hoped that the interest of auditing researchers can be focused on the topics discussed in this paper so that future publications on related issues will increase.

Following Hoque (2014), we classified the articles into five categories: (1) Topic, (2) Theory, (3) Research Setting, (4) Method, and (5) Data Analysis Techniques. This classification aligns with the Theory-Context-Characteristics-Methodology (TCCM) review framework, which ensures a thorough understanding of a specific research field (Sharma, Aswal, and Paul 2023). TCCM analysis helps address gaps in prior literature and provides avenues for future research (Paul and Rosado-Serrano, 2019). Our study offers an in-depth understanding of prevalent theories, contexts (research setting), characteristics (topics and related variables), and methods (research approaches and data analysis techniques). For this study, TCCM is integrated into Hoque's (2014) basic framework, which we use as the main reference. We then discuss the results of the review, highlighting current research developments and identifying future research opportunities.

Moods and emotions play an important role in accounting decision-making, particularly for auditors. The auditor's responsibilities need professional judgment, which might be subjective at times. According to mood congruency theory, people tend to make decisions that are consistent with their moods. A happy mood results in a favorable evaluation, whereas a bad mood results in a negative evaluation (Bower, 1981). Furthermore, the feelings-as-information hypothesis proposes that decision makers employ their emotions as information inputs to decision-making processes,

especially when they lack knowledge or experience in a choice context (Schwarz, 2012). According to these beliefs, auditors' decision-making processes are inextricably linked to the effects of their moods and emotions. While studies exist on this topic, they are still relatively limited in number and development. The topic has not been comprehensively explored through a systematic literature review. Therefore, our study aims at consolidating and advancing the understanding of studies on this topic, providing a more structured and comprehensive overview that will facilitate further research and development in this area. This study will describe mood and emotion studies, then do a bibliographical analysis, discuss current research, and provide recommendations for future research.

FIGURE 2
Literature Review Processes of Mood and Emotion on Auditor's Judgment and Decision-making (JDM) (Adopted from Hoque, 2014)



3. RESULTS

We conducted a bibliographic analysis that included the distribution of article frequency based on journal category, publication quality, topic, theory, research setting, research method, and data analysis techniques. Bibliographic analysis has been widely used in systematic literature reviews in business and accounting (e.g., Anggraini and Sholihin, 2023; Bahri, Ali, and Mohammad Aslam, 2022; Yusuf, Junurham, and Adam, 2021; Hoque, 2014). Specifically, our bibliographic analysis follows the approaches used by Hoque (2014) and Anggraini and Sholihin (2023). This method is a well-accepted approach in the field of accounting (Massaro et al., 2016).

3.1 JOURNAL AND PUBLICATION QUALITY

Table 1 documents the distribution of articles published on the research theme. Two journals, Auditing: A Journal of Practice & Theory and Contemporary Accounting Research. Each published four articles related to the relationship between mood, emotion, and the auditor's JDM, and the most published on this theme. The Journal of Business Ethics published two articles. These three journals are known to be very interested in issues of auditor behavior and have published many articles related to this theme.

Besides that, Table 1 shows that 18 (75%) of the 24 articles related to mood and emotion in the auditor's JDM were published after 2013, following the summary by Bhattacharjee and Moreno (2013). Twelve (50%) articles were published recently in 2018-2022. This suggests that this research theme has become attractive to academics in recent years.

We also documented the distribution of articles based on journal quality using the SCIMAGO Journal Rank to classify journals based on quality, Table 2 shows that 18 articles (75%) were published under Q1 and three (12.50%) under Q2. This means that 87.5% of the articles related to this topic were published in top-tier journals.

TABLE 1
Frequency Distribution of Articles Published Related to the Mood and Emotion of Auditors' Judgment and Decision-making (JDM) by Journals

Journal	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Auditing: A Journal of Practice & Theory	0	3	1	0	4	16.67
Contemporary Accounting Research	1	0	2	1	4	16.67
Accounting, Auditing and Accountability Journal	0	0	0	1	1	4.17
Accounting, Organizations, and Society	0	0	1	0	1	4.17
Asian Journal of Accounting Research	0	0	0	1	1	4.17
China Journal of Accounting Studies	0	0	0	1	1	4.17
Critical Perspectives on Accounting	0	0	0	1	1	4.17
Current Issues in Auditing	0	0	0	1	1	4.17
Gadjah Mada International Journal of Business	0	0	0	1	1	4.17
International Journal of Auditing	0	0	0	1	1	4.17
Journal of Asia Business Studies	0	0	0	1	1	4.17
Journal of Behavioral Decision Making	1	0	0	0	1	4.17
Journal of Business Ethics	0	0	1	1	2	8.33

TABLE 1 *(continued)*

Journal	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Managerial Auditing Journal	0	1	0	0	1	4.17
Organizational Behavior and Human Decision Processes	0	0	1	0	1	4.17
Problems and Perspectives in Management	0	0	0	1	1	4.17
Sustainability Accounting, Management, and Policy Journal	0	0	0	1	1	4.17

TABLE 2
Frequency Distribution of Articles Published Related to the Mood and Emotion of Auditors' Judgment and Decision-making (JDM) by Quality

Journal Quality	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Scimago rank*:*						
Q1	2	3	6	7	18	75.00
Q2	0	1	0	2	3	12.50
Q3	0	0	0	2	2	8.33
Q4	0	0	0	1	1	4.17

3.2 THE TOPICS

We classify the topics in the auditor's JDM, which are the focus of academics, based on the articles reviewed. We then label the five issues discussed in this area (Table 3): risk and probability judgment (9), risk decision (4), ethical judgment (3), conflict decision (2), and commitment to professional decision (6). Risk and probability judgment is the most widely discussed topic in auditors' JDM. This is reasonable because, in the field, the auditor faces many conditions of risk and probability judgment, such as inventory assessment and assessment of the audit evidence sufficiency. One interesting finding is that 24% (6) of the articles discussed the issue of auditors' decision to commit to their profession. This shows that mood and emotion affect auditors' working conditions and are closely related to their willingness to survive in this profession.

TABLE 3
Frequency Distribution of Articles Published Related to the Mood and Emotion on Auditors' JDM by Topic

Topic	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Risk and probability judgment	2	1	3	3	9	36.00
Risk decision	0	1	0	3	4	16.00
Ethical judgment	0	1	1	1	3	12.00
Conflict decision	0	0	1	1	2	8.00
Commit to the professional decision	0	1	1	4	6	24.00

3.3 THE THEORIES

No specific theory has been widely used in research on mood, emotion, or the auditor's JDM. Table 4 shows that mood maintenance theory is the most commonly used (three articles), explaining that individuals with a positive mood are interested in maintaining their positive mood. Other theories related to mood and emotion are affected by information theory and affective event theory. Affect-as-information theory states that individuals may use their perceived affective reactions as relevant information in their judgments. The effect's impact on judgment is a function of its perceived informational value (Schwarz, 2012).

Meanwhile, affective events describe how one's work environment, directly and indirectly, contributes to forming workplace attitudes and emotions through "affective events." (Weiss and Cropanzano, 1996). Social identity is another interesting psychological theory used in this research area. This theory states that individuals identify as members of a particular group and view others in the same group more favorably than those outside the group (Turner, Brown, and Tajfel 1979). Previous researchers used this theory to explain topics related to committing to professional decisions (Garcia-Falières and Herrbach, 2015; Reffett, Brewster, and Ballou, 2012).

TABLE 4
Frequency Distribution of Articles Published Related to the Mood and Emotion of Auditors' JDM by Theory

Theories	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Mood maintenance	0	2	0	1	3	12.00
Affect as information	1	0	1	0	2	8.00
Mood congruent retrieval of information explanation	0	1	0	0	1	4.00
Affective events	0	1	1	0	2	8.00
Social identity	0	0	2	0	2	8.00
Mood as information	0	1	0	0	1	4.00
Cognitive capacity	0	1	0	0	1	4.00
Psychodynamics of work	0	0	1	0	1	4.00
Theory of work	0	0	1	0	1	4.00
Theory of the subject	0	0	1	0	1	4.00
Self-categorization	0	0	1	0	1	4.00
Conservation of Resources	0	0	0	1	1	4.00
Role theory	0	0	0	1	1	4.00
Triandis's theory	0	0	0	1	1	4.00

TABLE 4 *(continued)*

Theories	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Theory of interpersonal behavior	0	0	0	1	1	4.00
The general theory of ethics	0	0	0	1	1	4.00
The classical theory of EDM	0	0	0	1	1	4.00
Theological/ moral perspectives	0	0	0	1	1	4.00
Emotional intelligence	0	0	0	1	1	4.00
Limperg's theory of inspired confidence	0	0	0	1	1	4.00

3.4 THE RESEARCH SETTINGS

Table 5 shows that, generally, research in this area is conducted in the United States (10), state settings, and Western countries such as France (3) and the Netherlands (1). Western locations contribute most of the studies related to the behavior and auditor's JDM. One study was conducted in the Middle East, namely, Lebanon, and one in Australia. Only eight articles (33.33%) cover studies conducted in Eastern countries such as China, Indonesia, and Vietnam.

TABLE 5
Frequency Distribution of Articles Published Related to the Mood and Emotion on Auditors' JDM by Settings

Settings	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
United States	2	2	4	2	10	41.67
Indonesia	0	0	0	4	4	16.67
France	0	1	2	0	3	12.50
China	0	0	0	3	3	12.50
Vietnam	0	0	0	1	1	4.17
Lebanon	0	0	0	1	1	4.17
Netherlands	0	0	0	1	1	4.17
Australia	0	1	0	0	1	4.17

Owing to the limited distribution of setting research, future research opportunities are open to exploring this theme in various other country settings. Future research can also use cross-country analysis to compare auditors' JDM related to mood and emotion. Given that there may be differences in the way judgment works across cultural contexts, future research could examine different cultural values, such as those in Asia, America, and Europe.

3.5 THE METHODS

Table 6 shows that most research on the relationship between mood, emotion, and auditor's JDM was conducted using experimental methods (10) and surveys (7). This is because mood, emotion, and JDM can be observed by providing participants with a series of scenarios. The researchers also used the interview method (4) to obtain a more in-depth analysis of the relationship between these variables. In particular, individual mood and emotional variables can be better captured through a series of interview approaches. In addition, some studies have used archival data (2) and mixed methods (1).

TABLE 6
Frequency Distribution of Articles Published Related to the Mood and Emotion of Auditors' JDM by Method

Methods	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
Experiment	2	3	4	1	10	41.67
Survey	0	1	1	5	7	29.17
Interview	0	0	1	3	4	16.67
Archival	0	0	0	2	2	8.33
Mixed methods	0	0	0	1	1	4.17

3.6 THE DATA ANALYSIS TECHNIQUES

Table 7 documents the data analysis techniques used in previous studies. In line with these research methods, most studies used the analysis techniques of ANOVA/MANOVA/ANCOVA (9) and regression (6). Several studies have tested the mood, emotion, and auditor's JDM models using SEM/PLS/path analysis (4). One study used the mixed method with descriptive analysis techniques, and the other four articles used a qualitative approach.

TABLE 7
Frequency Distribution of Articles Published Related to the Mood and Emotion of Auditors' JDM by Data Analysis Techniques

Data analysis techniques	<2008	2008-2012	2013-2017	2018-2022	Total	Total (%)
ANOVA/ MANOVA/ ANCOVA	2	3	4	0	9	37.50
Regression	0	1	1	4	6	25.00
SEM/ PLS/ Path analysis	0	0	0	4	4	16.67
Descriptive statistics	0	0	0	1	1	4.17
Others	0	0	1	3	4	16.67

4. DISCUSSION

4.1 CURRENT PROGRESS OF PREVIOUS RESEARCH

4.1.1 RISK AND PROBABILITY JUDGMENT

We found two articles that discussed the auditor's risk and probability judgment in the context of elements or task complexity. The first study by Kadous (2001) shows how emotions toward specific task components in an audit can affect judgment. The results of this study were confirmed by Bagley (2010), who found that negative emotion is related to task complexity, so the combination of these two things will affect auditor performance. The results of these studies show that emotion and mood are closely related to an auditor's tasks. Certain task elements and their level of complexity can affect emotions and mood, thereby reducing auditor performance.

Emotion and mood are also closely related to inventory valuation decisions during the audit process, and this influence also interacts with the auditor's experience. Bhattacharjee and Moreno (2002) tested the interaction of emotion and the auditor's experience on obsolescence risk judgment. The results of their research show that auditors with less experience and who receive negative emotion information assess inventory obsolescence risk as higher than experienced auditors who receive the same information. Bhattacharjee, Moreno, and Riley (2012) then expanded previous research by looking at the effect of reactions to client competence on inventory obsolescence ratings. Their study found that a negative emotional response toward lower client competence encourages auditors to provide higher obsolescence ratings. The results of these

studies indicate that when carrying out technical tasks in the field, the auditor's judgment is greatly influenced by their emotions and moods while carrying out these tasks.

Yang, Brink, and Wier (2018) examine the role of emotion on dysfunctional judgment. They found that the auditor's emotional intelligence mechanisms can reduce the dysfunctional behavior experienced by auditors due to pressure. The importance of an auditor's emotional intelligence is also confirmed by Phan, Mai, and Nguyen (2021) who found that this emotional mechanism influences the auditor's judgment and will affect audit sustainability.

Another study by Abdo, Feghali, and Zgheib (2022) confirmed the role of emotions and moods in judging the effectiveness of internal controls. The auditor's emotions will affect the auditor's view of the client's internal control. This will affect their professional skepticism and caution in auditing. This is confirmed by Guénin-Paracini, Malsch, and Paillé (2014), that studying the emotional mechanisms of auditors will help us understand audit risk and auditor skepticism.

We also found one study examining the effect of emotions on auditor liability judgment. Reffett et al. (2012) found that auditors who have experience of empathy with auditor defendants will assess lower auditor liability. These results confirm that emotional reactions predict auditors' negligence verdicts. Auditor evaluators become even less dependent on plaintiff losses as evidence, and are more likely to be swayed by their emotions when making judgments.

4.1.2 RISK DECISION

Risk decisions are different from risk and probability judgments. Judgments may not come to a decision. The first study by Chung, Cohen, and Monroe (2008) tested the effect of mood on inventory valuation decisions. Their experimental results found that mood leads to consensus on inventory valuation. Participants in a positive mood signed off the inventory value more conservatively than participants in a negative mood.

Another study by Gold et al. (2022) confirmed the relationship between negative emotions and a defensive strategy for fear of repercussions. In their research, communicating audit errors will stimulate auditors' negative emotions and cause them to become defensive. They became embarrassed, shocked, anxious, and fearful and decided to carry out defensive strategies to cover up.

We found two studies that investigated the effects of mood on auditor decisions using archival data. Song and Song (2018) and Chen, Tan and Cao (2021) found that mood will impact how the auditor communicates with the auditee and ultimately affect audit decisions. Auditor emotions influenced decisions related to audit efforts and discretionary accruals.

4.1.3 ETHICAL JUDGMENT

Several previous studies have found that mood and emotion affect the auditor's ethical judgment. Cianci and Bierstaker (2009) showed through experiments that auditors in a negative mood leads to correct explanations for fluctuations in financial ratios but make the least ethical judgments. This study provides evidence that moods differently influence auditor judgments, and this influence depends on the nature of the task (hypothesis generation, ethical). Then Blader et al. (2013) explored to what extent emotions reflecting subjective feelings of congruence with target emotions can influence auditors' evaluations of recipients' ethical decisions outcomes. They found that social emotions are significant in auditor subjective justice judgments. Finally, Latan, Jabbour, and Jabbour (2019) examine non-rational (emotional) factors and aspects that influence an auditor's ethical judgment when blowing the whistle. The results confirmed that emotions are related to ethical judgment and whistleblowing intentions.

4.1.4 CONFLICT DECISION

Little research has examined the relationship between emotions and conflict decisions. Johnson, Lowe, and Reckers (2016) argued that conflict situations generate negative emotions and interact with fear. These negative emotions will lead the auditor to follow superiors' unethical directives. Their research results confirm this. The second study by Carlisle and Hamilton (2021) examines the emotional relationship between auditors and clients. They found that face-to-face or e-mail communication will affect emotions and ultimately impact audit results.

4.1.5 COMMIT TO THE PROFESSIONAL DECISION

Many previous studies have linked emotions and moods with a commitment to the profession. The argument is that the negative

emotions and moods that auditors experience at work will affect their intention to stay in the profession. Garcia and Herrbach (2010) found that emotions are related to organizational commitment. Furthermore, Garcia-Falières and Herrbach (2015) state that positive and negative emotions impact on auditor professional identification. This professional identification will later affect their organizational identification, namely the ability to identify themselves as part of an auditing organization. Other research confirms that emotion and experience will affect auditor professionalism (Suyono and Farooque, 2019).

The influence of emotions on the auditor is significant and must be considered by the audit firm. Efferin and Hutomo (2021) show that managing the auditor's emotions will increase individual commitment and satisfaction. Good emotional quality will increase long-term commitment to audit firms (Beau and Jerman, 2022). These two studies strengthen that audit firms should maintain their staff's emotional work condition.

4.2 FUTURE RESEARCH OPPORTUNITIES

4.2.1 RISK AND PROBABILITY JUDGMENT

Previous studies have focused only on examining the influence of emotions and mood on several forms of risk and probability judgments. Many forms of risk and probability judgment faced by auditors in the field have not been tested in previous research, such as the risk of material misstatements, control risks, inherent risks, audit risks, business risks, engagement risks, and fraud risks. In particular, these risks are associated with engagement risk and fraud risk. These two forms of risk and probability judgment may be closely related to the auditor's emotions. Future research should also consider the role of pressure when examining the effects of emotions on these two risks. The pressure issue can also be divided into public accounting firms and auditors in the public sector, especially concerning investigative audit scenarios of certain corruption cases.

Risk and probability may also not be an individual judgment, because the audit process is usually performed as a team. Future research could focus on a judgment involving group judgments. Group audits may affect certain emotions and moods. Future research should also examine how to reduce the negative effects of mood and emotions. Individual emotions and moods cannot be eliminated;

however, some efforts may be able to control and reduce their negative impacts.

4.2.2 RISK DECISION

Several studies included in this review did not consider the knowledge and skills required to manage auditor emotions. Chung et al. (2008) suggest that knowledge of emotions and tasks will help auditors manage them well. Experience in dealing with specific tasks and problems plays a significant role in an auditor's success in making the best decisions in negative emotional and mood situations. Expertise helps stabilize emotions quickly, so that the auditor can return to making decisions objectively.

Additionally, future research is essential to investigate the role of audit time pressure. Does the busy audit season affect the auditor's mood and emotions and will this impact decision-making? In practice, auditors sometimes face many audit engagements within a short period. This undoubtedly affects the auditor's psychological condition, especially emotions and moods. In future, researchers will need to test this, and an experimental approach seems particularly suitable for this purpose.

4.2.3 ETHICAL JUDGMENT

The relationship between mood, emotion, and ethical judgment has not been extensively studied. For this reason, future research can further investigate the effect of these two variables on various kinds of ethical judgment, such as approval of earnings management, violations of environmental ethics, or other unethical behavior. This adds to our insight into the role of mood and emotion in explaining unethical auditor behavior.

Then, future research also needs to consider the experience and level of auditors' moral development. For example, in Kohlberg's (1981) ethical development model, at which stage are emotions and moods most influential when facing ethical judgment? Or could future research test whether an auditor's experience with negative mood situations in the past also influences current ethical judgment?

One interesting issue is examining the effect of the auditor's social environment, mood, or emotions on ethical judgment. For example, does the level of exposure to social media affect auditors' emotional stability and, in turn, affect ethical judgment? Social media presents various cases of ethical violations, which are updated

continuously so that they can affect auditor emotions and ethical preferences.

Another issue that might be of interest to future research is the role of personal culture in emotions and moods. For example, are auditors with an interdependent culture better at dealing with negative moods to make better decisions than are independent individuals? In addition to culture, future researchers can also consider other moderating variables, such as intrinsic religion, personal spirituality, moral obligation, retaliation, and intelligence.

4.2.4 CONFLICT DECISION

Previous studies have shown that mood and emotion are essential in conflict situations. This opens up many opportunities for future research, such as how the negative emotions and moods experienced by the auditor in the previous client affect the auditor in the next client. Do the moods and emotions experienced during the previous year's engagement affect mood and emotions in the current engagement, and will this affect the auditor's judgment and audit risk decisions? Does seniors' mood change from interacting with clients carry over to the team?

4.2.5 COMMITMENT TO THE PROFESSIONAL DECISION

Previous studies have shown that negative emotions in the workplace can make auditors uncomfortable and result in low organizational commitment. Therefore, future research can test whether emotional experiences in the previous office affect the mood and emotions of auditors in the current office. What are the company factors that can mitigate their staff's negative mood and emotions? Does the physical environment, such as office air quality, communication styles in the office, and health of the office environment affect the emotions and mood of the auditor and make them more committed to the organization?

5. CONCLUSIONS

Our study analyzes the trends, progress, and opportunities for future research on the relationship between mood and emotion on auditors' JDM. We identify five JDM auditor topics based on a literature review. This research contributes to auditor JDM research by conducting a bibliographic analysis of previous research on auditors'

mood, emotions, and JDM. We identified the quality of journals and publications, topics, theories, research settings, methods and data analysis techniques. We then analyze current research developments according to five main topics: risk and probability assessment, risk judgment, ethical judgment, conflict judgment, and commitment to professional judgment. Then, we identify specific gaps in the current literature regarding the topics of mood, emotion and auditor's JDM and provide recommendations for future research.

This literature review also provides several practical insights for auditors and firms. Our findings can help firms develop training programs that enhance emotional awareness and management among auditors. Audit firms can also use these insights to create more supportive work environments that mitigate negative emotional impacts and promote positive moods, potentially improving audit quality. Policymakers and standard-setters can also consider these findings when developing guidelines and standards that account for the psychological aspects of auditing, thereby enhancing the overall reliability and integrity of the auditing process.

This study had several limitations. The selection of keywords in search engines may be subjective, although we have attempted to include all articles related to this topic in business, management, and accounting. This study focuses on articles published online in the Scopus database that are accessible to me; therefore, there is a possibility that other articles on this topic are not included. Despite these limitations, this study provides a foundation for future research investigating the relationship between mood, emotion, and auditor JDM.

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ISLĀMIC FINANCE AND POVERTY REDUCTION IN AFRICAN COUNTRIES: AN EMPIRICAL ANALYSIS

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ABSTRACT

This paper examined the effect of *Islāmic* finance on poverty reduction in 53 African countries over the period 2013 to 2022. *Islāmic* finance, based on *Islāmic* principles and values, emphasizes ethical conduct, social responsibility, and promotion of social welfare. Poverty remains a pressing issue in many African countries, and traditional financial systems have for long struggled to effectively address this challenge. *Islāmic* finance offers unique features and mechanisms that can contribute to poverty reduction efforts. This study employs a panel System Generalized Method of Moments (SGMM) estimation technique and explores the empirical evidence on the relationship between *Islāmic* finance development and poverty reduction, while controlling for other variables such as foreign aid, government budgets, and government effectiveness. The findings indicate that *Islāmic* finance development, foreign aid, and government budgets have significant positive effects on poverty reduction, while government effectiveness has a negative effect. Thus, the findings highlight the potential of *Islāmic* finance in poverty reduction in African countries and provide valuable insights for policymakers, practitioners, and researchers in harnessing the benefits of *Islāmic* finance for inclusive and sustainable development.

JEL Classification: O16, G21, I32, C23

Keywords: *Islāmic* finance, Poverty reduction, African countries, *Maqāṣid* (higher objectives) of *Sharī'ah* (*Islāmic* law), System Generalized Method of Moments (SGMM)

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1. INTRODUCTION

Islāmic finance, which is based on the *Sharī'ah* principles, presents a major alternative financial system that values moral and social responsibility and promotes social welfare (Khan et al., 2022). From the poverty standpoint, *Islāmic* finance has distinct dimensions concerning needs of the poor and vulnerable groups by developing products that target underserved and the third sector (Wudil and Muhammad 2023; Wulandari, 2019). For example, *Islāmic* finance creates inclusive growth by allocating resources equitably and using risk-sharing instruments such as profit and loss sharing (i.e., *muḍārabah* and *mushārakah*). This boosts entrepreneurship and private property development by creating favorable business environments, hence increasing the wealth of the previously excluded (Sheikh, 2021; Shabbir et al., 2018). *Islāmic* finance indeed promotes financial inclusion by bringing financial services closer to the underserved. Through *Islāmic* microfinance, the poor can access interest-free credit and save to start or expand their businesses (Ali, Shirazi, and Nabi, 2013). Also, *Islāmic* finance promotes social welfare and protection against destitution through the *Zakāt*, *Wāqf*, and *Sadaqat*, which has the potential to cushion the poor and supports initiatives that enhance community welfare (Pericoli, 2020; Daly and Frikha, 2015).

Islāmic finance provides a viable solution to Africa's poverty alleviation, as the continent's traditional finance fails to offer an inclusive solution. Although *Islāmic* finance has spanned matured markets in regions such as the Gulf Cooperation Council (GCC) countries, Malaysia and others, it remains mostly under-developed in North Africa and many Muslim-majority countries (Bougatef, 2015). According to Kedir et al., (2017), to effectively combat poverty in Africa, substantial growth rates and investment levels are needed, with estimates suggesting a double-digit growth rate of 16.6% annually to end extreme poverty by 2030. *Islāmic* social finance, including *wāqf* and *zakāt* as distinct institutions in Islam, and other instruments such as *sadaqat*, have potential to make a significant contribution to poverty alleviation. This used to be the case during crises such as the COVID-19 pandemic (Umar et al., 2022; Ascarya, 2021). Integrating corporate social responsibility with the various forms of the *Islāmic* third sector finance such as *wāqf* and the *zakāt* system is a faith-based

intervention mechanism in a predominantly Muslim country (Raimi, Ashok, and Ismail, 2014). For example, *zakāt* has reduced poverty through several distributions to the poor, which has enabled them to live with dignity, good health, adequate nutrition, and access to education (Islam et al., 2023). Moreover, properly administered *Islāmic* microfinance can also complement poverty alleviation, as revealed in Nigeria and Indonesia case studies (Amsami et al., 2021; Prasetyo, Effendi, and Nursyamsiah, 2018). *Islāmic* cooperative societies and microfinance institutions also show the potential to deliver to socio-economic development, as evidenced in Nigeria (Olayinka et al., 2021).

While *Islāmic* finance potential contributions to poverty reduction in Africa seems promising, empirical evidence on the role of *Islāmic* finance in African countries is limited. Therefore, more research is needed to determine how *Islāmic* finance can effectively help reduce poverty in African countries. Thus, this paper aims at informing policymakers, practitioners, and researchers about the potential of *Islāmic* finance for poverty reduction in African countries. Following our introduction, section two presents our empirical literature review. Section three articulates the methodology while section four presents the results and discussion of the findings. Finally, section five presents the conclusions and policy implications of the study.

2. LITERATURE REVIEW

Literature on *Islāmic* finance reveals much on its potential in poverty reduction and economic growth, and sustainable development. Guled (2022), Saba, Khan, and Jawed (2021), Rahman and Asyifaa (2021) and Shabbir et al. (2018) emphasized on the positive impact of *Islāmic* finance on social development, aligning with principles of social justice and equality, which can aid in poverty reduction and social justice. Khavarinezhad, Biancone, and Jafari-Sadeghi (2021) and Kassim (2016) focused on how *Islāmic* finance can contribute to economic growth, with Sukuk playing a significant role in the real economic growth of *Islāmic* countries as well as macroeconomic indicators.

Moreover, *Islāmic* finance is shown to be well-aligned with sustainable development goals (SDGs), promoting sustainable economic growth, poverty eradication, gender equality, and sustainable infrastructure (Danlami, Abduh, and Razak, 2023; Nizami

2020; Rusydiana, 2020; Jan et al., 2021). Hamoudi, Hadi, and Abdul Rahman (2018) and Ahmed et al. (2015) explored how *Islāmic* finance supports education for sustainable development, providing funding to educational institutions and promoting overall development. *Islāmic* social finance instruments such as *zakāt, wāqf,* and *sadaqat* are highlighted for their role in supporting social enterprises, promoting social impact, and addressing the charitable sector, driving social innovation based on ethical principles (Walaa, 2021; Iannaci and Mekonnen, 2020; Pericoli, 2020; Azman and Ali, 2019).

The literature also delves into the potential of *Islāmic* finance in supporting economic sustainability, as seen in studies by Sarker, Khatun and Alam (2019), which reveal the testing of *Islāmic* finance in China for economic sustainability. Furthermore, the ethicality of *Islāmic* banks' business models and their impact on financial stability are discussed, emphasizing the importance of ethical principles in *Islāmic* finance (Jatmiko, Iqbal, and Ebrahim, 2023). The literature also explores the convergence of principles of *Islāmic* finance and corporate social responsibility (CSR), with CSR being a key factor in this relationship (Franzoni and Allali, 2018). This convergence is influenced by both formal and informal institutions, with *Islāmic* banks showing a stronger commitment to CSR, particularly in emerging countries (Aracil, 2019). Further integration of CSR activities with *Islāmic* and conventional elements is however needed in line with *Sharī'ah* principles (Sofian, 2016). The concept of CSR in *Islāmic* culture is also discussed, with a focus on the *Islāmic* reporting initiative and the integration of *Islāmic* values and beliefs in CSR practices (Litardi, Fiorani, and Harb, 2019).

Overall, most of the reviewed literature implied that *Islāmic* finance has the potential to contribute to poverty reduction, economic development, and sustainable growth under the identified mechanisms of ethical orientation, financial inclusion, social enterprise development, and targeted approach to sustainable development problems. The literature, however, has yet to demonstrate and make hopefully similar greater impact on African poverty reduction efforts. Despite the growing popularity of *Islāmic* finance in certain African countries, especially in countries with significant Muslim population, limited studies cover how *Islāmic* finance impacts poverty reduction across different African countries. Considering diverse socioeconomic and developmental problems among African countries, it is crucial to understand whether *Islāmic* finance can reduce poverty and promote sustainable development in the continent.

3. METHODOLOGY

3.1 THEORETICAL MODEL

From a theoretical perspective, this study uses the *maqāṣid* (higher objectives) of *Sharī'ah* theoretical model to evaluate and assess how *Islāmic* finance development impacts on poverty reduction. *Maqāṣid* of *Sharī'ah* rooted in *Islāmic* jurisprudence (*fiqh*), focuses on the higher purposes or aspirations of *Islāmic* law such as justice, fairness, responsibility, integrity, due diligence, and social welfare to name a few. By applying the *maqāṣid* of *Sharī'ah* framework, the study aims at analyzing how *Islāmic* finance aligns with these principles and its effectiveness in addressing poverty. The framework provides a comprehensive lens for examining the social impact of *Islāmic* finance development and its contribution to individual and societal well-being (Abu Bakar and Abdul Rahim, 2021; Siddiqi, 2010; Auda, 2008).

3.2 MODEL SPECIFICATION

The model is grounded in *maqāṣid* of *Sharī'ah* theory and the empirical works of Guled (2022) and Shabbir et al. (2018). As a result, the empirical model is as follows:

$$(1) \quad PR_{it} = f\ (IFD_{it}, AID_{it}, GB_{it}, GE_{it})$$

Where $PR_{it}$is the Poverty Reduction variable of country i at time t, IFD_{it} is the *Islāmic* finance development of country i at time t, AID_{it} is the foreign aid of country i at time t, GB_{it} is the Government budget of country i at time t, and GE_{it} is the government effectiveness as a measure of quality of governance of country i at time t.

On this basis, the econometric model can be specified as follows:

$$(2) \quad PR_{it} = \beta_0 + \beta_1 IFD_{it} + \beta_2 AID_{it} + \beta_3 GB_{it} + \beta_4 GE_{it} + \mu_{it}$$

β_0, β_1, β_2, β_3, and β_4 respectively, are the coefficients of *Islāmic* finance development, foreign aid, government budget, and government effectiveness. while μ_{it} is the error term which captured unobservable factors affecting poverty reduction variable not captured in the model. The error term is assumed to be normally distributed with zero mean and constant variance.

3.3 ESTIMATION TECHNIQUE

The Generalized Method of Moments (GMM) estimation technique, more precisely the System Generalized Method of Moments (SGMM) estimator, is employed. GMM is selected because of its advantages in mitigating endogeneity, omitted variable biases, unobserved panel heterogeneity, and consistency of estimation even when measurement error exists. The SGMM estimator is chosen for greater estimation efficiency as suggested by Blundell and Bond (1998). In comparison, the Difference Generalized Method of Moments (DGMM) lacks in that regard given its potential finite sample biases. Hence, by utilizing the SGMM estimator, this study obtains reliable and robust estimates of analysis concerning dynamic effects of *Islāmic* finance on poverty reduction. Therefore, equation (2) can be re-specified using SGMM developed by Blundell and Bond (1998) as follows:

$$InPR_{it} = \beta_0 + \beta_1 InPR_{it-1} + \beta_2 InIFD_{it} + \beta_3 InAID_{it} + \beta_4 InGB_{it} + \beta_5 GE_{it} + (\eta_i + \varepsilon_{it}) \quad (3)$$

$$\Delta InPR_{it} = \beta_0 + \beta_1(\Delta InPR_{it-1}) + \beta_2(\Delta InIFD_{it}) + \beta_3(\Delta InAID_{it}) + \beta_4(\Delta InGB_{it}) + \beta_5(\Delta GE_{it}) + \Delta\mu_{it} \quad (4)$$

Where $InPR_{it}$ is the natural log of the dependent variable poverty reduction, $InPR_{it-1}$ is the dependent variable's lag value, δi is country unobserved specific effect, $\Delta\mu_{it}$ is the error term and subscripts i and t represent country and time series respectively. In the system GMM estimation, lagged levels of the endogenous variables, i.e., $InPR_{it-1}$ are used as instruments in the level equation (3) and lagged differences of potential endogenous variables, i.e., $(\Delta InPR_{it-1})$ are used as instruments in the difference equation (4).

TABLE 1
Variables and their Operationalisation

Variables	Proxies	Notation	Type	A priori expectation	Source
Poverty Reduction	Consumption Expenditure	PR	Independent		World Development Indicators (WDI)
Islāmic Finance	*Islāmic* Finance Development	IFD	Dependent	Positive	Rifinitiv Database
Foreign Aid	Official Development Assistance (ODA)	AID	Control	Positive	World Development Indicators (WDI)
Government Budgets	Government Expenditure	GB	Control	Positive	World Development Indicators (WDI)
Government Effectiveness	GE Estimate	GE	Control	Positive or Negative	World Governance Indicators (WGI)

Source: Authors' Illustrations.

3.4 JUSTIFICATION FOR USING SYSTEM GMM (SGMM)

The procedure for deciding between difference and system GMM (DGMM and SGMM) estimators explained by Bond (2002) justifies our choice in this paper as follows:

a. Estimate pooled OLS estimator and get the lagged regression dependent variable coefficient value which establishes the upper bound.
b. Estimate the fixed effect model and get the lagged regression dependent on variable coefficient value which establishes the lower bound.
c. Estimate the DGMM model for the respective estimate and compare it to the fixed effect estimate. If the DGMM estimate is lower than or closest to the fixed effect estimate, the DGMM estimator is downward biased due to violations of instrument orthogonality conditions. Therefore, it concludes that the DGMM estimator lacks instrument strength (downward biased) and points to the SGMM estimator as the right choice.

3.5 DIAGNOSTIC TESTS

3.5.1 ARELLANO-BOND TEST

The Arellano-Bond test is used to identify serial correlation in the GMM estimation. The test checked for first- and second-order autocorrelations in the model. Assuming there should be no serial correlation, the null hypothesis is rejected when serial correlation is present. The first-order serial correlation, however, does not always necessarily lead to model misspecification. Hence, the second-order serial autocorrelation and validity of the instruments are mandatory to establish GMM estimator's consistency (Arellano and Bond, 1991; Maddala and Lahiri, 2009).

3.5.2 SARGAN-HANSEN TEST

The Sargan-Hansen test, also called the over-identification test, is a commonly used tool in Generalized Method of Moments (GMM) estimations to determine instrument validity. More specifically, it refers to examining whether the instruments are uncorrelated with the error term, which means that they support the assumption of instrument exogeneity. It is a comparison between the number of

instruments known as over-identifying restrictions and the number of estimated parameters in the model. The calculated test statistic is usually a chi-square statistic indicating whether the instruments are jointly significant with respect to the endogenous variables. An insignificant chi-square test statistic confirms that the instruments are valid. Thus, the model is correctly specified. Otherwise, it suggests the model has misspecification issues or inadequate instruments causing bias in the estimation (Roodman, 2009).

4. RESULTS AND DISCUSSIONS

4.1 DESCRIPTIVE STATISTICS AND CORRELATION MATRIX

As implicit from Table 2 on descriptive statistics and correlation matrix, maximum and minimum values for each variable and respective skewness and kurtosis identify the nature of distribution. We analyze each in due course.

Namely, Poverty Reduction (PR) has a mean score of 81.66. The minimum value is 44.26 while the maximum value is 116.44. The data reveals slightly negative skewness, -0.29, indicating a slight left-tail distribution since kurtosis value of 3.45 suggests moderately peaked distribution.

TABLE 2
Descriptive Statistics and Correlation Matrix

	PR	IFD	AID	GB	GE
Mean	81.65851	90.79176	56.46591	14.42230	-0.25498
Median	82.93416	9.00000	50.23036	13.71335	-0.68228
Maximum	116.43800	812.00000	304.83940	38.44804	14.63538
Minimum	44.25666	1.00000	0.32528	-1.02557	-1.79129
Std. Dev.	13.01229	144.04650	38.20287	7.18897	2.44551
Skewness	-0.28626	2.12087	2.25624	0.62647	5.15476
Kurtosis	3.44999	7.45417	11.97006	3.68173	29.04743
PR	1	0.841	0.318	0.080	-0.197
IFD	0.841	1	-0.005	-0.105	-0.107
AID	0.318	-0.005	1	0.015	0.146
GB	0.080	-0.105	0.015	1	-0.284
GE	-0.197	-0.107	0.146	-0.284	1

Source: Authors' Computations.

Islāmic Finance Development (IFD) has a mean score of 90.79 with a minimum value of 1 and a maximum value of 812. *Islāmic* finance data shows positive skewness of 2.12, indicating a right-tail distribution while the kurtosis value of 7.45 suggests a relatively peaked distribution.

Foreign Aid (AID) has a mean value of 56.47, with a minimum value of 0.33 and a maximum value of 304.84. Foreign aid data also shows positive skewness of 2.26, indicating right-tail distribution while kurtosis value of 11.97 implies a highly peaked distribution again.

Government Budgets (GB) have a mean of 14.42, with a minimum value of -1.03 and a maximum value of 38.45. The data reflects slightly positive skewness of 0.63, indicating slightly right-tail distribution. Kurtosis value of 3.68 suggests moderately peaked distribution.

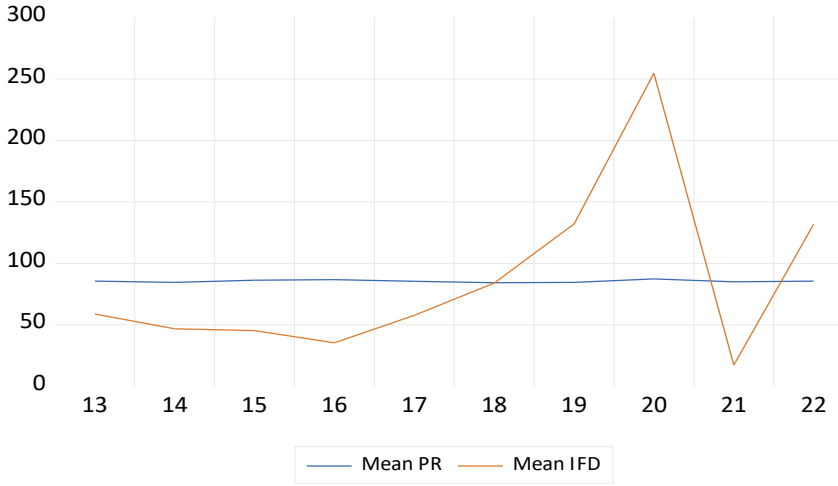
Lastly, Government Effectiveness (GE) has a mean of -0.25, with a minimum value of -1.79 and a maximum value of 14.64. The data have positive skewness of 5.15 indicating highly right-tail distribution, and the kurtosis is 29.05 suggesting a highly peaked distribution.

Analysis of correlation matrix among variables indicates that the correlation between Poverty Reduction (PR) and *Islāmic* Finance Development (IFD) is 0.084. This implies a weak positive relationship between the two variables. The correlation between PR and Foreign Aid (AID) is 0.318 and suggests a moderate positive correlation, indicating that higher levels of foreign aid are moderately associated with higher levels of poverty reduction. Insight into the correlation between PR and Government Budgets (GB) of 0.080 defines a weak positive correlation, suggesting, however, that higher government budgets are associated with slightly higher levels of poverty reduction. Lastly, the correlation between PR and Government Effectiveness (GE) is -0.197. This is a weak negative correlation, suggesting that higher government effectiveness is associated with slightly lower levels of poverty reduction.

Figure 1 illustrates the trend of Poverty Reduction (PR) and *Islāmic* Finance Development (IFD) across African countries. The denotations on the horizontal axes display values of variables while the vertical axes show years. The variable PR remained relatively stable over the years with slight fluctuation around the average value. There is no clear upward or downward trend observed in the data. On the other hand, IFD values show a relatively upward trend from 2016

to 2020. The observed decline in IFD in 2021 was attributable to the COVID-19 pandemic impact. The pandemic led to serial lockdowns and movement control orders (MCOs) across the globe, completely suspending much economic activity and impacting IFD growth and development. With the end of the pandemic measures and restoration of most operations 'back to normal', however, it is evident how IFD value restored its earlier growth and development path, with a likelihood and expectation of maintaining the momentum or increasing further.

FIGURE 1
Trend of *Islāmic* Finance Development (IFD) and Poverty Reduction (PR)



Source: Authors' Computations.

4.2 JUSTIFICATION FOR USING SYSTEM GMM (SGMM)

The coefficient of the lagged value of dependent variables through the three estimators was 0.846924 for Pool OLS in Table 3, 0.168259 for fixed effects (FE) in Table 4, and 0.124572 for DGMM in Table 5. Since the value of the lagged dependent variable is lower in the DGMM estimate compared to the value in the FE estimate, it indicates that the DGMM is biased downward. This is caused by the weak instrumentation problem. Therefore, the SGMM estimator was used to overcome the problem.

TABLE 3
Pooled OLS Estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	0.846924	0.027854	30.40564	0.0000
IFD	0.006096	0.002405	2.534879	0.0117
AID	0.023480	0.009989	2.350523	0.0194
GB	0.131132	0.042267	3.102461	0.0021
GE	-0.024744	0.155937	-0.158682	0.8740
C	8.671102	2.292039	3.783139	0.0002
Root MSE	6.005197	R-squared		0.797492
Mean dependent var	82.28503	Adjusted R-squared		0.794215
S.D. dependent var	13.36586	S.E. of regression		6.063220
Akaike info criterion	6.461223	Sum squared resid		11359.65
Schwarz criterion	6.532700	Log likelihood		-1011.643
Hannan-Quinn criter.	6.489781	F-statistic		243.3735
Durbin-Watson stat	2.692888	Prob(F-statistic)		0.000000

Source: Authors' Computations.

TABLE 4
Fixed Effect Estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	0.168259	0.049377	3.407640	0.0008
IFD	0.003200	0.002395	1.336298	0.1826
AID	0.030829	0.015820	1.948699	0.0523
GB	0.930887	0.098256	9.474074	0.0000
GE	0.557540	1.524656	0.365682	0.7149
C	52.50297	4.545132	11.55147	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
Root MSE	4.056710	R-squared		0.907587
Mean dependent var	82.28503	Adjusted R-squared		0.894481
S.D. dependent var	13.36586	S.E. of regression		4.341730
Akaike info criterion	5.892590	Sum squared resid		5183.922
Schwarz criterion	6.369107	Log likelihood		-888.0829
Hannan-Quinn criter.	6.082976	F-statistic		69.25022
Durbin-Watson stat	1.954334	Prob(F-statistic)		0.000000

Source: Authors' Computations.

TABLE 5
Difference GMM Estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PR(-1)	0.124572	0.004202	29.64775	0.0000
IFD	0.002490	0.000427	5.834153	0.0000
AID	-0.036676	0.003644	-10.06387	0.0000
GB	1.654692	0.010722	154.3261	0.0000
GE	-12.13733	1.120987	-10.82737	0.0000
Effects Specification				
Cross-section fixed (first differences)				
Root MSE	6.114812	Mean dependent var		-0.064209
S.D. dependent var	6.548349	S.E. of regression		6.170151
Sum squared resid	10469.46	J-statistic		30.11095
Instrument rank	35	Prob(J-statistic)		0.459982

Source: Authors' Computations.

Table 6 presents the results of the panel SGMM estimation for the relationship between the dependent variable Poverty Reduction (PR) and the independent variables. The results show that the PR(-1) coefficient is 0.4801 with a standard error of 0.015628. The t-statistics are 30.72244, indicating that the lagged value of PR has a highly significant positive effect on the current level of Poverty Reduction.

TABLE 6
System GMM Estimate (Dep. Var: logPR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
logPR(-1)	0.4801***	0.015628	30.72244	0.0000
logIFD	0.0027***	0.001038	2.626862	0.0131
logAID	0.0494***	0.006944	7.113145	0.0000
logGB	0.2410***	0.069949	3.444716	0.0016
GE	-6.7006***	1.572883	-4.260088	0.0002
No. of Obs.				264
R (2)				0.1526
J-statistic				28.1313
Group/Instrument rank				33/33
Sargan-Hansen				0.4575

Notes: ***, **, * are statistical significance at 1%, 5% and 10% level respectively.
Source: Authors' Computations.

Islāmic Finance Development (IFD) coefficient is 0.0027 with a standard error of 0.001038. The t-statistic is 2.626862, and indicates that IFD has a significant positive effect on PR. A percentage change in IFD is associated with a 0.27% increase in PR in the short run, at 1% level of significance on average - ceteris paribus. Hence, IFD and PR exhibit an inelastic relationship. This finding is consonant with the findings of Guled (2022) and Shabbir et al. (2018).

Foreign Aid (AID) coefficient is 0.0494 with a standard error of 0.006944. The t-statistic is 7.113145, indicating that AID has a highly significant positive effect on PR. A percentage change in AID leads to a 4.94% increase in PR in the short run, at 1% level of significance on average - ceteris paribus. Hence, AID and PR exhibit an elastic relationship. A range of studies have found a significant positive effect of foreign aid on poverty reduction. For instance, Alvi and Senbeta (2012) and Mahembe and Odhiambo (2019) reported that foreign aid is associated with a decline in poverty, with multilateral aid and grants being particularly effective.

Government Budgets (GB) coefficient is 0.2410 with a standard error of 0.069949. The t-statistics are 3.444716, indicating that GB have a significant positive effect on PR. A percentage reduction in GB results to a 24.1% increase in PR in the short run, at 1% level of significance on average - ceteris paribus. Hence, Government Budgets and poverty reduction exhibit an elastic relationship. Existing studies have found a positive relationship between government spending and poverty reduction. For example, Nigerian government expenditure on health, education, and building and construction was found to have a significant and positive impact on per capita income, which is closely linked with poverty reduction (Oriavwote and Ukawe, 2018). Moreover, Iranian constructive government expenditures were found to have a positive effect on poverty reduction (Dahmardeh and Tabar, 2013). Similarly, Pakistan's government spending on education and law and order was found to significantly contribute to poverty reduction (Asghar, Shirazi, and Nabi, 2012).

Government Effectiveness (GE) coefficient is -6.7006 with a standard error of 1.572883. The t-statistic is -4.260088, indicating that GE has a highly significant negative effect on PR. A percentage increase in GE results in a 670.6% decrease in PR in the short run, at 1% level of significance on average - ceteris paribus. Hence, GE and PR exhibit an elastic relationship. This finding aligns with the data, which show predominantly negative estimates of government

effectiveness across the studied African countries. The prevalence of embezzlement cases, coupled with high rates of money laundering, contributes to a lack of trust in institutions and governance frameworks in Nigeria (Abere and Akinbobola, 2019). This further highlights the challenges and impact of poor governance on social development outcomes in Nigeria and so also in many other African countries. Corroborating this finding, Nyamboga et al. (2014) and Musiba (2013) identified challenges in effectiveness of government policies and expenditure in poverty reduction, including weak mapping and coordination of the lead institutions, duplication of efforts, inadequate coverage by region and even gender, competition among and between players, and lack of clear policy direction. Furthermore, Tebaldi and Mohan (2010) highlighted the importance of a robust system to control corruption and ensure effective government in promoting economic growth and reducing poverty.

The Arellano-Bond Serial Correlation Test statistic value of 0.1526 suggests no significant evidence of serial correlation in the model's residuals, indicating that the model is free from second order serial correlation. In addition, the Sargan-Hansen Test statistic value of 0.457503 suggests that the instruments used in the model are valid. This establishes the reliability of instrumental variable estimation and indicates that the instruments are suitable for addressing endogeneity and obtaining consistent parameter estimates in our study.

Considering this in light of the *maqāṣid* (higher objectives) of *Sharī'ah,* we can convey that greater allocation of *Islāmic* financial funds, foreign aid and government funding and effectiveness in management and application has the potential to establish greater justice, consistency, fairness, inclusivity and integrity in African socio-economic growth and development. The theory of *Islāmic* finance, as advocated by scholars such as Saleem et al. (2023), and Siddiqi (2006) underscores a strong social commitment by emphasizing socio-economic objectives such as social justice, equity, cooperation, poverty alleviation, and human well-being, all of which are rooted in the *maqāṣid* (higher objectives) of *Sharī'ah*. Furthermore, Alhammadi (2022) highlights how *Islāmic* banking and finance can contribute to reconstructing the economy based on *maqāṣid* (higher objectives) of *Sharī'ah* to enhance social, economic, and environmental welfare, especially in challenging times such as the COVID-19 era.

5. CONCLUSION AND POLICY IMPLICATIONS

This study examined the effect of *Islāmic* finance on poverty reduction in 53 African countries over the period 2013 to 2022. The findings reveal that *Islāmic* finance development, foreign aid, government budgets, and government effectiveness have significant effects on poverty reduction. *Islāmic* finance development, foreign aid and government budgets exhibit a positive effect on poverty reduction. Government effectiveness, however, has a negative effect on poverty reduction. These results suggest that *Islāmic* finance can contribute to poverty reduction efforts in African countries by promoting inclusive economic growth and providing accessible financial services to the poor. This ensures the possibility of attaining the *maqāṣid* (higher objectives) of *Sharī'ah,* such as justice, fairness and greater socio-economic welfare.

The findings of this study have important implications for policymakers, practitioners, and researchers. First, policymakers can consider leveraging the potential of *Islāmic* finance when developing poverty reduction strategies. By promoting *Islāmic* finance principles and practices, governments can foster inclusive economic growth, improve financial inclusion, and support social welfare programs. Second, *Islāmic* finance industry practitioners can design and offer innovative financial products and services that specifically target the the poor and marginalized communities. This can include microfinance solutions, *Islāmic* social finance mechanisms, and ethical investment options. Lastly, researchers can build upon these findings to further explore *Islāmic* finance impact on poverty reduction, specifically in the African context. Future research can delve into specific mechanisms and channels through which *Islāmic* finance can effectively contribute to poverty reduction, besides investigating potential challenges and barriers in implementing *Islāmic* finance initiatives in African contexts.

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COMPETING MEASUREMENT MODELS OF *MAQĀṢID SHARĪʻAH*-BASED *SEJAHTERA* LIVING

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ABSRACT

The study examined four competing models, which are unidimensional model, correlated-factor, second-order factor, and bifactor model, using confirmatory factor analysis (CFA). It aimed at identifying the best-fitting model that measures *sejahtera* living (SL), an inventory which is based on *maqāṣid sharīʻah*. The study also evaluated the statistical properties of the optimal solution, in terms of factor dimensionality and reliability. An online self-reported SL inventory was created to collect the data. It is a questionnaire containing 21 content-validated items measuring five facets of SL, namely the preservation of religion, life, intellect, dignity, and wealth. A total of 461 employees and 596 students at a public university participated in the study. The bifactor model best fitted the data. The model yielded results that all items loaded on their specified dimensions. In addition, it confirmed the presence of a general factor that influenced the variability of responses across

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all items. The bifactor model confirmed the contributions of the general factor to the reliability of the SL inventory. The results indicate that inventory is an effective tool for assessing research and educational practices related to a good life.

JEL Classification: C520, I310, I200

Keywords: *Sejahtera* Living, *Maqāṣid Sharīʻah*, Confirmatory Factor Analysis, Questionnaire validation, Bifactor model

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1. INTRODUCTION

Maqāṣid sharīʻah is a concept that embodies the comprehensive view of *Islām* as an integrated way of life that encompasses individuals and society. A profound understanding of the *maqāṣid sharīʻah* requires a strong commitment from every individual and organization to achieve justice, brotherhood, and social welfare; and it will naturally result in a society where members cooperate and even compete constructively to attain *falah* (ultimate happiness) (Dusuki and Abozaid, 2007).

The phrase '*maqāṣid sharīʻah*' means goals, purposes, objectives, and principles of the *Islāmic* rulings (Afridi, 2016). Verses of *Qurʾān* and *Sunnah* fundamentally underscore the primary objectives of *maqāṣid sharīʻah*, which are to provide benefits for mankind and to prevent harm. Al-Ghazali and Al-Shatibi had effectively propounded the early systematic discourse of *maqāṣid sharīʻah* (Al-Raysuni, 2006). Currently, Ibn Ashur's notion of the concept is "arguably the most important attempt of the 20th century to further develop the theory of *maqāṣid*" (Afridi, 2016, 276) and substantially enriched the corpus of knowledge with contemporary perspectives.

Al-Ghazali indicated that the specific aim of *maqāṣid sharīʻah* is to preserve five essentials of human well-being, namely religion, life, intellect, lineage, and property; while Ibn Ashur propagates the notion that *maqāṣid sharīʻah* is also related to preservation of the family system, freedom of belief, orderliness, natural disposition, civility, human rights, freedom, and equality (Al-Raysuni, 2006). Other contemporary scholars such as Yusuf Al-Qaradawi and Mohammad Hashim Kamali have further extended the meaning of the construct to cover "social welfare, freedom, human dignity, and

human fraternity," as well as "the protection of fundamental rights and liberties, economic development, along with research and development in science and technology" (Afridi, 2016, 278).

Clearly, *maqāṣid sharī'ah* is an important part of Islam as it defines what is good and what is bad, to do good and to prevent bad deeds, and to reason everything one does in his or her daily lives. To a *Muslim*, *maqāṣid sharī'ah* serves as a framework of divine values and beliefs pertaining to good life. The *maqāṣid sharī'ah* framework guides *Muslims* in their daily routines, rituals, practices, beliefs, expectations, and norms, which could contribute to their well-being, as well as to the welfare of fellow human beings and other creatures. In essence, everything that a *Muslim* says, thinks, intends, and does is supposed to be for the sake and pleasure of *Allāh ʿazza wa jalla*. This is an expression of *sejahtera* living, where *maqāṣid sharī'ah* could guide a *Muslim* to live a *sejahtera* life (Abdullah et al., 2023). The degree to which a *Muslim* accomplishes *sejahtera* living (SL) is contingent upon fulfilling goodness and righteousness and warding off or getting rid of destruction. As explained by Mohd Kamal Hassan (2020, 7), SL is "a state of holistic and integrated wellbeing consisting of success, happiness, security and balance in this world and in the hereafter."

Empirical data on *sejahtera* living, however, is lacking, including the measurement model with statistical properties that suit the data. This study aimed at determining the measurement model that best fits the SL data. Four competing, non-nested SL models were tested, namely (i) a one-factor model, (ii) a four-factor model, (iii) a second-order factor, and (iv) bifactor model (Rodriguez et al., 2016). The study used the data collected from a 21-item instrument to address this objective. Contingent upon detection of the best fitting model, the study further estimated and evaluated additional statistical properties of the optimal to complement the construct-revalidation results from the CFA (Yang and Su, 2022).

Specifically, the study aimed at identifying the optimal SL model that best fits the data and examining the measurement properties of the optimal measure, in terms of its factor dimensionality and reliability.

This article will next discuss the Literature Review, followed by the *Maqāṣid Sharī'ah* Framework in section 3, the Methodology in section 4, the Results in section 5, before ending with the Conclusion and Recommendations in section 6.

2. LITERATURE REVIEW

Despite its importance in the life of *Muslims*, very little empirical data on *sejahtera* living (SL) exists. Not much is known about what and how the *Muslims* live *sejahtera* life. It is only recently that an effort to validate a five-factor measurement model of "*Maqasid Shariah* Quality of Life" (MSQoL) was documented (Mohamad et al., 2016). The researchers tested the quality of the instrument using data from 248 drug abuse inmates. The results of testing a third order MSQoL measure supported the data reliability and the construct validity of the questionnaire in terms of its convergent and discriminant validity.

In addition, Nordin et al. (2022) analyzed the prevalence of SL among students at an *Islāmic* university in Malaysia and found that its underlying structure was associated with the five fundamentals of *maqāṣid sharī'ah*. Furthermore, a scale to measure sejahtera living was developed by Abdullah et al. (2023) based on *maqāṣid sharī'ah* dimensions. The SL construct is validated using Rasch measurement analysis, and subsequently SL index scores were estimated for staff and students at a public university in Malaysia. The validation study established the reasonableness of the *maqāṣid sharī'ah* inventory, as well as the likelihood of measurement invariance across types of samples at a university.

Of late, current literature related to instrument validation strongly asserts for the testing of competing models. For instance, Mohamad et al. (2019) compared covariance-based structural equation modeling (CB-SEM) and partial-least squares SEM (PLS-SEM) using the same dataset to validate the MSQoL and found that the former is more accurate. At least four competing measurement models have been factored into scale validation studies. The commonly tested competing models include a single factor model, correlated-factor model, second-order factor model, and bifactor model (e.g., Mihić et al., 2021; Yang and Su, 2021; Gignac and Kretzschmar, 2017; Rodriguez, Reise, and Haviland, 2016). A substantial proportion of the studies found the bifactor model as the best fitting solution. Thus, to do justice to its use, it is imperative to assess the efficacy of competing models of a *maqāṣid sharī'ah*-based instrument.

The conclusion of many bifactor modelling relies mainly on the overall fit indices. Most studies merely reported the chi-square value, degree of freedom, comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). The authors seldom considered model-based reliability and

dimensionality indices, leaving rooms for misleading interpretations and inconsistent findings across studies.

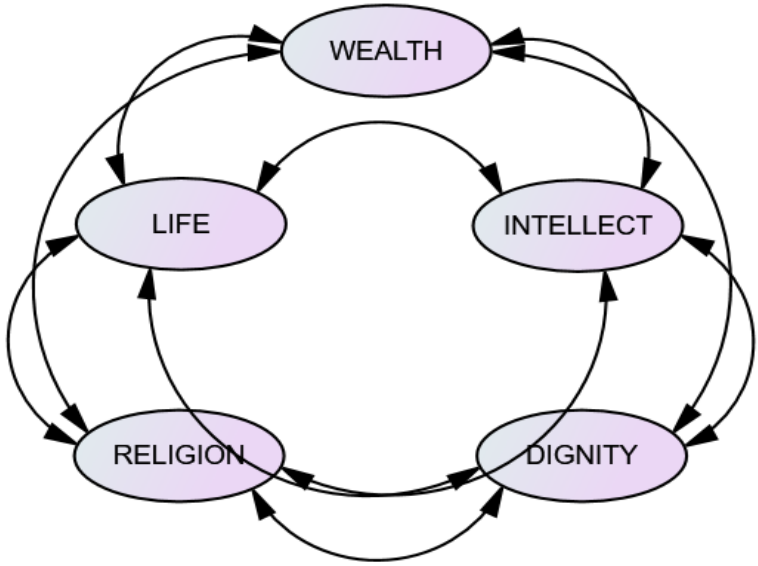
To address these issues, this study aimed at determining the measurement model that fits best the SL data from a list of four different models of SL which were not nested within each other: a one-factor model, a four-factor model, a second-order factor model, and a bifactor model.

3. *SEJAHTERA* LIVING IN *MAQĀṢID SHARĪ'AH* FRAMEWORK

The attempts to develop measurement models based on *maqāṣid sharī'ah* are not new. For example, several efforts included elements of *maqāṣid sharī'ah* in measuring the multidimensional nature of poverty (Zailani et al., 2023). Limited research however included *maqāṣid sharī'ah* elements in measuring the multidimensional life model, including for staff and students in an *Islāmic* institution of higher learning. For instance, the improvement of employee quality of work life through job satisfaction, encouragement of challenges, commitment and participation among employee leads to effectiveness and efficiency as well as achievement of organizational goals (Nikkhah, 2023). In this regard, *maqāṣid sharī'ah* has the great potential to guide a comprehensive life model that fulfils individual needs as well as realizing the institutional vision and mission.

According to Ibn Ashur, *maqāṣid sharī'ah* concept proliferates the preservation of order, attainment of benefit and inhibition of harm, establishment of equality among people, and enables the law to be respected and obeyed. In so doing, it empowers the believer to become powerful, respected, and confident. *Maqāṣid sharī'ah* is to sustain and promote human life toward quality and wellness in this world and the hereafter (Abdul Rasool, Mohd Yusof, and Ali, 2021). The following Figure 1 depicts the proposed five-factor SL model which is rooted in *maqāṣid sharī'ah*.

FIGURE 1
Framework for *Sejahtera* Living



3.1 PRESERVATION OF RELIGION

In this study, preservation of religion is defined as one's awareness and commitment in Islamic Worldview. It includes one's beliefs, knowledge, and practice of the absolute monotheism (*tawhid*) paradigm, which is driven by the *Islāmic* creed (‘*aqidah*). In addition to observing the different kinds of *‘Ibadah,”* defending the *Islāmic* faith can be done through various means such as in writings, speeches, and other practical means (Afridi, 2016). A contented *Muslim* is expected to, for example, endorse the idea that “God has a significant impact upon [him/her]” and “realize that [his/her] daily activities are parts of *ibadah*.”

3.2 PRESERVATION OF LIFE

Respondents who experience SL are cognizant of and engaged in protecting their physical and mental health, safety, and life. They take care of their surroundings and keep threats at bay. Such a respondent is likely to “[be] responsible to protect life,” “avoid harmful food or drink,” and “make sure that [his/her] surroundings are safe.”

Precautionary behaviors would shield him or her against the uncalled life-threatening situations. Afridi (2016) noted that, "It is important to note that generally, saving of one's life is required. However, it should not be done at the expense of the lives of others" (p. 281).

3.3 PRESERVATION OF INTELLECT

High levels of SL abound among those who unswervingly choose, perform, and grow in their advancement and protection of the intellect (*'aql*). In this study, the term intellect captures the cognitive, social, emotional, and spiritual domains, which are imbued with *Islāmic* values. One's reactions to the propositions, "made myself prepared in all my courses/work," "happy with my personal relationships," and "satisfied with the *Islāmic* environment" manifest his or her levels of intellect in *sejahtera* living. In this respect, Afridi (2016) argues that everyone should use their mental capabilities for the benefit of all and not in any way that could lead to evil or diminish their capabilities. This is the reason for upholding freedom of expression among individuals and tolerance for differences of opinions as long as they align with *Islāmic* ethical values.

3.4 PRESERVATION OF DIGNITY AND LINEAGE

Protection of dignity includes honoring individual rights to privacy, avoiding disclosing weaknesses of others, being respectful and responsible in men-women relationships, making decisions in matters pertinent related to family, and marriage and divorce (Afridi, 2016; Sidik, Saper, and Daud, 2019). These are in keeping with the *Islāmic* principle that "all individuals [deserve] to be treated in a way of dignity, nobility, and respect, and deserve to be taken decent care of for any issues" (Ahmad Khalid et al., 2021, 44). Logically, SL is demonstrated in one's endorsement that he or she is always "comfortable talking to/working with people of opposite gender," "good/prepared to be a good parent to my children," and "have the positive attributes to lead my family." These are instances of dignity-related SL which were measured in this study.

3.5 PRESERVATION OF WEALTH AND RESOURCES

This dimension of *maqāṣid sharī'ah* refers to one's activities to accumulate, use, protect, distribute, and purify his or her natural self-resources including natural potentials, wealth, and time in a just and

productive manner (Nasr, 2015). It is very likely that a *Muslim* who preserves wealth and resources will always avoid wastage in any form, contributes to *sadaqah*, pays *zakat*, and values time. This wealth dimension is in keeping with the notion that in *Islam*, wealth and resources are meant for one to meet his or her needs, which in turn should prosper the SL of society via community engagement (Abdullah, Has-Yun Hashim, and Yusri, 2020).

One commonality shared by these five dimensions of *maqāṣid sharī'ah* is that it embraces a set of divine principles of SL. Taken together, the principles help one to approach his or her raison détre—to worship *Allāh ʿazza wa jalla*, the Creator. It is the all-encompassing objective and ultimate justification of his or her existence. The *maqāṣid sharī'ah* provides guidance on what it means by worshipping *Allāh ʿazza wa jalla*, and how to do it. Obviously the five factors are distinct, albeit interrelated facets of worshipping *Allāh ʿazza wa jalla*. Collectively, the *maqāṣid sharī'ah* framework prompts a *Muslim* to strive to gain His pleasure by promoting good and repelling evil and harm to reach quality, happy, and meaningful living.

4. METHODOLOGY

4.1 SOURCE OF DATA

Data for this study were collected from 461 employees and 596 students at a Malaysian public university, the International Islamic University Malaysia (IIUM). The employee sample consisted of both the university teaching staff (66.8%) and the non-academic personnel (33.2%). The majority of employees sample comprised experienced university workforce, with more than 80% of the sample having been working between five and eight years.

IIUM was chosen because of its commitment to implementing SL in all aspects of its ecosystem. This is evident in the development and adoption of Sejahtera Academic Framework (SAF) as the university's overarching education principles where it aspires to nurture insan *sejahtera* (Borhan et al., 2021). The online SL questionnaire was disseminated to all staff and students. Various management levels assisted in ensuring a high response rate and balanced responses across various faculties and administration offices.

The Office for Strategy and Institutional Change (OSIC), IIUM, appointed a group of 20 trained researchers to develop the SL inventory. To account for the variability of perspectives regarding living and learning experiences, the team conducted a series of focus

group discussions. The qualitative data analysis yielded results which were then calibrated based on the university's vision of humanizing education, in which *maqāṣid sharī'ah* is the founding component (Borhan et al., 2021).

4.2 CONTENT-VALIDITY ANALYSIS AND QUESTIONNAIRE DEVELOPMENT

Based on the concept of *maqāṣid sharī'ah*, the research team initially identified more than 150 indicators of *sejahtera* living. To establish content-related validity of these indicators, the team applied content validation procedure (Colin and Andrew, 2013; Lewis, Templeton, and Byrd, 2005; Lawshe, 1975). First, we operationalized the construct and sub-constructs *maqāṣid as shariah*, using the conventionally recognized content-validation protocol. We used a form that contains the definition of each facet of *maqāṣid sharī'ah* relevant to living and learning experiences, items that represent the indicators of SL, scale of measurement for the employees to respond, and a response list to each of which an expert can check the item adequacy.

Second, the study solicited experts' judgment about item relevance and importance. A panel of nine experts was formed to examine and evaluate the operationalized variables. Each expert independently reviewed and rated the adequacy of definition of the dimensions of SL *vis-a-vis maqāṣid sharī'ah*, item-definition alignment, and the item sampling. The panel registered their response to each item on a 3-point scale, which are "Essential," "Important but Not Essential," or "Neither Important nor Essential." In addition, the panel was prompted to provide written feedback on item clarity and to comment on the inventory instructions, item format, response options, and language use.

Third, the study estimated the content validity ratio (CVR) of each item (e.g., Norashady et al., 2016; Baheiraei et al., 2013; Allahyari et al., 2011; Lawshe, 1975). Using a simplified content validity procedure, the threshold of critical level of agreement for a panel of nine experts is 0.778 (Ayre and Scally, 2014). The study retained only those items with CVRs exceeding the threshold value.

An online self-reported SL questionnaire was then created. It contains a total of 50 items measuring the content-validated indicators of the five facets of SL. Each facet is represented by 10 items, to each of which a respondent would check his/her agreement on a five-point frequency scale with responses ranging from "Never" to "Always." A

series of exploratory analyses (PAF) used the data collected from 461 staff and 596 students. The PAFs consistently extracted five underlying factors of students' *sejahtera* variables; each explained more than 60% of variance. Only 21 of the appropriately behaving items, however, were included in the confirmatory analysis. The present study sought to confirm the findings using data collected from the 1057 university students and staff.

4.3 ANALYTICAL PROCEDURE

Confirmatory factor analysis (CFA) was used to test the adequacy of the SL competing models. We applied the maximum-likelihood (ML) estimation method, using the AMOS 23 data fitting program. The five-factor reflective model was specified in which two factors were loaded with five items each (Life; Intellect), two factors were loaded with four items (Religion; Dignity), while the last three items loaded on the factor Wealth, making a total of 21 items for the model. The specification of the measurement model was informed by the *maqāṣid sharī'ah* framework and the findings from the PAFs. The adequacy of each measurement model was verified using the following good-fit statistics: (i) consistency of the measurement model with the data, and (ii) reasonableness of the parameter estimates, and (iii) fit indices, which include the comparative fit index (CFI) and root mean square error of approximation (RMSEA) (Byrne, 2010; Kline, 2016). We applied the widely used cut-off scores to determine adequacy of the SL inventory. Basically, a CFI value exceeding 0.90 is considered the benchmark- for a measure to be of good fit; RMSEA value of < 0.08 is considered critical for an adequate measure.

5. RESULTS

This section presents the results of CFA on each competing model. Table 1 summarizes the distributions of descriptive statistics of the items and internal consistency index of each factor.

TABLE 1
Descriptive Statistics, Composite Reliability, and Average Variance Extracted

Factor	Code	Item	Mean	SD	α
Religion	IW1	God has a significant impact upon my life	3.91	0.38	0.75
	IW2	I strive to be bearer of enjoining the right and forbidding the wrong	3.60	0.68	
	IW3	I realize that my daily activities are parts of ibadah	3.71	0.57	
	IW4	I strive to make Prophet Muhammad as the role model in my life	3.73	0.58	
Life	PL1	I am responsible to protect life	3.82	0.49	0.86
	PL2	I avoid harmful food or drink	3.69	0.58	
	PL3	I adhere to safety procedures	3.72	0.53	
	PL4	I make sure that my surroundings are safe	3.77	0.51	
	PL5	I am clear of my objectives in this life	3.48	0.76	
Wealth	PS6	I avoid wastage in any form	3.37	0.73	0.76
	PS7	I contribute to the community through obligatory zakat, sadaqah	3.38	0.80	
	PS8	I value time	3.40	0.74	

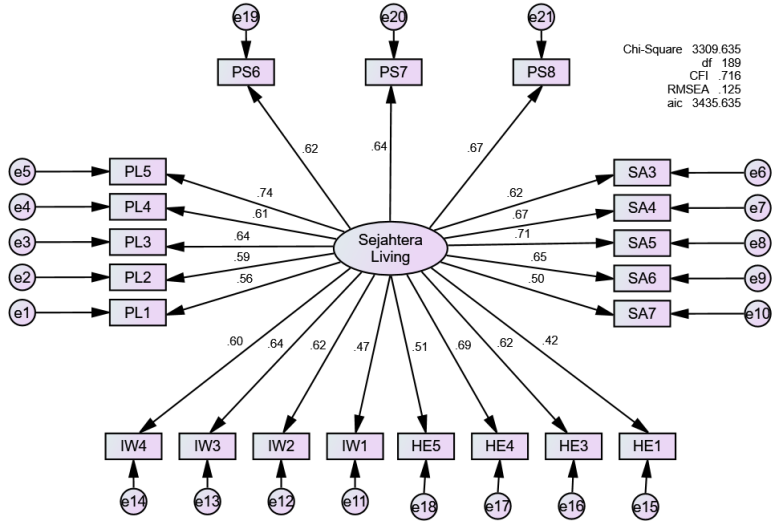
TABLE 1 *(continued)*

Factor	Code	Item	Mean	SD	α
Intellect	SA3	I am satisfied with my achievement in my studies/work	3.12	0.83	0.85
	SA4	I made myself prepared in all my courses/work	3.47	0.69	
	SA5	Every morning, I look forward to another day in class/at work	3.35	0.79	
	SA6	I am happy with my personal relationships	3.40	0.80	
	SA7	I am satisfied with the *Islāmic* environment	3.49	0.74	
Dignity	HE1	I am comfortable talking to/working with people of opposite gender	2.97	0.94	0.74
	HE3	I am a good/prepared to be a good parent to my children	3.23	0.98	
	HE4	I have the positive attributes to lead my family	3.22	0.87	
	HE5	I can explain LGBTQ issues from an *Islāmic* point of view	3.04	0.95	

5.1 ADEQUACY OF THE UNIDIMENSIONAL, SINGLE FACTOR MODEL

The study used confirmatory factor analysis to test the validity of the single factor SL inventory. The model contains only one factor, and it was loaded with all the 21 manifest variables. Figure 2 depicts results of the CFA.

FIGURE 2
Results of CFA of Single Factor



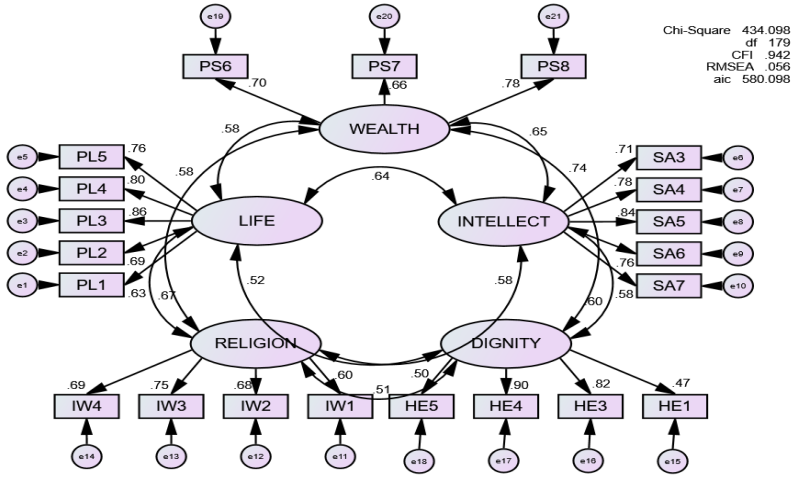
As shown in Figure 2, the measure was deficient ($\chi^2(189) = 3360$; CFI = 0.72; RMSEA = 0.125); the results indicated that it fell short of the standards deemed necessary for a good fit model. These statistics suggested that the unidimensional inventory did not reproduce the data, hence, the single factor SL inventory was inconsistent with the data. Therefore, a unidimensional model is an inadequate representation of the construct *maqāṣid sharī'ah*-based SL.

5.2 ADEQUACY OF THE FIVE CORRELATED COMMON FACTORS

The study then tested the adequacy of the five-factor SL structure. The model contains the SL construct with its five correlated latent variables or factors (Figure 1). The five factors were loaded with at least three manifest variables, which are the questionnaire items. Of the five factors, preservation of Life and Intellect were loaded with

five items each, Religion and Dignity got four items each, and Wealth three items. While the five subconstructs were expected to be correlated, each item was assumed to load only on its respective factor with uncorrelated error terms. As shown in Figure 3, the CFA yielded signs of an adequate measure; $\chi^2(179) = 434$; CFI = 0.94; RMSEA = 0.056, CI: 0.049, 0.062. These statistics suggested that the five-factor SL inventory was consistent with the data.

FIGURE 3
Results of CFA of Correlated Five-Factor Model

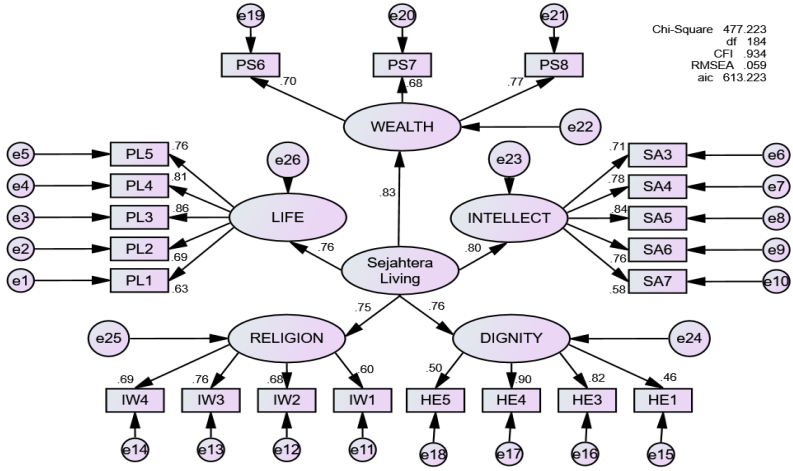


All loadings were statistically significant (p =0.001) and were of practically value ($\lambda \geq 0.5$) with the exception the Dignity-->HE1 loading ($\lambda \geq 0.47$). As expected, the underlying factors of *sejahtera* living, were positively correlated. All internal consistency statistics of the sub-scales exceeded the acceptable threshold; $\alpha \geq 0.70$.

5.3 ADEQUACY OF THE SECOND-ORDER *SEJAHTERA* LIVING MODEL

Next, we tested the good of fit of second order *sejahtera* living (SL) CFA (Figure 4). The model is somewhat like the correlated model, apart from the presence of a higher order factor (*Sejahtera* Living). The figures show that the second-order factor causally influenced the five lower levels factors, which in turn affected the variability of their respective directly measured variables.

FIGURE 4
Results of CFA of Second-Order Model

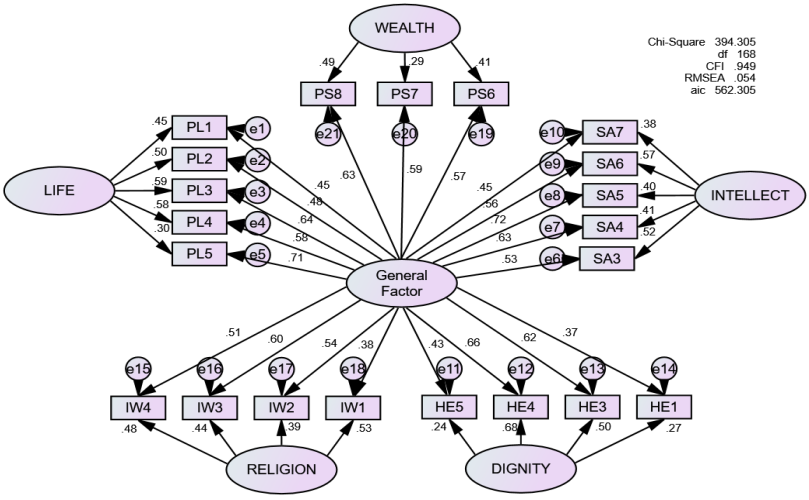


As shown in Figure 4, the results of the second-order CFA fittingly produced an acceptable solution; $\chi^2(184) = 477$; CFI = 0.93; RMSEA = 0.059, CI: 0.052, 0.065. These fit indices supported the efficacy of the second-order structure of the SL inventory. In addition, all loadings were statistically significant; and were of practicality value ($\lambda \geq 0.5$), with the exception the Dignity-->HE1 loading ($\lambda \geq 0.47$). The Cronbach's alpha of the sub-constructs exceeded 0.70, indicating acceptable degree of internal consistency of the sub-scales.

5.4 ADEQUACY OF BIFACTOR STRUCTURE

Apart from SL in general, a *Muslim* may also positively or negatively assess the specific aspects of his or her living—commonly agreed to encompass preservation of faith, life, intellect, dignity, and wealth as the underlying dimensions. Collectively, as depicted in Figure 5, the general and specific factors made up a bifactor structure of SL.

FIGURE 5
Results of CFA of Bifactor *Sejahtera* Living Structure



The results of the CFA supported the validity of the bifactor structure. The good fit of the bifactor model is supported in terms of the Normed Chi-square (2.35), CFI (0.95), RMSEA (0.054, CI: 0.047, 0.061). Additionally, all factor loadings were statistically significant at p = 0.001.

5.5 OPTIMAL *SEJAHTERA* LIVING MEASURE

Table 2 summarizes the fit indices of the competing models. Apparently, the model appeared to fit the data reasonably well except for the one-factor solution (Model A). The least restrictive bifactor model (Model D) yielded indicators of the best fit to the data in terms of the smallest AIC (562).

Thus, the data demonstrated the prevalence of a superordinate general SL factor, which directly explains the covariation among the measured variables. Over and beyond the general factor, the data yielded replicable specific SL factors. The results suggest that SL is also a socially constructed cognitive judgment about the quality of life. It is the result of one's systematic and logical judgment of the various dimensions or facets of their way of life.

TABLE 2
Fit Statistics of *Sejahtera* Living Competing Models

	Model A	Model B	Model C	Model D
χ^2	3310	434	477	394
df	189	179	184	168
χ^2/df	17.510	2.430	2.590	2.350
CFI	0.716	0.942	0.934	0.949
RMSEA	0.125	0.056	0.059	0.054
AIC	3437	580	613	562

Note: Model A ~ unidimensional model; Model B ~ Correlated factors model; Model C ~ Second-order model; Model D ~ Bifactor Model.

5.6 BIFACTOR MODEL-BASED PSYCHOMETRIC PROPERTIES

Table 3 presents indices of reliability and dimensionality of the bifactor SL model (Rodriguez et al., 2016) using Bifactor indices calculator (Deuber, 2017). Coefficient ω and ω_H respectively represent the proportion of the variance in the scale total score that was attributable to all sources of common variance and the proportion of the scale total score variance that was due to the general factor only. The high ω (0.940) and ω_H (0.872) values indicated highly reliable multidimensional CFA structure.

TABLE 3
Bifactor *Sejahtera* Living Reliability and Dimensionality Indices

Indices	Specific Factor					General Factor
	Religion	Life	Intellect	Dignity	Wealth	
ECV	0.446	0.419	0.382	0.426	0.314	0.599
ω	0.781	0.870	0.860	0.779	0.763	0.940
ω_H	0.351	0.361	0.329	0.310	0.233	0.872
H	0.523	0.631	0.585	0.572	0.377	0.914
Factor Determinacy	0.742	0.814	0.775	0.857	0.669	0.923

Note: ω (omega) ~ multidimensional reliability; ECV ~ explained common variance; H ~ construct reliability.

The data showed that for the general factor the expected common variance (ECV), which is the ratio of variance accounted for by the general factor over the variance accounted for by the specific

factors, was not dominant; it was merely 0.59. While the percentage of uncontaminated correlations (PUC) was 0.82, the GƆH and H index were 0.87 and 0.91, respectively.

For the specific factors, the ECVs range from 0.31 to 0.45, over and beyond the variance accounted for by the general factor; $GƆ_{Hs}$ range was between 0.23 and 0.35; H values were between 0.37 and 0.63. These results suggest that there is no evidence of a dominant unidimensional SL structure in lieu of a multidimensional structure. Hence, the use of separate scores for the general factor and specific factors as the criteria in a causal model is justifiable.

6. CONCLUSION AND RECOMMENDATIONS

One purpose of the study was to determine the measurement model that best fits the SL data. The study offered evidence that the bifactor structure is the optimal five-factor measurement model in that it generated the data collected from the employees of a public university. The results demonstrated the prevalence of a superordinate general SL factor, which directly explains the covariation among the observed indicators. Over and beyond the general factor, the analysis produced stable and replicable five specific SL factors. Thus, the use of bifactor model in SL t the findings from this study could assist in determining the right model to evaluate the progress of SAF and other similar *sejahtera*-based academic framework especially in measuring its effectiveness among university's staff, students, and community. The usage of the right model would enable detection of any issues that warrant speedy intervention.

Nevertheless, the study is limited in two ways. First, the study did not examine the measurement invariance of the bifactor structure across different groups of samples. Future studies may work on this to assess if the bifactor SL measure is applicable across groups of interest, for example gender. Second, the study did not examine the predictive validity of the common factors of the bifactor solution. Therefore, future studies may address this inadequacy by testing the causal correlational links between the common factors and external criteria, for example measures of mental well-being.

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ANALYZING DETERMINANTS OF *ISLĀMIC* STOCK MARKET PERFORMANCE IN INDONESIA AND MALAYSIA

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ABSTRACT

Indonesia has higher volatility in *Islāmic* stock market compared to Malaysia. As volatility of each market is derived from its *Islāmic* stock performance, the goal of this paper is to analyze determinant factors of *Islāmic* stock market performance in Indonesia and Malaysia. Using inflation and exchange rate as monetary policy objectives (MPO) and VIX (investors fear and market volatility), and gold price as global indicators for independent variables, ARDL bound test is performed with monthly Indonesia and Malaysia data. Indonesia data are gathered from December 1994 to February 2023, whereas Malaysia data are from January 2010 to February 2023. The results show that inflation and exchange rate become the main driving force of *Islāmic* stock market performance in Indonesia in the long run, while the exchange rate is true for Malaysia. In the short run, inflation become the driving factor of *Islāmic* stock performance in Indonesia and Malaysia. This paper also finds that gold investment able to become safe-haven asset in Indonesia in short and long run, while in Malaysia gold investment can be a safe-haven asset in the short run only. This paper also finds that VIX do not have any significant result only in Indonesia in short run. Implication of these results are the essential role of Central bank of Indonesia to achieve its inflation targeting, and the important role to rise capital gain tax.

JEL Classification: G1, E5, G150

Keywords: *Islāmic* stock performance, Monetary policy objectives, Global indicators

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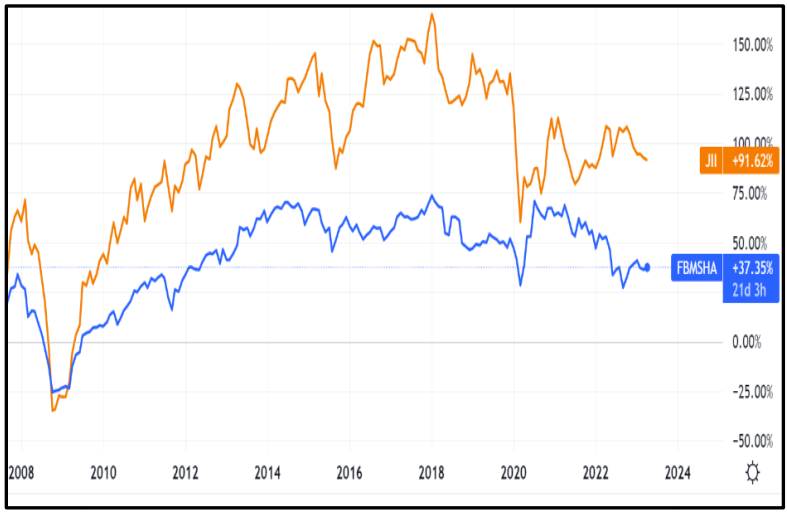
1. INTRODUCTION

Mohamed and Ahmed (2022) placed Malaysia and Indonesia as top countries in terms of *Islāmic* finance development indicators. As part of *Islāmic* finance, *Islāmic* capital market plays a crucial role for development of a country. However, based on national literacy and financial inclusion survey 2022 conducted by OJK (2022), Indonesia financial inclusion in capital market is only five, 19%, very low compared to financial inclusion in banking, insurance, and pension fund sectors. However, this drawback should be compensated by the opportunity that Indonesia is one country, among others, with the largest *Muslim* population in the world (Shikoh, 2022). Therefore, increasing financial inclusion with proper policy will lead to development of *Islāmic* capital market. Furthermore, Mishkin (2022) also explained that well-functioning capital market where long-term debt and equity instruments are traded is crucial to the health of an economy.

The development of financial investment has made investors globally to crave for higher investment returns, though with higher commensurate risks (Ayedh et al., 2021). Focusing on Jakarta *Islāmic* Index (JII) as the oldest *Islāmic* stock basis in Indonesia and also one of the benchmarks to measure performance in *Islāmic* stock investment (Masrizal, Al-Musthofa, and Herianingrum, 2021) and aggregate of the average price of the *Islāmic* stock, the following Figure 1 compares Monthly data on JII and FTSE Bursa Malaysia Emas *Sharīʿah* Index.

Figure 1 shows that the Indonesian Islamic Stock index performs better than that of Malaysia. However, focusing on the fluctuation of above *Islāmic* stock index, it is quite clear that Indonesia's *Islāmic* stock market moves quite volatile rather than Malaysia. Aziz, et al. (2020) shows that standard deviation that summarize the volatility of the movement in Indonesia stock market return is 5.01, more than Malaysia than only 2.92. As volatility shows risk of an asset, this paper argues that reduction in the stock market fluctuation will give positive signal about low risk of an asset for investors, then hopefully will increase financial inclusion especially in Indonesia's *Islāmic* stock market. Therefore, this paper tries to compare performance of *Islāmic* stock market both in Malaysia where volatility is low and Indonesia where level of volatility is high.

FIGURE 1
Stock Fluctuation of JII and Bursa Malaysia Emas *Sharīʿah* Index



Source: TradingView, 2023

Following Qoyum et al. (2022), others reason to compare Indonesia and Malaysia are: (1) *Sharīʿah*-compliant stocks encounter less risk in screening process, encouraging non-*Muslim* investors to Invest in *Sharīʿah*-compliant firms in both countries, (2) support in the promotion of *Islāmic* finance and *Islāmic* capital market in both countries are significant, (3) *Islāmic* finance as an industry is making rapid progress in these two countries, (4) effective regulatory framework for *sharīʿah*-compliant firms that is expected to increase the confidence of institutional and retail investors for both countries.

Studying stock performance, especially *Islāmic* stock market is important for two reasons. first, as stock market index is the calculation from the prices of many different stocks (Bursa Malaysia, n.d), and market capitalization can be measured by multiplying number of stock and the stock market price (Bacha and Mirakhor, 2013), the dynamic movement of *Islāmic* stock will depict average market capitalization of listed *sharīʿah*-compliant firms. Market capitalization is important for the firms. it shows, among other things, market value of a company and can help enhancie business volume (Farooq et al., 2022). More specifically,

when a company has high market capital, it can obtain funds more easily, which has positive spillover on engaging in physical projects (Farooq et al., 2022).

Second, better performance projects and also better market capitalization is expected to increase investor confidence, where study in China shows that investor (over)confidence is positively related to stock market participation (Cupak et al., 2022; Chu et al., 2017; Xia, Wang, and Li, 2014). Therefore, studying *Islāmic* capital market performance, especially in Indonesia and making comparation with Malaysia, is important to describe unique characteristics in both markets.

As economy is divided between financial market and goods market, and *Islāmic* capital market is in the financial market, this paper proposes that MPO play an important role in *Islāmic* stock market performance in both countries. Furthermore, as globalization has led to an increased number of countries gradually liberalizing their capital markets (Liu, Wang, and Dai, 2023) the effect of global indicator might significantly affect *Islāmic* stock market performance. Therefore, these two general variables might be important factors of *Islāmic* stock performance in both countries.

Very limited studies on *Islāmic* stock market performance exists, especially that focus on comparing Indonesia and Malaysia. Danila et al. (2021); Fatima, Rashid, and Khan (2018); and Kumar and Sahu (2017) for instance, each study *Islāmic* stock indices performance but not specific in Indonesia and Malaysia. Their study tries to catch the relation of shock and also macroeconomics factors on *Islāmic* stocks. Lai and Windawati (2017) study focuses on Indonesia and Malaysia however, they study stock market performance in general, not specific to *Islāmic* stock performance. Others study only compare *Islāmic* stock market performance and conventional one such as study conducted by Djedovic and Djedovic (2019), Jabeen and Kausar (2022), Qamar, Hassan, Nazir, and Haque (2022), AlKhazali, Lean, and Zoubi (2022), and Foglie and Panetta (2020). Others study focusses on integration in *Islāmic* capital market such as Majdoub, Mansour and Jouini (2016) and Qizam, Ardiansyah, and Qoyum (2020).

Some studies, such as Ahmadi and Soroushyar (2022), Dincer, Yuksel, and Adali (2019), Suriani et al. (2021), Yang and Hamori (2014), Tomar and Kesharwani (2022), Depren, Kartal, and Depren (2021), focus on monetary policies but not specifies its effect on *Islāmic* stock performance. Whereas study conducted

by Naifar (2016) and Lin and Su (2020) focus on *Islāmic* stock market that is affected by only global indicators but not with monetary policy. Therefore, this study tries to shed light on the *Islāmic* stock market performance in Indonesia and Malaysia which is affected by monetary policies and also global indicators.

After the introduction, this paper is organized as follows. Section 2 describes the theoretical framework that focuses mainly on Efficient Market Hypothesis (EMH) and some explanation about the relationship among independent and dependent variables. Section 3 explains the method used to investigate the research goal. Section 4 is about empirical results and discussion, and the last section is a conclusion based on the results of this study.

2. THEORETICAL FRAMEWORK

2.1 *ISLĀMIC* STOCK MARKET AND EFFICIENT MARKET HYPOTHESIS

Stock market has been considered as one indicator of a country's strength and development (Bialkowski in Chirwa and Odhiambo, 2020). Mishkin (2022) also explained that well-functioning financial market is crucial to economic health. Farid, Mohsan, and Jan (2022) also found that the development of the *Islāmic* capital market leads to an augmented level of real economic activity. As stock market is part of financial market, the change in stock market performance is important to be considered and can be used as an indicator, among others, of the development of countries and economic health.

In *Islāmic* stock market, different from conventional one, there are some steps in screening process to determine whether companies are *sharīʿah*-compliant or not. Bacha and Mirakhor (2013) explained that basically there are two screening process to determine a firm is *sharīʿah*-compliant. First to see the line of business or core business of underlying company. Company's core activities such as the sale of pork, alcohol, bar, casinos, conventional bank, and others prohibited activities in *Islām* will be excluded. The second one is company finance. The following Table 1 explains about the rulebook of whether company's finance performance is categorized as *sharīʿah*-compliant or not.

If a company's financial ratio is more than the limit, the company will be excluded from *sharīʿah*-compliant. Moreover,

Marzhab (2011) also explained that the different about above rulebook generally lies on the use of either total asset or market capitalization as a base to value a company and to be used as denominator for financial ratio. After the screening process, companies categorized as *sharīʿah*-compliant can issue stock and sell the stocks in the *Islāmic* stock market. Because stocks are assets whose price is determined by the buyer-seller interaction, one theoretical model that can explain such interaction is the Efficient Market Hypothesis (EMH) (Chirwa and Odhiambo, 2020).

TABLE 1
Rulebook for Determining *Sharīʿah*-Compliant Firm

Asset-based rulebook	Market-capitalization rulebook
1. Non-permissible income/total income, < 5%	1. Non-permissible income/total income, < 5%
2. Interest-bearing cash and Investment/Asset, < 33%	2. Interest-bearing cash and investment/12-month average market capitalization, < 33%
3. Receivables/Assets, < 33%	3. Receivables/12-month average market capitalization, < 33%
4. Interest-bearing debt/asset, < 33%	4. Interest-bearing debt/12-month average market capitalization, < 33%

Source: Marzhab (2011).

Bacha and Mirakhor (2013) explained that the EMH comes from the work of Eugene Fama in 1960's where it has rooted in the work of Louis Bacheleir, whose Theory of Speculation first showed the unpredictability of stock prices. According to EMH, the change of asset price in stock market in competitive market is expected to reflect all available information. Stock prices change when information changes (Mankiw, 2012). For example, Mankiw (2012) further explains that when good news about company's prospects becomes public, the value and stock price rise, in reverse when the company's prospect moves back then the value and stock price will decrease.

Later in 1970, Bacha and Mirakhor (2013) explained that Fama refined the theory by explaining that the available information and its effect to the change of stock price in the market

has three versions, viz weak form EMH, semi-strong EMH, and strong form EMH. Following Chirwa and Odhiambo (2020)'s explanation, EMH is linked to random walk theory where in the absence of arbitrage, the change of stock price will be represented by a random walk and a drift, known as drift parameter. The model is as follows:

$$Y_t = \alpha + Y_{t-1} + u_t$$

In the equation, Y_t is the dependent variable, or stock price, α is drift parameter, and Y_{t-1} is the price of stock one period before. Rewriting above equation, then become (Chirwa and Odhiambo, 2020):

$$\Delta Y_t = Y_t - Y_{t-1} = a + u_t$$

Based on this equation, the upward and downward change of Y_t, (ΔY_t) will depend on the drift parameter, α. Furthermore, this drift parameter will be influenced by any available information. As explained before that information in EMH has three versions. Chirwa and Odhiambo (2020) propose using adjusted R-square to categorized that version. 0 to 0.5 representing weak-form EMH, 0.5 to 0.7 representing semi-strong EMH, and 0.7 to 1 is strong-form EMH. Furthermore, available information in drift parameter can be any form of information. Because stock market is a part of financial market, and now many countries have liberalized policy, the form of information can be monetary policy to intervene financial market, and also global indicators.

2.2 MONETARY POLICIES

Mankiw (2013) explained that monetary policy is made by the central bank and it refers, generally, to decisions about the national system of coin, currency, and banking. Furthermore, there are two forms of monetary policy, viz tightening monetary policy and expansionary monetary policy. Syarifuddin and Sakti (2021) explained that expansionary policy aims at boosting economic activities, whereas tight monetary policy aims at slowing down economic activities. Blanchard (2021) explained that these choices of monetary policy can be achieved through controlling money supply or directly setting the interest rate.

Furthermore, as price stability continues to be the monetary policy stance of major central banks, macroeconomics' new consensus treated monetary policy and price stability objective as synonyms (Nair and Anand, 2020). More specifically, price stability in the form of low and stable level of inflation is increasingly viewed as the most important goal of expansionary or tight monetary policy (Mishkin, 2022). Moreover, as exchange rate is defined as the price of one currency in terms of another currency (Mishkin 2022), this variable can be used also to see achieve price stability objective besides inflation.

As the main objective of monetary policy is to maintain price stability that is reflected by the rate of inflation and exchange rate, the way these variables can affect *Islāmic* stock price movement can be explained theoretically by the fundamental analysis. As defined by Bodie, Kane, and Marcus (2023), fundamental analysis is the analysis of how the determinants of value or specifically intrinsic value of a stock depends on the dividend and earnings to be expected from the firm. As the firm's prospect is better as reflected by the company's financial performance, then investors will expect to get more dividends and earnings. This will lead to higher stock price increase.

Bodie et al. (2023) associate inflation with "overheated" economies where demand for goods and services outstrip production capacity. The higher demand leads to Inflation and can affect stock price through the performance of company in a form of company's profit. Profit is determined by revenue minus total cost. Inflation will affect to the rise of total revenue because of higher demand on produced goods or services. If company products are produced mostly with fixed cost rather than variable cost, Bodie et al. (2023) explained that firms will get higher profit. Better profit will lead to better company performance and higher stock price.

Other explanation can be found in Omran and Pointon (2001). As common stock can be considered as capital goods, then the stock price should move with the general level of price. So as the general level of price increase (because of expansionary monetary policy), stock should also increase to compensate investors for the decrease in the value of money. Therefore, this paper argues that:

H1: Inflation has a positive relation with *Islāmic* stock performance. The exchange rate also is related to stock price as the price is valued by domestic currency.

Mankiw (2013) stated that increasing real exchange rate will make foreign goods relatively cheap and domestic goods relatively more expensive, vice versa. As capital market is now becoming more liberalized, stock market liberalization can provide foreign investors the opportunity to invest in domestic equity security (Ilhan, 2019). This condition allows investors to trade equity security like goods that depend on the exchange rate. As lower real exchange rate will make domestic price of goods become cheaper, this also happens to *Islāmic* stock price where lower real exchange rate will lower the price of domestic *Islāmic* stock price; furthermore, as demand from foreign investors increase, this condition will push the price of *Islāmic* stock price, making *Islāmic* stock performance increase. Erdogan, Gedikli, and Cevik (2020) also explain that the increase in exchange rate will increase input cost, leveling up borrowing cost, triggering financial crisis expectations, and therefore negatively affects consumption and investment expenditure. This making lower level of *Islāmic* stock performance. Therefore, this paper argues that:

H2: Real exchange rate has a negative relation on *Islāmic* stock performance

2.3 GLOBAL INDICATOR

The average *Islāmic* stock price performance that is reflected by the movement of *Islāmic* stock indices is not only affected by monetary policy and objectives, but also affected by other global indicators that must be considered. One of global indicator itself is the fear of economic actors and volatility in financial market, because these are very important in shaping investment preference (Depren et al., 2021) that will affect *Islāmic* stock price performance. As fear of economic actors can reflect investor's risk-aversion level, Kasih and Viverita (2021) use VIX as a proxy of market volatility and also level of investors' risk-aversion. Raza et al. (2019) explained that volatility index has a negative correlation to *Islāmic* stock indices because the market will lose money when

level of volatility is increasing. Therefore, following Raza et al. (2019), a negative relationship is expected between volatility and fear of economic actors in stock market and *Islāmic* stock performance.

H3: Volatility index and fear of economic actors in stock market have negative relation to *Islāmic* stock performance.

The last variable that might affect *Islāmic* stock market performance from global indicators is the price of gold. Important study conducted by Maghyereh, Abdoh, and Awartani (2019) found that gold plays stable role in hedging and diversifying *Islāmic* equities across all investment horizons. This implies that gold can be a safe haven from the risk which is brought by *Islāmic* stock market. Conceptually, safe haven instruments such as gold have a negative relation to economic condition. Froot in Tuna (2019) also explained that investors generally seek assets with suitable average returns and negative relationship with stock and bond. When the price of gold increases, this indicates economic condition is in a downturn situation, making *Islāmic* stock market underperform. Conversely, as the gold price decreases, this indicates better economic performance, and investors switch to owning *Islāmic* stocks, hence increasing the stock price. Therefore, this paper argues that

H4: Gold price has a negative relation to the *Islāmic* stock performance.

3. RESEARCH METHOD

This paper uses Autoregressive Distributed Lag (ARDL) bound test to test the effect of MPO and global indicators on *Islāmic* stock price performance in Indonesia and Malaysia. Following Aziz et al. (2020), this paper uses *Islāmic* stock market returns to reflect performance of the stock in Indonesia and Malaysia which is calculated by ($\frac{Ln\,P_t - Ln\,P_{t-1}}{Ln\,P}$) for Indonesia and Malaysia where Ln stands for natural log and P stands for Index of *Islāmic* stocks. This paper uses monthly data gathered from Bloomberg, and St Louis FED. Data for Indonesia are gathered from December 1994 to February 2023, whereas Malaysia is from January 2010 to

February 2023. Table 2 explains variables used in this paper both for Indonesia and Malaysia.

TABLE 2
Variable and Proxy for Indonesia and Malaysia

Group	Variable	Proxy	Notation	Source of Data
Dependent Variables	Indonesia Islamic Stock Index	Return on Jakarta Islamic Index (JII)	JII	Bloomberg
	Malaysia Islamic Stock Index	Return on FTSE EMAS Syariah	FES	Bloomberg
Monetary Policy Objectives	Indonesia and Malaysia Inflation	Consumer Price Index (CPI)	CPI	St. Louis FRED (for Indonesia) Bloomberg (for Malaysia)
	Indonesia and Malaysia Real Exchange Rate	Real Board Effective Exchange Rate	REER	Bloomberg
Global Indictors	Investor Fear and Market Volatility	CBOE Volatility Index (VIX)	VIX	Bloomberg
	Gold Price	XAU Currency Gold Ounce to USD	GP	Bloomberg

Source: Author, 2023

This paper tries to compare *Islāmic* stock performance in Indonesia and Malaysia using above variables. Therefore, ARDL bound test developed by Pesaran, Shin, and Smith (2021) is performed for each of both markets. To run ARDL bound test, several steps should be applied. The first step is unit root test to

ensure no one of these above variables are integrated in order 2 or *I*(2) (Singhania and Saini, 2020). This is because Akmal (2007) and also Bist and Bista (2018) explained that ARDL bound test cannot be applicable if series of *I*(2) exists in the model. Second step is to examine whether there is any cointegration in the model and to compute F-statistics if the data show no one has integrated of order 2, or *I(2)*. To test cointegration among variables, the ARDL bound test compares the H0 of no cointegration against the H1 of cointegration (Singhania and Saini, 2020). If computed F-statistics is above the upper bound, then H0 can be rejected, if lower than lower bound, then H0 cannot be rejected, if between the upper and lower bound, then result is inconclusive. Inspired by Yakubu, Manu, and Bala (2015) and Kaur (2019), ARDL bound test model to test existence of cointegration for Indonesia can be written as follows:

$$(1)\quad \begin{aligned}\Delta LNJII_t = {} & \alpha + \omega T + \gamma_1 D1_{jii} + \gamma_2 D2_{jii} + \\ & \beta_1\, LNJII_{t-1} + \beta_2\, LNCPI_{t-1} + \beta_3\, LNREER_{t-1} + \\ & \beta_4\, LNVIX_{t-1} + \beta_5\, LNGP_{t-1} + \textstyle\sum_{i=0}^{1} \delta_{1i}\, \Delta LNJII_{t-i} + \\ & \textstyle\sum_{i=0}^{1} \delta_{2i}\, \Delta LNCPI_{t-i} + \sum_{i=0}^{1} \delta_{3i}\, \Delta LNREER_{t-i} + \\ & \textstyle\sum_{i=0}^{1} \delta_{4i}\, \Delta LNVIX_{t-i} + \sum_{i=0}^{1} \delta_{5i}\, \Delta LNGP_{t-i} + U_t\end{aligned}$$

Equation 1 above using ARDL cointegration model with case 1 (no constant and no trend), therefore $\alpha = \omega = 0$. D1 and D2 stand for structural breaks for JII that is detected using Lee and Strazicich (2003). For Malaysia, model specification for cointegration test is written as follows:

$$(2)\quad \begin{aligned}\Delta FES_t = {} & \alpha + \omega T + \gamma_1 D1_{fes} + \beta_1\, LNFES_{t-1} + \\ & \beta_2\, LNCPI_{t-1} + \beta_3\, LNREER_{t-1} + \beta_4\, LNVIX_{t-1} + \\ & \beta_5\, LNGP_{t-1} + \textstyle\sum_{i=0}^{1} \delta_{1i}\, \Delta LNFES_{t-i} + \\ & \textstyle\sum_{i=0}^{1} \delta_{2i}\, \Delta LNCPI_{t-i} + \sum_{i=0}^{1} \delta_{3i}\, \Delta LNREER_{t-i} + \\ & \textstyle\sum_{i=0}^{1} \delta_{4i}\, \Delta LNVIX_{t-i} + \sum_{i=0}^{1} \delta_{5i}\, \Delta LNGP_{t-i} + U_t\end{aligned}$$

Where the cointegration model is the same as Indonesia (case 1). For dependent variable, JII stands for return on Indonesia Islamic stock market and FES stands for return on Malaysia FTSE EMAS Syariah. CPI is inflation and REER is the exchange rate. These two represent MPO. For global indicators, there are GP for gold price and VIX for volatility index. LN is log natural, Δ is difference operation, "t" is time series, γ , β and δ are coefficient

from independent variables and *U* is error term. In the *fourth step,* following the Acaravci, Acaravci, and Ozturk (2011) explanation, if there is co-integration exist after estimating equation 1 and 2 above one by one, then in *step three,* long and short run estimation can be estimated. The long run model can be written as follows:

(3) $$LNJII_t = \alpha + \omega T + \gamma_1 D1_{jii} + \gamma_2 D2_{jii} + \sum_{i=1}^{1} \delta_{1i}\ LNJII_{t-i} + \sum_{i=m}^{1} \delta_{2i}\ LNCPI_{t-i} + \sum_{i=m}^{1} \delta_{3i}\ LNREER_{t-i} + \sum_{i=m}^{1} \delta_{4i}\ LNVIX_{t-i} + \sum_{i=m}^{1} \delta_{5i}\ LNGP_{t-i} + U_t$$

(4) $$FES_t = \alpha + \omega T + \gamma_1 D1_{fes} + \sum_{i=1}^{1} \delta_{1i}\ LNFES_{t-i} + \sum_{i=m}^{1} \delta_{2i}\ LNCPI_{t-i} + \sum_{i=m}^{1} \delta_{3i}\ LNREER_{t-i} + \sum_{i=m}^{1} \delta_{4i}\ LNVIX_{t-i} + \sum_{i=m}^{1} \delta_{5i}\ LNGP_{t-i} + U_t$$

Equation 3 is the long run model for Indonesia whereas equation 4 is for Malaysia, with α = ω = 0. Furthermore, in the fourth step, short run model for Indonesia and Malaysia can be estimated from equation 5 and 6 respectively with the equation are written below:

(5) $$\Delta LNJII_t = \alpha + \omega T + \gamma_1 D1_{jii} + \gamma_2 D2_{jii} + \sum_{i=1}^{1} \delta_{1i}\ \Delta LNJII_{t-i} + \sum_{i=m}^{1} \delta_{2i}\ \Delta LNCPI_{t-i} + \sum_{i=m}^{1} \delta_{3i}\ \Delta LNREER_{t-i} + \sum_{i=m}^{1} \delta_{4i}\ \Delta LNVIX_{t-i} + \sum_{i=m}^{1} \delta_{5i}\ \Delta LNGP_{t-i} + \theta\ ECT_{t-1} + U_t$$

(6) $$\Delta FES_t = \alpha + \omega T + \gamma_1 D1_{fes} + \sum_{i=1}^{1} \delta_{1i}\ \Delta LNFES_{t-i} + \sum_{i=m}^{1} \delta_{2i}\ \Delta LNCPI_{t-i} + \sum_{i=m}^{1} \delta_{3i}\ \Delta LNREER_{t-i} + \sum_{i=m}^{1} \delta_{4i}\ \Delta LNVIX_{t-i} + \sum_{i=m}^{1} \delta_{5i}\ \Delta LNGP_{t-i} + \theta\ ECT_{t-1} + U_t$$

Symbol θ in equation 5 and 6, as explained by Deka and Dube (2021), shows speed of adjustment to achieve long run equilibrium from short run. Atri, Kouki, and Gallali (2021) explained that the coefficient of θ should be negative and statistically significant. This paper also uses some diagnostic tests such as Heteroscedasticity, Ramsey reset, autocorrelation, and multicollinearity. As this paper uses more than 100 observations (n)

that reasonably large, normality assumption can be relaxed as explained by Gujarati and Porter (2009). Lastly in the fifth step, CUSUM and CUSUM sq test are performed to check the stability of the long run and short run coefficient (Bahmani-Oskooee and Kanitpong, 2017; Shahbaz, Islam, and Rehman, 2016).

4. EMPIRICAL RESULTS AND DISCUSSION

4.1 RESULTS

The first pivotal step in using ARDL bound test is to check whether each variable in the study has integrated in order 2, or *I(2)* or not. As each variable is integrated in level, *I(0)* or in order 1, *I(1),* then ARDL bound test can be employed. Table 3 and Table 4 depict unit root test using Fisher-ADF to see level of integration for each variable in Indonesia and Malaysia. With 1% level of significance, JII, FES, VIX Indonesia and GP Malaysia have integrated in level, *I(0),* both in intercept and also in intercept and trend. Furthermore, all data also shows integration in the first difference, or *I(1),* making no one of the data are stationary in second order of *I(2).* Therefore, in this case ARDL bound test can be employed to analyze the gathered data.

TABLE 3
Unit Root Test for Indonesia Data

INDONESIA (Individual root – Fisher- ADF)			
Variables	Level/difference	Indiv. Intercept (Prob)	Indv Intercept and Trend (prob)
LnJII	Level	0,000	0,000
LnCPI	Level	0,999	0,925
LnREER	Level	0,046	0,155
LnVIX	Level	0,000	0,000
LnGP	Level	0,7837	0,911
ΔLnJII	First difference	0,000	0,000
ΔLnCPI	First difference	0,000	0,000
ΔLnREER	First difference	0,000	0,000
ΔLnVIX	First difference	0,000	0,000
ΔLnGP	First difference	0,000	0,000

Source: Researcher's own computation using Eviews 10 (2023).

TABLE 4
Unit Root Test for Malaysia Data

MALAYSIA (Individual root – Fisher-ADF)			
Variables	Level/difference	Indiv. Intercept (prob)	Indv Intercept and trend (Prob)
LnFES	Level	0,000	0,000
LnCPI	Level	0,808	0,580
LnREER	Level	0,497	0,123
LnVIX	Level	0,024	0,085
LnGP	Level	0,004	0,576
ΔLnJII	First difference	0,000	0,000
ΔLnCPI	First difference	0,000	0,000
ΔLnREER	First difference	0,000	0,000
ΔLnVIX	First difference	0,000	0,000
ΔLnGP	First difference	0,000	0,000

Source: Researcher's own computation using Eviews 10 (2023).

For the next step, as the data are time series with relatively large observation (more than 100 observations), the structural break is very important to be incorporated in the ARDL model. Method for detecting Structural break in Indonesia and Malaysia are from Lee and Strazicich (2003) method where following Bist and Bista (2018), the break is chosen in dependent variable. Two structural breaks are detected in Indonesia, which are February 2019 and November 2019, whereas Malaysia only one structural break which is in August 2011. Furthermore, in computing of F-statistics from equation 1 and 2, both uses 7 as maximum lag for ensuring no serial correlation in the regression result in Indonesia and Malaysia data; White method for correcting standard error in the presence of heteroscedasticity, trend specification using "none" that shows case one in ARDL model (no constant and no trend) and Akaike information criterion (IAC) for choosing lag length. The result is depicted in Table 5.

The computed F-statistics for Indonesia and also Malaysia shows more than upper bound value I(1) with 1% level of significance, which means that cointegration existed among variables. Lag length chosen by AIC is 4,7,7,2,5,0,0 for Indonesia and 1,1,4,5,3,0 for Malaysia. As cointegration exists among variables, the next step is to compute the long run and short run

model. The long run and short run estimation result for Indonesia and Malaysia are depicted in Table 6.

TABLE 5
Bound Test Cointegration

	Indonesia	Malaysia
Dependent Variable	JII	FES
Independent Variable	D1, D2, CPI, REER, VIX, GP	D1, CPI, REER, VIX, GP
Lag Length	4,7,7,2,5,0,0	1,1,4,5,3,0
Critical Bound Value (1%)	I(0) 2.66 – I(1) 4.05	I(0) 2.82 – I(1) 4.21
F-Statistics	11.2036	36.4934
Result	Co-integration	Co-integration

Source: Table created by author (2023).

Based on the Chirwa and Odhiambo (2020) explanation about level of information in EMH, adjusted R-square in Indonesia can be categorized as strong EMH, whereas Malaysia shows semi-strong EMH in explaining *Islāmic* stock performance. Furthermore, by keeping other variables constant and focusing only on four main variables (inflation (CPI), exchange rate (REER), investor fear and market volatility (VIX) and Gold Price (GP)), this analysis allows estimation of the average value of *Islāmic* stock market performance in Indonesia and Malaysia, which depicts the average results from volatility movement in both markets.

TABLE 6
Long Run, Short Run, and Error Correction.

Long run estimation		
Variable	Indonesia	Malaysia
D1	0,0369** (0,0167)	0,0023** (0,0011)
D2	-0,0571*** (0,0186)	
LNCPI	-0,0129* (0,0068)	0,0066 (0,0068)
LNREER	0,0123*** (0,0035)	-0,0146** (0,0072)
LNVIX	-0,009*** (0,0026)	0,0019* (0,0009)
LNGP	0,0042 (0,0041)	0,005*** (0,0012)
Short Run estimation		
Variable	Indonesia	Malaysia
ECT(-1)	-0,849*** (0,095)	-1,183*** (0,078)
ΔD1	0,0873*** (0,013)	-0,006* (0,003)
ΔD2	-0,0704*** (0,015)	

TABLE 6 *(continued)*

Short Run estimation		
Variable	Indonesia	Malaysia
ΔLNCPI (-1)	0,267*** (0,094)	-0,326*** (0,073)
ΔLNREER	-0,139*** (0,025)	-0,0548*** (0,021)
ΔLNVIX (-1)		-0,0037** (0,0017)
R-squared	0,757	0,679
Adjusted R-Squared	0,738	0,649
χ^2 SC	0,229	0,188
χ^2 HET	0,075	0,884
Multicol.	All variables less than 10	All variables are less than 10
Ramsey	0,000	0,000

Notes: Standard Error in parentheses, ***,**,* indicate statistical significance at 1, 5, and 10% respectively, χ^2 SC for Chi-Square Breusch-Godfrey Serial Correlation LM test, χ^2 HET for Chi-Square ARCH heteroskedasticity test, Ramsey for ramsey reset, and Multicol for multicollinearity test.

Source: Author computation (2023).

4.2 DISCUSSION

Table 6 shows that inflation and exchange rate as MPO is statistically significant and become the main driving factors for Indonesia's long run *Islāmic* stock performance, while inflation can become the main driving force of the performance in the short run. For Malaysia, exchange rate is statistically significant and has the highest sensitivity value to *Islāmic* stock performance in the long run, while in the short run, the main driving force of the performance is inflation. This different results from short run and long run will give different implication on how both countries will expect the performance of their stock in the market regarding their monetary policy stance. For instance, in inflation targeting, even though both countries apply inflation targeting (Based on Bank Indonesia (n.d) and Akalpler and Duhok (2018)), but central bank's target of inflation in Indonesia is more important rather than in Malaysia as this inflation targeting will affect *Islāmic* stock in short run and long run. Therefore, credibility of central bank in Indonesia to achieve its target is essential.

Furthermore, by assuming all significant independent variables increase, Malaysia can reduce its risk of loss from its *Islāmic* stock performance from -0.384 in the short run to -0.0077 in the long run, while Indonesia's performance reduces from positive return in the short run by 0.128 to negative return in the long run by -0.0096. In more detail, in the short run, performance of Indonesia *Islāmic* stock market is driven by inflation, followed by exchange rate only, whereas Malaysia's performance is characterized mainly by inflation followed by exchange rate and VIX which reflects investor fear and market volatility respectively. Assuming these significant independent variables to increase, performance of *Islāmic* stock market in Malaysia falls sharply by -0.384, while Indonesia performs better by 0.128. In addition, gold price does not have any significant effect on *Islāmic* stock in Indonesia (in short run and long run) and Malaysia (in short run) whereas inflation does not have significant effect in Malaysia in the long run, and VIX does not have significant effect in Indonesia only in the short run.

In the long run, performance of *Islāmic* stock market in Indonesia is driven mainly by inflation because of its highest impact, followed by exchange rate where the value is quite close to inflation and investor fear and market volatility (VIX), whereas the average performance of *Islāmic* stock in Malaysia is mainly driven by exchange rate, followed by investor fear and market volatility (VIX), and gold price. By assuming that inflation and exchange rate as MPO are increasing, at the same time with increasing market volatility and investor fear (VIX), the average performance value of Indonesia *Islāmic* stock will reduce by -0.0096, higher risk is reflected here compared to Malaysia which only reduces by -0.0077 because of the increase in exchange rate, VIX, and gold price. This result shows that in the long run, estimated Malaysia's *Islāmic* stock market performance has lower risk of loss rather than estimated performance of the Indonesian market.

Those different results of short run and long run sensitivity analysis show that investors of *Islāmic* stock market in Indonesia tend to maximize profit only in short period of time without any intention to invest in the long term, while in Malaysia many investors show the intention to invest in stock market for long term period. By this result, it is very imperative that policy makers in Indonesia ensure stability of economic condition be maintained,

and second to prevent investors from leaving in the short period; increasing capital gains tax might become a proper policy.

Coefficient of θ from equation 5 and 6 shows the speed of adjustment to equilibrium in the long run as explained by Deka and Dube (2021). This notation also shows how quickly or slowly variables return to equilibrium (Pahlavi, 2005). By following Nguyen and Ngoc (2020)'s interpretation, Indonesia needs 1.17 or at least 1 month for adjustment (=1/|θ|) whereas Malaysia needs only 0.84 or less than a month for the adjustment. This means that the speed for adjustment process from short run condition into long run condition in Indonesia is less than in Malaysia. This implies that, for instance, when shocks are coming (disequilibrium condition in the short run), then Malaysia will correct these shocks faster than Indonesia in the long run (equilibrium condition).

When discussing the sign of the regression result, in the long run, inflation and exchange rate in Indonesia shows different sign from what is hypothesized and in Malaysia is VIX and gold price. In the short run, only inflation in Malaysia that shows different sign from what is hypothesized. The negative relation between inflation and *Islāmic* stock performance that differ from what is hypothesized might happen because as increasing inflation reduces consumer's purchasing power, the lower demand leads to lower profit and performance of corporations go down. Therefore, *Islāmic* stock performance is lower. Negative relation between inflation and *Islāmic* stock performance aligns with research by Bahloul, Mroua, and Naifar (2017); Yurista and Ayuningtyas (2019) and Omar and Masih (2017).

Exchange rate in the long run in Indonesia has positive effect on *Islāmic* stock performance. This result is supported by Sanusi, Jihad, and Mawardi (2021); Menacer and Nurein (2018) and Rana and Akhter (2015). According to the official website of International Monetary Fund (n.d), the rise in real effective exchange rate implies that export is more expensive (a loss in trade competitiveness), on the other hand, imports become cheaper. In condition where countries lose in trade competitiveness, it might be reasonable for *sharīʿah* companies in Indonesia focusing to meet domestic demand. With cheap import price, the price of goods where the ingredients are from import, become competitive when sold domestically rather than exporting to other countries. This condition is supported by data such as Euromeat (2023) showing

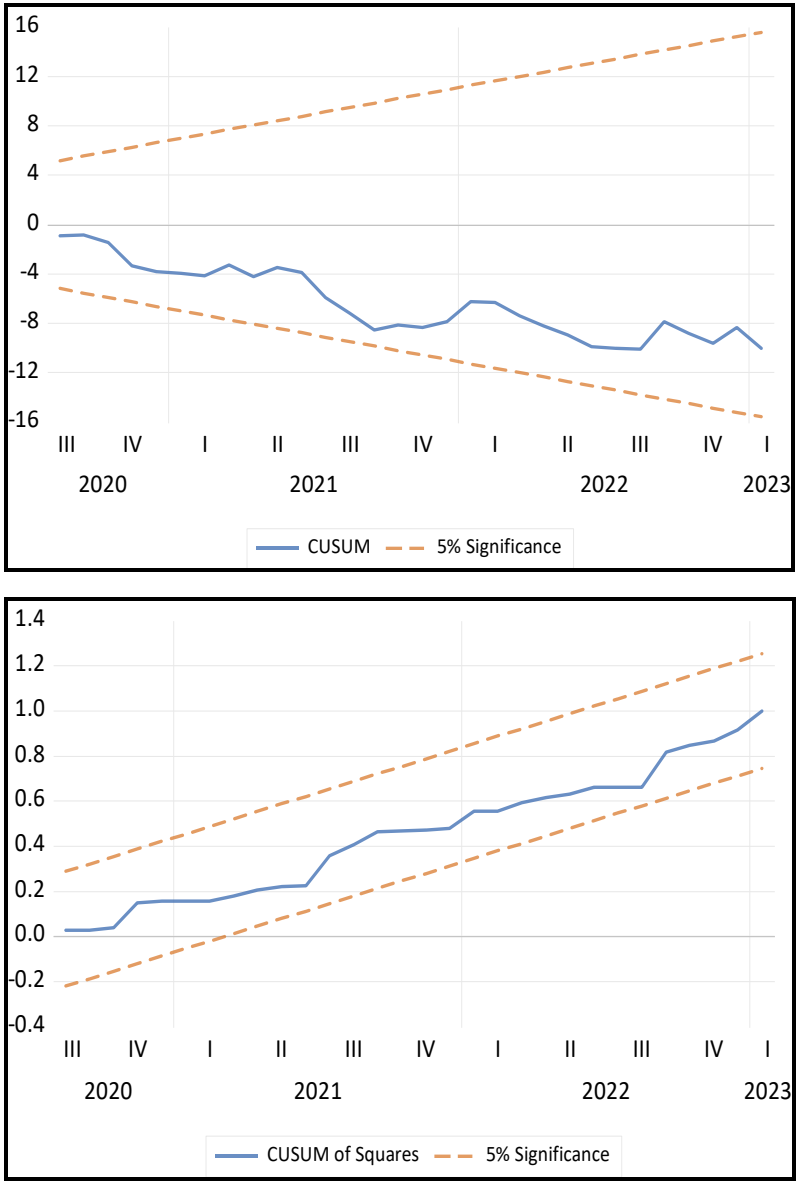
that Indonesia is not included as top 10 countries exporting halal foods, so then will make *sharīʿah* companies continuously show good performance even when trade competitiveness is decreasing. Therefore, this condition will lead to positive performance of their stock return.

As for VIX or investor fear and volatility, Mandaci and Cagli (2021) asserted that *Islāmic* stocks are safe-haven instrument from the global risk factors because of their own distinctive and conservative features. Increase of volatility in the market and also increasing fear of investors will make investors buy other safe haven assets or buy *Islāmic* stock. Buying behavior of investors in the present of increasing fear and volatility will push the price of *Islāmic* stock, making its performance rise. Therefore, this condition makes positive relation between VIX and *Islāmic* stock performance. This result is the same with study conducted by Arfaoui and Rejeb (2021) and Wahyudi and Sani (2014) but differs from Shear and Ashraf (2022) and Karim, Kawsar, and Ariff (2022).

Furthermore, based on Naeem, Qureshi, Arif, and Balli (2021) the diversification hypothesis states that asset is positively correlated with other assets in normal market condition, whereas safe-haven hypothesis asserts the negative or no relationship between assets under extreme market distress. By using this explanation, the positive relationship between gold price and *Islāmic* stock performance means that investors there in Malaysia trying to expand and diversify their portfolios. This positive and significant result is the same as Widjaja, Gaby, and Havidz (2023) in specific condition, and Godil, Sarwat, Sharif, and Jermsittiparsert (2020) butcontradicts findings by Chkili (2022), and Tuna (2019).

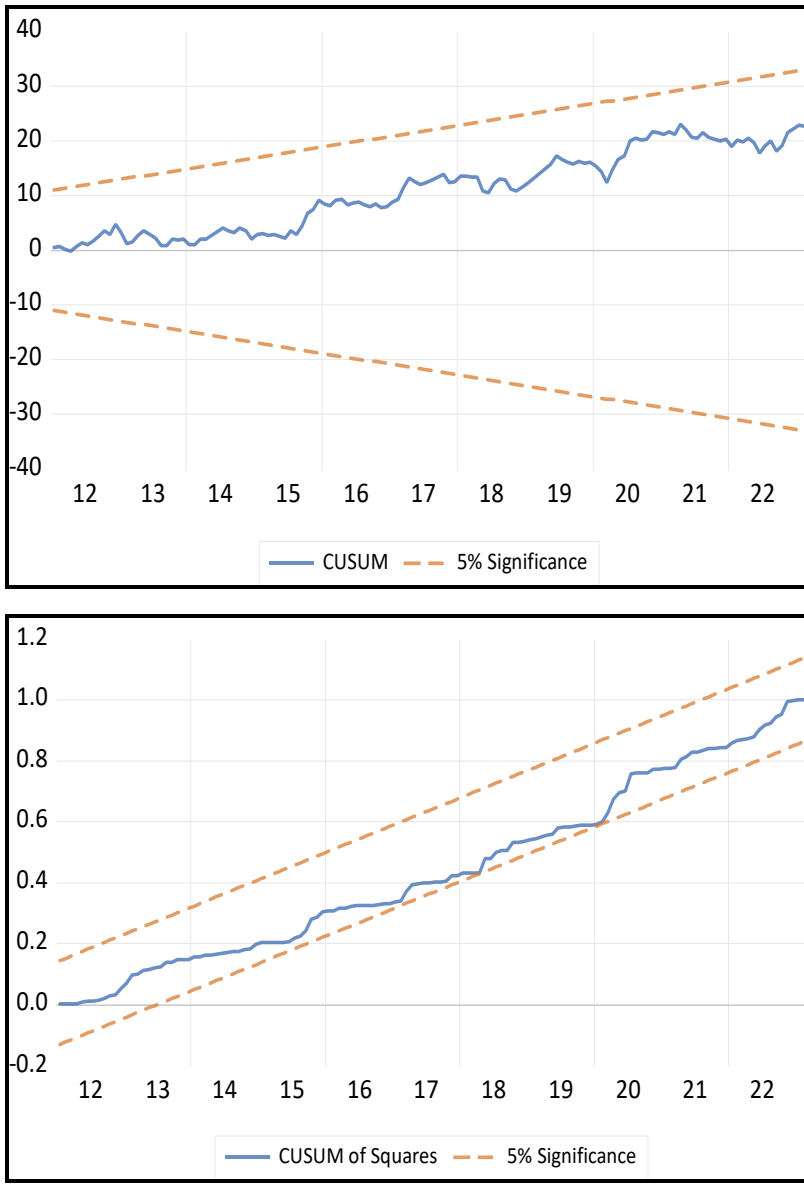
As shown in Table 6, the results pass several diagnostic tests such as autocorrelation, multicollinearity, and heteroscedasticity, but not for Ramsey reset. Furthermore, for stability in parameter as shown in Figure 2 and Figure 3, as there is no movement outside the critical line, this result indicates stability of regression parameters in Indonesia and also Malaysia.

FIGURE 2
Stability Parameter for Indonesia



CUSUM and CUSUM Sq for Indonesia

FIGURE 3
Stability Parameter for Malaysia



CUSUM and CUSUM Sq for Malaysia

5. CONCLUSION

This paper analyzes the determinant factors that cause different performance in *Islāmic* stock market in Indonesia and Malaysia, where Malaysia has lower volatility than Indonesia. As Indonesia financial inclusion in stock market is very low, this paper argues that low volatility means low risk, and lower risk hopefully will enhance financial inclusion in capital market especially in *Islāmic* stock market in Indonesia to boost economic growth and economic health. By using ARDL bound test, this paper finds different characteristics in determining performance of *Islāmic* stock market in both Indonesia and Malaysia. Indonesia's market performance is driven mainly by inflation and exchange rate in the long run and Inflation in the short run, while Malaysia's market performance is driven mainly by exchange rate in the long run and inflation in the short run. By assuming observed significant independent variables to increase, Indonesia's *Islāmic* stock performance reduces from positive return in the short run to negative return in the long run, while Malaysia can reduce its risk of loss from short run to long run. The results also suggest that policy makers in Indonesia should mainly focus on managing inflation if they will control the performance and volatility of *Islāmic* stock market in the short run and long run, while Malaysia can control inflation in the short run and exchange rate in the long run to maintain performance and reduce volatility of its *Islāmic* stock market. Gold price does not have any significant effects on *Islāmic* stock performance in Indonesia both in long and short run, making gold investment a safe-haven asset, while in Malaysia gold investment can be a safe-haven in the short run only. Lastly, VIX does not have any relationship to *Islāmic* stock performance only in Indonesia in the short run.

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DO ENVIRONMENTAL INNOVATIONS, TRADE, AND ECONOMIC GROWTH AFFECT THE ECOLOGICAL FOOTPRINT IN INDUSTRIALIZED COUNTRIES? PANEL AUGMENTED MEAN GROUP AND COMMON CORRELATED EFFECT ESTIMATIONS

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ABSTRACT

This study assessed the environmental technological innovation (ETI) of the 13 countries with the highest industrial added value (China, the United States, Japan, Germany, India, the United Kingdom, South Korea, France, Russia, Italy, Mexico, Brazil, Indonesia) over the period between 1992 and 2019. The objective is to evaluate the impact of carbon dioxide (CO_2) emissions, trade openness (TO), and economic growth (EG) on the ecological footprint (EFP). In this study, a panel data analysis was conducted utilizing the second-generation PANIC unit root test, the Westerlund cointegration test, the Dumitrescu-Hurlin causality test, and the common correlated effect mean group (CCEMG) and augmented mean group (AMG) estimator methods. The results of the analysis demonstrate that, according to the CCEMG, ETI exerts a mitigating influence on EFP in Indonesia. In numerous countries, CO_2 has been observed to increase EFP, whereas in a select few countries, EG has been found to have a similar effect. Conversely, in China and South Korea, TO has been identified as a factor contributing to an increase in EFP, while in the United States, it has been identified as a factor that contributes to a decrease in EFP. The AMG indicates that ETI results in a decrease in EFP in Brazil and Indonesia, while simultaneously producing an increase in Mexico. While CO_2 is observed to increase EFP in numerous countries, EG is seen to increase EFP in many countries, although this is only the case in India. TO is found to decrease EFP in China, India, South Korea, and Brazil, while simultaneously increasing it in Germany. The empirical evidence suggests that policies aimed at limiting uncontrolled economic growth, prioritising

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environmentally friendly technological innovations, improving international trade processes and policies with the objective of reducing emissions, and developing environmentally friendly processes and products in production are likely to be effective.

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1. INTRODUCTION

Increasing social welfare is undoubtedly one of the main objectives of national economies. Improvements in social welfare are possible with sustainable economic growth (EG). EG, which can be defined as an increase in output, represents a fundamental transformation in social life. EG is a driving force behind societal change, facilitating the transition from an agricultural to an industrial society, industrialization, population growth, urbanization and increased consumption. While EG offers numerous benefits to society, the expansion of production scale has a detrimental impact on the ecosystem, leading to a decline in natural capital (Islam, 2021). The acceleration of economic activities and growth has resulted in increased output across a range of sectors, including agriculture, industry, and mining. While technological advancement has been a key driver of this expansion, it is not a standalone factor. The utilization of existing resources more than their current levels is also a necessary condition for continued output growth. In this context, previous periods of EG neglected sustainable growth processes, and economic progress and welfare improvements through growth-oriented policies also cause environmental problems (Destek and Manga, 2020, 21991).

Rapid expansion and development of economic practices increase the strain on natural resources and accelerated waste generation (Sarkodie, 2021). As economic activities expand, the environment is exposed to an increasing number of hazardous residues resulting from human actions. While the environment has the capacity to resist pollution, exceeding the the pollution load has a detrimental impact on environmental quality (Islam, 2021). Climate change, global warming and carbon dioxide (CO_2) emissions result from

advances in agriculture, industry and mining and the increased use of natural resources.

In the context of the environmental impacts of EG, the factor of trade openness (TO), which is a principal determinant of growth, is a key area of focus. The role of TO in accelerating industrialization is of particular significance. The substantial expansion in international TO, when assessed in terms of imports and exports, has led to a notable shift in the global trade balance, increasing from 10% in the 19th century to 50% in the present era. The TO of countries plays a supportive role in terms of economic progress and development, particularly by facilitating mutual trade. The improvement in living standards, especially in developing countries, contributes to the perception that trade is a significant factor in enhancing economic power (Appiah et al., 2022). On the other hand, the liberalization of international trade and the adoption of an open economy model facilitate acceleration of industrial production. This increased production, however, also leads to adverse environmental consequences, including air pollution and the greenhouse gas effect (Islam and Rahaman, 2023).

The accelerated environmental degradation resulting from human activities has caused a significant deterioration of the ecosystem, adversely affecting both the natural world and humanity (Chu, 2022a, 23779; Chu, 2022b). The deterioration of the natural environment has a detrimental impact on human well-being and the functioning of ecosystems. A degraded environment endangers the physical and mental health of individuals, predisposing them to a range of health issues. Disease proliferation impairs production efficiency, leading to lower economic prosperity. Furthermore, environmental degradation contributes to extinction of animal species (Islam, 2022; Islam, 2021). Destruction of the environment increases both climate change and global warming. The rising sea and ocean levels due to global warming, the extinction of some living species, and the melting of ice in polar regions are examples of negative environmental impacts (Ali et al., 2016). In this context, Berstein et al. (2007) predict a sea level rise of 18-59 cm and a global average temperature increase of 1.1-6.4°C by 2100.

The global impact of climate change and environmental pollution is becoming increasingly evident. Given that human and economic activities have contributed to global warming for approximately 200 years, reducing environmental pollution has become a key objective of the Sustainable Development Goals (SDGs) (Islam, 2024). Growing environmental problems threaten both

developed and developing countries. To address this threat, several international meetings have been held. These include the Kyoto Conference (1997) and the Paris Conference (2015). The main themes of these meetings are the transition from the consumption of non-renewable energy to renewable energy and increasing the use of renewable energy, controlling CO_2 emissions, protecting natural water resources and forest areas, and implementing green and technological innovations to protect the environment (Görmüş and Aydın, 2020, 279-90; Twum et al., 2020, 20-21; Danish, Ulucak and Khan, 2020, 1; Rees, 1992) The desire for rapid EG leads to the overuse and misuse of natural resources, reducing the biological capacity of the environment and increasing the ecological footprint (EFP).

Ecological footprint (EFP) in its shortest definition expresses human pressure on the environment (Baabou et al., 2017, 94). One indicator of environmental sustainability is EFP. It expresses the need for natural capital for the productive environment, which is defined as carrying capacity. On the other hand, the EFP measures biocapacity related to carrying out economic activities according to the SDGs. In this context, the EFP does not ignore other human activities detrimental to ecological sustainability, unlike emissions, which can limit the focus on ecological sustainability among major industrial activities (Destek and Sinha, 2020). The EFP measures environmental problems and damage in this respect. It is possible to find an unlimited number of studies that measure the negative impact of human and economic activities on the environment through CO_2 emissions. The CO_2 emissions, however, measure only a certain part of environmental damage (Öcal et al., 2020, 668).

Only a limited number of studies measure environmental damage using the EFP as a key indicator. Hence, a more realistic and comprehensive perspective is to use the EFP as a measure of environmental damage instead of CO_2 emissions. This is because the EFP fully captures environmental dynamics such as rangelands, fisheries, plantations, settlements, and CO_2 emissions (Sarkodie, 2021). The world's growing population and accelerating urbanization are putting pressure on the EFP. The United Nations estimates that by 2030, the world's population will be around 8.5 billion, and by 2050, the urban population is expected to reach 68%. The total world population will be 10.4 billion in 2100. The concentration of population in cities and the expectation that this concentration will increase over the years will also affect the environment.

Because of the climate change emerging after industrialisation gave rise to significant challenges and an ever-increasing necessity for

energy, all countries are contemplating implementing measures designed to reduce greenhouse gas emissions (Jiang et al, 2022). To achieves sustainable growth and development, both developed and developing countries have reached consensus on the necessity of mitigating the negative environmental impacts of economic activities. Furthermore, there is agreement on the importance of a green transition and the adoption of innovative technologies. It is essential to protect the environment from the harmful effects of conventional production methods by prioritizing technological advances for environmental sustainability (Twum et al., 2021, 17119). Besides technological innovations, the impact of environmental protection policies on the environment is undeniable. As a result, Porter and Claas (1995) state that environmental regulations play an important role in creating environmentally friendly (green innovation) technological innovations. R&D studies and innovative approaches, especially in the energy field, effectively reduce environmental negativities and increase environmental quality (Sinha and Sengupta, 2020).

Technology innovations enable reduced emissions per unit of output produced, reduced environmental pollution costs, and introduce new environmentally friendly and environmentally protective products to the market (Carraro, 2000, 271). On the other hand, technology innovations are the active factor in converting energy consumption, one of the important determinants of EF, from fossil sources to renewable energy sources. Technology innovations save energy and reduce emissions per unit by increasing energy efficiency. Again, while innovations enable cost reduction, they also facilitate the introduction of environmentally friendly green products to the market. When evaluated in terms of renewable energy production, technology innovations are again a factor in developing renewable energy processes (Lin and Zhu, 2015: 1505, Carraro, 2000, 270). Ultimately, improving environmental quality allows individuals to live in better conditions and improve their living standards (Chien et al., 2022:2). Environmental innovations are acknowledged as technological advancements that enhance environmental quality by reducing energy consumption and detrimental emissions. Consequently, environmental innovation is regarded by economists and policymakers as a potent instrument for curbing environmental contamination. Given the efficacy of environmental innovations in addressing environmental concerns, many countries are pursuing environmental innovation and environmentally friendly technologies (Islam et al., 2024).

This study examines the relationship between ecological footprint (EFP) and environmental technological innovation (ETI). The other independent variables in the study are Gross Domestic Product (GDP), CO_2, and trade. The study differs from previous studies in a number of ways. Studies investigating the role of ETI on EFP are limited, and further research is required in this area. Previous literature frequently utilises CO_2 emissions as a metric for environmental degradation; however, EFP can be regarded as a more comprehensive measure. Additionally, no studies have been conducted on the group of countries with the highest industrial value added. This study addresses an existing research gap in the relevant country group by measuring the impact of ETI on EFP with the help of other control variables in 13 countries with the highest industrial added value. Finally, EFP as a variable in assessimg environmental degradation represents a novel approach that provides a comprehensive evaluation of the ecological impacts of pollution in countries with the highest industrial added value. The following sections of the study include a literature review, a description of the methodology and data set, the compilation and interpretation of results, and a conclusion and discussion section, which provides an overall assessment and policy recommendations.

2. LITERATURE REVIEW

In the post-World War II era, a widespread belief in the positive impact of EG and development on societal well-being drove the expansion of economic activity. However, in recent decades, the global drive for EG has accelerated environmental damage. Rapid and uncontrolled EG threatens sustainability by causing climate change and global warming (Öcal et al., 2020, 668). This has led scientists to question and study EG environmental impact. The literature includes various theoretical and empirical studies on ETI, EG and TO. Theoretical studies in the literature are based on a number of hypotheses. The relationship between environmental degradation and economic activities is associated with the hypothesis initially proposed by Kuznets (1955), which postulates an inverted U-shaped relationship between EG and income inequality. Indeed, Grossman and Krueger (1991) renamed the hypothesis as the Environmental Kuznets Curve Hypothesis (EKC) and interpreted the relationship between EG and the environment. The hypothesis postulates that environmental degradation occurs in the initial phase of the EG process, but that improvements in the economy limit environmental

degradation by improving environmental quality (Islam, 2022). Similarly, the effect of TO on environmental degradation is also included in the theoretical literature. In particular, the pollution haven hypothesis (Antweiler et al., 2001) posits that as underdeveloped and developing countries engage in international commercial activities, their environmental quality will decline. Specifically, trade liberalization will prompt multinational companies to relocate pollution-intensive industrial production to underdeveloped and developing countries where costs and environmental controls are less stringent. Over time, these countries will become havens for pollution-intensive industries. The factor endowment hypothesis (FEH) considers the impact of endowments and technology on trade, rather than focusing on the role of policies. While a capital-rich country may increase pollution within its own borders through capital-intensive production, a capital-deprived country will experience a decrease in pollution due to the inability to support capital-intensive production. Therefore, the effects of trade on the environment, both nationally and globally, are contingent upon the distribution of comparative advantages among countries (Temurshoev, 2006).

It is imperative to leverage technological progress to sustain EG while concurrently minimizing environmental degradation. Technological progress depends on generating technological innovations (TI) through research and development (R&D) activities. These innovations give rise to new industries, products, and production processes, which in turn enhance existing industrial capabilities. From an economic perspective, the advancement of productivity and the development of new products and production processes not only facilitate accelerated growth but also present opportunities for creating employment and improving living standards. Endogenous growth theories posit that technological advancements facilitate sustainable EG and development by enhancing productivity (Romer, 1990). The expectation that technological advances will be used to protect the environment is based on the premise that these developments will benefit society in other ways. This issue, which was previously the focus of scientists and policymakers in developed economies, has also been brought to the attention of developing countries over time.

Various empirical studies in the literature cover the environmental effects of technological innovations. Studies evaluate factors impacting the EFP, which expresses environmental damage more comprehensively, EG process, natural resources, globalization, human capital, urbanization, and so forth. Socio-economic factors are

associated with the environment and the environmental effects of these factors are analyzed. Some studies analyzie the impact of ecological activities on the environment through the environmental Kuznets curve (EKC). For example, Destek et al. (2018) suggest that the environmental Kuznets curve, which explains the relationship between real income and EFP, takes a U shape. The study concluded that non-renewable energy consumption harms the environment, while renewable energy and TO reduce environmental damage.

In their 2015 study, Al-Mulali et al. examined the environmental Kuznets curve (EKC) hypothesis across a range of income levels, including 16 low-income, 26 lower middle-income, 26 upper middle-income, and 31 high-income countries. They employed EFP as a proxy for environmental degradation. In the study, the relationship between EFP and GDP takes an inverted U shape in countries with high, middle, and high-income groups. In addition, energy consumption, urbanization and TO are among the factors that increase the EFP for all country groups. Destek and Sarkodie (2019) investigated the validity of the environmental Kuznets curve hypothesis by examining the relationship between EG, energy consumption, financial development and EFP in 11 newly industrialized countries for the period 1977-2013. In order to achieve this, both the augmented mean group (AMG) estimator and the heterogeneous panel causality method were employed in the study.

The results of the estimator demonstrate that there is an inverted U-shaped relationship between EG and EFP. The causality test results indicate that there is bidirectional causality between EG and EFP. Ali et al. (2016) examined the relationship between CO_2 emissions and the determinants of EG, energy consumption, financial development and TI in Malaysia between 1985 and 2012. The findings of the study, which employed the lag distributed autoregressive (ARDL) model, indicate that there is a negative but statistically insignificant correlation between TI and environmental pollution in Malaysia. Furthermore, the findings indicate that elevated EG enhances environmental quality over the long term, aligning with the Environmental Kuznets Curve (EKC) hypothesis. Similarly, the results indicate that financial sector development will result in reducing CO_2 emissions, thereby improving environmental quality in Malaysia. The Granger causality approach employed in the study identifies bidirectional causality between EG and CO_2 emissions, as well as between TI and CO_2 emissions in the long run. Furthermore, the results demonstrate existence of bidirectional causality between

energy consumption and EG, as well as between EG and TI in the short run.

Islam (2024) analyzed the impact of environmental innovations on environmental quality in Saudi Arabia for the period between 1990 and 2020 using the NARDL method. The findings indicate that the positive aspects of environmental technologies exert a relatively limited influence on environmental pollution, largely due to the relatively modest share of environmental technology patents within the total technology landscape in Saudi Arabia. Conversely, the negative aspects of environmental technologies are responsible for an increase in pollutant emissions, both in the long and short term, due to the low level of environmental technology. It is important to note, however, that EG, energy consumption and trade volume also contribute to an increase in pollutant emissions.

In another study for Saudi Arabia, Islam, Rehman, and Khan (2024) examined the impact of environmental technology on CO_2 emissions by examining the influence of information and communication technologies, energy use, energy intensity, and financial development over the period between 1990 and 2020. The NARDL method was employed in the study, and the findings indicated that the deficiency of environmental technologies in Saudi Arabia fosters environmental contamination. It was demonstrated that ICT stimulates environmental contamination due to its limited scope in comparison to the technological foundation of the Kingdom. Information and communication technologies enhance environmental quality, whereas energy consumption impairs environmental quality. The NARDL test also suggests that energy intensity and financial development have deleterious effects on emissions.

Ersin et al. (2024) conducted an analysis of the long- and short-run relationships between EFP, environmental technology patents, high technology exports and EG in four major high technology exporters (the USA, Germany, France and China) over the period between 1988 and 2019. The results obtained from the study, which employed the Fourier ARDL method, underscore the significance of environmental technology innovations in mitigating the EFP and environmental impacts in the USA, Germany, and France. The expansion of high-tech exports in international trade has the potential to exacerbate the EFPs in these countries, particularly when considered alongside the adverse effects of EG in all countries, including China. Jiang et al. (2022) employed the Stochastic Impacts by Regression on Population, Affluence, and Technology (STIRPAT) framework to analyze the impact of environmental technologies, coal

consumption, EG and population density on consumption-based CO_2 in BRICS (Brazil, Russia, India, China and South Africa) countries for the period between 1985 and 2018. The long-term empirical findings indicate that environmental technologies exert a negative influence on consumption-based CO_2 emissions, whereas GDP per capita and coal consumption exert a positive influence. The empirical evidence suggests that environmental technologies are of significant importance for the BRICS countries. Furthermore, the findings suggest that energy intensity and financial development have a detrimental effect on emissions.

Another study, Islam et al. (2024a) analyzed the relationship between remittances and environmental quality in Saudi Arabia for the period between 1990 and 2020. This analysis employed the use of information and communication technologies, environmental innovation, and energy consumption control variables. The study employed nonlinear autoregressive distributed lag (NARDL) and autoregressive distributed lag (ARDL) methods, which yielded evidence of a long-run relationship between the variables. In this context, the overall effect of remittance flows on CO_2 emissions is negative. Furthermore, the effect of negative shocks significant, while the effect of positive shocks is insignificant. The introduction of positive shocks in information and communication technologies has been found to significantly reduce environmental pollution. Pollution levels tend to decline in line with increased investment in environmental technologies, but conversely, they tend to rise in line with decreased investment. Given that the majority of energy consumed in the Kingdom is derived from non-renewable sources, it can be argued that energy use is a significant contributor to environmental degradation. Ozkan et al. (2023) employed the dynamic ARDL method to analyze the interrelationship between green technology innovation and EFP in Turkey over the period between 1990 and 2018. The results of the dynamic ARDL test indicate that green TI exert a mitigating influence on the EFP, both in the long and short term. In the short term, positive shocks in TO have a detrimental impact on environmental quality, whereas negative shocks have a beneficial effect. In the long run, the opposite is true.

Alola et al. (2019) analyzed the driving forces for achieving the SDGs on reducing environmental pollution in EU member states, and examined the relationship between EFP, real gross domestic product, TO, fertility rate, and renewable and non-renewable energy consumption in 16 EU countries between 1997 and 2014. The

application of PMG-ARDL analysis revealed that non-renewable energy consumption has a detrimental impact on environmental quality, whereas renewable energy utilization has beneficial effect on environmental sustainability. Additionally, the observed long-run fertility-EFP link is associated with disparate fertility rate data across EU Member States.

Studies in the literature have examined the relationship between technological innovations and the environment in the context of CO_2 emissions. For example, Ahmad et al. (2020) researched the interconnections between natural resources, TI, EG and the resulting EFP in emerging economies. In the study, the second generation panel cointegration test was employed using data from 1984 to 2016. The cointegration results substantiate the existence of a stable and long-run relationship between the EFP, natural resources, TI and EG. In the long term, the expansion of natural resources and EG contribute to increased EFP, whereas TI facilitate the reduction of environmental degradation. Findings from the CS-ARDL are corroborated by the Augmented Mean Group (AMG) method. Furthermore, the Dumitrescu-Hurlin Granger causality test indicates that natural resources, TI and EG-oriented policies exert a significant influence on the EFP, and vice versa.

Ahmad et al. (2023) applied the autoregressive distributed lag method (ARDL) to examine the influence of technological advancement on China's sustainable development from 1982 to 2018. Their objective was twofold: to ascertain the extent to which TI contributes to sustainable development and to identify how this occurs. The findings indicate that TI is a key driver of sustainable development, while also supporting EG without causing environmental degradation. The results also demonstrate that financial development plays a pivotal role in China's sustainable development, particularly through the reduction of CO_2 emissions. Furthermore, EG accelerates the sustainability process by further reducing CO_2 emissions. Chu (2022a) studied how environmental technologies influenced EFP of 20 OECD countries between 1990 and 2015. The findings substantiate the existence of a long-term relationship between EFP and several key variables, including green technologies, renewable energy, international trade, energy intensity, and real income.

Chien et al. (2021) examined the impact of CO_2 emissions and PM2.5 on the largest Asian economies between 1990 and 2017. They investigate the influence of various energy sources, environmental

taxation, and ecological innovation on these emissions. This study considers a number of analytical techniques, including cross-sectional dependence analysis, unit root tests with and without structural breaks, slope heterogeneity analysis, Westerlund and Edgerton panel cointegration analysis, Banerjee and Carrion-i-Silvestre cointegration analysis, long- and short-run CS-ARDL results, and AMG and CCEMG, to ensure robustness of the findings. The empirical evidence from both the short and long run confirmed the negative and significant impact of renewable energy, ecological innovation and environmental taxes on CO_2 emissions and PM2.5. The analysis revealed that non-renewable energy sources cause environmental degradation in the Asian economies included in the study. Destek and Manga (2021), evaluated the relationship between technologic innovations and EF, considering CO_2 emissions in BEM (Argentina, Brazil, China, India, Indonesia, Mexico, Poland, S. Africa, S. Korea and Turkey) countries for the period between 1995-2016. The results show that increasing the use of renewable energy results in a reduction of CO_2 emissions and EFP but increasing non-renewable energy use results in expansion of CO_2 emissions and EFP. On the other hand, technology innovations reduce CO2 emissions in these countries but do not impact their EFP. In addition to all these, it is claimed that financialization negatively affects both CO_2 emissions and EFP in the case of large developing economies. Koseoglu et al. (2022) examinesd the relationship between green innovation and EFP in the top 20 green innovator countries. In order to test for horizontal cross-section dependence, panel unit roots and panel cointegration, the study employs tests covering the period from 1993 to 2016. The results indicate that EG is the primary driver of environmental degradation. Renewable energy consumption exerts a moderate influence on the EFP, while environmental technologies have a statistically significant impact.

The findings suggest that environmental protection and EG can coexist. However, the analysis revealed a concerning trend of degradation in the Asian economies included in the study. The literature shows a consensus that technological and environmental innovations generally reduce CO_2 emissions and environmental pollution, but some other studies suggest that innovations increase CO_2 emissions. The starting point of the argument is that decrease in energy prices resulting from innovations reduces energy costs and triggers CO_2 emissions by increasing energy consumption in the production process due to the cost advantage. The results of studies

generally suggest that R&D expenditures, which form the basis of innovation in developing countries, increase CO_2 emissions contrary to expectations, while they often reduce CO_2 emissions in developed economies (Fernandez et al. 2018, Dauda et al., 2019). Another article with similar results argues that technological innovations increase environmental damage. In this context, Aydın et al. (2023) analyzed the impact of environmental innovation on the EF of 26 European countries using the PSTR model. The results indicate that below a certain threshold, environmental pressure on per capita EF increases with environmental innovations; however, after the threshold is exceeded, the pressure decreases. The study also suggests that environmental innovations alone are insufficient to reduce the pressure on the Earth's ecosystem. Additional resources are required to achieve this goal.

3. RESEARCH DESIGN AND METHODOLOGY

3.1 EMPIRICAL MODEL

In line with the above explanations, we aim at examining the effects of some variables on the EF in industrialized countries. In this context, the top 14 countries in terms of industrial added value were selected. The study covers the period from 1992 to 2017. Canada, however, was not included in the analysis due to a lack of data. Therefore, the 13 countries included in the analysis are China, the USA, Japan, Germany, India, the UK, Korea, France, Russia, Italy, Mexico, Brazil, and Indonesia. The model examined is defined as follows:

$$Ecofoot = f (Envtech, LogCO_2 , Trade, LogGDP)$$

Table 1 defines variables, data sources, and some descriptive statistics. Accordingly, each variable has 364 observations, and this is balanced panel data. In addition, the moderate instability in the variables is due to the low standard deviation value.

Finally, the expectations about the sign of the variables should be mentioned. The Envtech variable represents the eco-friendly technologies and environmentally related technologies data were used to represent technological innovations. The variable in question reveals the environmental effects of technological progress. An increase in this variable is anticipated to decrease in EF, meaning it is expected to have a negative sign, since an increase in CO_2 emissions

leads to an increase in EF due to positive sign expectation between CO_2 emissions and EF. The sign of the Trade variable may be positive or negative based on the overriding effect on EF. Trade relations between countries are closely related to logistics activities, and these activities increase pollution. If this effect is high, the sign of this variable is expected to be positive. However, given the increased specialization and efficient production as a result of trade, the sign of this variable is expected to be negative. Finally, the Loggdp variable is expected to have an increasing effect on the EF. Therefore, the sign of this variable is expected to be positive.

TABLE 1
Variables, Definitions, and Descriptive Statistics

Variables	Description	Data source	Number of obs.	Mean	Std. Dev.
Ecofootprint	EFP (per capita hga)	GFN*	364	4.4172	2.2558
Envtech	ETI	OECD	364	6.5442	9.0840
$Logco_2$	Logarithm of CO_2 (kiloton)	World Bank	364	5.9190	0.4262
Trade	Share of trade in GDP (%) (TO)	World Bank	364	47.6880	18.5365
Loggdp	Logarithm of GDP per capita (EG)	World Bank	364	12.2972	0.3883

Note: * Global Footprint Network

3.2 ECONOMETRIC METHODOLOGY

Based on the model described, we first examined the cross-sectional dependence (CSD) of the series and based on the results from this examination, we applied the Panic unit root test as a second-generation unit root test. After detecting that all variables become stationary at the first difference, we applied Westerlund (2007) cointegration tests. Based on the presence of cointegration, we finally estimated the long-run coefficient with AMG and CCEMG methods. The methodological explanation is given in this section of the study.

3.2.1 PANEL UNIT ROOT TESTS

Bai and Ng (2004, 2010) put forth a series of tests based on examination of stationarity in the residue and the factors on an individual basis. This test is referenced in the academic literature as the Panel Analysis of Nonstationarity, Idiosyncratic and Common Components (PANIC). The PANIC test is one of the second-generation tests. PANIC test, is as follows:

(1) $$X_{i,t} = D_{it} + \lambda_i' F_t + e_{i,t}$$

Where D_{it} polynomial trend function, F_t is an rx1 dimensional vector of common factors, λ_i is a vector of factor loadings. The series $X_{i,t}$ is the sum of deterministic component D_{it}, a common component $\lambda_i' F_t$, and an error $e_{i,t}$ that is largely idiosyncratic. At the same time;

(2) $$e_{i,t} = p_i\, e_{it-1} + e_{i,t} \qquad i=1\ldots\ldots,N$$

However, the deterministic components are represented by the following equation, $D_{it} = \sum_{j=0}^{p} \delta_{ij} t^j$ when p=0, $D_{it} = \delta_i$ the outcome has been determined. If p=1 in equation (1) above, there is an individual time trend. If P=-1, there is no deterministic term ($D_{it} = 0$) In this case, the first difference model.

(3) $$y_{it} = \lambda_i' F_t + z_{it}$$

In equation (3), the abbreviations are $y_{it} = \Delta y_{it}$, $F_t = \Delta f_t$ and $z_{it} = \Delta e_{it}$. In the event that P = 1, the mean of the first difference data set is to be eliminated. In the final instance a definitive outcome will be reached.

$$y_{it} = \Delta Y_{it} - \Delta \bar{Y}_i, \quad F_t = \Delta F_t - \Delta \bar{F} \text{ and } z_{it} = \Delta e_{it} - \Delta \bar{e}_i$$

When the PC method is applied to first differenced data y_{it}), factors ($\hat{f}_t$), and factor loadings ($\hat{\lambda}_i$), $\hat{z}_{it}$ ($= \hat{y}_{it} - \hat{\lambda}_i' f_t$) are obtained. In the PANIC test, the stationarity of the residue is evaluated subsequent to the assessment of the stationarity of the common factors. Two stages are employed to ascertain the stability of the residue. Initially, the hypothesis that $\hat{e}_{it}$ is individually stationary is evaluated through ADF regression. Subsequently, the stationarity of

the entire panel is assessed by aggregating the p-values of the individual tests (Tatoğlu, 2017).

3.2.2 PANEL COINTEGRATION ANALYSIS

The subsequent stage is to undertake a review of the cointegration relationship among the series. The long-term relationship between the series is investigated by using cointegration tests. Cointegration tests are classified into two categories: the first and second generation tests. The former are employed in scenarios where there is no cross-sectional dependence, whereas the latter are utilized where cross-sectional dependence exists. This test is designed to accommodate cross-sectional dependency and slope heterogeneity among the panel units (Islam, 2022). This study employed the panel cointegration test proposed by Westerlund (2007), which accounts for cross-sectional dependence between units.

$$\Delta Y_{it} = \delta_i' d_t + \alpha_i (Y_{it-1} - \beta_i' X_{it-1}) + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=-qi}^{p_i} y_{ij} \Delta X_{it-j} + e_{it} \quad (4)$$

t=1…… T is the time dimension; I = 1…….N is the unit dimension and d_t is the deterministic components. d_t=0 means the situation without deterministic term (without constant and trend); d_t=1 is the situation with constant; and finally, d_t = (1,t) is the situation with constant and trend. Upon readjustment of the error correction model, the following equation can be formulated:

$$\Delta Y_{it} = \delta_i' d_t + \alpha_i Y_{it-1} + \lambda_i' X_{it-1} + \sum_{j=1}^{p_i} \alpha_{ij} \Delta Y_{it-j} + \sum_{j=-qi}^{p_i} y_{ij} \Delta X_{it-j} + e_{it} \quad (5)$$

Here is the equation of λ_i'=$-\alpha_i \beta_i'$. α_i The term 'parameter' is used to describe the speed of return to equilibrium following a sudden shock. The possibility of an error correction is also under discussion. if α_i < 0; this position means a cointegration relation between y_{it} and x_{it}. There is no correction if α_i =0; namely, there is no cointegration relation. The null hypothesis (H_0: $\alpha_i = 0$) in the Westerlund cointegration relation indicates that no cointegration relation exists for all i. However, this depends on the assumption regarding the homogeneity of the alternative hypothesis, α_i. The initial two

cointegration tests are designated as the ensemble average test. This test evaluates the H_0 hypothesis for a minimum of one i value in opposition to H_i^g: $\alpha_i < 0$, obviating the necessity for an equation of α_i. Two further tests, known as panel tests, assume that the α_i values are equal for all i. Once again, the H_0 hypothesis is tested for all i values against H_i^g: $\alpha_i = \alpha < 0$ as outlined by Persyn and Westerlund (2008:233). Westerlund cointegration tests comprise two groups of statistics: ensemble average variance and panel variance statistics. The following equation can be written for each unit with reference to the group mean statistics of the variance least squares method.

(6) $$\Delta y_{it} = \hat{\delta}'_i d_t + \hat{\alpha}_i y_{it-1} + \hat{\lambda}'_i x_{it-1} + \sum_{j=1}^{pi} \hat{\alpha}_{ij} \Delta y_{it-j} + \sum_{j=0}^{pi} \hat{\gamma}_{ij} \Delta x_{it-j} + \hat{e}_{it}$$

Subsequently, the ensemble average variance statistics (Gt and Ga) are calculated.

(7) $$G_t = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \; and \; G_a = \frac{1}{N} \sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)}$$ In the second phase, the common error correction parameter (α) and its standard error are estimated using the following formula: $\Delta\tilde{y}_{it}$ and $\tilde{y}_{it-1}$.

(8) $$\hat{\alpha} = \left(\sum_{i=1}^{N} \sum_{t=2}^{T} \tilde{y}_{it-1}^2\right)^{-1} \sum_{i=1}^{N} \sum_{t=2}^{T} \frac{1}{\hat{\alpha}_{(1)}} \tilde{y}_{it-1} \Delta\tilde{y}_{it}$$ In the final stage, the Pa and Pt statistics are calculated in accordance with the following procedure.

(9) $$P_t = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \; and \; P_a = T\hat{\alpha}$$

The rejection of the null hypothesis for both group tests indicates the absence of a cointegration relationship across the entire panel (Tatoğlu, 2017: 202).

3.2.3 COMMON CORRELATED EFFECT MEAN GROUP (CCEMG) AND AUGMENTED MEAN GROUP (AMG) ESTIMATORS

Once the co-integration has been established in the panel data, the final step is estimation of the long-run coefficients. At this juncture, the CCEMG estimator, as developed by Pesaran (2006), and the AMG estimator, as introduced by Eberhardt and Bond (2009), are employed.

The Common Correlated Effect mean group (CCEMG) method, developed by Pesaran (2006), is employed in the case of CSD in the model's residuals. The model used by Pesaran (2006), i=1,2,…,N and t=1,2,…,T where i refers to cross-section units and t to time.

$$y_{it} = \alpha'_i d_t + \beta'_i x_{it} + e_{it} \quad (10)$$

In this context, d_t represents the observed common effect vector, which has an nx1 dimension. Similarly, x_{it} denotes the explanatory variables vector, which has a kx1 dimension. It is notable that the error vector exhibits a multifactor property.

$$e_{it} = \gamma'_i f_t + \varepsilon_{it} \quad (11)$$

In Equation (11), f_t represents an unobserved common factor vector with a m x 1 dimension, while ε_{it} denotes error terms specific to cross-section units. The coefficient of the long-run relationship is estimated as follows (Pesaran, 2006):

$$\hat{\beta}_{MG} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_i \quad (12)$$

In Equation (12), $\hat{\beta}_i$ represents the estimation for cross-section i. The long-run coefficient for the overall panel is obtained by averaging the coefficients of the cross-section units.

The AMG employs an estimation method incorporating the CSD through a 'common dynamic effect' within the regression for each country. Furthermore, it is assumed that the observable inputs x_{it} and output y_{it}, as well as the unobserved common factors f_t and g_t, are a priori non-stationary (Eberhardt and Bond, 2009, 2). To enhance precision of this methodology, two key steps are undertaken (Eberhardt and Bond, 2009: 3). The initial step involves a standard FD-OLS regression with T-1 year dummies in first differences. The authors then collected the year dummy coefficients and relabelled them as $\hat{\mu}_t$. Second, this variable was incorporated into each of the N standard country regressions with linear trend terms representing omitted idiosyncratic processes (Eberhardt and Bond, 2009: 3). As a result, the AMG estimator offers a number of significant advantages. Primarily, it permits the utilization of variables exhibiting disparate stationary levels, while also accommodating CSD and parameter heterogeneity (Eberhardt and Teal, 2010: 4).

3.2.4 PANEL CAUSALITY ANALYSIS

The final step is to test the causal relationship between the variables. While potential exists for a unidirectional causal relationship between economic variables, it is also possible to observe a mutual causality relationship between the variables. In some cases, there may be no discernible causal relationship. The Dumitrescu and Hurlin test, which is one of the causality tests used in models where all parameters are heterogeneous, was employed in the model. Dumitrescu and Hurlin extended the Granger causality test for heterogeneous panels (Tatoğlu, 2017:154). For stationary x and y values, the linear model for each unit in the case of i=1…..N and t = 1…….T is as follows (Dumitrescu and Hurlin, 2012:1451);

(13)

$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} Y_{it-k} + \sum_{k=1}^{K} \beta_i^{(k)} X_{it-k} + \varepsilon_{i,t}$$

The aforementioned equation is employed to ascertain whether the x variable is the causal factor behind the y variable. The fundamental premise is that if the preceding values of x are a significant predictor of the current value of y, even when the preceding values of y are incorporated into the model, then x is the causal factor behind y (Lopez and Weber, 2017: 2). The causality in question is tested with the following hypothesis:

$$H_0: \beta_i = 0 \quad i=1,\ldots..N$$

The fundamental assumption is that β_i is equal to zero. Concurrently, the null hypothesis (H_0) posits the absence of homogeneous panel causality from x to y. The alternative hypothesis is:

$$H_1: \beta_i = 0 \quad i=1,\ldots..N \quad ve \quad \beta_i \neq 0 \quad i=N_1+1, N_2+2, \ldots N$$

In accordance with the alternative hypothesis, the inequality N1 < N signifies the absence of causality from x to y. Despite the uncertainty surrounding N1, it is constrained by the condition $0 \leq N1/N < 1$. In the event of N1 = N, the conclusion that no causality exists within the panel is reached, a scenario analogous to that of the

basic hypothesis. When N_1 is equal to zero, the variable x is identified as the causal factor for y across all units within the panel. If H_0 is accepted, it can be concluded that the variable x does not cause the variable y for all units of the panel. In contrast, the null hypothesis (H_0) is rejected, and when $N_1 = 0$, the variable x is found to cause the variable y for all units in the panel. In this case of causality, a homogeneous result is obtained. Conversely, if $N_1>0$, the causality relationship is heterogeneous (Dumitrescu and Hurlin, 2012). For the basic hypothesis i = 1, ..., N, which asserts that there is no causality, the average of Wald statistics specific to each unit is used (Tatoğlu, 2017: 155).

$$\bar{W}_{N,T} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \quad (14)$$

In the aforementioned equation, the unit-specific Wald test statistic, denoted as W_i,T, is employed to test the null hypothesis, H_0: $\beta_i = 0$, at the level of unit i.

3.2.5 EMPIRICAL RESULTS

It is crucial to assess the stationarity of the variables before applying econometric techniques, to prevent occurrence of spurious regressions. The existing literature on this subject identifies two principal categories of unit root tests: the first and the second generation. The former is employed when there are no CSD, whereas the latter is utilized when CSD are present (Brooks, 2014: 547). Consequently, the CSD tests were initially applied to all variables (see Annex A). Based on these results, all variables were found to exhibit CSD. Consequently, the PANIC test, a second-generation test, was applied to all variables. The results of the unit root test are presented in Table 2.

The results presented in Table 2 indicate that the null hypothesis cannot be rejected for any of the variables. This implies that all of the variables exhibit a unit root at the level. Nevertheless, all variables are stationary at first differencing. If all the variables are I(1), then they are likely to be related to each other in the long run. Cointegration tests are applied to detect this kind of relationship. Therefore, we have summarized the cointegration test results and some diagnostics in Table 3.

TABLE 2
Unit Root Test

Variables	Level		1st difference	
	PCe_Choi	PCe_MW	PCe_Choi	PCe_MW
Ecofoot	-0.2526	24.1785	7.5128***	80.1758***
	(0.5997)	(0.5658)	(0.000)	(0.000)
Envtech	-1.1218	17.9109	7.1934***	77.8724***
	(0.8690)	(0.8790)	(0.000)	(0.000)
$LogCO_2$	-2.5985	7.2620	7.0853***	77.0926***
	(0.9953)	(0.9999)	(0.000)	(0.000)
Trade	-2.7710	6.0182	9.3053***	93.1018***
	(0.9972)	(1.0000)	(0.000)	(0.000)
Loggdp	-2.6151	7.1422	2.8740***	46.7248***
	(0.9955)	(0.9999)	(0.0020)	(0.0076)

Note: *** and ** refer to 1% and 5% significance levels. The values in parenthesis are p-values.

TABLE 3
Cointegration Tests

Westerlund Cointegration Test				
	Test stat.			p-value
G_t	10.690***			(0.001)
G_a	6.994			(0.500)
P_t	-17.794***			(0.000)
P_a	5.801***			(0.000)
Diagnostics				
CSD for the Model				
	CDLM 1	p-value	Lmadj	p-value
Model	10.23***	(0.0000)	20.69***	(0.0000)
Pesaran-Yamagata Homogeneity Test				
	Delta	p-value	Delta adj	p-value
Model	20.106***	(0.000)	22.683***	(0.000)

Note: *** and ** refer to 1% and 5% significance levels.

Second-generation Westerlund (2007) panel cointegration tests were applied under lagged (2) constant and trend assumptions. The results are recorded in Table 3. The Gt, Pt and Pa statistics are significant at the 1% level, indicating that the null hypothesis of no cointegration is rejected. Consequently, it is possible to discuss the existence of a long-term cointegration relationship between the

variables. Certain diagnostics, however, are employed to determine the most suitable estimator. One such diagnostic is the CSD test for the residuals of the model in question. The results presented in Table 3 indicate that the p-values are less than 0.05, thus rejecting the null hypothesis that there is no CSD. Consequently, a second-generation estimator is necessary if the CSD is present in the residuals generated from the model. Therefore, we used CCEMG and AMG estimators to measure the coefficients. Before examining the coefficients, however, we need to test the homogeneity of slope coefficients. In Table 3, there is also the result of the Pesaran-Yamagata test, which is used to examine the homogeneity of coefficients among the cross-section units. It is observed that we reject the null hypothesis of homogeneity if the p-value is lower than 0.05. Hence, we estimated long-run coefficients for each cross-section unit separately.

One more issue to consider before estimating the coefficients is multicollinearity. The method to examine multicollinearity in the model examined is to analyze the bivariate correlations of the explanatory variables. The bivariate correlations must be lower than 0.80 to avoid multicollinearity issues (Senaviratna and Cooray, 2019: 3). Another way to detect multicollinearity is to examine the Variance Inflation Factor (VIF) values. Accordingly, if the VIF value of any variable has a high correlation with other explanatory variables this causes a multicollinearity problem (Kim, 2019: 559). Depending on the bivariate correlations (see Appendix 2) and the VIF values (see Appendix 3), it is observed that there is no multicollinearity problem in the model. The estimation results are given in Table 4.

TABLE 4
Long-Run Coefficient Estimation Results

	CCEMG Estimation Results				AMG Estimation Results			
	envtech	logco2	loggdp	trade	envtech	logco2	loggdp	trade
CHN	0.008	5.271***	-0.639	-0.012***	0.004	4.606***	-0.315	-0.011***
	(0.469)	(0.000)	(0.587)	(0.000)	(0.560)	(0.000)	(0.171)	(0.000)
USA	0.004	11.213**	18.071**	0.072*	-0.031	13.627***	5.188*	-0.014
	(0.888)	(0.015)	(0.017)	(0.054)	(0.257)	(0.000)	(0.062)	(0.496)
JPN	-0.019	7.348***	1.767	0.003	0.012	5.497***	3.563	-0.007
	(0.504)	(0.009)	(0.724)	(0.868)	(0.551)	(0.002)	(0.370)	(0.661)
DEU	0.018	6.388**	3.026	0.009	0.029	5.953***	-0.7079	0.017***
	(0.614)	(0.024)	(0.625)	(0.633)	(0.303)	(0.002)	(0.756)	(0.001)
IND	-0.053	1.504***	0.100	0.001	-0.009	1.598***	-0.654***	-0.002**
	(0.194)	(0.000)	(0.771)	(0.339)	(0.844)	(0.000)	(0.000)	(0.011)

TABLE 4 (*continued*)

	CCEMG Estimation Results				AMG Estimation Results			
	envtech	logco2	loggdp	trade	envtech	logco2	loggdp	trade
GBR	0.006	10.803***	5.274	-0.008	0.045	8.490***	8.840***	-0.002
	(0.980)	(0.000)	(0.247)	(0.680)	(0.851)	(0.000)	(0.000)	(0.890)
KOR	-0.005	13.667***	-2.794	-0.025***	-0.009	7.598***	3.373***	-0.012***
	(0.889)	(0.000)	(0.427)	(0.000)	(0.807)	(0.000)	(0.007)	(0.000)
FRA	0.011	1.760	7.530	0.022	0.153	4.393**	7.901***	0.010
	(0.919)	(0.554)	(0.221)	(0.315)	(0.129)	(0.027)	(0.002)	(0.482)
RUS	-0.505	4.380	5.364*	0.003	-0.338	3.769*	5.623***	0.0049
	(0.432)	(0.315)	(0.053)	(0.689)	(0.537)	(0.071)	(0.000)	(0.236)
ITA	-0.114	3.827	14.305**	-0.012	-0.203	4.438***	13.27***	-0.010
	(0.559)	(0.154)	(0.022)	(0.255)	(0.175)	(0.001)	(0.000)	(0.293)
MEX	3.694	-8.784	14.441	0.009	4.776**	2.049	3.398	0.009
	(0.177)	(0.275)	(0.117)	(0.467)	(0.049)	(0.373)	(0.296)	(0.401)
BRA	-0.443	1.185	5.420***	-0.012	-0.864**	1.558**	1.351	-0.023***
	(0.296)	(0.277)	(0.007)	(0.136)	(0.028)	(0.046)	(0.256)	(0.000)
IDN	-1.790*	1.044***	1.028***	-0.002	-2.291*	0.196	1.003***	0.000
	(0.096)	(0.005)	(0.003)	(0.115)	(0.060)	(0.387)	(0.008)	(0.754)

Note: ***, ** and * refer to 1%, 5% and 10% significance levels, respectively. The values in parenthesis correspond to p-values.
(CHN: China, USA: United States, JPN: Japan, DEU: Germany, IND: India, GBR: United Kingdom, KOR: South Korea, FRA: France, RUS: Russia, ITA: Italy, MEX: Mexico, BRA: Brazil, IDN: Indonesia)

The results of the CCEMG indicate that the impact of ETI on the EFP is significant only in Indonesia. The AMG results, however, suggest that this is also the case in Mexico, Indonesia and Brazil. In contrast, results from other countries are not statistically significant. The CCEMG and AMG results both indicate that ETI reduce the EFP. The mitigating effects of TI are consistent with the results of Ali et al. (2016) for Malaysia, Islam (2024) for Saudi Arabia, and Ozkan et al. (2023) for Turkiye. However, the AMG results also indicate that in Mexico, these innovations have the opposite effect, increasing the EFP. The advent of ETI in Mexico has led to an increase in the country's EFP. This suggests that Mexico is currently undergoing industrialization, is in the initial stages of developing environmental technologies, and that the developed technologies are not yet fully implementable or commercially viable. These findings also prompt the question of how these technologies can be effectively utilized in Mexico.

The CCEMG results indicate that CO_2 emission has an increasing effect on the EFP in China, the USA, Japan, Germany,

India, the UK, Korea and Indonesia. The AMG results indicate that EFP expansion is associated with growth in CO_2 emissions in China, the USA, Japan, Germany, India, the UK, Korea, France, Russia, Italy and Brazil. The analysis results demonstrate that CO_2 emission has a detrimental impact on EFP in most countries, endangering the environment and future generations through its role in environmental degradation. The CCEMG results indicate that the loggdp variable exerts an increasing influence on the EFP in the US, Russia, Italy, Brazil, and Indonesia. Similarly, the AMG results demonstrate that in the United States, India, the UK, South Korea, France, Russia, Italy, and Indonesia, the loggdp variable also has a positive effect on the EFP. Results are consistent with that in Destek and Sarkodie (2019) for 11 newly industrilized countries, and Alola et al. (2019) for EU countries. The findings indicate that the initial tenets of the EKC hypothesis remain pertinent in the present era, even in nations that have attained the final stage of industrialization. In other words, the EG process continues to have a detrimental impact on the environment, even in developed countries.

The CCEMG results indicate that trade has decreasing effect on the EFP in South Korea and China. However, it has an enhancing effect in the USA. The results of AMG indicate that while trade contributes to a reduction in China, India, Korea and Brazil's EFP, it concurrently leads to an increase in Germany's. According to CCEMG and AMG, the results suggesting that TO reduces the EFP coincide with the results of Destek and Sinha's (2020) study for OECD countries and with Aydın and Turan (2020) for BRICS countries. International trade has the potential to facilitate technology transfer to other countries. This could allow nations to access cleaner technologies, which could reduce the adverse impact on the environment and improve environmental quality. The results of the two tests (CCEMG and AMG) demonstrate that trade is responsible for an increase in the EFP in both Germany and the USA. The results indicate that the impact of trade on the EFP is statistically limited in terms of both its increasing and decreasing effects.

The Dumitrescu-Hurlin panel causality test results are outlined in Table 5, which provide two bidirectional (Envtech ↔ ecofootprint; Trade ↔ ecofootprint) and two unidirectional (Ecofootprint → logco2kt ; loggdp → ecofootprint) causalities. The bidirectional causality between envtech and ecofootprint confirms that envtech causes ecofootprint vice versa. These result indicate that any policy targeting the ecofootprint, will accelerate envtech and any change in envtech will affect ecofootprint. The outcome confirms the

finding of Ahmad et al. (2020). Technological progress and the adaptation of innovations to the environment contribute positively to environmental sustainability. The bidirectional causality between trade and ecofootprint reveals that trade causes environmental damage vice versa. The bilateral causality relationship between TO and EFP is analogous to the causality relationships obtained from Zhou et al. (2024). The results of the causality test indicate a unidirectional relationship from loggdp to ecofootprint, which lends support to the findings of Chu (2022b). The expansion of economic activity causes the EFP. Finally, a one-way causal relationship was detected from ecofootprint to logco2kt. This relationship explains that approaches to reduce the EFP are the reason for the decrease in logco2kt, one of the harmful emissions to the environment.

TABLE 5
Dumitrescu-Hurlin Panel Causality Test Results

Null Hypothesis	W-Bar	Z-Bar	Prob	Decision
envtech does not Granger-cause ecofootprint	8.8979	1.8289	0.0674*	Envtech ↔ ecofootprint
ecofootprint does not Granger-cause envtech	17.8297	10.4358	0.0000***	
logco2kt does not Granger-cause ecofootprint	1.4261	1.0863	0.2773	Ecofootprint → logco2kt
ecofootprint does not Granger-cause logco2kt	10.2857	3.1662	0.0015***	
trade does not Granger-cause ecofootprint	12.7983	5.5874	0.0000***	Trade ↔ ecofootprint
ecofootprint does not Granger-cause trade	8.9648	3.0858	0.0020***	
loggdp does not Granger-cause ecofootprint.	8.7359	1.6727	0.0944*	loggdp → ecofootprint.
ecofootprint does not Granger-cause loggdp	1.5765	1.4698	0.1416	

Note: ***, ** and * refer to 1%, 5% and 10% significance levels, respectively.

4. DISCUSSION AND CONCLUSION

Today, the attempt to enhance social welfare in terms of national economies has entailed pursuit of sustainable EG. In this process, where EG efforts become the main goal, environmental sustainability is ignored. Pursuit of economic progress and increased prosperity has resulted in environmental challenges, including global warming, climate change, and an increase in CO_2 emissions. Concurrently, the rise in consumption driven by urbanization and population growth has significantly increased energy consumption, reaching envionmentally threatening levels for both developed and developing countries.

In this study, the concept of exclusively focusing on CO_2 emissions for assessing environmental damage was deemed insufficient. In this framework, the EF approach was employed, which is a more comprehensive indicator that examines environmental sustainability in a broader context and includes CO_2 emissions. In essence, a heightened awareness of environmental degradation among policymakers and academics engaged with this subject area has prompted a shift in focus from an exclusive emphasis on CO_2 emissions to a more encompassing examination of the EF.

The CCEMG and AMG results indicate that in countries such as Indonesia and Brazil, where TI reduces the EFP, it is advisable for policymakers and governments to strengthen ETI policies with the aim of decreasing the EFP and solving the environmental pollution problems. In this instance, it is crucial to increase the proportion of environmental technology within the technological landscape and to provide a range of financial and investment incentives aimed at fostering environmental technology advancement. In addition to all this, in a country like Mexico, where ETI are increasing the EFP and environmental degradation is occurring, policymakers must take responsibility. Furthermore, in conjunction with advances in environmental technologies, it is of paramount importance for governments to formulate effective implementation strategies for environmental policies. In most countries included in the study, the impact of CO_2 emissions on EFP is incorporated into the analysis of CCEMG and AMG results. The implementation of measures such as using alternative energy sources, particularly for industrial production, the expansion of public transportation opportunities and the increased use of hybrid vehicles, the development of environmentally-friendly and environmentally conscious smart city plans, and the incorporation of environmentally friendly components in agricultural production will contribute to reducing CO_2 emissions.

The results of CCEMG and AMG analyses indicate that the EG process has a detrimental impact on the EFP in numerous countries. The findings demonstrate that countries tend to prioritize EG over environmental considerations in their production processes. In light of these findings, it is recommended that countries consider implementing measures aimed at promoting environmentally conscious practices within their production processes. This could entail adopting environmentally-friendly techniques and transitioning to more sustainable products and production methods. The production of environmentally friendly products and services in the EG process is more costly and time-consuming. It is important to utilize economic incentives in producing such products and services. On the other hand, a combination of effective policy interventions is needed to ensure sustainable growth, improve living standards and foster technological advances. Global co-operation summits should be established to address issues related to economic activity impact on the environment. Additionally, policies aimed at reducing excessive consumption may prove beneficial in this regard. The results of the CCEMG and AMG indicate the necessity for more rigorous trade policy implementation in both exports and imports in countries where trade intensifies the EFP. The creation of trade policies should encompass an assessment of the potential negative impacts of commercial activities on the environment. Furthermore, prioritizing environmentally friendly products in export and import processes, coupled with incentive factors for these products, is crucial in formulating effective environmental policy.

It should be noted that the study is subject to a number of limitations. The present study encompasses 13 countries with the highest added value. The number of countries included in the study could be further expanded by including additional data sets. Furthermore, data from the years 1992 to 2019 were employed in this study. Data to be published in the future, particularly with regard to the EFP, will extend the time period of future studies. The study was conducted using four independent variables: ETI, CO_2 emissions, GDP and trade. In future studies, institutional and social data, in addition to economic data, can also be used for this group of countries.

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APPENDIX 1
CSD Test for the Residuals of the Model

Variables	CDLM	LM adj
Ecofoot	3.388	118.620
	(0.000)	(0.000)
envtech	1.909	112.528
	(0.028)	(0.000)
LogCO2 emissions	4.403	106.358
	(0.000)	(0.000)
Trade	9.059	67.090
	(0.000)	(0.000)
Loggdp	16.678	114.527
	(0.000)	(0.000)

APPENDIX 2
Bivariate Correlation Matrix for Explanatory Variables

	Logenv	LogCO2 emissions	Trade	Loggdp
Logenv	1	-	-	-
LogCO2 emissions	0.4444	1	-	-
Trade	0.6975	0.6999	1	-
Loggdp	-0.2910	-0.2648	-0.2755	1

APPENDIX 3
Variance Inflation Factor Values for Explanatory Variables

Variables	VIF
envtechinov	2.01
logco2kt	2.00
loggdpc2015	3.09
tradeofgdp	1.12
Mean VIF	2.06

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DETERMINANTS OF CONSUMERS' INTENTION TO USE MOBILE COMMERCE: DELONE AND MCLEAN PERSPECTIVE

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ABSTRACT

In the last few decades, substantial progress was seen in mobile commerce development. Although the Internet and smartphones have become more widely used in Malaysia, mobile commerce acceptance is still low. The current study investigates the determinants of intention to use mobile commerce among consumers in Malaysia. Additionally, this study aims at proposing a conceptual framework that emphasizes the impact of information quality, system quality, and service quality on consumer intentions to use mobile commerce in Malaysia. The DeLone and McLean Updated Information System Success Model (ISSM) Theory is the theoretical background of this study's proposed model. Mobile commerce providers must create user-friendly websites, applications, and platforms; they must also provide valuable information regarding their offerings, and provide high service quality to mobile commerce users to build a favourable intention to use mobile commerce in Malaysia. The primary contribution of this research is the conception of a model to examine the determinants of consumer intention to use mobile commerce in Malaysia. This research provides practical insights for mobile commerce service providers, enhancing their understanding of the determinants affecting consumer intention to use mobile commerce. This study will benefit academicians, scholars, students, providers, mobile marketing practitioners, and all industry stakeholders. Since this paper is conceptual, it necessitates empirical investigation to validate the proposed model of this study; thus, additional research is recommended.

JEL Classifications: M1, M150, M3

Keywords: Mobile commerce, Information quality, System quality, Service quality, Intention

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1. INTRODUCTION

Innovation has been dramatically accelerated in recent years by the growth of mobile technology (Ghazali et al., 2018). Mobile devices are used for many different types of services nowadays, including mobile payments, mobile commerce, and mobile social networking, through the flexibility of communication networks unrestricted by location and time (Barry et al., 2024a; O'Dea, 2020). Mobile devices are quickly overtaking other access points for communication. The mobile network is more affordable than a landline phone and offers customers more freedom and accessibility (Asampana et al., 2022; Jahansahi et al., 2011). As they revolutionize businesses across all industries, mobile devices are accepted as the principal method of performing commercial transactions in emerging and developed nations. The widespread use of mobile devices for commercial transactions has disrupted established corporate procedures and made wireless telecommunication the primary method for modernizing established infrastructure using accepted standards (Jain et al., 2021). Mobile commerce has become a brand-new business phenomenon because of the quick uptake and adoption of mobile devices and the ongoing development of mobile technology (Sarkar et al., 2020). Access to wireless technologies and mobile devices has changed business communication and made it simpler and faster to engage with potential customers.

In terms of expanding access to wireless communication, which has impacted billions of people worldwide, advancement in wireless communications is astounding. Access to technology has changed communication speed and allows marketers to reach out to potential customers whenever and wherever they choose. A robust telecommunications service network has been determined to have a considerable positive impact on a country's economic growth, according to Barry et al. (2024a). According to World Bank study in 120 countries, a 10% increase in mobile commerce subscriptions results in a 0.8% increase in GDP (Barry and Jan, 2018). Customers now utilize mobile cellular extensively, and this trend is only growing. Regarding subscriptions and popularity, the mobile cellular market has experienced the fastest growth in the telecommunications sector (Mohamad and Sabri, 2022). According to a World Bank report in 2022, more than 8.27 billion people use mobile phones, while more than 6.5 billion use smartphones, predicted to expand quickly in the coming years (Statista, 2022). According to the International Telecommunication Union (ITU), 4.9 billion people, or

63% of the world's population, used the Internet in 2021, up from only 16% in 2005. According to Statista (2022), 63% of the world's population, or 5 billion people, were internet users as of April 2022. Social media users comprise 4.65 billion of the global population, or more than 93% (Statista, 2022).

Mobile commerce, the expansion of electronic commerce utilizing a wireless mobile device, has also been made possible by developing this mobile technology (Chan et al., 2022). By facilitating many business owners to start and run their businesses, mobile commerce, also known as m-commerce, has considerably contributed to world economic growth (Thevaranjan and Samantha, 2022). The new potential that mobile commerce technology has provided for business owners, customers, and marketers is already being studied by researchers (Laudon and Laudon, 2016). Several different types of mobile commerce services, such as mobile tickets, mobile travel, mobile shopping, mobile health, mobile agriculture, mobile advertising, mobile education, mobile wallet, and mobile purchase of films, songs, or games, have all seen significant increases arising from mobile commerce (Barry et al., 2024c; Septiani et al., 2017).

Mobile commerce, however, is viewed as the next step in the evolution of electronic commerce (e-commerce), as it employs wireless technology to meet customer needs conveniently and makes all elements of conventional e-commerce accessible via smartphones or other portable devices. Given the massive appeal of mobile devices and the ongoing development of wireless networks, mobile commerce is quickly becoming increasingly popular. Since mobile devices are used to conduct online transactions in a wireless environment, mobile commerce is considered a potential expansion of e-commerce (Vinerean et al., 2022). By 2021, mobile commerce accounted for 54% of all e-commerce sales (Misra et al., 2022). Mobile devices proliferation has been the primary catalyst for the significant growth of e-commerce in Malaysia. In 2022, over 70% of all e-commerce transactions were done using smartphones. The upward trajectory of this trend underscores the need to implement mobile-friendly solutions for organizations (Kaur, 2022).

Malaysia’s total population is around 32.78 million, with approximately 89.53% (29.35 million) using mobile Internet (Statista, 2022). Nearly 20 million Malaysians shop through mobile devices, and 62% of the 16.53 million online shoppers in the country complete transactions on mobile platforms (Embassies, 2019). Morgan (2019) reports that 47% of all e-commerce transactions in

Malaysia occur via mobile phones, contributing to an estimated $5.6 billion (RM23.9 billion) in consumer sales by 2021, with a compound annual growth rate of 31.4%. Hence, 90% of Malaysian are expected to use mobile commerce by 2024 (Tran, 2024). Despite high smartphone penetration, the adoption of mobile commerce in Malaysia is relatively low (Barry et al., 2024c; Yahaya et al., 2022).

In 2021, Malaysia experienced significant e-commerce adoption, fueled by a large internet user population (27.4 billion, or 80%) and a high mobile phone penetration rate (84.2%), according to ITA. Mordor Intelligence (2022) reported that 83% of Malaysians participated in e-commerce, with 68.4% using mobile devices for purchases (Ganbold, 2021; Yandamuri et al., 2020). GSMA intelligence data indicates that mobile commerce constitutes 55.9% of all e-commerce transactions in Malaysia (Commission Factory, 2022), which is expected to reach 70% by 2024 (Tran, 2024). Despite this, the country still has fewer mobile commerce transactions than overall e-commerce activity (Barry, Haque, and Jan, 2024a; Ganbold, 2021; Yandamuri et al., 2020). This study examines the determinants of consumers' intentions to use mobile commerce in Malaysia, employing the updated information system success model. In addition, after a review of previous studies, a research model is proposed in this study to examine the determinants of consumers' intentions to use mobile commerce in Malaysia.

2. LITERATURE REVIEW

2.1 MOBILE COMMERCE

Mobile commerce, despite being in its infancy, has already achieved significant success and has the potential to revolutionize any industry, thereby influencing modern human existence (Jahanshahi et al., 2011). This potential has been recognized in earlier studies, where mobile commerce has been described in various ways. According to Sadi and Noordin (2011) and Wei et al. (2009), mobile commerce is the use of a wireless device, such as a smartphone, cellular phone, or personal digital assistant (PDA), and a network to access information and transact for goods, services, or information. Furthermore, Sadi and Noordin (2011) and Barry and Jan (2016) stressed that mobile commerce is a natural extension of electronic commerce (e-commerce), enabling customers to seamlessly collaborate with businesses or one another whenever and wherever they desire. Any verbal or written transaction of money for

goods, services, or information over a wireless network is called mobile commerce (Hung et al., 2004; Skiba et al., 2000).

Yang (2005) and Barry, Haque, and Jan (2024b) however, agree that every transaction directly or indirectly via a cellular telecommunications network is included in m-commerce. According to Khalifa and Shen (2008), mobile commerce has officially begun when consumers use their smartphone or any other device, such as an iPhone, iPad, or Android device. Additionally, they assert that a subset of electronic commerce is mobile commerce. Wong and Hiew (2005) contend that m-commerce is separate from electronic commerce due to mobile devices' unique characteristics, limitations, and features. Feng et al. (2006) claim that mobile commerce differs from electronic commerce in terms of its style, interactions, usage patterns, and value chain. According to Feng et al. (2006), mobile commerce offers a creative and innovative business opportunity because of its unique characteristics, such as mobility and internet connectivity. Any money exchange for goods, services, or information over a smartphone or wireless device is called "mobile commerce" (Barry and Jan 2018).

2.2 INTENTION TO USE MOBILE COMMERCE

In general, a person's capacity to exercise purpose and observation towards anything is impacted by various circumstances. The aim will only be evident to someone if something naturally influences their interest in something and causes it to develop into an objective goal. However, the purpose is likely linked to a person's dedication to a course of action or linked to a person's component belief in an object. Therefore, Davis (1989) defined intention to use as "an individual's subjective probability that he or she will perform a specified behaviour." According to Venkatesh et al. (2012), a person's behavioral intention influences their willingness to use and continue their technology, which also influences how they use it. LaMorte (2019) and Ahmed and Barry (2023) agreed that "behavioural intention refers to the motivational factors that influence a given behaviour where the stronger the intention to perform the behaviour, the more likely the behaviour will be performed."

In mobile commerce context, intention to use mobile commerce refers to consumers' perceived likelihood of using a certain innovation such as mobile commerce (Vinerean et al., 2022). Wu and Wang (2005) define intention to use mobile commerce as the potential for a user of mobile commerce to complete online

transactions using mobile commerce. As a result, the researcher's definition of intention to use mobile commerce in this study refers to the possibility that a user will use mobile commerce to make online transactions. Additionally, according to Kitjaroenchai and Chaipoopiratana (2022), the likelihood that a buyer will keep purchasing from the same online vendor is known as online purchase intention. They emphasized once more that "online purchase intention" refers to customer intentions to make future purchases from the same online vendors of goods and services. According to Ha et al. (2010), customer willingness to use the exact online purchasing service counts as an intention to make an online purchase.

Literature review shows that information quality, service quality, and system quality have a positive impact on the intention to use mobile commerce among consumers (Walker et al., 2023; Vinerean et al., 2022; Kitjaroenchai and Chaipoopiratana, 2022; Mehedintu and Soava, 2022; Wang and Choi, 2022; Li et al., 2022). Furthermore, previous literature also revealed that information quality, service quality, and system quality were strong predictors of the consumer intention to use mobile commerce (Walker et al., 2023; Wang and Choi, 2022). The researchers carefully considered these elements as they emerged from the literature while compiling the proposed model for the intention to use mobile commerce. Information, service, and system quality are represented as exogenous variables in the model (see Figure 1), and intention is the endogenous variable in the study. According to the literature, all these exogenous factors significantly positively impact the intention to use mobile commerce.

2.3 INFORMATION QUALITY

DeLone and McLean (2003) concurred that, "Information quality is related to the semantic level and the information product characteristics such as accuracy, meaningfulness, and timeliness." The features and output characteristics of an IT application are referred to as the "information quality" of that application (Petter and McLean, 2009). Reicks (2001) asserts that the timeliness, consistency, relevance, appropriateness, format, and correctness of the information provided to end users by an IT application are also factors in information quality. Information should be accurate, timely, complete, and current in mobile commerce. Thus, the information offered to customers is impacted in several different

ways by information quality. Information quality refers to information that the users value (Gani et al., 2023).

According to Walker et al. (2023), the impact of low-quality information on user behavior cannot be overstated. They describe information quality as current, reasonable, valuable, and accurate information. Zheng et al. (2013) further highlight that consumers become more distracted and must work more to digest low-quality information. If the app's designer fails to deliver correct and up-to-date information, the end user will lose faith in it and stop using it. It is believed that the websites or apps for mobile commerce would be of high quality and provide users with accurate, up-to-date information. Users lose motivation when they must put in a lot of time and effort to find information, which reduces their propensity to use mobile commerce apps or websites (Zheng et al., 2013). This underscores the urgency of providing high-quality information in mobile commerce.

Barry et al. (2024a) discovered that system quality significantly impacts the intention to use mobile commerce, underscoring its influence. Liu and Forsythe (2011) opine that a successful system that provides clear information immediately attracts customers since it seems dependable and trustworthy. It is essential to comprehend what makes m-commerce information quality appealing to clients, just as m-commerce information affects customer ability to buy and sell things. As a result, consumer information may include things such as user-specific data, product data, supplier data, and more. Even when individuals can access sufficient information, reviewing and evaluating each product to make the best choice can be difficult and time-consuming. This highlights the significant role of system quality in mobile commerce adoption.

Information quality and the intention to utilize technology are significantly correlated, according to earlier studies (Zheng et al., 2013; Petter et al., 2008; Lin, 2007). For instance, Tarhini, Alalwan, Shammout, and Al-Badi (2019) researched the factors influencing mobile commerce adoption in developing nations. They discovered that, in developing nations, the quality of information influences consumer behavioral intention to adopt mobile commerce positively. They discovered that the most significant determinant of customer behavioral intention to adopt mobile commerce in developing nations is information quality combined with habit. Huwaida et al. (2024) found intention to be strongly predicted by information quality. Their findings support those of Saibaba (2024) and Liu (2024).

2.4 SYSTEM QUALITY

System quality evaluates the information processing system (Gai et al., 2024). Since the COVID-19 issue started, consumers' purchasing patterns have changed, and they now rely more frequently on mobile applications (Eger et al., 2021; Gao et al., 2020). As a result, companies now prioritise shifting to e-commerce mobile platforms and changing their websites accordingly (Sarkar et al., 2020). In addition to streamlining the shopping process, the emergence of mobile commerce websites has improved it by allowing customers to browse numerous stores, learn more about products, and make purchases whenever and wherever they like (Mehedintu and Soava, 2022). Commercial websites' and applications' quality needs to be guaranteed from the user's point of view, including the content, search, and navigation, to increase their credibility (Brush and Rappel, 2020). These websites and applications benefit users while also considering their ongoing improvement by increasing internet speed, expanding 5G and Wi-Fi networks, and increasing accessibility and trust in mobile devices and applications (Varzaru and Bocean, 2021). The foundational requirement for commercial applications must also be the starting point for developing successful mobile commerce websites (Varzaru and Bocean, 2021).

According to several researchers, system quality significantly affects consumers' intentions to use mobile commerce (Wang and Choi, 2022;; Kang et al., 2021; Tseng et al., 2021; Ghazali et al., 2018). Additionally, studies (Ivanova and Noh, 2022; Al-Naimat et al., 2020; Hossain et al., 2020; Dongmo et al., 2020; Ali andd Ju 2019; Alqatan and Alshirah, 2019;) showed that system quality strongly affects the intention to use of mobile commerce. For instance, Ali and Ju (2019) found that system quality is one of the primary factors influencing system use. They also found that service quality has a substantial impact on system use. Similarly, Al-Naimat et al. (2020) investigated the factors influencing the use of mobile commerce among Jordanian customers, and their findings suggested that system quality has a substantial impact on mobile commerce intention. They also discovered that system quality among Jordanian tourists is one of the most crucial factors influencing whether they use mobile commerce. Barry et al. (2024a) found that system quality significantly impacts the intention to use mobile commerce. Likewise, Gai et al. (2024) found that system quality significantly impacts repurchase intention of online shopping platforms through customers satisfaction. Additionally, Ng et al. (2024) found that

system quality, directly and indirectly, impacts continuance of intention to use mobile shopping apps through satisfaction. These findings support that of Barry et al. (2024b).

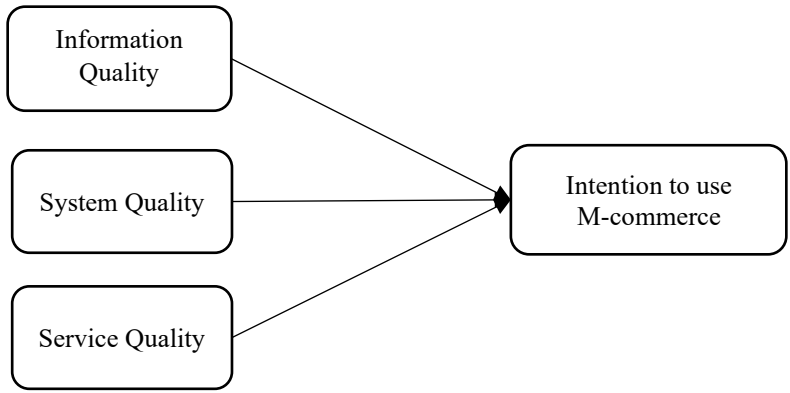
2.5 SERVICE QUALITY

Service quality refers to the extent to which a service meets the customer requirements or anticipations. It refers to the disparity between the level of service the client anticipates and the customer experience (Gai et al., 2024). Organizations have begun to prioritise service quality more heavily in today's customer-focused business environments (Blut, 2016). Zhao et al. (2012) assert that the quality of service customers receive influences their perception of a company. Their decision to make purchases will continue to be influenced by this in terms of frequency. However, to understand and enhance service quality, its components must be measured and identified (Blut, 2016). Customers frequently check the quality of a product before buying it. On occasion, consumers examine both price and quality before making a purchase. Customers look for quality to improve the products' longevity and safety (Abdullah, Prabhu, and Othman, 2022). According to Abdullah et al. (2022), managers must find ways to modernize or improve their service facilities and offer excellent or high-quality customer services if they want to maintain their competitive advantage in the highly competitive market economy. This is because the quality of the products and services customers receive determines whether they will make additional purchases.

Therefore, in this study, the researcher concurs that service quality in mobile commerce refers to the quality of the support provided to mobile commerce users by the technical staff of the mobile commerce provider, which will positively affect user satisfaction and use of mobile commerce. Ivanova and Noh (2022); Li et al. (2022); Al-Naimat et al. (2020); Wang and Teo (2020); Dongmo et al. (2020); Hossain et al. (2020), among others, found that service quality strongly affects actual use of m-commerce. According to researchers, service quality significantly affects consumers' intentions to use mobile commerce (Tseng et al. in 2021; Tseng et al. in 2021; Jain et al. in 2021; Wang et al. in 2019). For instance, a study conducted by Al-Naimat et al. (2020) revealed that service quality influences the intention of mobile commerce users in a positive way. Similarly, Barry et al. (2024a) found that system quality significantly impacts the intention to use mobile commerce.

Wang and Teo (2020) showed that service quality significantly impacts mobile commerce adoption among Chinese internet shoppers. According to Dongmo et al. (2020), service quality significantly impacts how well-liked mobile commerce is. According to Hossain et al. (2020), service excellence influences the adoption of mobile commerce in a favorable way. Lin et al. (2024) found that service quality significantly influences purchase intention. This finding supports that of Barry et al. (2024b). Similarly, Al-Naimi and Abu-Shanab (2024) found that service quality predicts the intention to use mobile banking apps firmly. Siyal et al. (2024) significantly found service quality to predict intention through customisation.

FIGURE 1
Conceptual Framework



3. THEORETICAL UNDERPINNINGS

3.1 INFORMATION SYSTEM SUCCESS MODEL

Several theories have been proposed to comprehend consumers' intention to use information system technology. However, DeLone and McLean (1992) proposed the information system success model, commonly known as the IS success model. This model was developed to assess the effectiveness of information systems (IS). The paradigm introduces six key constructs: individual impact, organizational impact, system quality, information quality, use, and user satisfaction. The model has received widespread acceptance and has been chosen as an adequate foundation for additional theoretical and empirical studies (DeLone and McLean, 1992). The concept,

however, is widely acknowledged and utilised in IS studies (Cho et al., 2011). Numerous research studies on mobile commerce employed the IS success model (Ivanova and Noh, 2022; Nani and Lina, 2022; Yoo, 2020; Al-Naimat et al., 2020; Ali and Ju, 2019; Njanga et al., 2016).

Therefore, this study attempts to study the relationships among factors such as service quality, system quality, and intention to use mobile commerce. However, this study proposed a research framework based on the updated information system success model (ISSM) theory to achieve this objective. Hence, the theoretical background of this study is the up dated information system success model theory (ISSM). The variables of this study were chosen after reviewing previous studies on the updated information system success model theory.

4. RESEARCH METHODOLOGY

Since this study is qualitative, it is advised that researchers should conduct an empirical study to examine the determinants of consumers' intention to use mobile commerce in Malaysia. The target population should be smartphone owners who engage in mobile commerce activities in Malaysia (Barry et al., 2024c). Non-probability convenience sampling technique should be used to collect data from the target respondents (Di Franco, 2024; Naseri et al., 2024; Akkaş and Meydan, 2024), as it is the best sampling technique and most widely used to collect data from the target respondents (Nyimbili and Nyimbili, 2024; Nasir et al., 2024; Michelucci, 2024). As a non-probability sampling technique, convenience sampling refers to choosing units for the sample based on the most convenient for the researcher to reach (Akkaş and Meydan, 2024). The researcher should administer Online survey questionnaires as it will be easier for the target respondents to open the link provided and answer the questions at their convenience (Khan, 2024; Ceccato et al., 2024; Barry, Barrie, and Kuyateh, 2024). The researcher should evaluate the instrument's validity to perform data analysis techniques such as regression, factor analysis, or other data analysis techniques. Finally, the causal relationships should be examined to see how the suggested variables affect mobile commerce users' intention to use mobile commerce activities in Malaysia.

5. PRACTICAL IMPLICATIONS

The present study is carried out to advance knowledge for scholars and professionals interested in mobile commerce, particularly in Malaysia. This study may be the first to address the relevant challenges of mobile commerce in Malaysia. This attempt may significantly advance our knowledge of how information, service, and system quality impact on Malaysian consumers' intention to use mobile commerce. The primary gap in the literature in the relevant field that this study was first able to identify was the impact of information quality, service quality, and system quality on the intention to use mobile commerce can be summed up by proposing a conceptual model based on a solid theoretical underpinning. The researcher achieves this by employing the information system success model (ISSM).

Businesses should build user-friendly applications or websites that regularly update information about their goods and services. Designers must also ensure that mobile commerce applications can assist and serve clients effectively and efficiently without flaws or faults. By putting forth a conceptual model built on a solid theoretical foundation, this may be summed up as increasing the level of adoption of mobile commerce among potential customers (Yoo, 2023; Lucas et al., 2023; Tarhini et al., 2019; Lai and Lai, 2014). Designers should focus more on maintaining mobile commerce services and growing the commercial activities established by using these applications or websites (Lucas et al., 2023; Yadav et al., 2016; Zhou et al., 2010).

Hence, marketers need to spread the notion that using mobile commerce is a natural extension of using other mobile applications such as social media or phone calls on smartphones. Regarding information quality, system quality, and service quality, a cutting-edge, high-quality interface created to meet users' preferences will enhance all areas of information quality, system quality, and service quality to increase mobile commerce uptake in Malaysia. Additionally, the data accessible through mobile commerce needs to be complete, accurate, and often updated. Initially, banks must focus on offering self-service technology channels compatible with other widely used technologies by customers while persuading them that using these channels is not significantly different from using other technologies (Mansour et al., 2016; Kuriakose and Paul, 2016; Koenig-Lewis et al., 2010).

6. CONCLUSIONS

Concerning how mobile commerce users perceive mobile commerce, it is clear from the thorough analysis of the literature that elements to consider consist of information quality, service quality, and system quality. As a significant contribution to the field, the current work conceptualized several crucial aspects and suggested a model for additional research and empirical testing. This paper emphasizes explicitly the determinants of intention to use mobile commerce to help mobile commerce providers address or ensure the quality of their information, systems, and services that will further increase mobile commerce usage. Customer intention to use mobile commerce, however, should be adequately scrutinized, considering information quality, system quality, and service quality concerns, as this may have a significant impact on their acceptance of mobile commerce.

It is crucial to note that this study has several limitations, mainly the methodology employed to develop it because it is conceptual and might not offer an empirical justification for its assertions. This paper does not cover other variables such as usefulness, ease of use, privacy, security, cost, or perceived trust that could also impact consumer intention to use mobile commerce. Other elements may also impact consumers' intention to use mobile commerce, such as religious or cultural issues. To improve mobile commerce, providers should promote and expand a positive intention among consumers to use mobile commerce in Malaysia. This paper calls for a more quantitative and empirical approach that can incorporate other constructs such as consumers' attitudes, their actual use of mobile commerce, and, more critically, the trust, privacy, and security issues that might be included in future studies to determine whether this might improve consumers intention to use mobile commerce in Malaysia. Future studies may also consider the proposed model of the present study for a different context or conduct a comparative study to determine the impact of information quality, system quality, and service quality on the intention to use mobile commerce among consumers. Since this paper is conceptual and necessitates empirical investigation to validate the proposed model of this study, additional research is advised.

Future researchers who intend to use the model described in this paper and start empirical testing should adhere to a few key steps. First, data from smartphone users who perform mobile commerce transactions of all ages should be collected online or

offline. Second, additional caution should be taken since the study primarily focuses on mobile commerce users. The researcher should also review the data for missing data, outliers, and normalcy to prepare it for further study. Reliability analysis should be carried out to examine the scale's consistency, and then exploratory factor analysis (EFA) should be employed to determine how many dimensions underlie the data. The researcher might compare the proposed and investigated dimensions at this step. Third, confirmatory factor analysis (CFA) should be used to verify the studied dimensions. The researcher can evaluate the instrument's validity at this point. Finally, the causal relationships may be examined to see how the suggested variables affect mobile commerce users' intention to use mobile commerce in Malaysia.

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THE CAUSALITY RELATIONSHIP BETWEEN EXCHANGE RATE PROTECTED DEPOSITS AND INVESTMENT INSTRUMENTS: EVIDENCE FROM TÜRKİYE

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ABSTRACT

This paper examines the causality relationship and the sign and magnitude of the relationship between the Exchange Rate Protected Deposit (ERPD) application, which was introduced to prevent the negative trend in exchange rates in Türkiye, and the stock market, exchange rate, and interest rate, which are considered as alternative investment instruments. ISE100 index closing prices, USD and EUR prices, weighted average deposit interest rate, and weekly data for the period 18.02.2022-17.11.2023 were used as the data set. Toda-Yamamoto causality, impulse-response, and variance decomposition analysis were applied. It is determined that the application of the ERPD affects alternative investment instruments and it is affected by them. In addition, it has been determined that the order of magnitude affecting the ERPD is as follows: euro prices, deposit interest rate, stock market index, money supply, and dollar prices. It was determined that the ERPD negatively affected the stock market and deposit interest rates. However, it was concluded that the ERPD application could not achieve the target of decreasing the euro and dollar prices. This paper will contribute to the literature, and it is thought that the results will be useful for policymakers, investors, and similar financial actors who wish to learn about ERPD.

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1. INTRODUCTION

Many countries adopt inflation targeting as a national policy. Under inflation targeting, the central bank announces quantitative targets for inflation and states that controlling inflation is a long-term objective of monetary policy. In cases where the monetary policy target cannot be achieved, policies are put forward to bring inflation back to the target. In addition, inflation-targeting central banks often adopt a more transparent policy that requires detailed communication with the public (Dotsey, 2006). Individual and institutional investors include foreign currencies to hedge-against inflation. Determining the demand for foreign currencies is important in determining economic and financial policies. In countries such as Türkiye, where the inflation rate and the demand for foreign currency are high, confidence in the domestic currency should be ensured to reduce inflation to the desired levels. In parallel with the global and national problems, however, Türkiye has experienced unpredictable fluctuations and increases in exchange rates. As stated in Kholdy and Sohrabian (1990), Leigh and Rossi (2002), Işık et al. (2004), McCarthy (2007), Peker and Görmüş (2008), Akgül and Özdemir (2018), Agustina and Permadi (2023), Gür (2022), Bilgin (2023), Çabaş (2023), Çitçi and Kaya (2023), Sözen, Şeyranlıoğlu, and İspiroğlu (2024), there has been an increase in inflation rates due to the rise in exchange rates.

The 1990s are remembered as a period when fixed exchange rate regimes largely lost the importance of maintaining monetary policy. As one of the consequences of the financial crisis, many developing countries were forced to abandon fixed exchange rate regimes and replace them with more flexible exchange rate arrangements. Moreover, some countries did not have to abandon fixed exchange rates as a result of financial crises or market pressures on their currencies but started to adopt more flexible exchange rate regimes regularly (Jonas and Mishkin, 2003).

After the 2001 crisis, Türkiye completely switched to a flexible exchange rate regime. Over time, a stable period in exchange rates occurred as financial market participants adapted to the flexible exchange rate regime. However, Türkiye experienced a currency crisis in 2018 due to the Gezi Park events in May 2013, the treacherous coup

attempts on July 15, 2016, and the arrest of Pastor Brunson in December 2016. In 2018, the Turkish Lira lost 29% of its value against the dollar as the United States of America and the European Union made sanctions rhetoric against Türkiye. In July 2018, inflationary pressures and exchange rate increases continued to rise as inflation rates did not fall from double digits following the currency shock. The New Economic Program was announced in Türkiye, which lost economic momentum due to the impact of exchange rate attacks in 2019, when the growth rate in the global economy slowed down. In 2019, the Turkish Lira lost its value by 12% against the dollar, and its effects were also felt with the increase in the inflation rate. In 2019, in parallel with the policy rate cuts by the US and European Central Banks, Türkiye started to cut interest rates in the second half of the year, and the policy rate fell to 12% in December 2019. The year 2019 ended with the COVID-19 pandemic, which emerged in China and affected the world.

In 2020, when the global economy went through a difficult time due to the COVID-19 pandemic, the Turkish economy was also negatively affected. Until June 2020, when the foreign exchange market experienced a historic rise, the policy rate was continuously reduced. In November, there was a change in the economic administration with the appointment of Lütfi ELVAN as the Minister of Treasury, and in 2020, the Turkish lira lost its value by 23% against the dollar, and annual inflation was at 14.6%. The COVID-19 pandemic and the preventive measures taken to keep the economy afloat continued in 2021. The policy rate, which was 17% in January 2021, was raised to 19% before the dismissal of CBRT Governor Naci AĞBAL in March and then gradually reduced to 14% until December. On December 2, 2021, Nurettin NEBATİ became the Minister of Treasury and Finance. On December 20, 2021, the US dollar hit a record high of TRY 18.36 and fell sharply to TRY 12 on December 21. On the same day, the new economic administration introduced the exchange rate protected deposit (ERPD) system to prevent the exchange rate increase. The US dollar ended 2021 trading at 13.3 TRY.

According to data from the Ministry of Treasury and Finance, the ERPD, which was launched to reduce the share of foreign currency deposits in total deposits, cost the budget 92.5 billion TL in 2022, when Türkiye's primary agenda was the economy. Despite the ERPD, the Turkish lira depreciated by more than 30% against the dollar in 2022, and annual inflation rose to 64%. The new economic administration started to raise interest rates to control inflation after

the post-election appointment of Mehmet ŞİMŞEK as the Minister of Treasury and Finance and Hafize Gaye ERKAN as the first female Governor of the CBRT on June 4, 2023. In June 2021, the policy rate, which had not been raised since March 2021, was raised to 15% for the first time and then gradually increased to 42.5% until the end of 2023. The ISE 100 Index surpassed 8500 points in October, reaching a historic high, as the new appointments to the economic administration were welcomed by the markets. Despite the positive views of international financial institutions on the Turkish economy, the Turkish lira depreciated by 30% against the dollar in 2023, and annual inflation rose to 64%, similar to 2022. As of the end of 2021, when the ERPD started, the amount of residents' foreign currency deposits continued to increase, although the annual rate of increase in the amount of foreign currency deposits decreased every year.

As of December 21, 2021, a new instrument was included in the financial markets to protect investors and ensure that they can earn returns against fluctuations and increases in exchange rates. This instrument, called ERPD, was applied for individual or institutional investors who have their savings in foreign currency deposit accounts and participation fund accounts denominated in foreign currency to voluntarily convert their savings into Turkish Lira. The bank where the investors make the transaction transmits the foreign currency to the CBRT at the conversion rate. The CBRT, in turn, transfers the equivalent amount to the bank in Turkish Lira. The bank in question opens a Turkish Lira or participation account with a maturity of 3 months, 6 months, or 1 year. The interest rate that the bank applies to the deposit account must not be below the one-week repo auction interest rate. In addition, if the return to be transferred to participation accounts is lower than the cost of one-week repo transactions that participation banks perform with the CBRT under open market transactions, the difference must be covered by the bank. At maturity, the principal and interest or dividends to be transferred to the Turkish Lira or participation account are paid by the bank. There is a possibility that the exchange rate at maturity may be higher than the conversion rate, or the interest or dividend to be transferred by the bank may be less than the amount calculated on the exchange rate difference. If these possibilities occur, the CBRT transfers the amount calculated on the exchange rate difference, less interest or dividends, to the bank to be paid to the investor holding a deposit or participation account (CBRT, 2021).

The main problem of the current study is to determine the sign and magnitude of the causal relationships between the KKM

application, which individual and institutional investors benefit from as of 2022, and alternative investment instruments. In this context, it is aimed to find a solution to which alternative investment instruments ERPD, which is a new application for Turkish financial markets, may be affected, and which investment instruments it may affect. The fact that no similar study is found in the literature specifically for Türkiye and the increasing demand for ERPD, in which investors earn returns from both interest and exchange rate differences, constitutes the motivation for the paper. Studies on ERPD, a new application, have been published recently. It is thought that the results obtained will contribute to future studies aimed at filling the gap in the literature in the field of alternative investment instruments.

2. LITERATURE REVIEW

This section provides a detailed review of prior literature on ERPD.

Ceylan (2024) aimed to reveal the nature of the long-run equilibrium relationships between exchange rates and price indices. The deterioration of the long-run equilibrium relationship between producer prices and the dollar exchange rate was attributed to the ERPD implementation. Akkaya (2023) analyzed the macroeconomic and financial variables affecting the dollarization process in the Turkish economy by excluding the year 2022, the year in which the Exchange Rate Protected Deposit system was introduced. Similar to the current paper, he concluded that the real exchange rate and the US Dollar/Turkish Lira exchange rate variables also affect the dollarization process in the Turkish economy. Arslan (2023) aimed to investigate the effects of ERPD on the Turkish economy. The findings indicated that the level of savings in the national currency increased with ERPD implementation. Karagöl (2023) examined the drivers of cash substitution in Türkiye after the Global Financial Crisis by using a dummy variable for the ERPD period in addition to exchange rate expectations, inflation rate, and domestic foreign interest rate differential variables. The findings suggested that exchange rate expectations are a determinant of cash substitution. Reductions in the interest rate spread lead to an increase in cash substitution. It was determined that ERPD implementation leads to a high rate of decrease in cash substitution. Sarıgül (2023) examined the relationship between dollarization and profitability in publicly owned deposit banks in Türkiye. In this study, which uses the data of Halkbank, Vakıfbank, and Ziraat Bank for the period 2005-2021, three dollarization-related variables, namely deposit dollarization, on-balance sheet currency

mismatch, and foreign currency derivatives, were used together for the first time in the literature. The findings showed that these variables have an impact on profitability in publicly-owned deposit banks. Yıldırım et al. (2023) analyzed the effects of credit volume, stock market trading volume, and ERPD system on the financial deepening of the Turkish economy for the period considered in their study. The financial deepening ratio was at its lowest level at the end of the analysis period when the ERPD system was announced. It was stated that the financial deepening ratio improved and increased with ERPD implementation. Despite the success of the ERPD system, it was concluded that rational policies are needed to strengthen financial deepening. Yurttadur and Taşçı (2023) aimed to measure the effect of ERPD implementation on the financial performance of participation banks. The financial performance evaluation of participation banks was made with Total Dividend Income, Return on Assets, Return on Equity, Operating Expenses/Total Assets, and Foreign Resources/Total Equity indicators. Findings revealed that the indicator with the highest weight in determining the financial performance of participation banks is Operating Expenses/Total Assets. It was indicated that the financial performance of participation banks increased with the ERPD implementation, and the performance increased continuously in 2022, with the best performance in September. Zuhal and Göcen (2023) analyzed the effectiveness of ERPD accounts on exchange rates in their study. The implementation of the ERPD account was found to have led to a significant break in the euro and the US dollar as of the date of implementation. In addition, it was indicated that this implementation was effective in reducing exchange rate volatility. In his study, Alpdoğan (2022) mentioned that ERPD accounts issued to stabilize the exchange rate had a negative impact on the economy during the period when the effects of the exchange rate crisis continued. Yılmaz (2022) analyzed the short-term (3 months) effects of ERPD on the Turkish economy. For the period under consideration, it was indicated that the cost of ERPD decreased as the depreciation of the exchange rate decreased. It was also concluded that the ERPD policy reduced exchange rates, increased the Central Bank's foreign exchange reserves, reduced dollarization, and supported the liberalization process.

After the literature review on ERPD, the literature review on exchange rates, interest rates, and ISE 100, which are the other variables used in the study, is presented.

Demiralp and Belliler (2023) found a long-run relationship between the interest rate and the ISE 100 index. Kazak (2023) stated

that the ISE 100 index affects the policy rate. Canöz and Yiğit (2022) revealed a causal relationship from the dollar exchange rate to the ISE100 index. Petek, Doğaner, and Altun (2022) found unidirectional causality from real effective exchange rate decreases to ISE 100 increases and from policy rate increases to ISE 100 decreases. Tekin and Görmüş (2022) showed that interest rates and exchange rates have a negative effect on the ISE100 index. Bezgin and Karaçayır (2021) found that the exchange rate has a negative effect on the Istanbul Stock Exchange index, while the interest rate has a positive effect. Makhdom (2021) found a positive relationship between exchange rates and interest rates in the long run. Şanlı, Konak, and Özmen (2021) stated that there is a bidirectional causality relationship between the ISE 100 index, exchange rate, and interest rate. Alıcı (2020) found that there is a causality relationship between the dollar exchange rate and the ISE 100 index. Fattah and Kocabıyık (2020) found bidirectional causality between the exchange rate and the ISE 100 index for Türkiye. He et al. (2020) found a causality from the Turkish stock market to exchange rates. Saka Ilgın and Sarı (2020) stated that an increase in interest rates in the short and long run leads to a decline in the ISE All index. Güney and Saka Ilgın (2019) found bidirectional causality between interest rates and ISE 100 and unidirectional causality between foreign exchange and ISE 100. Uzunel and Güven (2019) found a negative long-run relationship between the ISE 100 index and the real effective exchange rate. Zarei, Ariff, and Bhatti (2019) stated in their paper that the exchange rate affects stock index returns in selected countries. Khan and Khan (2018) showed that the stock market is affected by exchange rates and interest rates in the long run. Koyuncu (2018) concluded that interest rates have a negative effect on ISE100. Budak, Cangi, and Tuna (2017) found that there is a relationship between the ISE 100 index and foreign exchange and interest rate, and PPI in the long run. Khalid (2017) found a unidirectional causality from the exchange rate to the interest rate. Altınbaş, Kutay, and Akkaya (2015) concluded that the exchange rate has explanatory power on ISE 100. Şentürk and Dücan (2014) found a unidirectional causality relationship from exchange rate to stock market return and from interest rate to exchange rate. Vejzagic and Zarafat (2013) concluded that the stock market index affects the interest rate and exchange rate. Beer (2008) showed that there are positive and significant price spillovers from the foreign exchange market to the stock market.

The next section of the paper is the data and methodology section, which describes the data set, explains the empirical

procedures, and presents the findings. The conclusion and discussion section provides conclusions and suggestions based on the empirical findings.

3. DATA AND METHODOLOGY

The paper aims to examine the reciprocal causality relationship between the amount of currency rate protected deposits and the stock market, interest rate, dollar, euro selling price, and money supply in line with the currency rate protected deposit practice implemented in the Turkish banking sector in recent years. The paper uses weekly data including 92 observations for the period 18.02.2022-17.11.2023. An attempt was made to obtain a sufficient number of datasets using weekly data instead of monthly or quarterly data since the currency rate protected deposit application is a new practice in recent years and this data has been published weekly since 2022. The weekly amount of currency rate protected Turkish Lira deposits in the banking sector, the weekly closing prices of the ISE100 index, the weighted average interest rate applied to deposits opened by banks (current up to 3 months), the dollar selling price, and the euro selling price. The M2 money supply is the control variable of the model. All variables are logarithmically transformed. Table 1 presents the variables and data sources used in the paper. EViews 10.0 package program was used for the analysis.

TABLE 1
Variables and Data Sources

Variable Abbreviation	Description	Data Source
LERPD	Amount of Currency Rate Protected Turkish Lira Deposits	CBRT –EDDS
LISE100	Istanbul Stock Exchange 100 Index Closing Prices	BRSA
LDINTR	Weighted Average Deposit Interest Rate	CBRT –EDDS
LUSDTL	Dollar Price (USD/TRY)	CBRT –EDDS
LEURTL	Euro Price (EUR/TRY)	CBRT –EDDS
LM2	Money Supply	CBRT –EDDS

Note: CBRT, Central Bank of the Republic of Türkiye; EDDS, Electronic Data Distribution System; BRSA, Banking Regulation and Supervision Agency

Figures 1-6 show the time-dependent oscillation graphs of the variables.

FIGURE 1
Time-Dependent Oscillation Graph of LERPD

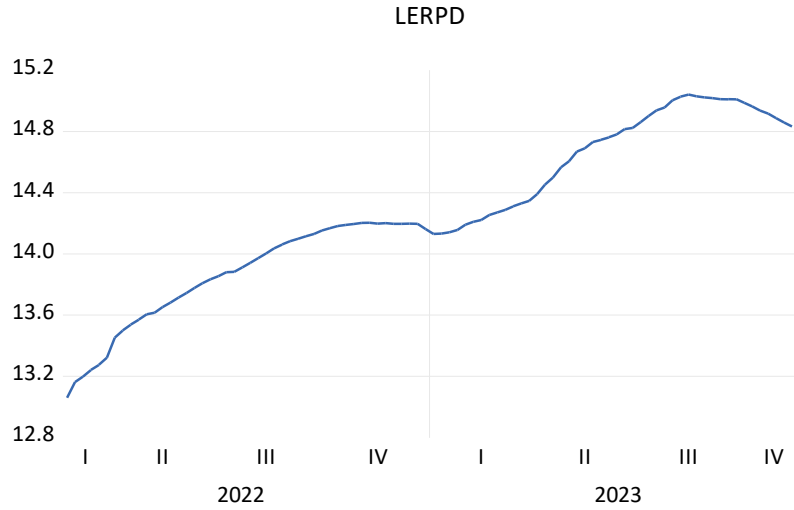


FIGURE 2
Time-Dependent Oscillation Graph of LISE100

FIGURE 3
Time-Dependent Oscillation Graph of LDINTR

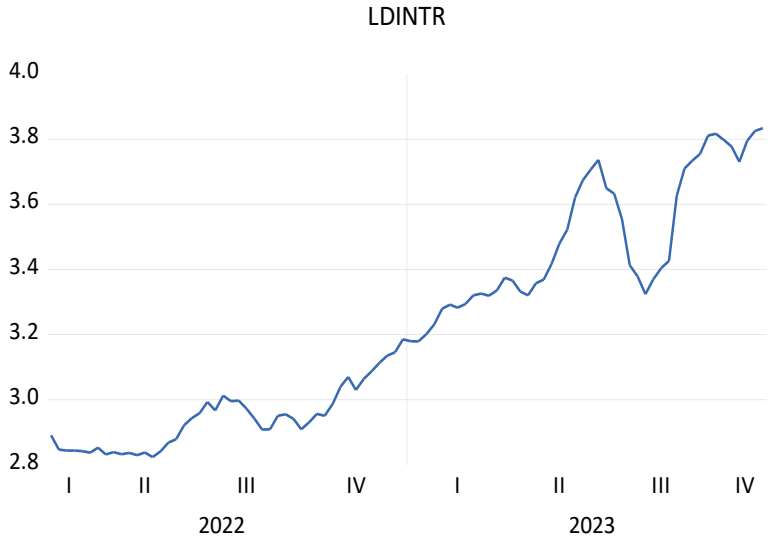


FIGURE 4
Time-Dependent Oscillation Graph of LUSDTL

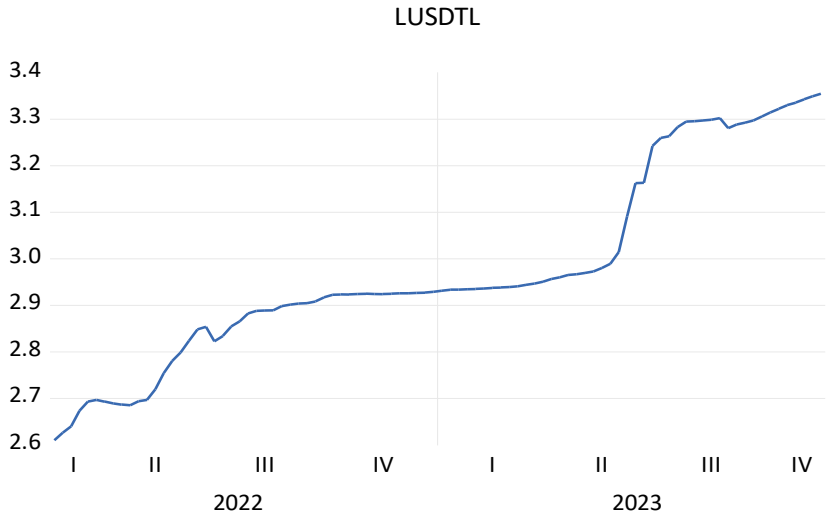


FIGURE 5
Time-Dependent Oscillation Graph of LEURTL

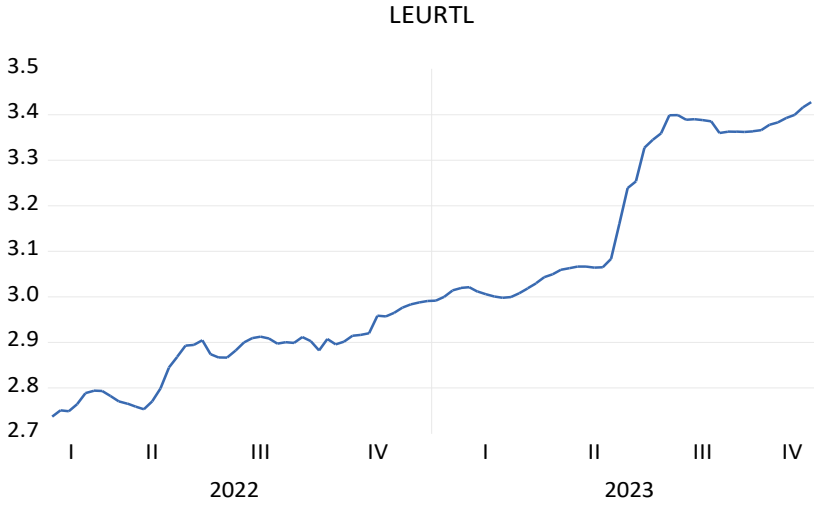
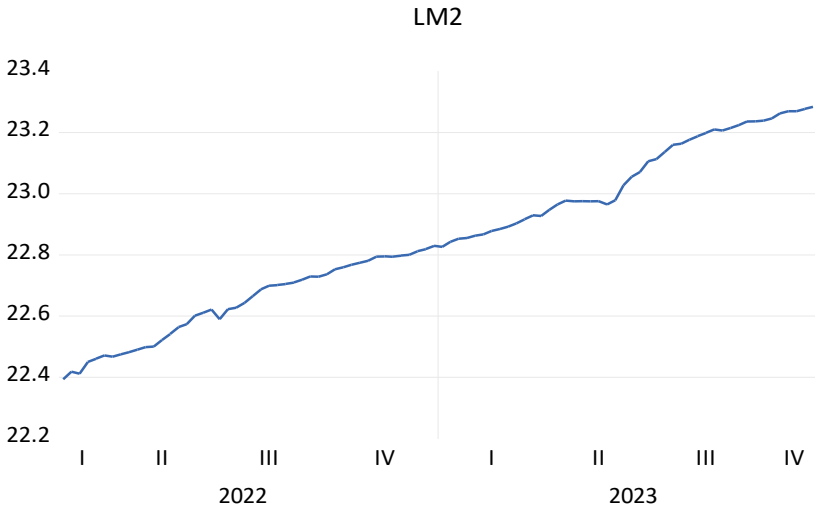


FIGURE 6
Time-Dependent Oscillation Graph of LM2



According to Figures 1-6, it can be stated that the series contains a trend, and although they fluctuate from time to time during the period under review, they are generally on an upward trend.

Equation (1) is the model established in line with the purpose of the paper is given below:

$$(1) \qquad LERPD = a_0 + a_1 LISE + a_2 LDINTR + a_3 LUSDTL + a_4 LEURTL + a_5 LM2 + \varepsilon_t$$

The stationarity of the variables in the model established in the paper was examined first. Since variables with different degrees of stationarity are considered, and one of the variables in the model is stationary in the second difference, it was decided that the methodology of the paper should be VAR (Vector Autoregressive) analysis, the Toda-Yamamoto causality test, impulse-response, and variance decomposition analysis.

Various methods such as the Granger and Toda-Yamamoto causality test are used to determine the causality relationship. One of these methods is the VAR model developed by Granger (1969). However, to eliminate spurious regression in the Granger causality test, the variables to be analyzed must be stationary. By taking the difference of the variables. Stationarity reveals the lack of information in explaining causality. Again, if the variables reach the same level of stationarity in the Granger causality test, the cointegration relationship between the variables should also be investigated. If there is a cointegration relationship, the Vector Error Correction Model can be used. If there is no cointegration between the variables, the Vector Error Correction Model becomes invalid. In the causality test developed by Toda and Yamamoto (1995), causality analysis can be performed without these conditions.

Classical Granger causality analysis is applied in most of the academic studies examining the causality relationships between time series. While investigating the causality relationship between time series with the classical Granger causality test, the prerequisite is that the series is stationary and there is a cointegration relationship. The Toda Yamamoto test does not take into account whether the series is stationary or not, and whether there is a cointegration relationship between them or not. In the Toda-Yamamoto causality test, the fact that the time series is stationary at the same level or that there is a cointegration relationship does not invalidate the test. In the Granger causality test, if the series is stationary by taking the difference of the series, data loss occurs, but the fact that this test prevents data loss is

an important advantage of the Toda-Yamamoto test (Toda and Yamamoto, 1995).

The VAR (Vector Auto Regression) model must first be established and the appropriate lag length (k) of the model must be determined to apply the Toda-Yamamoto test. Then, the maximum degree of integration (d_{max}) of the model is found and added to the lag length. Although stationarity is not a prerequisite for the Toda-Yamamoto test, unit root tests are applied to determine the maximum cointegration degree of the model. Here, the necessary condition of the analysis is that d_{max} is not greater than k. In the next step of the analysis, the VAR ($k + d_{max}$) model is estimated. The Wald test is applied to the VAR(k) model to determine causality.

Toda and Yamamoto (1995) developed the Granger causality test by estimating a system of two equations using the Seemingly Unrelated Regression (SUR) technique. The model is expressed as follows:

$$(2) \quad Y_t = \alpha_1 + \sum_{i=0}^{k+d} \gamma_{1i} Y_{t-i} + \sum_{t-i}^{k+d} \gamma_{2i} X_{t-i} + \varepsilon_{yt}$$

$$(3) \quad X_t = \alpha_2 + \sum_{i=0}^{k+d} \delta_{1i} Y_{t-i} + \sum_{t-i}^{k+d} \delta_{2i} X_{t-i} + \varepsilon_{xt}$$

Where k is the optimal lag length, d is the maximum degree of integration, and ε_{xt} are the error terms. The hypotheses of the Wald test applied to determine the direction of causality are defined as follows.

If $\gamma_{2i} \neq 0$ in (2), X_t is the Granger cause of Y_t.
If $\delta_{2i} \neq 0$ in (3), Y_t is the Granger cause of X_t.

In this model, the test statistic value is tested with the Wald test with chi-square distribution (Alimi and Ofonyelu, 2013).

There is no restriction on structural models in the VAR analysis. All variables are examined as a system. Each variable is assumed to be endogenous in the model, and the values up to the lag length of both dependent and independent variables are included in the analysis (Kirchgässner, Wolters, and Hassler, 2012). In the VAR model, the responses of variables to sudden shocks are tested through the impulse response function. Impulse response functions indicate how one of the variables will react to this shock in the face of a 1% deviation in the error term. The variance decomposition obtained from the moving average section of the VAR model expresses the sources of shocks occurring in the variables and other variables as percentages.

It shows what percentage of the change will happen in the variables used is due to itself and what percentage is due to different variables. If the majority of the changes occurring in a variable are due to shocks by itself, it shows that this variable acts exogenously. Variance decomposition also provides information about the degree of causality between variables (Enders, 2008).

4. FINDINGS

The first step of the Toda-Yamamoto test for the examined models is the unit root test was first applied to the variables, and the stationarity degrees of the variables were examined to determine the maximum cointegration degrees of the variables. Table 2 presents the results of the ADF unit root test.

TABLE 2
Unit Root Test Results

Variables	ADF Unit Root Test (Trend and Constant)					
	$t_{ist-level}$	p-value	$t_{ist-1st.difference}$	p-value	$t_{ist-2nd difference}$	p-value
LERPD	-1.8	0.69	-2.9	0.15	-14.7	0.00
LISE100	-1.7	0.70	-9.0	0.00		
LDINTR	-2.4	0.33	-6.6	0.00		
LUSDTL	-2.4	0.36	-5.9	0.00		
LEURTL	-1.9	0.60	-5.9	0.00		
LM2	-1.9	0.62	-3.0	0.00		

Table 2 shows that the LERPD variable becomes stationary when the second difference of the series is taken, while the LISE100, LDINTR, LUSDTL, LEURTL, and LM2 variables, which are considered as dependent variables in the models, become stationary when the first differences of the series are taken. Therefore, the LERPD series is I(2), while the LISE100, LDINTR, LUSDTL, LEURTL, and LM2 series are I(1). In this case, it is determined that the maximum degree of cointegration (d_{max}) to be used when applying the Toda-Yamamoto test is 2 for the model ((d_{max}) = 2).

The second step in the Toda-Yamamoto test is to determine the optimal lag length (k) for the VAR (Vector Autoregression) model. Table 3 shows the optimal lag length for the VAR model according to various information criteria. While determining the lag length, the diagnostic tests of the model at the relevant lag were also taken into

account. These tests are the graphs shown in Figure 7, which represent the Inverse Roots of the AR Characteristic Polynomials of the model, and the Autocorrelation LM Test and White Heteroscedasticity tests shown in Table 4.

TABLE 3
Optimal Lag Length of the VAR Model

Lag	LogL	LR	FPE	AIC	SC	HQ
2	1099.47	65.83*	1.10e-1*	-24.86*	-23.27	-24.22*

Notes: LR: Sequential Modified LR Test, FPE: Final Estimation Error, AIC: Akaike Information Criterion, SIC: Schwarz Information Criterion, and HQ: Hannan-Quinn Information Criteria. *It indicates that the lag specified according to the relevant information criterion is the optimal lag length.

FIGURE 7
Inverse Roots of the AR Characteristic Polynomial of the VAR(2) Model

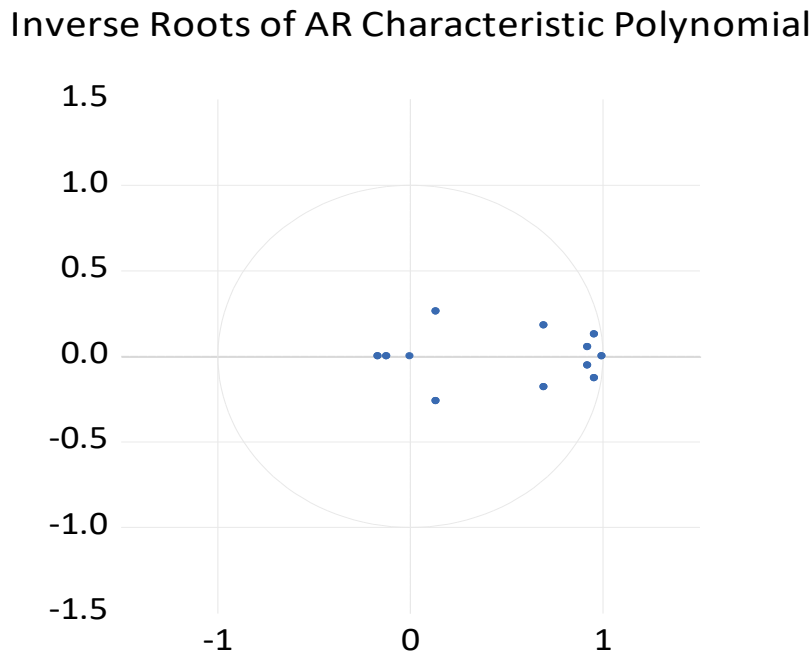


Table 3 shows that the optimal lag lengths obtained according to various information criteria are 2 for the model (k=2). The lag

length of the model is supported by various diagnostic tests in Figure 7 and Table 4. Figure 7 shows the inverse roots of the AR characteristic polynomial for the model constructed according to the specified lag lengths, while Table 4 reports the autocorrelation and Table 5 reports the heteroscedasticity test results.

TABLE 4
LM Autocorrelation Test Results

Lag (k)	LM Test Statistic	p-value
2	30.90153	0.7110

TABLE 5
White Heteroscedasticity Test Results

Lag (k)	White Test Statistic	p-value
2	560.8465	0.0602

The result obtained in Figure 7 shows that the inverse roots of the AR polynomial of the variables are within the unit circle for the model when the specified lag lengths are taken into account. The results in Tables 4 and 5 indicate that the p-values of the LM and White Test Statistic, which have the opposite hypothesis, are greater than 0.05, therefore, the model constructed according to the appropriate lag lengths does not have autocorrelation and heteroscedasticity problems.

In the third stage of the analysis, the optimal lag lengths (k) obtained from the classical VAR analysis were added to the maximum degree of integration (d_{max}) obtained from the unit root tests to construct ($k+ d_{max}$) lagged improved VAR model. In the last stage, the causality relationship between the variables was analyzed by applying the Wald test statistic to the k-lagged values in the VAR ($k+ d_{max}$) model. The results of the Toda-Yamamoto Causality Analysis, showing the Wald test statistic results, are presented in Table 6.

According to the Toda-Yamamato causality analysis results in Table 6, for the VAR(4) model, there is a unidirectional causality from ISE100 to ERPD; there are bidirectional causalities between ERPD and all of the other variables in the model. The findings indicate that the ERPD implementation in Türkiye is affected by all of the variables in the model as the Istanbul Stock Exchange 100 index, deposit interest rate, dollar, euro selling prices, and the money supply. At the same time, it is concluded that the amount of currency rate protected

deposits also affects all of the variables in the model except the Istanbul Stock Exchange 100 index.

TABLE 6
Toda-Yamamoto Causality Analysis Results

Model VAR(k+ d_{max})=VAR(4)	Wald Test Chi-square Statistic [p-value]
ISE100-ERPD	12.92389 [0.001561]
ERPD-ISE100	3.321374 [0.190013]
DINTR-ERPD	13.75856 [0.001028]
ERPD-DINTR	10.43453 [0.005422]
USDTL-ERPD	18.21454 [0.000110]
ERPD-USDTL	26.07334 [0.000000]
EURTL-ERPD	11.86095 [0.002657]
ERPD- EURTL	11.59261 [0.003038]
M2-ERPD	23.79262 [0.000000]
ERPD-M2	7.071890 [0.029131]

Note: [p-value] indicates the probability values of the Wald statistic calculated by the author according to k.

The impulse response and variance decomposition analyses were applied to obtain information about the direction and magnitude of the reactions of the variables to each other after creating the VAR model, performing causality analysis, and determining causality relationships. Figures 8 and 9 show the results of the impulse response analysis, and Table 7 shows the results of the variance decomposition. ERPD responses to a one standard deviation shock occurring in ISE100, DINTR, USDTL, EURTL, and M2 are shown in Figures 8 and 9. According to Figures 8 and 9, the response of ISE100 to ERPD is positive for 10 weeks, and the increase rate of this response is higher in the first 3 weeks. While the response of DINTR to ERPD was negative until 10 weeks, the effect started to turn positive in the 10th week. The rapid increase in the negative effect in the first 3 weeks is striking. The reactions of USDTL and EURTL to ERPD are similar but negative, and the effect turned positive towards the 10th week. M2 positively affects ERPD, and this effect decreases until the 6th week and then increases. The response of the ERPD to ISE100 and DINTR is negative, while the responses of the ERPD to M2 and EURTL are positive. However, the response of the ERPD to USDTL was positive in the first 6 weeks, and then the effect turned negative.

FIGURE 8
Impulse Response Analysis Results

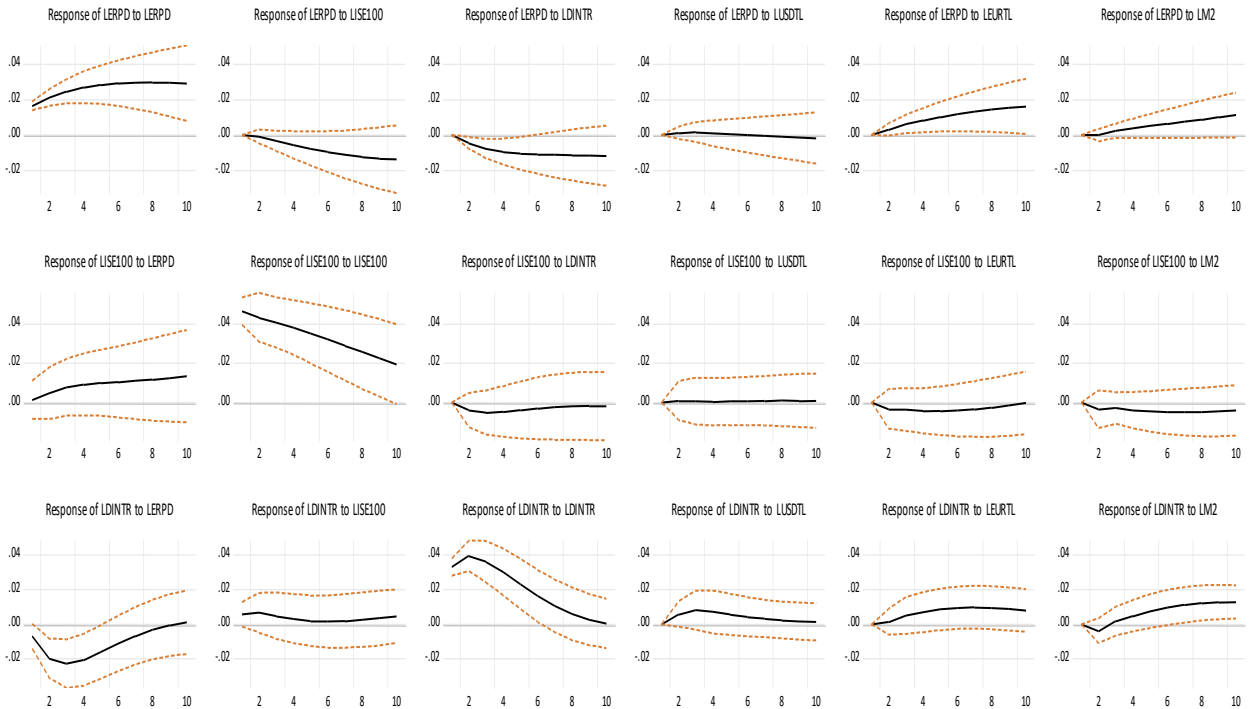


FIGURE 9
Impulse Response Analysis Results *(continued)*

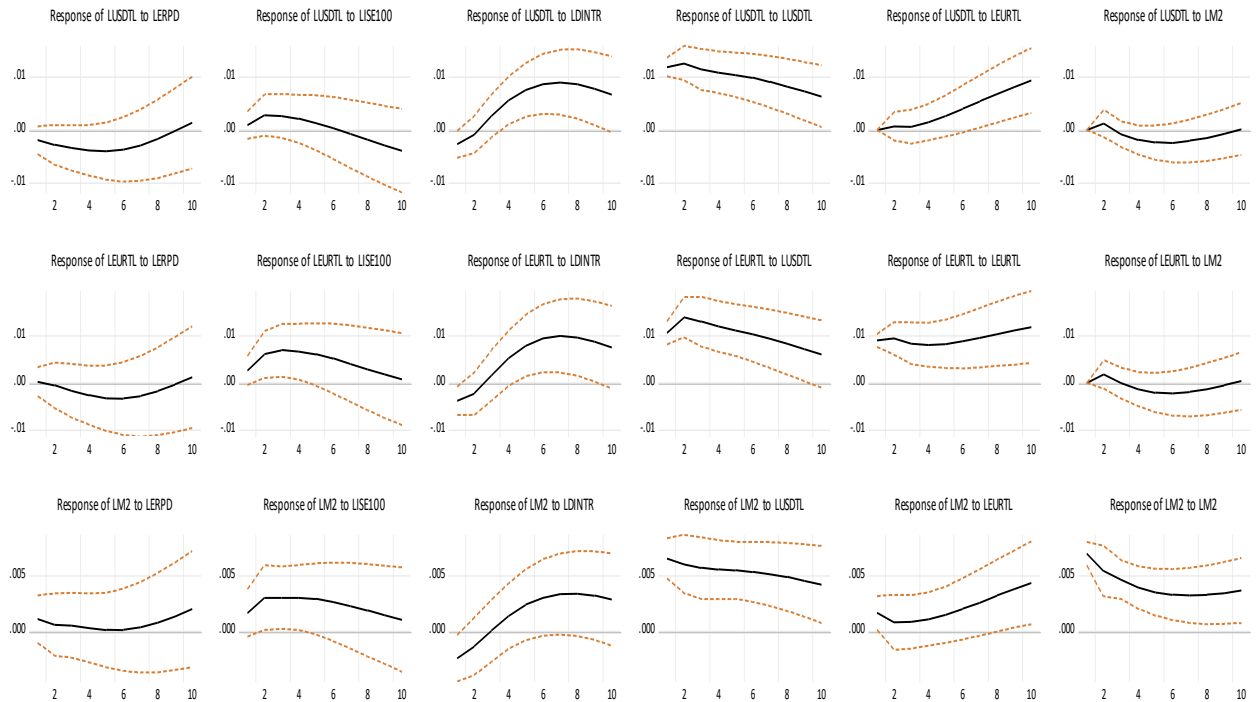


TABLE 7
Variance Decomposition Results

Period	Standart Error	LERPD	LISE100	LDINTR	LUSDTL	LEURTL	LM2
1	0.016464	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.027418	95.78360	0.079293	2.491255	0.260400	1.385396	5.37E-05
3	0.038453	89.86758	0.707931	5.249503	0.325950	3.395562	0.453475
4	0.049154	85.24739	1.668219	6.857950	0.246110	5.052681	0.927651
5	0.059413	81.43310	2.769767	7.697060	0.175070	6.513527	1.411472
6	0.069165	78.12868	3.881542	8.112861	0.129182	7.830345	1.917388
7	0.078419	75.16220	4.944466	8.308322	0.103602	9.020395	2.461021
8	0.087203	72.45399	5.923759	8.395560	0.093597	10.08553	3.047570
9	0.095539	69.96830	6.795992	8.437534	0.095892	11.02461	3.677671
10	0.103435	67.68954	7.546445	8.469242	0.108004	11.83749	4.349272

Cholesky Ordering: LERPD LISE100 LDINTR LUSDTL LEURTL LM2

According to Table 7, approximately 67% of the changes in exchange rate protected deposits are caused by their own lagged values, 11% by Euro prices, 8% by deposit interest rates, 7.5% by ISE100 index prices, 4% by money supply, and approximately 0.1% by dollar prices. While ERPD was completely determined by its shocks at the beginning of the period, this rate decreased to 67% at the end of the 10th week, but it can still be said that it was affected by its shocks the most.

5. CONCLUSION

Emerging countries such as Türkiye need to remove the obstacles to financial stability to achieve their targeted economic growth and social welfare. Fluctuations and increases in exchange rates adversely affect this stability and many macroeconomic variables. It is accepted that one of the decisive steps to be taken in ensuring financial stability and macroeconomic performance is exchange rate policies consistent with inflation targets. The ERPD was put into effect as of December 21, 2021, to mitigate exchange rate pressure on inflation. Since the level of the exchange rate is one of the variables contributing to disinflation in Türkiye, there is a close relationship between the exchange rate and inflation. This relationship becomes more important when the Turkish lira depreciates. Therefore, it may be inevitable for the CBRT to implement ERPD and similar practices to maintain the exchange rate at an optimal level.

This paper aims to examine the effect of ERPD implementation on dollar selling price, euro selling price, deposit interest rate, and the ISE 100 index. For this purpose, the reciprocal causality relationship between the amount of currency rate protected Turkish Lira deposits and other alternative investment instruments is investigated using the Toda-Yamamoto causality test. In line with the findings of the analysis, it can be stated that this new but uncertain practice has an impact on other investment instruments.

In the empirical part of the study, causality analysis was conducted and concluded that there is a bidirectional causality relationship between ERPD and other variables. The only exception is the absence of causality from the ERPD to the ISE100 index. Changes in ERPD cause changes in interest rates, euro, dollar sales prices, and money supply. In addition, changes in the ISE100 index, interest rates, euro and dollar sales prices, and M2 also cause changes in ERPD. The results obtained in the study align with those in Tunalı and Kalkay

(2023) for Türkiye. Impulse-response and variance decomposition analyses were applied to gain an idea about the direction and intensity of these relationships after determining the causality relationship between the variables of the paper. According to these findings, it was determined that a positive shock in the ISE100 index positively affects the amount of ERPD. This result shows that if there is an increase in the ISE100 index, this increase causes an increase in the amount of the ERPD. Here, it is seen that the ISE100 index plays an important role in the ERPD application, and the increase in demand for the stock exchange increases the ISE100 index and the amount of ERPD. The reaction of the ERPD to ISE100 is negative. Investors' belief that they can obtain more returns in the ERPD application may hurt stock markets. According to another finding, a positive shock in the interest rate negatively affects the ERPD amount. This result shows that if there is an increase in the interest rate, this change causes a decrease in the ERPD amount. Similarly, it has been found that the increase in ERPD negatively affects the interest rate. Here, it is seen that the interest rate plays an important role in the ERPD application and that the reflection of monetary policy transactions on the interest rate affects the ERPD amount. It can be stated that the ERPD amount decreases because the increase in interest rates directs investors to invest in interest. Another finding is that a positive shock in the dollar and euro sales price negatively affects the ERPD amount, and this effect turns positive at the end of the period. This result shows that if there is an increase in the dollar and euro sales price, this increase first causes a decrease in the ERPD amount and then an increase in the period observed. This finding can be interpreted as investors initially investing in foreign exchange with the expectation of high returns upon seeing the increasing foreign exchange prices, but the excessive increase in foreign exchange prices directed investors to ERPD over time. Here, it is seen that the dollar and euro sales prices play an important role in the ERPD application and that dollarization affects the ERPD amount. While the ERPD response to euro prices is positive, its response to the dollar is first positive and then negative. This finding also shows that the ERPD application in Türkiye cannot prevent dollarization in the country very much.

Finally, we found that a positive shock in M2 positively affects the ERPD amount, and the ERPD increases M2. Here, it is seen that M2 plays an important role in the ERPD application, and the increase in money in circulation increases the ERPD amount. The variance decomposition analysis findings also show that when the

ERPD amount changes, approximately 11% of this change originates from the euro sales price, 8.5% from interest, 7.5% from the BIST 100 index, 4% from M2, and finally 0.1% from the dollar sales price. These findings show that when there is a change in the amount of ERPD, the investment instruments that affect this change the most are the Euro, deposit interest rate, ISE100 index, and the dollar, respectively, and that the money supply also significantly affects this change.

Based on the findings, the ERPD application can be used as a new indicator for individual and institutional investors when making predictions in stock markets. The ERPD application can guide domestic and foreign stock investors in different financial instruments. In addition, the fact that these investors think that they can obtain more returns with the ERPD application can hurt stock markets. Our analysis suggests that the ERPD application in Türkiye affects the deposit interest rate; likewise, the deposit interest rate is affected by the ERPD application. Based on the findings, it can be interpreted that the ERPD investors are interested in financial instruments that provide interest income in the Turkish Lira. Hence, it can be stated that the application's success is debatable since the ERPD application cannot prevent the significant increase in the foreign exchange prices it targets in Türkiye.

In line with the analyses conducted in this paper, it is seen that the ERPD implementation can be effective on alternative investment instruments. It is thought that the results obtained will be beneficial for policymakers, investors, and similar financial actors who want information about ERPD. The relationship between ERPD and macroeconomic indicators can be compared by including different variable groups and methods in future studies. This paper is thought to contribute to literature, especially as a guide to applied studies.

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EXPLORING CONSUMER PREFERENCES: ORGANIC VS. NON-ORGANIC BODY WASH BRANDS IN MALAYSIA

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ABSTRACT

The COVID-19 pandemic has heightened consumer awareness of personal hygiene, leading to a surge in demand for bath and shower products in Malaysia. Despite this growth, the organic body wash segment has faced challenges, including consumer skepticism due to the proliferation of greenwashing. This study explores the factors influencing consumer choices between organic and non-organic body wash brands in Malaysia, while understanding whether consumers' choices reflect their environmentally conscious behavior, with a focus on young adults aged 18-25. Through semi-structured interviews, the research draws on the Theory of Planned Behavior and Garvin's Eight Dimensions of Product Quality to analyze perceived quality, performance, price, and environmental concern. Findings reveal that price is the critical determinant of consumer preference, while perceived environmental concern plays a negligible role, challenging the previous research that suggests individuals' purchases of organic products reflects environmental concern. Parental influence also emerges as a key factor in the decision-making process, highlighting the importance of family and social influences on consumers' decisions. The study underscores the importance of transparent marketing and addresses the impact of greenwashing on consumer trust. The research contributes to understanding consumer behavior in the organic personal care sector and offers insights for marketers to refine their strategies. Future research should investigate the sustainable packaging role and expand demographic considerations to enhance generalizability.

JEL Classification: M31 Marketing

Keywords: Green marketing, Greenwashing, Consumer choices, Personal care products, Organic

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1. INTRODUCTION

The bath and shower industry in Malaysia has witnessed a surge in demand as a result of the COVID-19 pandemic. MarketResearch.com (2021) and Vodus (2021) reported that the pandemic heightened public awareness of personal hygiene, prompting consumers to seek hygiene products infused with antibacterial properties to prevent viral transmission since 2020. Simultaneously, Fortune Business Insights (2021) revealed a growing inclination toward organic and non-organic bath products reflecting a broader consumer trend towards embracing greener and healthier lifestyles.

For consumers, the trend centered 'going green' centered on promoting healthier living has given rise to an influx of organic products in the markets to satisfy saw emerge consumer desire for a healthy lifestyle (Osarodion et al., 2020). Following this trend, green marketing emerged as a strategy emphasizing improving product quality while minimizing negative environmental impact, capitalizing on consumers' concerns for personal health to influence their optimism and purchase intentions toward organic products (Zollo et al., 2021). Notably, young consumers, as highlighted by both Sun et al. (2021) and Zollo et al. (2021) exhibit a willingness to pay for organic products.

Statista (2021) reported a significant revenue growth in Malaysia's personal care industry in 2020 and 2021, with the personal hygiene sector presenting lucrative opportunities for bath and shower manufacturers. Several recent studies have shown that implementing organic practices can positively impact business performance and corporate image, prompting marketers to integrate organic attributes into products to align with consumer preferences for a healthier lifestyle (Alam and Islam, 2021; Darlius and Keni, 2021; Mukonza and Swarts, 2020).

Despite the growing preference for organic body wash products, however, the proliferation of greenwashing has resulted in consumers' distrust of organic claims by brands, leading to a decreased desire for organic products (Szabo and Webster, 2021). As greenwashing is getting rampant in the market, Lin and Chang (2012) and Usrey et al. (2020) have argued that consumers might no longer favor brands and products with organic attributes. Fortune Business Insights (2021) also highlighted that, even with the surge in demand for bath and shower products during the COVID-19 outbreak, the

organic segment in the bath and shower industry has experienced a negative sales growth of -3.9 %, challenging the notion that consumers perceive organic products as superior. Hence, understanding the reasons influencing consumer choice and their perception of organic will provide insights into this phenomenon.

The objectives of this study are twofold; first, to explore the reasons behind consumers' choice of organic or non-organic body wash brands in Malaysia. Second, the study aims at understanding whether the choice of organic or non-organic body wash brands reflects environmentally conscious behavior among consumers. The investigation into the differences in consumers' decisions of organic and non-organic brands can overcome consumer trade-off behavior between organic and non-organic brands or products, while contributing useful insights for advertising agencies when creating advertising messages to avoid giving consumers the impression of greenwashing in organic brands.

2. LITERATURE REVIEW

2.1 CONSUMERS' INTENTIONS ON CHOICE OF ORGANIC OR NON-ORGANIC

The shift in consumers' green preferences for environmentally friendly products has compelled companies to make their product development and marketing strategies increasingly greener (Osarodion et al., 2020). The trend toward adopting a green lifestyle has spurred extensive research on green purchasing intentions, aiming to comprehend consumers' willingness to invest in green products. Even though consumers show a preference for buying green products and are willing to pay premiums for organic items (Zollo et al., 2021; Sun et al., 2021), studies by Janssen and Vanhamme (2015) and Lin and Chang (2012) indicated the avoidance behavior in consumers' green purchase intentions. For instance, Janssen and Vanhamme (2015) discovered a disparity between consumers expressing green purchase intentions and their actual behavior during the purchasing stage. Lin and Chang (2012) noted that consumers, despite possessing green product knowledge, often face trade-offs between environmentalism and product attributes. These findings reflected the incongruity between consumers' green purchase intentions and purchase behaviors. Further, when exploring the relationship between green purchase intentions and behaviors, Usrey et al. (2020) found that consumers tend to negatively evaluate product's performance with

green attributes, such as eco-labels, eco-modes and green claims (environmental-related and eco-friendly advertising messages) when faced with a choice between organic or non-organic brands.

2.2 THEORY OF PLANNED BEHAVIOR

This study employs the Theory of Planned Behavior (TPB), a well-validated cognitive theory extensively used in studies on purchase intentions for organic products. Developed by Ajzen (1985) as an extension of the Theory of Reasoned Action (TRA), the TPB incorporates perceived behavioral control as antecedents to behavioral intentions, introducing three key constructs to explain consumers' purchase intentions: Attitude toward behavior, Subjective Norms, and Perceived Behavioral Control (Fishbein and Ajzen, 1975).

While the TPB has been widely used in previous quantitative research on consumers' purchase intentions for organic products (Shimul, Cheah, and Khan, 2022; Zhuang, Luo, and Riaz, 2021; Zhang et al., 2019), Ajzen (1991) proposed belief elicitation research that aims to gain insight into the salient beliefs of specific groups of people in specific contexts, as the result from such exploratory qualitative studies provide a list of relevant outcomes, referents, and control elements (Fishbein and Ajzen, 2009). Ajzen (1991) further asserted the necessity to elicit and evaluate the accessible behavioral, normative, and control beliefs if the goal of the study is to comprehend the elements that serve as the foundation for intentions, while Fishbein and Ajzen (2009) also state the need for qualitative research that looks at beliefs to comprehend what influences a target demographic to engage in a particular behavior. Additionally, despite the overall effectiveness of the theory, TPB can be enhanced through incorporating other factors to increase the predictive power of behavior in various contexts. Some previous studies have also adopted qualitative methods to understand consumers' beliefs about green products (Djafarova and Foots, 2022; Qi, Yu, and Ploeger, 2020), demonstrating that TPB can also be applied in qualitative settings. Therefore, the study introduces the variables including Perceived Quality and Perceived Performance from Garvin's Eight Dimensions of Product Quality (Garvin 1987), along with Perceived Price and Perceived Environmental Concern. This extended framework aims at exploring consumers' beliefs towards organic and non-organic body wash brands. In this research, the perceived quality of both organic and non-organic body wash was assessed based on factors such as ingredients and packaging. Meanwhile, the perceived performance of

these body washes was evaluated in terms of cleaning capability, fragrances, antibacterial properties, and other additional functions.

2.3 ATTITUDE

Attitudes toward behavior involves the general evaluation and judgement of items, individuals or topics (Moser, 2015). It is characterized by favorable and unfavorable evaluations of behavior, determining the likeability or aversion to engaging in the behavior (Paul, Modi, and Patel, 2016). Numerous studies have explored the relationship between attitude and green purchase intentions, emphasizing its pivotal role in predicting consumer willingness to choose environmentally friendly products (Yadav and Pathak, 2017; Zhang et al., 2019). Moser (2015) however discovered that attitude did not influence consumers' purchase intentions, highlighting the greater significance of the monetary counter value variable. Recent research has also emphasized the substantial impact of perceived price on consumer intention to purchase green products (Qomariah and Prabawani, 2020).

2.4 SUBJECTIVE NORMS

Beyond attitude, individuals' morality plays a role in influencing their purchase intentions (Moser, 2015). Subjective norms encompass the perceived social pressure from important individuals or groups regarding a specific behavior (Ahmed et al., 2021). While Roh, Seok, and Kim (2022) and Zhang et al. (2019) underscore the indispensable nature of subjective norms in predicting and influencing purchase intentions, Sharma and Foropon (2019) expressed that subjective norms might not wield the expected influence on green product purchase intentions.

2.5. PERCEIVED BEHAVIORAL CONTROL

Perceived behavioral control gauges the ease or difficulty an individual faces in executing a behavior (Zhang et al., 2019). Perceived behavioral control comprises two factors including internal control factors (self-efficacy) and external control factors (perceived barriers) (Kautish, Paul, and Sharma, 2019). Self-efficacy reflects an individual's perception of their capability to perform the necessary actions, while perceived barriers denote the perceived difficulty associated with using the product (Vamvaka et al., 2020). While

Wang, Tao, and Chu (2020) as well as Zhuang et al. (2021) studies recognize the significant impact of perceived behavioral control on purchase intentions, Shimul et al. (2022) found that this factor does not influence consumer intention to purchase organic products.

2.6 GARVIN'S EIGHT DIMENSIONS OF PRODUCT QUALITY

2.6.1 PERCEIVED QUALITY

An integral dimension of Garvin's Eight Dimensions of Product Quality, perceived quality is frequently employed by researchers to study consumer perceptions and attitudes (Hoe and Mansori, 2018; Jakpar et al., 2012). It plays a crucial role in distinguishing a brand or product among competitors, as consumers often base their judgments on product superiority (Chen, Lin, and Chang, 2013). Research by Cheung, Lam, and Lau (2015) also suggested that consumers' green purchase intentions are influenced by perceived quality. As consumers' primary goal is to purchase high-quality products and products with acceptable functionality, they are more inclined to pick alternative brands or items when they do not perceive a reasonable degree of product quality (Song and Kim, 2018).

2.6.2 PERCEIVED PERFORMANCE

As another key element of Garvin's Eight Dimensions of Product Quality, performance denotes the primary operating characteristics, encompassing dimensions of traditional quality (Garvin 1987). In the context of body wash, performance characteristics include cleaning capability, long-lasting scent, moisturizing and hydrating benefits. Gouda et al. (2019) proposed a new evaluation notion in the field of 'green', where performance also represents the dimensions of green quality, emphasizing characteristics such as being paraben-free to minimize negative impacts on consumers and the environment.

2.6.3 PERCEIVED PRICE

Product pricing emerges as a pivotal factor influencing consumers' purchase intentions and brand behaviors. Notably, green products typically command higher prices than their conventional counterparts. Despite the initial perception that elevated prices might deter consumers from choosing these brands, Yang et al. (2019) suggested that consumers often equate higher pricing with superior brand

quality. This phenomenon in consumers' perceptions has been reflected in their purchase intentions, with Shahbandeh (2020) reporting that 61% of Generation Y, followed by Generation Z (56%), Generation X (55%), and Baby Boomers (46%), are willing to pay more for eco-friendly products. Lin and Chang (2012), however. highlighted an inherent discrepancy between consumer willingness to buy green and actual purchase behaviors.

2.6.4 PERCEIVED ENVIRONMENTAL CONCERN

Perceived environmental concern revolves around an individual's comprehension of facts, concepts, and relationships pertaining to the natural environment and ecosystems (Kaufmann, Panni, and Orphanidou, 2012). In contrast to the aforementioned perceived variables, perceived environmental concern delves into an individual's belief about the environment, encompassing their consistent evaluation, perception, and predisposition toward environmental considerations (Huang et al., 2014). Prior studies have explored the influence of consumers' environmental knowledge and consciousness on their green purchase intentions (Indriani, Rahayu, and Hadiwidjojo, 2019; Ariffin et al. 2016). Ariffin et al. (2016) emphasized the significance of environmental consciousness and knowledge as influential factors positively impacting consumers' purchase intentions and attitudes towards green products. Similarly, Indriani, Rahayu, and Hadiwidjojo (2019) asserted that environmental knowledge plays a crucial role in shaping consumers' attitudes to green products and positively influence their green purchase intentions.

3. METHODS

3.1 SEMI-STRUCTURED INTERVIEW

To extend TPB, a qualitative approach was employed to identify a broad range of different beliefs about organic or non-organic body wash and the primary factors that influenced consumers' choice to prioritize such products. An elicitation study using semi-structured interviews was used to explore the beliefs of consumers related to organic or non-organic body wash. The sampling frame employed young adults aged 18 to 25 in Malaysia who purchase organic and non-organic body wash, and self-identify as either green or conventional consumers based on the criteria outlined by Fonseca-Santos, Corrêa,

and Chorilli (2015). Research reported that Generation Z aged 18-25 years is the largest age group in Malaysia making up 29% of the population, with a monthly disposable income of USD$ 327 million (MYR1.35 billion) (Tjiptono et al., 2020). Due to their purchasing power, numerous researchers often use the age group of 18-25 as their research subjects (Khalid, Adnan, and Mohamed 2023; Djafarova and Foots 2022). Therefore, this study targets consumers aged 18-25 as the primary population.

The first category of semi-structured interviews was conducted with green consumers. By the sixth interview, the researchers observed that informants were offering similar opinions, with no new themes or concepts emerging. A similar pattern was observed during the interviews with conventional consumers. As a result, a total of 12 informants were purposively selected for this study, with an equal number of green and traditional consumers, ensuring a well-balanced representation. A semi-structured guide based on Nimri, Patiar, and Jin (2020), as well as Han (2020) was used to probe questions regarding attitude (e.g. "What do you believe are the benefits of using organic and non-organic body wash?"), subjective norms (Who of the people important to you would support your decision when purchasing body wash?") and perceived behavioral control (e.g. "What would motivate you to purchase a body wash in the future?"). The discussions were transcribed verbatim, and thematic analysis was performed.

4. FINDINGS AND DISCUSSION

A total of 12 informants, aged between 18 and 25 years, were selected using a purposive sampling method. The interviews were conducted both offline and online, each lasting approximately between 30 and 45 minutes. Six informants identified themselves as green consumers, while the remaining six identified as conventional consumers.

4.1 ATTITUDE TOWARDS PERCEIVED QUALITY

The study revealed that perceived quality exerts an influence on the consumers' attitude. This is consistent with the research of Echchad and Ghaith (2022) and Cheung, Lam, and Lau (2015), which highlights the impact of perceived quality, particularly in the realm of organic product purchases. However, it is less impactful than perceived performance and price. Among the 12 informants, only four identified themselves as quality-conscious consumers, while the

remaining eight were less concerned with product quality. The weaker influence of perceived quality can be attributed to the fact that body wash is a low-involvement product, meaning that consumers typically do not spend a lot of time or cognitive effort comparing product attributes. In such cases, functional benefits (perceived performance) and cost considerations (perceived price) take precedence over product quality, as they provide more tangible and immediate value to the consumer. Additionally, brand reputation strongly influences perceived quality, with four informants noting that trusted brands often outweigh objective product attributes. This is crucial for low-involvement products, where consumers rely on familiar brands as a quality proxy.

A majority (9 out of 12) of the informants believed that organic body wash has higher quality due to stricter production and ingredient sourcing processes. This finding reinforces the common consumer perception that organic products are inherently superior in terms of purity and safety. However, the dissenting views of two informants, who could not differentiate between the quality of organic and non-organic, suggest that not all consumers are fully convinced of organic products' superiority. This skepticism reflects an important challenge for organic brands: despite the premium placed on their manufacturing processes, some consumers may see the benefits as marginal or even inflated by marketing tactics, as informants argued that "compared to conventional one, the organic body wash maybe just a slight improvement, because company always try to boost their products." (P4) and "organic and non-organic body wash they are the same" (P12). Therefore, although perceived quality matters, in the context of low-involvement products, brand reputation, performance, and price are often more decisive. Organic brands should focus on trust-building and clear messaging to stand out in the market.

4.2 ATTITUDE TOWARD PERCEIVED PERFORMANCE

The findings emphasize that perceived performance plays a critical role in shaping consumers' attitudes toward body wash. Key performance attributes such as cleaning ability, antibacterial properties, and fragrance were discussed by informants, highlighting the importance of body wash in providing long-lasting cleanliness and pleasant, non-chemical fragrances. Verbal phrases including "light" (P7, P5), "fresh" (P7, P5) and "non-chemical fragrances" (P8, P4)

were highlighted when informants described their preferences in choosing and evaluating an ideal body wash.

When evaluating performance, the discussions were diverse. Five informants favored non-organic body wash, attributing its superior performance to artificial ingredients that enhance cleaning efficacy and bacteria prevention. Notably, informants tended to associate green attributes as a sign of weak performance, which aligns with study that suggest green products are sometimes perceived as less effective in previous study (Usrey et al., 2020). In contrast, another five informants believed organic body wash performed better, emphasizing its milder nature, natural ingredients, and safety, especially due to the absence of parabens. Nonetheless, two informants argued that there is no discernible difference between organic and non-organic body wash, because "most of the body wash cleaning capability can be achieved easily, based on my personal experience" (P3) and "each body wash can complete their basic cleaning task since they are body wash" (P5).

These varying perceptions indicate that performance preferences are subjective, driven by individual priorities. Some consumers associate artificial ingredients with better efficacy, while others prioritize safety and skin benefits linked to natural ingredients. This suggests that marketing strategies should be tailored to target different consumer segments. Conventional body wash brands could emphasize functional performance such as antibacterial properties, whereas organic brands should highlight ingredient safety and health benefits. Overall, while perceived performance is a key factor in shaping consumer choices, its influence depends on how consumers define a well-performing product.

4.3 ATTITUDE TOWARD PERCEIVED PRICE

Findings showed that price is the most influential factor in affecting informant attitudes toward both organic and non-organic body wash, supporting findings by Qomariah and Prabawani (2020) on price's impact on consumer intentions toward purchasing green products.

While all informants agreed on the premium pricing of organic products, their perspectives on the justification varied. Some perceived the higher price as reasonable considering the cost of natural ingredients and production processes involved in organic body wash. Other informants viewed the higher price as a result of greenwashing and marketing tactics rather than genuine production costs. As one informant (P8) indicated, "organic deserved higher

price, because company putting a lot of effort in their business strategy, and I feel it is acceptable for them to gain a higher profit… but I curious about the organic production, not really sure whether the product has really gone through a strict production and manufacturing process to warrant the higher price." This skepticism mirrors the Szabo and Webster (2021) findings, which indicated that greenwashing practices erode consumer trust in organic claims.

Notably, two informants believed that higher price products are more trustworthy. Statements such as "usually I think the higher price product is trustworthy" (P5) reflect this belief. Conversely, four informants expressed skepticism, arguing that higher prices could simply reflect brand reputation rather than product quality. Some informants highlighted that "I believe that the organic product is better than conventional products, but most of the time, the advertising agency is just trying to brag about their products" (P12) and "higher price may only indicate the fame of the brand, not the product itself……. the product which is really good may have been cheaper because of the brand reputation or something the price is inflated……the cheapest product may actually be better than the more expensive product" (P8).

This divergence in perception indicates that premium pricing does not guarantee a positive attitude toward a product. In fact, high priced may lead to distrust, especially when consumers suspect greenwashing or fail to perceive a significant difference between expensive and cheaper alternatives. The findings suggest that price sensitivity plays a critical role in shaping consumer attitudes, with skepticism toward high-priced organic products often resulting from perceived marketing strategies rather than actual product differences. Thus, organic brands need to clearly justify their pricing to avoid consumer doubt and maintain trust.

4.4 ATTITUDE TOWARD PERCEIVED ENVIRONMENTAL CONCERN

The study's findings challenge common assumptions about the relationship between environmental concern and consumer attitudes towards organic body wash. While previous research by Ariffin et al. (2016), as well as Indriani, Rahayu, and Hadiwidjojo (2019), suggested a stronger influence of environmental concern on purchasing behavior, this study reveals that environment concern has the least impact in shaping attitudes toward organic products in this category.

A closer look at the findings reveals that informants do not necessarily associate buying organic products with reducing environmental harm. This highlights a possible limitation in the way organic body washes are perceived as part of environmental solutions. The divergence between the study's findings and previous research could be explained by the specificity of the product category. For instance, organic body wash may be viewed more as a "symbolic choice" rather than a functional solution to environmental issues. Consumers could be prioritizing actions that they perceive as having a direct and observable environmental impact (e.g., cutting down on plastic waste or energy consumption) rather than purchasing organic personal care products, which might feel like a more abstract contribution to environmental sustainability.

Given that perceived environmental concern exhibits the least impact on consumer attitudes towards body wash, marketing efforts for organic products in this category need reconsideration. Companies that aim to encourage environmentally conscious purchasing must address several issues, such as reframing environmental benefits by quantifying them in terms that resonate with consumers (e.g. fewer chemical pollutants), integrating health, safety, and performance benefits into messaging to highlight how organic products align with personal well-being and lifestyle preferences, and improving distribution channels, or offering incentives for eco-friendly purchases (e.g., discounts for sustainable packaging).

4.5 ATTITUDE AND PURCHASE INTENTION

Attitude was found to have the most significant impact on purchase intention in this study. Informants in this study heavily relied on their attitudes to decide what to buy, which aligns with previous research by Yadav and Pathak (2017), Zhang et al. (2019) and Zhuang et al. (2021). The evaluations of organic and non-organic body wash by informants were significantly influenced by their perceived quality, perceived performance, and perceived price. This result was not unanticipated, as most consumers will rely on their evaluation whether the item is likeable or unlikeable to determine their purchase behavior (Paul, Modi, and Patel 2016). Interestingly, both green and conventional consumers unanimously expressed their favorability toward organic body wash. However, a noteworthy phenomenon emerged during the buying stage: despite expressing a preference for organic body wash, many of both green and conventional consumers indicated a tendency to purchase non-organic body wash after

assessing the two options. This points to the well-documented "attitude-behavior gap" in environmental psychology (Park and Lin 2020), where individuals express concern for the environment but do not translate this concern into consistent eco-friendly behavior. This finding aligns with the result of Lin and Chang (2012), who stated that consumers with green product knowledge are not necessarily embodied in their purchasing behaviors, as consumers always face trade-off between environmentalism and product attributes. Hence, the findings may prove that price is an essential variable in influencing consumer attitude, thus affecting consumers' purchase intentions toward organic or non-organic body wash.

4.6 SUBJECTIVE NORMS AND PURCHASE INTENTION

The study elucidated the substantial influence of subjective norms on purchase intention, which supported by the studies of Zhang et al. (2019) and Roh, Seok, and Kim (2022). The findings discovered that four informants sourced information on organic products from their parents, primarily their mothers, while six of them turned to online platforms. Furthermore, two informants obtained information from both parents and social media. Despite these diverse information sources, a majority of informants acknowledged being significantly influenced by their parents' advice, a trend consistent with Agil, Ahmad, and Azlan (2022), highlighting the influence of family and friends recommendations among Generation Z consumers before making purchases.

An intriguing contradiction however surfaced when examining the influence of others on purchase behavior. Despite acknowledging the influence of their parents on attitudes to organic or non-organic body wash, all informants asserted that their parents' opinions did not directly affect their actual purchase decisions. The informants views are as follows:

> "My mom is an organic lover……My mom told me that organic has higher quality…… But I don't rely on my mom's opinion when I buy body wash." (P2).

> "My choice of body wash is not affected by my family……My mother thinks I should use organic product…I was independent in deciding what to buy" (P8).

> "Yes, I am affected by my parents, but I highly rely on the academic research information on advertisements to decide whether the brand is trustworthy or not" (P3).

> "If I feel the brands that my family purchased before are good, then I will continue to purchase it . . .. . . But I rely on news (scandal) to decide what to buy" (P10).

Interestingly, a deviation was observed when the informants were asked whether someone important to them think they should purchase organic body wash instead of non-organic. Three out of 12 informants indicated that their parents hope informants use organic body wash, and those expectations have affected informants purchase behavior, making informants purchase based on the expectations of others. Moreover, 11 informants exhibited a tendency to purchase the same brand that their parents purchased previously, contradicting their earlier statements regarding the limited impact of parents' advice. Majority of informants indicated that they would purchase the body wash that their family often used and purchased because they were accustomed to a particular body wash brand from an early age. Nonetheless, one informant indicated that they were not influenced by their family at all because body wash is merely a common product: "I will not follow what they buy before . . .it is just a body wash, I just randomly buy it" (P7).

This contradiction result may be attributed to their unconscious habitual purchase behavior and the impact of social influence. According to Putri (2020), habitual buying behavior is a consumer buying decision with a low level of consumer involvement. This means that consumers do not search for much information among the available brands and they do not perceive significant differences between the brands, which generally occurs when the item is frequently bought and does not cost much money. Hence, consumers tend to purchase the same brand repeatedly out of habit. Yet, if the particular brand is no longer available or consumers found a better deal from another competing brand, they are more likely to switch (Putri 2020). Subjective norms, therefore, play a significant role in influencing consumers' purchase intentions, even when consumers may not consciously recognize this influence.

4.7 PERCEIVED BEHAVIORAL CONTROL AND PURCHASE INTENTION

Perceived behavioral control was also found to have substantial impact on purchase intention, consistent with the findings of Wang, Tao, and Chu (2020) as well as Zhuang et al. (2021). Seven informants emphasized the pivotal role of ease of availability in their decision to purchase body wash, with a preference for retail outlets such as Watson, Guardian, and Aeon Wellness, while online platforms emerged as their second choice. They further indicated that they only buy based on availability in the store. This result is not surprising because most consumers may perceive risk when purchasing online, including delivery uncertainties and potential product discrepancies (Mokhtar et al., 2020). While five informants self-identified as online shopping enthusiasts, only one informant expressed a willingness to purchase body wash online, whereas the others considered it as their second choice: "if I cannot buy from outlet, then I will consider buying from online channel" (P6).

Additionally, some informants even asserted that they would choose not to purchase a particular body wash brand if it were unavailable in retail outlets, emphasizing the perceived difficulty associated with online purchases. The study underscores the importance for body wash brands to establish a presence in physical stores, facilitating easy access for consumers and subsequently influencing their purchase behavior. Therefore, consumers' purchase intentions were greatly affected by perceived behavioral control to execute their purchase behavior.

5. CONCLUSION AND RECOMMENDATION

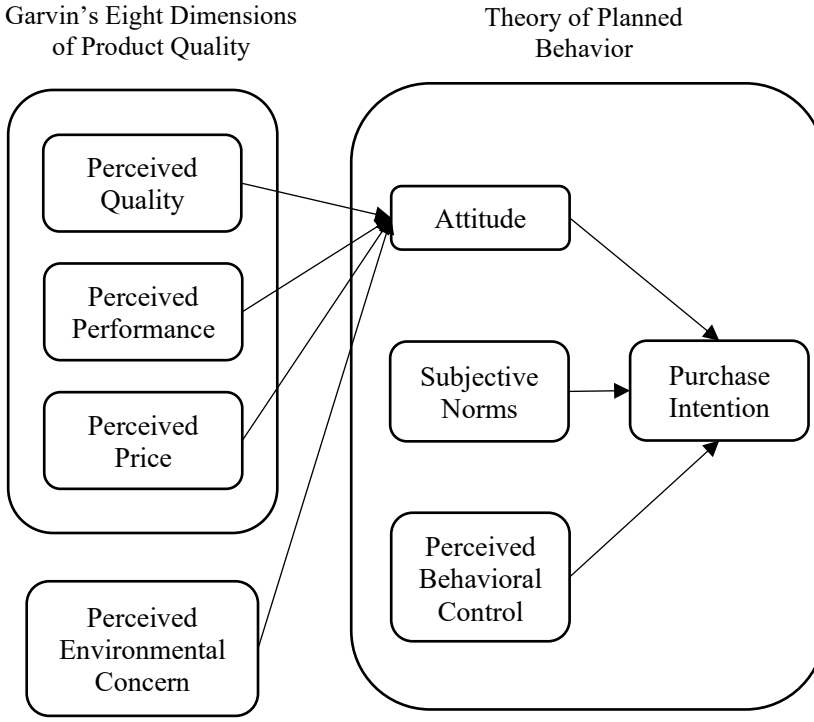
The study underscores the pivotal role of pricing in shaping consumers' choices between organic and non-organic body wash. Consumers perceive high-priced body wash brands as potentially engaging in greenwashing, emphasizing the importance of appropriate pricing. Cleaning capabilities, antibacterial properties, and fragrance are key considerations for a good-performing body wash, outweighing the influence of ingredients. Perceived quality demonstrates a lesser impact on consumers' attitudes compared to perceived performance and price, as most consumers are unable to discern quality disparities between organic and non-organic body wash. Despite informants' self-identification as environmentally aware, perceived environmental

concern surprisingly exerts no influence on consumers' attitudes. Informants do not view purchasing organic products as a solution to reduce environmental issues. Hence, the study challenges the assumption that choosing organic products reflects environmentally conscious behavior.

This study introduces a new framework, combining the TPB and Garvin's Eight Dimensions of Product Quality, expanding the literature on consumer choices in the organic and non-organic personal care product domain (see the following Figure 1). The research contributes to the understanding of the green marketing trend and its impact on consumer choices. The study acknowledges the positive inclination of consumers toward organic products for health reasons but also highlights the challenge posed by greenwashing. It emphasizes the need for marketers to be cautious in their green marketing strategies to avoid eroding consumer trust. The findings provide practical implications for marketers and advertisers, specifically in avoiding greenwashing and tailoring advertising messages to address consumer concerns about quality, performance and price.

Future studies may investigate how product packaging influences consumer perceptions of organic and non-organic bath and shower products, assessing the adoption of sustainable and eco-friendly packaging significantly impacts purchase intentions and serves as a potential mitigating factor for greenwashing concerns. It is also necessary to further examine the preferences of Generation Z in Malaysia for sustainable practices, not only in personal care products but also across various aspects of their lives, providing a more holistic understanding of their eco-conscious lifestyle. There were some limitations in this study. First, this study focused on body wash products restricts generalizability to other personal care sectors such as cosmetics and skincare. Second, the exclusive concentration on Generation Z demographics prompts a call for further exploration across diverse personal care categories and demographic profiles, encompassing age, income, and regional variations. Third, acknowledging the qualitative nature of this study, it serves as a foundation for prospective quantitative investigations, offering the potential for objective data presentation through statistical analysis and numerical representation.

FIGURE 1
Proposed Framework



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BOOK REVIEW

ISLĀM AND ECONOMICS: SHAH *WALI-ALLĀH's* APPROACH

by Abdul Azim Islahi, Kube Publishing Ltd, 2022, ISBN: 978-0-86037-851-8

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Abdul Azim Islahi's book, *Islām* and Economics: Shah *Wali-Allāh's* Approach, narrates the life and scholarly ideas of Shah *Wali-Allāh* (1703-1762), an 18th century *Muslim* scholar renowned for his insights into various topics, including economics. He is regarded as the bridge connecting classical and modern *Islāmic* economic thought. His contributions are comparable to his contemporaries Adam Smith (1723-1790), the father of modern economics in the West, and Muhammad ibn Abd al-Wahhab (1703-1792) and Uthman dan Fodio (1754-1817), notable *Islāmic* economic thinkers. An academician, writer, translator, philosopher, biographer, and multifaceted thinker—*Wali-Allāh's* numerous roles demonstrate his eminence as a scholar. In just 256 pages, the author effectively captures *Wali-Allāh's* thoughts and writings, creating a comprehensive compilation of his works.

The book consists of nine chapters; illustrating the *Muslim* context during *Wali-Allāh's* era and exploring his intellectual ideas, with a particular emphasis on the economic aspects. Chapters 1 and 2 explore the *Muslim* situation and *Wali-Allāh's* history during his time. Chapters 3 and 4 discuss his intellectual and academic heritage and economic ideas, respectively. Chapters 5 to 8 examine his economic ideas, covering topics such as *Tadbīr al-Manzil* (Household Management), money and interest, public finance, and stages of socio-economic development. Chapter 9 concludes the book with the author's comparison and evaluation of *Wali-Allāh's Islāmic* economic thoughts. The book's bibliography shows that the author has included

an extensive range of references, accompanied by thorough explanations in the notes and references sections of each chapter.

First, the book provides an overview of the *Muslim* conditions during *Wali-Allāh's* lifetime, detailing the socio-political landscapes of six pivotal regions and their rulers. *Wali-Allāh* lived during times of political turbulence and social unrest. This was the beginning of Western colonization of *Muslim* lands. The Indian subcontinent, where he resided, faced instability because of frequent changes in leadership. Emperor Aurangzeb, the sixth Mughal emperor, passed away in 1707, and sixty years later, the empire witnessed the reign of 10 emperors, neither of whom could maintain the prestige and authority of their predecessors due to various challenges. This era also witnessed the beginning of intellectual resurgence, modernization, and religious reformation among *Muslims*, during which *Wali-Allāh* followed the trend of reformist thinking of *Islāmic* scholars.

The second chapter highlights *Wali-Allāh's* situation during his time. His life started during the power struggle in the Mughal Empire, marked by weak rulers that caused political instability, leading to economic and religious disorder. Born into a family of scholars, he received rigorous academic training and began teaching at age fifteen. His return from the Hijaz (Makkah and Madinah) inspired his mission to reform India, a perspective he could not have changed if he had remained in India. He initiated comprehensive reforms where he addressed various societal sectors through his teachings and writings before advocating for the change in the whole population. It was his dissatisfaction with the plight of the artisans and craftsmen which prompted his writings on economic aspects.

Chapter three delves into *Wali-Allāh's* intellectual and academic writings. He extensively wrote on various subjects, and his distinctive style of writing and method of argument greatly contributed to the popularity of his works. Influenced by Ibn Taymiyyah, his writings consistently drew from the *Qur'ān*, *Sunnah*, and the teachings of earlier *Muslim* scholars. He attracted students and scholars who followed his works, and his influence extended beyond his homeland, reaching Arabia and Turkey within a century. He authored around 60 books, with other works attributed to him. His books and writings survive to this day, preserved by his loyal followers and the *Madrasah* where he taught. Regarded as a genius of his time during a period of intellectual decline in *Muslim* thought, he is revered alongside historical *Islāmic* intellectuals such as al-Ghazali and Ibn Rushd.

The author introduces *Wali-Allāh's Islāmic* economic ideas in the fourth chapter. *Wali-Allāh* became interested in economics after

observing the situation around him. Chaos came from all angles of society, prompting him to provide insights into the causes and how it led to society's poor economic condition. *Wali-Allāh* especially examined the artisans and craftsmen, recognizing their significant role in economic development. The challenges these workers faced and the potential he saw for reformation and improvement inspired his writings on various economic areas. *Wali-Allāh* provided insights into theoretical economic concepts such as human wants, cooperation, and the division of labor. He even identified various economic activities within an *Islāmic* framework and suggested measures to prevent disputes in economic transactions.

In chapter five, the author mentions that *Wali-Allāh's* wrote extensively on *tadbīr al-manzil* (household management) from an *Islāmic* perspective compared to earlier scholars. The term originates from Greek philosophers, *Oikonomia*, which evolved into the modern discipline of economics. However, the term may now have broader implications than its initial Greek counterpart as Western economists primarily focus on the market rather than the family, unlike many *Islāmic* economists who emphasize the family. *Wali-Allāh* defined it as the science that explores methods for upholding relationships among household members according to the second level of societal support. He outlined several subject matters of *tadbīr al-manzil,* including cooperation between men and women, the art of economic transactions, the responsibilities of man as the head of the house, equitable treatment of slaves and servants, and management of children's affairs. Additionally, he addressed inheritance distribution and cooperation, and division of labor within household management.

The author explores *Wali-Allāh's* views on the importance of money and the prohibition of interest in chapter six. *Wali-Allāh* aligned with Greek philosophers and past *Muslim* scholars' views on various aspects of money while adding his views on the matter. Furthermore, his perspectives on money and interest are significantly influenced by Al-Ghazali. *Wali-Allāh* acknowledged money as a crucial tool in economics, where the division of labor and specialization calls for the necessity of money as a medium of exchange. He however stressed that misuse of money through interest-based lending, where money becomes a desire in itself, leads to societal problems. Instead, *Wali-Allāh* advocated for *muḍārabah* (profit sharing) as a preferable alternative for business transactions.

Chapter seven explores public finance as a topic of interest to *Wali-Allāh* due to his dissatisfaction with the deteriorating state of the Mughal empire. Factors such as public treasury depletion, the decline

in government lands, and poor management contributed to the Empire's weakening state. He advocated for the government to fully replenish the public treasury and to set reasonable tax rates without overburdening the populace. *Wali-Allāh* also touched on the institution of *zakāt* (almsgiving), emphasizing appropriate rates and collection times. The chapter then covers public expenditure, where the author notes that *Wali-Allāh* distinguished between purely *Muslim* and mixed-population countries in terms of fiscal allocation. He also addressed public borrowing and expressed concern for the poor.

The eighth chapter explores *Wali-Allāh's* stages of socio-economic development. *Wali-Allāh* is among the few *Islāmic* scholars capable of presenting a theoretical framework for economic development. His theory, known to the West as the 'stages of history approach', was later adopted by several Western economists. Like other scholars, he adopted a holistic approach, integrating faith and action, spirit and matter, health and education, peace and security, and political power with economic factors. *Wali-Allāh* outlined four stages in his systematic theory of socio-economic development: rudimentary life, town building and the city-state, the formation of government and a country-state, and internationalism. He stressed the promotion of religious life, justice, education, and overall economic improvement. *Wali-Allāh* introduced the concept of *irtifāqāt*, describing it as the natural progression of humankind through different stages in its quest for spiritual purification and development, aligning it with the pursuit of seeking *Allāh's* pleasure. The author concludes the book in chapter nine with an evaluation and comparison of *Wali-Allāh's* works with those of other scholars as discussed throughout the book.

The book offers valuable insights into how *Wali-Allāh* formulated his views during the turbulent conditions of his era and the determination he exhibited in reforming various aspects of society, as evidenced in his writings and biographies. The author demonstrates meticulous attention in describing the circumstances of *Wali-Allāh's* era, considering factors ranging from the Mughal empire to other regional influences that contributed to his country's decline. The book also examines the reasoning behind *Wali-Allāh* choosing the path of a scholar rather than entering politics to influence his country, asserting that reform comes from changing society rather than relying on weak leadership. The author exhibits a deep understanding and thorough handling of the sources related to *Wali-Allāh*, making this book an invaluable reference for anyone interested in *Wali-Allāh's* views, particularly in economics. It serves as a comprehensive source for scholars and researchers looking to delve deeper into *Wali-Allāh's*

works, stimulating fresh ideas in his contributions. This book lays a solid foundation for future research, including comparative studies of his economic ideas with other *Islāmic* and Western economists.

While not solely intended as a historical account, it deeply explores *Wali-Allāh's* thoughts and perspectives on the political, societal, and economic dynamics of his time. The author provides a clear summary of the sources of *Wali-Allāh's* books after listing them one by one and even categorizes them based on major and other works. He even lists the books on economic topics in chapter four, making it easier for readers studying *Wali-Allāh's* works. Furthermore, the book offers a comprehensive and insightful exploration of *Wali-Allāh's* economic views. Each area of discussion connects cohesively, culminating in *Wali-Allāh's* systematic theory of stages of socio-economic development. Despite its concise and simple explanation, the book could benefit from drawing stronger connections to contemporary relevance. A more thorough comparison with contemporary Western economists might offer readers a broader perspective, particularly in exploring how *Wali-Allāh's* theories align with or diverge from modern economic principles. Overall, the book constitutes a significant contribution for those interested in *Islāmic* economics and *Wali-Allāh's* stages of socio-economic development theory. Further reading on the theory can also be found from the author's earlier article (Islahi, 2010) on *Wali-Allāh's* Islamic economic ideas.

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