Innovations in Financial Systems: Global Perspectives on Access, Policy, and Inclusion

Scholarly Insights into Financial Innovation, Policy Dynamics, and Market Transformation

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INNOVATIONS IN FINANCIAL SYSTEMS: GLOBAL PERSPECTIVES ON ACCESS, POLICY, AND INCLUSION

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Message from Head of Department

It gives me great pleasure and honour to present this edited volume comprising selected research papers from the International Conference on Financial Access and Transformation (ICFAT 2025), organised by the School of Business and Management, CHRIST (Deemed to be University).The conference demonstrates our department's dedication to promoting substantive conversation and intellectual exploration in the dynamic realm of finance and business.

ICFAT 2025 functions as a forum for uniting esteemed scholars, researchers, professionals, and students worldwide to examine matters related to financial inclusion, sustainable and green finance, fintech innovation, internal governance, and policy-relevant analysis, this volume brings together diverse yet interconnected strands of modern financial research. The studies highlight the expanding scope of finance scholarship through integrative perspectives on ESG frameworks, risk management, digital finance, microfinance, and market efficiency.

This compilation exemplifies the academic rigour of our writers and fosters critical thinking and collaboration among scholars and industry experts. I express my sincere gratitude to all participants, reviewers, and organisers for their significant contributions and assistance in ensuring the success of this event. I wish all readers an enlightening and rewarding experience.

Dr Mareena Mathew
Head Of Department
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Message from Conference Chair

We are delighted to welcome you to the International Conference on Financial Access and Transformation (ICFAT 2025) and to the edited volume, which includes scholarly papers reflecting the spirit of innovation, critical analysis, and global perspectives. The conference has received an enthusiastic reaction from scholars and professionals from various academic institutions and enterprises, both national and worldwide. The chapters in this edited volume present rigorous empirical and theoretical research across key areas of contemporary finance, including capital markets, portfolio construction, volatility modelling, behavioural finance, cryptocurrency markets, geopolitical risk, and energy-related financial dynamics. These contributions collectively advance scholarly understanding of financial systems in both domestic and global contexts.

We sincerely thank all authors for their thoughtful submissions and our reviewers for their diligent evaluations. A special thank you to the organising team for their dedication to academic excellence and the successful execution of ICFAT 2025.

This book aims to promote academic study and discussion in finance and related fields, including policy transformation. This book's wide collection of manuscripts demonstrates the depth and breadth of current research in fields such as fintech, sustainable finance, risk management, microfinance, capital markets, and corporate governance. We feel that this compilation not only reflects our contributors' academic rigour, but also promotes critical thinking and collaboration among scholars and industry professionals. I want to express my heartfelt gratitude to all participants, reviewers, and organisers for their invaluable contributions and assistance in making this event a success.

I wish all readers an enlightening and enriching experience.

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A STUDY ON AWARENESS OF RETAIL INVESTORS WITH REGARDS TO GREEN BONDS

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ABSTRACT:

This study investigates the awareness, willingness, and adoption barriers of green bonds among retail investors in India. The study uses online questionnaire to survey 228 retail investors from four major districts in India using a structured questionnaire comprising of Likert scale and multiple-choice questions. It evaluates the relations among awareness levels with investor willingness to invest in green bonds and also the barriers to adoption of green bonds together with exploring how tax incentives and governmental policies influence funding choices. The research utilized descriptive and inferential statistical methods to extract valuable information from the obtained data. The study points out that the need for government intervention is necessary to promote and endorse green bonds among investors. This can be achieved through introduction of tax benefits and improved regulatory frameworks can encourage higher retail participation. It also identifies adoption hindrances that will enable policymakers to create recommendations for boosting green bond market engagement in India. It contributes to literature by identifying key behavioural and structural barriers that need to be addressed to promote green bonds in India and shaping the path towards sustainable finance. The study concludes that policy-driven awareness campaigns, simplified products, and financial incentives are crucial for stimulating retail engagement in the green bond market

INTRODUCTION

The green passion that seems to sweep the world today has necessitated the development of financial instruments that are friendly to the environment and mitigate climate change. Among these, green bonds have emerged as prominent tools for pooling funds for environment-friendly projects (Singh, 2016). This thesis seeks to research the awareness and adoption levels of green bonds by retail investors in India—a rather underpenetrated market (Prajapati, 2021). Awareness, perceived risk, investment preferences, and demographic variables such as age, income, or educational level are some of the factors influencing the behaviour of a retail investor, according to this study (Joshi, 2023).

While green bonds have witnessed hectic growth worldwide, the scope of green bonds in India, especially for the retail investor, is relatively uncharted (Goswami, 2024). This paper aims to bridge this gap by providing further insights into how retail investors perceive green bonds, experience challenges

in investments, and explore opportunities that exist to enhance participation in this growing market (Prajapati, 2021).

What is a Green Bond?

Green bonds are a type of fixed-income financial instrument designed to raise revenues specifically for projects that deliver positive environmental or climate-related benefits. They provide funding for green projects, including the installation of renewable energy systems, energy efficiency upgrades, sustainable water management, pollution control, and sustainable land use practices (Climate Bonds Initiative, 2023). Unlike traditional bonds, where proceeds can be used for general purposes, green bonds are uniquely structured to ensure that the capital raised is exclusively directed toward green projects that generate measurable environmental impacts (OECD, 2020).

Green bonds have thus taken on a pivotal role in sustainable finance, enabling investors to align their financial strategies with environmental objectives. As nations commit to implementing low-carbon development pathways under international frameworks such as the Paris Agreement, green bonds represent a key point of convergence for cooperative efforts between the public and private sectors. These instruments offer investors not only an opportunity to contribute to environmental sustainability but also a chance to earn competitive returns on their investments (World Bank, 2021).

LITERATURE REVIEW

India and Importance of Green Bonds

India is facing a paradox: rapid economic growth and rising environmental worries. It is expected that the nation's energy consumption and carbon footprint will rise sharply as urbanization, industry, and population expansion pick up speed. Under the Paris Agreement, India has committed to achieving net-zero carbon emissions by 2070, among other ambitious environmental sustainability goals (Government of India, 2021).

It is through raising billions of dollars for sustainable infrastructure, clean transportation, renewable energy, and climate resilience, that these objectives will be reached. According to the Climate Bonds Initiative (2023), the green bonds have been considered one of the strongest financial instruments that can be utilized in financing these projects, aligned with India's goal of implementing $10 billion worth of green projects.

While the Indian green bond market remains relatively small compared to global leaders, its growth since the issuance of the first green bond has been steady. Key issuers have included government agencies like the Indian Renewable Energy Development Agency and major corporations. However, retail investors largely remain outside this market, representing an untapped opportunity (Chatterjee, 2023). Engaging individual investors more effectively could significantly enhance capital inflow, positioning retail participants as pivotal contributors to fostering the green bond ecosystem in India (Pablo, 2021).

The Role of Retail Investors in Green Bonds

The majority are small investors known as individual buyers and sellers. Retail investors of India often take up more relatively smaller investment deals in smaller volume compared to India's institutional investor. A study conducted in recent times reveals an

escalation in retail investing in India driven by rising electronic investment portals and access to wider financial services portfolios, higher penetration of education pertaining to money handling (NSE India, 2023).

Despite this growth, retail investors in India tend to prefer familiar and conventional investment products. As a result, the adoption of green bonds among this group has been minimal due to several challenges:

- **Limited Awareness:** Most retail investors are unaware of green bonds, their purpose, and how these instruments enable financial returns while supporting environmental goals (SEBI, 2022).
- **Perceived Complexity:** Green bonds are usually perceived to be more complex than traditional financial products. Retail investors find it hard to know how the proceeds are utilized and also assess the environmental impacts of their investments (World Bank, 2021).
- **Availability of Green Bonds:** Green bonds are usually issued in large denominations. Therefore, these instruments are only accessible to institutional investors. Retail investors find it hard to access these instruments through traditional investment channels (Business Standard, 2023).
- **Lack of Incentive Perception:** Finances are mostly the driving factors for retail investors. Without material incentives such as extra financial returns or tax deductions, most retail investors may lack the motivation to embrace environmental factors into their investment (OECD, 2020).

The Emergence of the Global Green Bond Market

The green bond market is rapidly growing in the past few years. This can be attributed to increasing demand for sustainable investment options and regulatory requirements for environmental responsibility. In 2021, global green bond issuance surpassed $500 billion, hence the growing recognition of the role capital markets may play in financing climate action (Climate Bonds Initiative, 2023).

Europe is the global leader in the green bond market, and its countries are mainly France, Germany, and the Netherlands. Such leadership is driven by an adequate regulatory framework that includes the EU Green Bond Standard, thus creating and standardizing the market (European Commission, 2023).

In North America, the main contributors to the issuance of green bonds are from the United States, with important contributions from companies and an increasingly growing number of municipal governments. These entities are funding sustainable projects using green bonds, further solidifying the region's presence in this sector (World Bank, 2021).

Asia is becoming one of the big players in the green bond market, with the largest issuers being China and Japan. Another country that might become a key market for green bonds is India, given the enormous and continuous demand for green infrastructure. At the same time, the retail segment in India is still rather underdeveloped, which accounts for a sizeable growth opportunity (OECD, 2020).

Retail Investor Behaviour in India

Traditionally, Indian retail investors have preferred risk-averse investments and have been attracted towards safe avenues, such as

fixed deposits, Public Provident Funds (PPF), and government bonds. In contrast, the availability of online trading sites and internet-based access to financial information is empowering more and more retail investors to explore alternative investment vehicles, such as mutual funds, equities, and corporate bonds (NSE India, 2023).

In India, young investors, with more environmental concern and awareness, exhibit higher levels of interest towards the green investment than others. The concept of green bonds, though new to the Indian financial space, does not attract more involvement from retail investors (SEBI, 2022).

The key factors influencing the decision to invest in green bonds among Indian retail investors are financial education, income levels, and risk tolerance. The primary barrier to adoption is the lack of education about the financial returns and environmental benefits associated with green bonds (World Bank, 2021).

Challenges in Increasing Retail Investor Participation in the Green Bond Market

A few challenges need to be addressed to increase retail investor participation in the green bond market:

Awareness

Retail investors require targeted awareness campaigns to educate them on green bonds; this can be done more sensitively through financial institutions and the government in creating awareness about the benefits of green bonds with more accessibility to retail investors (Climate Bonds Initiative, 2023; EY, 2023).

Access

Green bonds are usually issued with a high ticket, so they are accessed less by retail investors. That constraint could be overcome either by reducing the minimum amount of investment or by developing retail-oriented green bond products (Chandra, S., 2023; RBI, 2022).

Perceived Risk

A retail investor may find green bonds relatively more risk-prone or complex compared to traditional bonds. Financial institutions must provide transparent and easily understandable information regarding risks and returns associated with green bonds (World Bank, 2023; S&P Global Ratings, 2023).

Tax Incentives and Financial Returns

To induct more retail investors efficiently, financial incentives like tax breaks or subsidies for green bond investments could be introduced. Retail investors would be more inclined to invest if there is a pocketable benefit coupled with the perceived environmental good (SEBI, 2021; Kumar, R., 2023).

Increasing Critical Role of Green Bonds in Finance towards Sustainable Global and National Trends

Green bonds are fast becoming an important funding instrument for climate-resilient infrastructure and projects (Climate Bonds Initiative, 2023). Green bond issuances reached more than $500 billion per annum globally, while India has been witnessing constant growth in green bond issuances, with regulatory support and an emphasis on environmental sustainability (Prajapati, D, 2023; RBI, 2022).

However, the Indian green bond market is still largely institutionalized as corporate entities, banks, and public sector undertakings dominate the landscape (SEBI, 2021). Retail participation is quite marginal due to a lack of awareness, accessibility challenges, and inadequate incentives, and understanding these is pertinent to unlocking the retail market (S&P Global Ratings, 2023).

Alignment with Climate Goals

India's net-zero carbon emission target by 2070 requires innovative financing mechanisms for renewable energy, clean transportation, and other clean areas (Government of India, 2021). Green bonds can act as a structured and transparent source of mobilization of resources for these objectives (World Bank, 2023). Growing in numbers and appetite for investing, retail investors might be the turning point in amplifying this impact (Prajapati, D, 2023).

Behavioural Barriers

There are several barriers to the participation of retail investors in the green bond market:

- **Low Awareness**: Most investors lack knowledge about green bonds, what they are for, and what they bring (Climate Bonds Initiative, 2023).
- **Perceived Complexity**: Green bonds are usually perceived as complicated, specialized financial products that require extensive knowledge (World Bank, 2022).
- **Lack of Accessibility**: Green bonds are hardly available on the retail market and are not accessible to small investors (Chandra, S., 2023).

Perceived Lack of Incentives

The retail investor tends to seek known and risk-free products, such as fixed deposits and equity-linked savings schemes (Kumar, R., 2023). To get the retail investor to buy green bonds, the financial incentives that can be provided (tax exemption, for instance) must be identified and effectively communicated with competitive returns (SEBI, 2022).

RESEARCH GAP:

The world's need to fight climate change has led to the creation of sustainable financial instruments such as green bonds, which channel investments into the most environmentally beneficial projects. As per the literature review green bonds have gained significant traction globally, yet their adoption in India is relatively low, with few retail investors participating as opposed to institutional investors. Studies on green finance primarily focus on macro-level aspects, such as market trends, institutional investments, and the overall uptake of financial products This underrepresentation of individual investors is critically important, reflecting the significant gap in unlocking untapped potential retail investors to drive sustainable finance in India. Several factors might be contributing to this gap. First, there might be a lack of awareness among retail investors about the concept, features, and benefits of green bonds, which leads to low engagement. Moreover, literature review has also revealed the scope of checking the impact of perceived barriers such as limited accessibility, lack of competitive returns, and complex product structures on adoption of green bonds. The review of literature has also identified that little exploration has been done on the influence of variables such as age, income, education, and geographic location on the rate of adoption of green bonds. Apart from that it was also noted that although to date the Indian government has initiated various policies and incentives like tax benefits and sovereign green bonds, the full

extent of how such actions affect retail investors' participation is inconclusively analysed.

OBJECTIVES OF THE STUDY:

- To examine the level of awareness and understanding of green bonds among retail investors in India
- To examine the impact of perceived barriers such as accessibility, returns, and product intricacy on the adoption of green bonds by retail investors.
- To assess the influence of demographic factors such as age on adoption of green bonds.
- To evaluate the effectiveness of government policies and incentives in promoting green bond investments in India.

RESEARCH METHODOLOGY:

This paper adopts a descriptive research methodology. The data collection instrument was a structured questionnaire and the respondent were selected through convenience sampling method. Convenience sampling was adopted as it helped save considerable time and was also comparatively cost-effective in collection of data especially from 228 young investors retail investors in India with varying levels of knowledge about financial markets and investment options, particularly green bonds. Efforts were made to include individuals from diverse demographic backgrounds from four districts of India including Ahmedabad, Bangalore, Madras and Chhattisgarh ensuring a comprehensive representation of the target population.

The survey was conducted through digital platforms, and tools such as Google Forms were used to collect data efficiently. Links to the questionnaire were shared on social media platforms like WhatsApp, LinkedIn, and investment-related forums to reach a maximum number of people. The questionnaire was live for 10 days, and responses were collected from 228 participants.

Data Instrument:

The data collection instrument which was a structured questionnaire included mainly two types of questions- i.e. Likert scale and multiple-choice questions.

Likert Scale Questions: - These questions were applied to test familiarity, perceptions, and willingness in one of five categories - a scale of 1 to 5, where 1 is marked as "Strongly Disagree" and 5 marked as "Strongly Agree."

Multiple Choice Questions: These questions were put to gather data on demographics and investment preference. For instance, "Which of the following best describes your current investment portfolio?" with categories such as stocks, mutual funds, bonds, or fixed deposits.

Variables of the study:

The independent variables of the study are age, awareness level, income level, perceived risk, accessibility of green bonds, perceived returns, government incentives (tax exemptions), and product complexity. The dependent variables of the study adoption/willingness to invest and pperception about green bonds. Geographical location and type of investor (student, employed, etc)

The data collected was analysed by frequency tables, Chi Square test and Mann Whitney U test and Wilcoxon Signed Rank Test using SPSS (Statistical Package for the Social Sciences).

Reliability Test

Table-1

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha based on Standardized Items	No of Items
0.803	0.813	15

The Reliability test measures the consistency and stability of the test questionnaire. The method used here Cronbach's Alpha which studies the internal consistency of a set of items to determine their reliability. For the same responses collected through a pilot study of 30 respondents was used. The Cronbach's Alpha value of 0.803 as shown in table-1 is a high reliability score. It assures that the questions have good internal consistency. The questionnaire thus demonstrated statistical reliability.

FINDINGS THROUGH DESCRIPTIVE ANALYSIS:

Awareness and Perception of Green Bonds

The study has shown that a major portion of the retail investors in India remains uninformed about green bonds. With the rising global momentum towards sustainable finance, most individual investors either are not aware of green bonds or are unaware of the underlying mechanism of such bonds. Perception of green bonds as an investment avenue is still limited, and they are mainly considered to be financial instruments that are suited only for institutional investors or for financing large corporate companies.

One of the most important trends observed was that younger investor, especially those between 18 and 25 years old, were more aware and interested in green bonds than older age groups. This may be due to the growing environmental awareness among the younger generation and their increased exposure to digital financial platforms, which often feature sustainable investment products.

Nonetheless, many investors still view green bonds as overly complex financial instruments, reflecting a necessity of deep comprehension in the sustainability metrics and project impact assessments. It was also determined that, for retail investors, environmental benefits of green bonds are associated in high proportions but less cognizant on the expected financial return. Therefore, there is a hesitation among many to consider green bonds as an investment option.

Adoption Barriers

Lack of Information- The other main challenge is that information regarding green bonds is not easily available and is quite limited. Compared to other conventional financial products such as fixed deposits, mutual funds, or even stocks, green bonds are not marketed or advertised much to retail investors. Not many people are aware of the existence of these products, nor are they informed about the benefits that these offers. This severely hampers the interest as well as adoption levels.

Low Accessibility- They are also usually issued in large denomination that is difficult for small retail investors to purchase. Institutional investors, for example, pension funds and banks are often the big players in

such a market, leaving very little room for an individual investor. Dedicated green bond funds or low denomination green bonds are also not available, thus competing more firmly with the retail investors.

Subjective Risk- Green bonds are perceived to be riskier than traditional fixed-income instruments by retail investors due to the uncertainties of the projects they finance. Many people do not know whether green infrastructure projects, such as renewable energy developments or water conservation initiatives, will yield stable returns over time. Moreover, there is a concern about greenwashing, where companies claim environmental benefits that are not real, thus adding to the skepticism of green bond investments.

Hypothesis Testing and Data Analysis:

Chi-square analysis: To test relationship between age and awareness about green bonds**.**

HYPOTHESIS-

H_0: There is no relationship between age and the awareness about green bonds.

H_1: Age has a significant relationship with the awareness about green bonds.

Table-2

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.19	12	0.35
Likelihood Ratio	27.67	12	0.006
No of valid cases	228		

Source: Primary SPSS Output

Table-3

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	0.502	0.035
	Cramer's V	0.290	0.035
No of Valid Cases		228	

Source: Primary SPSS Output

The Chi-Square value of 22.190 and p-value of 0.035 on the Chi Square Test results confirm that there is a significant relationship between age and green bond awareness and thus rejects the null hypothesis. Another way to see this is with the highly significant p value of the Likelihood Ratio Test (with p value <0.01 even further reinforced By a Phi coefficient (0.502) and Cramér's V (0.290), it is also indicated that there is a good association and the awareness of green bonds varies among age groups. This, in turn, verifies the need to promote age specific awareness initiatives that will increase people's knowledge and involvement with sustainable investment.

Interpretations:

The test results reveal that age is significantly associated with awareness of green bonds. Younger individuals (e.g., 18–25) are more likely to be aware of green bonds compared to older groups. The symmetric measures (Phi and Cramér's V) suggest a moderate relationship strength between age and awareness. These findings suggest that targeted awareness campaigns for older age groups might be beneficial to increase overall knowledge about green bonds and related policies.

MANN-WHITNEY U TEST

Hypothesis Testing

H_0-There is no significant difference in people's decision to adopt green bonds based on whether the government introduces incentives such as capital gains tax exemptions on green bonds

H_7-There is a significant difference between people's decision to adopt green bonds based on if the government introduces incentives such as capital gains tax exemptions on green bonds.

Findings:

Significance Level: The p-value (0.001) is much smaller than the standard significance threshold (0.05). This indicates a statistically significant difference between the two groups who consider investing in green bonds based on whether they are backed by government incentives. considering portfolio with respect to their scores on investfgovtpolicies.

The above findings through the Mann Whitney U Test are supported and aligned with the percentage analysis and its findings as shown below:

Targeted question in the questionnaire**:**

I would consider green bonds as a long-term investment if the government introduced incentives such as capital gains tax exemptions.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

Table-4

Test Statistics	
Mann-Whitney U	123.000
Wilcoxon W	259.000
Z	-3.221
Asym.Sig. (2-tailed)	0.001

Source: Primary Data (SPSS output)

Diagram-1 (Pie-Chart Analysis)

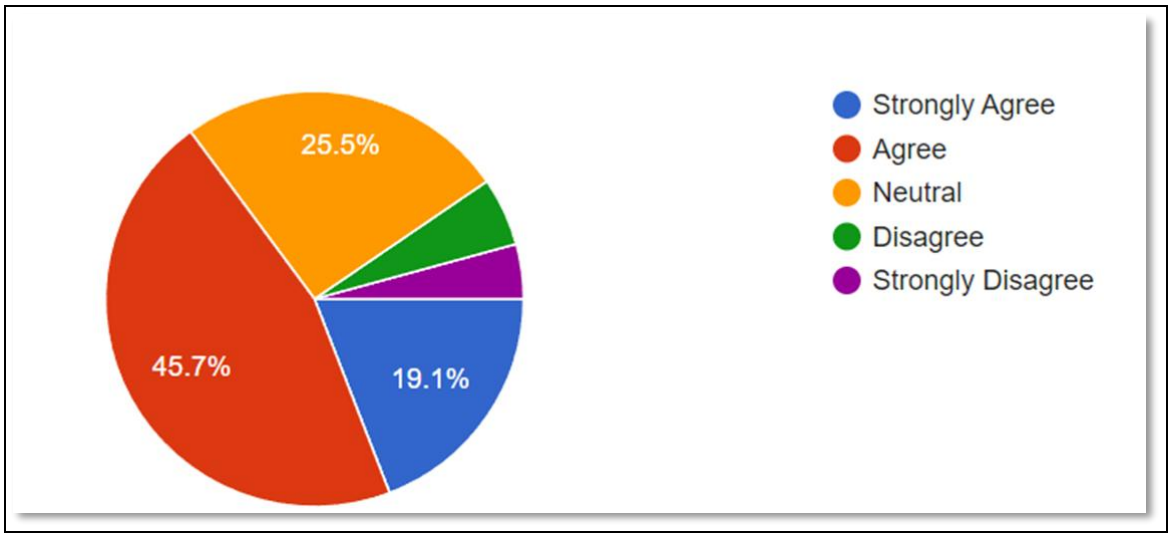

Table: 5

Test Statistics		
Z	-3.029	-3.434
Asmp.Sig (2-tailed)	0.002	<0.001

Source-Primary-SPSS Output

The pie chart represents respondents' willingness to consider green bonds as a long-term investment if the government introduced incentives such as capital gains tax exemptions. The distribution of responses is as follows:

- Strongly Agree (Blue - 19.1%)
- Agree (Red - 45.7%)
- Neutral (Orange - 25.5%)
- Disagree (Green - Small percentage)
- Strongly Disagree (Purple - Small percentage)

INTERPRETATION

High Positive Sentiment (64.8%)

- A majority (45.7% Agree + 19.1% Strongly Agree) support the idea that tax incentives would encourage them to invest in green bonds.
- This suggests that a large proportion of investors see financial benefits in government-backed green bonds and would be more likely to invest if favorable tax policies were introduced.

Neutral Stance (25.5%)

- One-fourth of respondents remain neutral, indicating that while they may not be opposed to the idea, other factors (such as risk perception, liquidity, or awareness) may influence their decision.

Low Opposition (Disagree & Strongly Disagree - Small Percentage)

- Very few respondents outright disagree or strongly disagree, suggesting minimal resistance to the introduction of tax incentives for green bonds.
- Those who disagree may not view tax exemptions as a sufficient motivator or may have concerns about the reliability and profitability of green bonds.

Recommendations: Strong government intervention through tax exemptions or subsidies could significantly boost green bond adoption, as over 64% of respondents are inclined to invest under such conditions.

WILCOXON SIGNED RANKED TEST:

Hypothesis Testing

H_0: There is no significant difference between people's decision to adopt green bonds based on whether they are backed by govt securities

H_3: There is a significant difference between people's decision to adopt green bonds based on whether they are backed by govt securities

FINDINGS & INTERPRETATION:

The Wilcoxon Signed-Rank Test evaluated how investors prefer government-backed securities versus investing government policies in their portfolios. The statistical values of -3.029 (-3.434) demonstrate the continuous inferior ranking distribution between the two categories. Investors demonstrate sizeable distinctive preferences between choosing between these two investment alternatives.

These findings gain additional support through the p-values of The Asymptotic Significance (2-tailed). The results obtained for government-backed securities confirm a significant difference between their investment ranking and other factors with a p-value at 0.002 while investing in government policies exhibits an exceptionally significant difference when p-value reaches below 0.001. The test concludes that the observed differences in preferences exceed experimental chance because both p-values fall below 0.05. Investors treat government-supported securities differently from purchasing government policies because their ranking perceptions depend on risk attitudes combined with trust elements and anticipated returns.

CONCLUSION:

Green bonds have a strong growth potential but are still underutilized by retail investors due to low awareness about it, accessibility issues with respect to green bonds, and lack of direct financial incentives. The study confirms that retail investors in India possess limited awareness of green bonds despite the rising importance of green bonds in global sustainable finance. It was found that young, urban, and higher-income investors show the highest interest in green bonds, and therefore targeted awareness campaigns for all age groups are important. The study also revealed that investors prioritize financial security and tangible returns over environmental benefits when making investment decisions

The study also points out the need for government intervention which is necessary to promote and endorse green bonds among investors. This can be achieved through introduction of tax benefits and improved regulatory frameworks can encourage higher retail participation. More than 64% of respondents expressed readiness to invest if tax benefits such as capital gains exemptions were introduced. The Wilcoxon Signed Rank Test confirmed that investors trust government-backed securities more than

private-sector green bonds. Accessibility emerged as a key barrier, as green bonds are often issued in high denominations, excluding small investors. Green bonds need to be made easily accessible by providing the same in small denominations and as an integral part of the mainstream investment products of financial institutions and fintech platforms. Thus, financial education, effective marketing, and regulatory incentives would work well in promoting adoption. Green bonds are going to be a mainstream investment choice in India.

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Declaration by the Author:

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AN EMPIRICAL STUDY ON RISK PERCEPTION, LOSS AVERSION, AND RISK TOLERANCE IN THE CRYPTOCURRENCY MARKET.

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ABSTRACT:

This paper aims to determine the risk perception, herding behaviour, and risk tolerance on investment decisions within the cryptocurrency market, focusing on investors in two major cities in Karnataka. Regression analysis on survey dat from115 participants, the study reveals that loss aversion significantly and positively impacts risk perception, while risk tolerance exhibits significant negative relationship. Herding behaviour shows positive but marginally significant influence. Demographic factors such as gender, age, investment experience and income were found to be statistically insignificant predictors in the regression model. The findings highlight the importance of understanding psychological factors in cryptocurrency investment decisions, highlighting the requirement for investors to consider their risk profiles and behavioural biases. The research contributes to the growing body of knowledge on behavioural finance context of digital assets, offering insights for both individual investment strategies and regulatory frameworks.

KEYWORDS*:* Cryptocurrency, Risk tolerance, Herding behaviour, Risk Perception

INTRODUCTION:

The cryptocurrency market has emerged as a revolutionary force in global financial systems, distinguished by its decentralised nature, extreme volatility, and unprecedented growth over the last decade. Born from the development of blockchain technology and the debut of Bitcoin in 2009, cryptocurrencies have since become an intriguing but divisive asset class, appealing to both seasoned investors and newcomers. However, their intrinsic volatility and speculative character complicate understanding investor behaviour, risk dynamics, and decision-making processes. This study aims to investigate the complex links between risk perception, loss aversion, and risk tolerance in the Bitcoin market, yielding insights that can be used in both academic research and practical applications. This paper highlights the risk perception of cryptocurrency users. This study surveys investors who have invested in cryptocurrency for several years. The cryptocurrency market has evolved as a vibrant and volatile asset class, attracting the interest of investors, financial analysts, and authorities throughout the world. This market, with its decentralised character and quick price volatility, offers unique difficulties and opportunities for both rookie and experienced investors. Unlike traditional asset classes, cryptocurrencies

are driven by a combination of technology innovation, speculation, and market sentiment, resulting in significant uncertainty and risk. These characteristics make it critical to understand the psychological and behavioural aspects that influence investment decisions in this domain.

Cryptocurrencies, as a unique mode of exchange created by the internet having no physical form, are potentially bringing a revolution in the social structure of the world financial system. Previous studies have identified several factors that influence investment decisions. Risk perception is a factor that influences investment decisions. According to, (Rachel Halim et.al), risk perception positively impacts investment decisions by providing individuals with more knowledge about risk and allowing them to modify their rate of return. Cryptocurrency and blockchain have gained more attention from investors in many countries. This paper highlights the risk perception of cryptocurrency users. This study surveys investors who have invested in cryptocurrency for several years.

Risk perception, loss aversion, and risk tolerance are all important behavioural characteristics that influence how investors interact with the bitcoin market. Risk perception refers to an investor's subjective assessment of the uncertainty and potential losses connected with an investment. In a highly volatile market such as cryptocurrencies, perceived risks frequently outweigh possible returns, impacting investing decisions. Loss aversion, a tenet of behavioural finance, defines people's proclivity to value losses more severely than similar gains. This bias can result in inefficient decision-making, especially in volatile markets where investors may overreact to market declines. Risk tolerance, on the other hand, measures an individual's readiness to take risks in the quest of financial benefit. This attribute varies substantially among investors, and is frequently influenced by demographic, psychological, and situational factors.

Because of its speculative nature and vulnerability to herding behaviour, media influence, and significant price volatility, the bitcoin market is an excellent setting for investigating these behavioural traits. This study attempts to provide a detailed understanding of the psychological drivers driving cryptocurrency investment decisions by investigating how risk perception, loss aversion, and risk tolerance interact in this market. This knowledge can help to shape both individual investment plans and regulatory frameworks, resulting in a more informed and resilient investor base.This research presents an empirical investigation into these behavioural components, using a structured approach to determine their impact on bitcoin investment decisions. This study adds to the growing body of knowledge on behavioural finance theories and statistical analysis.

Blockchain technology, originally conceived for a digital cash system (Nakimoto, 2008), has gained popularity in other businesses. Along with other cryptocurrencies, Bitcoin has triggered many academic discussions. Some of these studies focus on cryptocurrency economics and provide evidence of the presence of cryptocurrency market bubbles (Tong Fang, Zhi Sub, Libo Yin 2020). Investment decision-making based on those factors is

quite difficult and intricate for investors, hence seeking expert advice is more pragmatic in these circumstances. Moreover, the recent developments and enormous growth of artificial intelligence applications in financial services are well suited for client's needs in terms of transparency, cost efficiency, and accessibility(Zeeshan Ahmed 2022).

Research in behavioral finance suggests that investors are more sensitive to losses than gains. Research by Kahneman, Knetsch, and Thaler [1990] and Tversky and Kahneman [1992] suggests that losses are valued twice as much as gains. Losing $100 has nearly double the usefulness of getting $100.4 Kahneman and Tversky [1979] identified loss aversion as a component of prospect theory.

Financial research frequently investigates and tests predicted aspects that influence investment decisions and risk perception. As previously stated, the choice process is complex and cannot be explained solely by the risk-return connection. This research focuses on characteristics that influence individual investors' investment preferences and risk perceptions. Investment preferences differed based on financial literacy and perceived risk.

Loss aversion is based on the idea that investors assign more weight to losses than they do to gains. According to prospect theory,(Kahneman and Tversky [1979]) an individual evaluates an alternative of losses and gains based on an acceptable reference point (or anchor) in dollar terms related to the loss aversion concept. An emerging topic of examination by behavioral finance researchers concerns evaluating an inverse Risk Perception and Risk Tolerance relationship between perceived risk and return. Ricciardi (2010) provides a more extensive discussion of risk perception. This study focused solely on how structuring an asset as a cryptocurrency or stock affects risk perception (Bas Robbemond 2022). To be sure, we blend the technology acceptance model with the prospect theory to aid us in our understanding of this important decision (Uma Sridharan et al, 2023). Investors in the Cryptocurrency market have distinct obstacles and opportunities. Unlike traditional assets like stocks and bonds, cryptocurrencies are mostly unregulated, extremely speculative, and subject to abrupt market movements caused by news, sentiment, and technological breakthroughs. These traits emphasise the psychological aspects of investment behaviour. Scholars continue to dispute how investors perceive risk, respond to losses, and tolerate uncertainty in the search for returns. By investigating these psychological and behavioural components, this study hopes to contribute to the burgeoning literature on behavioural finance while also providing a better understanding of the Cryptocurrency market's unique ecosystem. Even though the cryptocurrency industry is growing quickly, investors still face a lot of uncertainty because of its high volatility, lax regulation, and behavioural biases that skew logical judgement. What psychological elements like risk perception, loss aversion, and risk tolerance affect investors' attitudes towards cryptocurrencies is not adequately explained by conventional financial theories. The purpose of this study is to investigate how these behavioural factors and demographic traits interact to influence how risk is perceived by Karnataka bitcoin investors. It specifically

aims to determine the most important predictors influencing investors' investment decisions and evaluate the impact of behavioural elements such as risk tolerance, loss aversion, and herding behaviour on investors' perceptions of risk.

The research aims to find the difference in risk perception based on whether an investment is framed as a cryptocurrency. The goal of this research is to extend the literature on framing and financial decision-making: financial risk perception, and cryptocurrency. The research question that follows is: Is there a link between confidence in cryptocurrency market returns and perceived investment risk?
To what extent does loss aversion influence investors' risk perceptions in Cryptocurrency investments?
How does herding behaviour affect investors' risk perceptions in the Cryptocurrency market? Do those who hold or have owned cryptocurrencies think it's less risky?

LITERATURE REVIEW

Theoretical framework and important works in behavioural finance:
A recent study has focused on risk perception in cryptocurrencies, reflecting both the volatility character of the market and the various factors impacting investor opinion. Recent research has shown that risk perception in cryptocurrencies is influenced by a combination of market dynamics, legislative developments, and media attention. Bouri et al. (2023) discovered that regulatory notifications and high-profile security breaches dramatically raise perceived risk, resulting in higher market volatility.

Loss aversion, first described by Kahneman and Tversky (1979) in Prospect Theory, refers to people's tendency to experience the pain of losses more strongly than the pleasure of similar gains. In the cryptocurrency market, this behavioural bias reveals itself in how investors react to market downturns, which frequently results in panic selling during price drops. According to Liu and Tsyvinski's (2021) research, the speculative character of the cryptocurrency market exacerbates loss aversion, resulting in illogical decision-making and heightened emotional responses. Furthermore, Corbet et al. (2023) highlight the significance of social media in determining risk perception, stating that positive or negative opinions on platforms such as Twitter can influence investor confidence and market behaviour. Furthermore, psychological factors like as fear of missing out (FOMO) and overconfidence play critical roles in how investors perceive the risks connected. Transacting in cryptocurrency is essentially the decision to adopt a new technology. The technology acceptance model in information systems (Davis 1988) suggests that perceived usefulness and perceived ease of use of the technology drive adoption. (Uma Sridharan et al, 2023). Behavioral finance has been extensively studied using cognitive psychology to understand thinking, perception, and decision-making. Research in behavioral finance suggests that investors are more sensitive to losses than gains. Research by Kahneman, Knetsch, and Thaler [1990] and Tversky and Kahneman [1992] indicates that losses are valued twice as much as gains. In this paper, we study how individual investors perceive risk by asking individual experimental questions to cryptocurrency investors across Bangalore and Davanagere city. The

concept of risk perception originated in behavioral and decision science (Slovic, 1987; Slovic, Fischhoff, & Lichtenstein, 1982) Slovic stated that "studies of risk perception examine the judgments people make when they are asked to characterize and evaluate hazardous activities and technologies.". The interaction of socio-demographic factors and rational decision theory has been widely explored, resulting in the identification of socio-demographic factors' influence on rational decision-making (Goll and Rasheed, 2005; Mathanika et al., 2018). Savage (1992) investigated demographic influences on risk perception.

Academics are increasingly interested in understanding the elements that impact investors' risk perception and attitudes, motivated by these theories in the field of behavioural finance. Behavioural finance, which studies the impact of psychological aspects on financial decisions, highlights limitations in traditional finance models. According to Almansour (2015), existing models fail to account for investors' irrational behaviour, leading to poor investment decisions. Behavioural finance theories suggest that cognitive biases including overconfidence, loss aversion, and herd mentality can influence investors' decisions, leading to irrational investments (Bashar Yaser Almansour et al., 2023). According to Areiqat et al. (2019), the relationship between behavioural finance and investment decision-making is mediated by investors' perception and evaluation of risk. Overconfident investors may see a risky investment as less risky than it is, increasing the likelihood of making unsuitable investments. Loss-averse investors may overestimate the danger of a low-risk investment, missing out on potential benefits.

The literature on behavioural finance is divided into five strands that focus on different aspects of risk perception and investment decision-making. (Bashar Yaser Almansour et al., 2023) The first stand investigates the Herding behaviour as studied.Another important factor determining investment behaviour is risk tolerance, or the capacity of an individual to withstand monetary losses in exchange for possible profits. Age, income, and financial literacy are some demographic variables that affect it (Grable & Lytton, 1999). Chuen et al. (2017) discovered that younger investors, who are more likely to welcome innovation and volatility, have a higher risk tolerance for cryptocurrencies. However, even the most risk-tolerant investors are frequently put to the test by the tremendous volatility of cryptocurrencies, which affects their long-term market participation. This paper emphasises the necessity for further empirical research into these constructs in the bitcoin market. By incorporating these behavioural finance principles, researchers can provide useful insights into the psychological basis of investment decisions in one of the most unpredictable financial markets.

Risk propensity and behavioural biases:

Risk propensity and behavioural bias are significant influences on decision-making processes, particularly in financial circumstances. An individual's predisposition to take or avoid risks, known as risk propensity, can substantially impact their financial decisions and tactics. Behavioral biases, such as overconfidence, loss aversion, and herd behaviour, exacerbate these judgments by producing

systematic deviations from rationality (Saivasan & Lokhande, 2022a). Overconfidence, for example, can induce investors to undervalue risks and overestimate their knowledge or influence over outcomes. In contrast, loss aversion might force them to hang onto lost assets to prevent losses unreasonably. Understanding the relationship between risk propensity and behavioral biases is critical for designing methods to reduce irrational decision- making and improve financial results. As per Oxford Learner's Dictionary (2021), "risk" is defined as "the possibility of something bad happening at some time in the future". Risk propensity in common parlance is an individual's attitude towards variability in outcomes. According to Hung and Tangpong (2010), risk propensity is a characteristic that influences the individual to take or avoid risks (Saivasan & Lokhande, 2022a) . High-risk tolerance mixed with low-risk perception may result in speculative investments with the potential for large rewards, whereas low-risk tolerance combined with high loss aversion may lead to conservative methods or market exit during downturns.

Investors knowledge and risk tolerance:

Investors' understanding and evaluation of investment possibilities depend on their investing knowledge. Financial illiteracy is a prevalent issue that contributes to the worldwide wealth and participation divide (Baeckström et al., 2024). Individuals with high financial literacy tend to make better investment decisions and achieve higher risk-adjusted returns than their less aware colleagues. Financial education can help individuals accept investing risks (Bianchi, 2018). Knowledge generated from prior investment experience significantly explains some of the variables as such, investment knowledge is an important determinant in financial investing and acceptance of investment risk. There is still much to learn about how risk perception, loss aversion, and risk tolerance interact in the Bitcoin market. Research shows that these elements interact to influence total investing behaviour rather than acting alone.Objective of the Study:

- To examine the role of demographic factors in shaping investor's risk perception towards Cryptocurrencies
- To assess the impact of behavioural factors such as herding behaviour, risk tolerance and loss aversion on investors perception of risk
- To establish the relationship between these behavioural and demographic variables and investors overall perception of risk in the volatile Cryptocurrency market.
- To identify the most significant predictors of investors risk perception through regression analysis.

METHODOLOGY:

Research Design:

This study employs a descriptive research design to explore the influence of behavioral and demographic factors on investors' perception of risk within the cryptocurrency market. The chosen design is well-suited to systematically examine the relationships among key variables such as herding behavior, risk perception, loss aversion, and risk tolerance without involving experimental interventions. The primary objective is to observe and characterize naturally occurring patterns

and associations among investors rather than to infer causal links. This approach enables a comprehensive understanding of how psychological traits and individual characteristics collectively shape investment attitudes and decision-making processes in a highly volatile and uncertain market context.

Participants and Procedure

A descriptive research design was adopted to examine the factors influencing investors' risk perception in the cryptocurrency market. The study utilized a convenience sampling technique to recruit participants from two major cities in Karnataka. Convenience sampling was chosen due to its practicality and efficiency in collecting data within the constraints of time and available resources. This method is particularly suitable for exploratory research in specific geographical areas, as it facilitates the recruitment of willing and accessible respondents.

Participants were required to meet eligibility criteria, including being at least 18 years of age, having investment experience in cryptocurrencies, and possessing a stable source of income. Data collection was conducted using a structured online questionnaire administered via Google Forms. The survey link was distributed to 150 potential respondents, of which 115 completed valid and comprehensive responses, resulting in a satisfactory response rate.

To ensure thorough coverage of the research objectives, the questionnaire was systematically divided into several sections, each addressing specific aspects of the study into five sections as below:

Table: 1 Variables

Variable	No. of item	Example Item	Primary source
Herding Behaviour	5 Items	I tend to follow the investment decisions of other investors while investing in Cryptocurrencies	Halim and pamungkas (2023); Saivasan and Lokhande (2022)
Risk Perception	5 items	Investing in cryptocurrencies involves a high degree of risk compared to other forms of investment.	Özyeşil and Tembelo (2024); Singh and Bhowal (2010); Siegrist and Árvai (2020)
Loss Aversion	3 items	The amount of losing money on a cryptocurrency investment is greater than the pleasure of an equivalent gain	Kahneman and Tversky (1979), Liu and Tsyvinski(2021), Corbet et al (2023)
Risk Tolerance	3 items	I am willing to accept high level of risk in cryptocurrency investments for the chance of high returns.	Grable and Lytton (1999), Aren and Zengin (2016), Sridharan et el. (2023)
Demographic Variables	7 items	Gender, Age, Education, Employment Status, Annual Income, Investment Experience, Frequency of Investment	Self-developed (based on prior demographic frameworks in behavioural finance studies)

All behavioural variables were measured using a 5-point Likert scale ranging from 1= Strongly Disagree to 5= Strongly Agree, adapted from validated scales in prior behavioural finance and cryptocurrency investment studies. The responses were subsequently analysed using reliability tests (Cronbach's Alpha), normality assessment, and regression analysis to explore relationship among the identified variables.

Measures:

Table 2: Demographic Information of the sample

	N	%
Gender		
Male	94	81.7%
Female	21	18.3 %
Age		
18-24	25	21.7%
25-34	52	45.2%
35-44	34	29.6%
45-54	4	3.5%
Level of Education		
Bachelor's degree	42	36.5%
Master's degree	65	56.5%
Doctoral degree	8	7.0%
Level of employment		
Employed	58	50.4 %
Self-employed	43	37.4 %
Student	10	8.7 %
Retired	4	3.5 %
Annual Income		
Less than 20000	9	7.8%
20000-49000	26	22.6%
50000-99000	24	20.9%
100,000-1,50,000	56	48.7%
Resident		
Bangalore	101	87%
Non-resident of Bangalore	14	12.2%

Investment Experience		
Less than 1 year	27	23.5%
1-3 years	48	41.7%
4-6 years	38	33%
More than 6 years	2	1.7%
Frequency of Investment		
Weekly	22	19.1%
Monthly	58	50.4%
Occasionally	35	30.4%
Primary Source of Information		
Social media	33	28.7 %
News Websites	21	18.3 %
Financial Advisors	13	11.3 %
Friends and Family	48	41.7 %

Table 2. presents the demographic parameters in three columns. The first column describes each variable, with gender, residence, qualification, and experience as control variables. The second and third columns show the frequency and percentage of these specific control variables.

Prior to final data collection, the questionnaire underwent expert review by two academicians in the field of behavioural finance to ensure content validity and clarity of wording. A pilot test involving 30 respondents was conducted to refine the language and ensure reliability.

The reliability of the instrument was later confirmed using Cronbach's Alpha, with all constructs showing acceptable internal consistency ($\alpha > 0.70$). The questionnaire design thus provided a comprehensive framework to ensure the psychological and demographic factors which influencing investors' risk perception in the cryptocurrency market.

ANALYSIS AND RESULTS

Herding Behaviour:

	Mean	SD	Cronbach's α
scale	3.34	0.705	0.723

	Mean	SD	Item-rest correlation
H1	2.64	1.208	0.412
H2	3.12	1.043	0.49
H3	3.72	0.858	0.461
H4	3.94	0.89	0.501
H5	3.3	1.074	0.585

The "Herding Behaviour" scale, which measures how much cryptocurrency market investors are influenced by the choices or actions of others, is shown in the above table along with its descriptive statistics and item-rest correlations. With a standard deviation of 0.705 and an overall mean score of 3.34 on the herding behaviour scale, the participants exhibit a moderate degree of herding behaviour. The scale's Cronbach's alpha is 0.723, indicating that the items taken together offer accurate assessments of herding behaviour and indicating acceptable internal consistency.

Risk perception:

Scale Reliability Statistics

	Mean	SD	Cronbach's α
scale	3.59	0.763	0.752

Item Reliability Statistics

	Mean	SD	Item-rest correlation
P1	3.44	1.110	0.598
P2	3.68	0.999	0.446
P3	3.68	0.978	0.653
P4	3.64	1.102	0.377
P5	3.50	1.182	0.539

The results show that the entire scale has a mean of 3.59, indicating that respondents generally agree with the items and have moderate perceptions about the concept being measured. The SD of 0.763 indicates moderate variability in responses, while Cronbach's Alpha (α) of 0.752 indicates strong internal consistency and reliability of the scale. At the item level, P1(Risk perception) has a mean of 3.44 and the greatest item-rest correlation (0.598), indicating that it contributes significantly to overall dependability.

P3 is the most dependable contributor to the total scale, according to the research, which shows that it has the highest item-rest correlation (0.653). P3 successfully captures a significant component of the construct it is assessing, as indicated by the mean score of 3.68, which indicates a general agreement among respondents and probably reflects a consistent impression or attitude shared by the majority of participants. P3 is regarded as extremely reliable and is essential to maintaining the scale's dependability due to its high item-rest correlation and the strong agreement it generates.

On the other hand, P4 has the lowest item-rest correlation (0.377), indicating that it makes the least contribution to the scale's internal consistency. P4 may not be as closely matched with the other items in measuring the same underlying construct, according to its comparatively low correlation. It can mean that respondents interpret P4 differently or that it does not capture the desired feature of risk perception as well as other items. There may possibly be some variation in participants' comprehension or reactions to P4, as evidenced by the lower item-rest correlation. In light of this, P4 may require additional examination or improvement in order to better align it with the broader scale and increase its contribution to the construct being measured.

Future studies should look at possible explanations for P4's weaker correlation and consider modifications to better capture the pertinent aspects of risk perception.

Loss Aversion:

Scale Reliability Statistics

	Mean	SD	Cronbach's α
scale	3.74	0.861	0.800

Item Reliability Statistics

	Mean	SD	Item-rest correlation
L1	3.62	0.987	0.761
L2	3.92	0.853	0.609
L3	3.68	1.186	0.611

The total scale has a mean of 3.93, showing that respondents typically agree with the items, implying a slightly positive or strong view of the construct under consideration. The standard deviation (SD) of 0.830 indicates substantial diversity in respondents' answers. The Cronbach's

Alpha (α) of 0.738 demonstrates adequate internal consistency, indicating the scale is fairly dependable. At the item level, L1 (Loss aversion) has the highest item-rest correlation (0.761) and a mean of 3.62, showing that it significantly contributes to the scale's overall dependability. L2 has the greatest mean (3.92) but a somewhat lower item-rest correlation (0.609), indicating that respondents agree more with this item, even though it contributes less to internal consistency than L1. The mean for L3 is 3.68, and the item-rest correlation is 0.611.

Risk tolerance:

The total scale has a mean score of 3.93, showing that respondents typically agree with the items, implying a somewhat good opinion of the issue evaluated. The scale has moderate variability in responses (SD = 0.830) and acceptable internal consistency (α = 0.738), indicating reliability. At the item level, T2 (Risk Tolerance) has the highest item-rest correlation (0.654) and a mean of 3.94, indicating that it contributes significantly to the scale's overall dependability and that respondents generally agree with it. T1 has a mean score of 3.76 and an item-rest correlation of 0.553, indicating a significant contribution to internal consistency. T3, with a mean of 4.10 (the highest among the items), demonstrates substantial agreement by respondents.

Regression Analysis:

A multiple linear regression was conducted thought Jamovi Software to examine the influence of behavioural and demographic variables on investors' perception of risk in the cryptocurrency market. The dependent variable was Risk Perception, while Herding Behaviour, Loss Aversion, Risk Tolerance, Age, Gender, Income, and Investment Experience served as independent variables. The overall regression model was statistically significant, $F(7,107) = 8.365$, $p < 0.001$, indicating that the set of predictors reliably explained variations in risk perception. The model accounted for 35.4% of the variance in the dependent variable ($R^2 = 0.354$, Adjusted $R^2 = 0.311$). The regression coefficients, standard errors, t-values, and significance levels are presented in Table below.

4. Scale Reliability Statistics

	Mean	SD	Cronbach's α
scale	3.93	0.830	0.738

Item Reliability Statistics

	Mean	SD	Item-rest correlation
T1	3.76	1.080	0.553
T2	3.94	1.018	0.654
T3	4.10	0.974	0.489

Table 3: Regression Analysis

Predictor Variable	Unstandardized Coefficient (B)	Std. Error	t-value	p-value	95% Confidence Interval
(Constant)	**2.148**	0.734	2.927	**0.004**	[0.689, 3.608]
Herding Behaviour	0.140	0.082	1.707	0.091	[−0.023, 0.303]
Loss Aversion	**0.458**	0.083	**5.500**	**<0.001**	[0.293, 0.623]
Risk Tolerance	**−0.170**	0.085	**−2.008**	**0.047**	[−0.338, −0.002]
Age	−0.001	0.012	−0.083	0.934	[−0.026, 0.024]
Gender (0=Female,1=Male)	−0.013	0.314	−0.040	0.968	[−0.635, 0.610]
Income (₹ in thousands)	−0.004	0.003	−1.611	0.110	[−0.009, 0.001]
Investment Experience (years)	−0.027	0.062	−0.438	0.662	[−0.149, 0.095]

Source: Jamovi Software

The results indicate that Loss Aversion and Risk Tolerance are significant predictors of investors' risk perception. Loss Aversion (B = 0.458, p < 0.001): A positive and highly significant relationship, suggesting that investors who are more sensitive to potential losses tend to perceive higher risk in cryptocurrency investments. Risk Tolerance (B = −0.170, p = 0.047): A significant negative relationship, indicating that investors with higher tolerance for risk perceive cryptocurrencies as less risky. Herding Behaviour (B = 0.140, p = 0.091): Exhibits a positive but marginally significant relationship, implying that individuals influenced by others' decisions may perceive slightly greater risk, though evidence is weaker. Age, Gender, Income, and Investment Experience were not statistically significant predictors in this model. Diagnostic tests confirmed the model's robustness. The Variance Inflation Factor (VIF) values ranged from 1.00 to 1.18, suggesting no multicollinearity. The Shapiro–Wilk test indicated that the residuals were normally distributed (W = 0.987, p = 0.321), and the Durbin–Watson statistic (1.97) confirmed the absence of autocorrelation.

FINDINGS:

The empirical analysis revealed significant behavioural determinants shaping cryptocurrency investors' risk perception. The regression results indicated that Loss Aversion and Risk Tolerance emerged as statistically significant predictors of risk perception, together explaining 35.4% of the variance in the model (R^2 = 0.354). Specifically, Loss Aversion (B = 0.458, p < 0.001) showed a strong positive influence, suggesting that investors who are more sensitive to potential losses perceive cryptocurrency investments as riskier. Conversely, Risk Tolerance (B = −0.170, p = 0.047) exhibited a significant negative effect, implying that individuals with greater willingness to take risks view cryptocurrencies as comparatively less risky. Herding Behaviour (B = 0.140, p = 0.091) displayed a positive but marginally significant influence, indicating that investors who follow the crowd may experience slightly elevated perceptions of risk. However, demographic variables such as age, gender, income, and investment experience did not significantly predict risk perception, suggesting that psychological and behavioural traits exert a stronger influence than demographic characteristics in this volatile asset class. The diagnostic results confirmed the statistical soundness of the model, with no multicollinearity, normally distributed residuals, and no autocorrelation

DISCUSSION:

The findings underscore the dominance of behavioural biases in influencing investment perceptions within the cryptocurrency market. The positive relationship between loss aversion and risk perception aligns with Prospect Theory (Kahneman & Tversky, 1979), which posits that individuals disproportionately weigh potential losses over equivalent gains. In the context of cryptocurrencies, known for extreme volatility, this heightened sensitivity to losses amplifies perceived risks and may lead to conservative or reactive investment behaviour. Conversely, the negative relationship between risk tolerance and perceived risk corroborates earlier findings by Grable and Lytton (2022), indicating that risk-tolerant investors are better

equipped psychologically to manage uncertainty and thus perceive lower levels of risk. The weak yet positive association of herding behaviour suggests that social influence plays a nuanced role— while following others' actions may offer psychological comfort, it can also reinforce risk awareness through collective uncertainty. The insignificance of demographic factors reflects the idea that cryptocurrency markets attract a diverse investor base where psychological tendencies overshadow traditional sociodemographic influences. Overall, the results reinforce the behavioural finance perspective that investor decisions in emerging digital assets are shaped more by emotional and cognitive factors than by rational evaluation.

Managerial implications

From a managerial perspective, the results hold valuable implications for financial advisors, cryptocurrency platforms, and policymakers. Financial advisors should tailor investment guidance based on individual behavioural profiles rather than relying solely on demographic segmentation, recognizing that loss aversion and risk tolerance significantly drive investment attitudes. Cryptocurrency exchanges and fintech platforms can leverage these insights to design investor education modules and risk communication strategies that address behavioural biases—such as overreaction to losses or herd-driven trading. For instance, providing real-time risk analytics and behavioural nudges can help investors make more balanced decisions. Regulators and policymakers can utilize these findings to enhance investor protection frameworks, ensuring transparent disclosure of risk factors and promoting awareness of psychological pitfalls associated with speculative digital assets. Ultimately, understanding the behavioural foundations of investor perception can foster more resilient investment ecosystems and improve financial decision-making in the rapidly evolving cryptocurrency domain.

Future research direction:

Future research can build upon this study by including larger and more diverse samples across different regions to improve generalizability. Longitudinal studies could examine how risk perception, tolerance, and loss aversion evolve with changing market and regulatory conditions. Advanced methods such as Structural Equation Modelling (SEM) or AI-based behavioural models can be used to explore causal relationships among behavioural variables. Researchers may also investigate how digital literacy, blockchain awareness, and platform trust influence investment behaviour, and compare behavioural patterns between traditional assets and cryptocurrencies. Qualitative approaches like interviews or focus groups could further uncover deeper psychological factors shaping investor decisions in the evolving digital asset market

CONCLUSION:

This study provides empirical evidence that behavioural variables—particularly loss aversion and risk tolerance—play a decisive role in shaping investors' perception of risk in the cryptocurrency market. The findings contribute to behavioural finance literature by

highlighting the psychological complexity underlying decision-making in high-volatility environments. Investors who exhibit high loss aversion perceive cryptocurrencies as riskier and are thus more cautious, whereas risk-tolerant investors show lower perceived risk and greater investment confidence. The study confirms that emotional and cognitive factors outweigh demographic determinants in influencing how investors evaluate risk in digital asset markets. These insights extend the understanding of investor psychology within non-traditional financial instruments and support integrating behavioural models into risk assessment frameworks.

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Investigation, Data Curation, Writing – Review & Editing

Conducted literature search across five databases, collected and curated data, participated in analysis, and critically reviewed the manuscript.

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ASSESSING THE IMPACT OF GEOPOLITICAL RISKS ON BRICS STOCK MARKET VOLATILITY AND RETURNS USING GARCH MODEL

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ABSTRACT

Purpose

The purpose of the research is to find the impact of geopolitical risk (GPR) on the returns and volatility of stock indices of BRICS countries, focusing on both global and regional geopolitical influences on financial markets.

Design/Methodology

This research uses Granger Causality Tests, Generalized Autoregressive Conditional Heteroskedasticity models (GARCH), and correlation analysis to analyses the GPR and BRICS stock indices. The global and regional geopolitical risks were used as well as the financial indices of BRICS countries including Brazil, Russia, India, China, and South Africa, to examine the patterns in returns switch and volatility.

Findings

The study finds that geopolitical risks globally show weak or negative correlations with BRICS stock indices. The GARCH model effectively forecasts volatility, revealing that the stock markets of Russia, India, Brazil, China, and South Africa are not significantly sensitive to geopolitical risks.

Originality

This paper offers an in-depth analysis of how geopolitical risks impact emerging markets in BRICS countries, providing new insights into regional differences in response to global and localized geopolitical events.

Research Limitations/Implications

The research acknowledges limitations, including limited geopolitical risk data and the exclusion of qualitative factors. Future work could incorporate event-specific analysis for a deeper understanding of geopolitical shocks.

Practical Implications

Investors can use these findings to make informed market decisions and manage portfolios, addressing location-specific business risks and geopolitical uncertainties.

Social Implications

The results underscore the importance of global stability for investor confidence and financial growth in emerging markets, guiding policymakers and international organizations in strategic planning and diplomacy to mitigate geopolitical risks.

Keywords: Geopolitical risk, BRICS, Volatility, Stock Market

INTRODUCTION

A country's growth can be identified by assessing the performance of the stock market. The uncertainties and the risks in the future can outperform the market. If investors have confidence and a better outlook in the future, it will help in the rise of the stock market. The sudden panic or negative news have a major impact on the stock market. The volatility of the market is one of the major factors that relates to the return and the investors psychology. Major economic events or the

market trends can significantly impact the market volatility. Any event which may include; change in interest rates, tensions between countries, inflation rate releases or any other corporate earnings may cause changes in price levels of the assets. These fluctuations create investor insecurity, resulting in risk averse relying on safer securities while risk seekers look forward to high returns on their investment.

Geopolitical Risk (GPR) is one of the major drivers of uncertainty in the global financial markets, with effects on the emerging economies. These risks comprise political instability, war or conflicts, diplomatic problems, which are global, normally lead to fluctuations in stock markets thus affecting investment choices and economic stability of the emerging economy countries. The BRICS countries – Brazil, Russia, India, China, and South Africa are in a strategic and significant position with reference to their economy and dependence on the global economy. It is essential for the international investors, policy makers as well as the researchers in the field of finance why these geopolitical risks affect these country's stock market volatility and returns.

The importance of this research is to assess the connection between geopolitical risks and performance of BRICS stock markets. Using the GARCH model, a well-known model popular for modelling of volatility clustering and persistence of variance in time series data, this study develops a sound model for identifying dynamic impact of geopolitical risks on stock returns and volatility.

The study utilizes Granger causality tests and correlation analysis to identify the past and current causal effects and dependencies of the global/ regional geopolitical risk's components on BRICS stock indices. The results add to existing knowledge of how geopolitical factors that characterize locales, for instance, Russia and China, affect not only their home markets but also the global risk perception. On the other hand, the study reveals and explains the stability and decoupled behavior of markets such as India, Brazil, and South Africa from geopolitical influences.

Responding to an identified literature gap, this study contributes to the understanding of the impact of geopolitics on emerging markets and presents meaningful implications of the

findings for investors, asset management, and policy-making. The resource will be useful in aiming at understanding geopolitical risks for various actors in global financial markets, such as institutional investors, regulators and policymakers.

REVIEW OF LITERATURE

The existing body of literature extensively investigates the influence of geopolitical risk (GPR) on financial markets, particularly focusing on stock market volatility and return dynamics across both developed and emerging economies.

Geopolitical Risks and Stock Market Volatility in Emerging Markets

Strong financial structure and openness to global markets can mitigate the effects of geopolitical shocks, especially those from terrorism**,** cross sessional effects showing that geopolitical risk influence each market differently. **Balcilar et al. (2018)** finds the heterogeneous nature of GPR effects, with Russia identified as the most susceptible and India as the least. During extreme geopolitical conditions, long-term spillovers dominate, with Russia acting as the principal transmitter of GPR-related shocks **Vo and Dang (2023)**. **Yang et al. (2021)** mainly focuses China's CSI 300 index using GARCH-MIDAS model. They find that global and the regional GPR, especially the geopolitical action index (GPRAct), significantly impact China's stock volatility. These insights are particularly valuable given the unanticipated nature of GPR. **Li et al. (2024)** Emerging economies particularly BRICS counties have bidirectional spillover effects among their stock markets. The study finds that both geopolitical risk and policy related uncertainties have a critical role in shaping cross-market linkages and overall market stability.

Global Geopolitical Risk and Volatility Transmission across different Markets

Feng et al. (2023) analyzed the impact of GPR on volatility transmission among global stock markets, used a time-varying parameter vector auto regression (TVP-VAR) model to analyze volatility spillovers between G7 and BRICS markets. Their results demonstrated a temporal variation in spillover intensity, particularly during crises such as the COVID-19 pandemic, emphasizing GPR's evolving role in global financial interconnectedness. **Sohag et al. (2022)** further investigated stock market synchronization between the US, China, and Russia using the TVP-VAR framework. They revealed that GPR negatively affects total and bilateral connectedness indices, particularly in bullish market scenarios, thereby limiting opportunities for international diversification.

Sectoral Impacts of Geopolitical Risk And Commodity Volatility

Bouri et al. (2023) analyzed the interplay between oil price volatility, GPR, and sectoral stock indices in GCC countries. The study concluded that oil implied volatility exerts a stronger influence than GPR, especially during bull markets and crisis periods such as COVID-19. Sector-specific responses were observed, offering insights for tailored hedging strategies.

Predictive Role of Geopolitical Risk in Stock Market Returns

Salisu et al. (2021) developed a forecasting model to assess the predictive strength of GPR on the stock markets of the G7 and

Switzerland over a century-long period. The study demonstrated that GPR effectively forecasts stock returns, particularly during heightened geopolitical events such as wars and terror attacks, thereby reinforcing its utility in financial modeling. **Bouras et al. (2018)** a GARCH framework to differentiate between country-specific and global GPR effects across 18 emerging markets. While domestic GPRs showed limited influence on stock returns and modest impact on volatility, global GPRs demonstrated significantly higher statistical and economic relevance in affecting market behavior.

Geopolitical Risk, Market Liquidity and Investor Behavior

GPR, especially when driven by threats rather than realized events, correlate with decreased liquidity. The impact is more severe for less transparent and financially vulnerable firms, contributing to broader uncertainty in market functioning **Fiorillo et al. (2023)**. Predictive capabilities of GPR by analyzing its role in forecasting volatility jumps in the Dow Jones Industrial Average (DJIA). Using causality-in-quantiles, the study affirmed strong nonlinear relationships between GPR and volatility, particularly at the tails of the distribution **Gkillas et al. (2018)**. The reviewed literature collectively affirms the importance of incorporating GPR into models of financial volatility and return forecasting. While multiple methodologies such as GARCH, TVP-VAR, and quantile-based approaches have been used, a consistent theme emerges, the influence of GPR is both dynamic and asymmetric across regions, markets, and time periods. Notably, emerging markets, particularly the BRICS nations, are more susceptible to long-term spillovers, while developed markets exhibit more predictable, yet non-linear, responses to geopolitical shocks.

METHODOLOGY

Data sources

This study has used secondary data sourced from Yahoo finance and Economic Policy Uncertainty (EPU) website. This research uses 20 years monthly data, extending from September 2004 to September 2024. The data set includes Bovespa Index (BVSP) which is Brazilian stock market index, Moscow Exchange (MOEX) which is Russia's stock market index , Nifty 50(NSEI) India's stock index, Shanghai Stock Exchange(SSE) which is the stock market index of China , and Johannesburg Stock Exchange (FTSE/JSE) which is a stock exchange index of South Africa from Yahoo Finance. The geopolitical risk indices (GPR), Historic geopolitical risk Acts (GPRHA) and country specific GPR indices for Brazil, Russia, India, China, and South Africa sourced from the Economic Policy Uncertainty (EPU) website.

In this study, we use Granger causality tests, GARCH, and correlation analysis. It therefore offers a framework of techniques for the analysis of the nature of the relationships between geopolitical risks and stock market shifts. For testing stationarity, the Augmented Dickey-Fuller (ADF) test was used in this research. For testing stationarity, the Augmented Dickey-Fuller (ADF) test was used in this research. This study did not perform a normality test (such as the Jarque-Bera test) on the residuals, as the primary objective is to evaluate causality, volatility clustering, and correlation structures rather than parameter estimation under the

assumption of normality. In financial time series, returns often exhibit non-normal behavior due to skewness and heavy tails. Therefore, models like GARCH are preferred for capturing such volatility characteristics, even when residuals are non-normally distributed. Additionally, most time-series econometric tests, including Granger causality and GARCH models, do not strictly require the assumption of normality for valid inference, especially when using large sample sizes, as in this study with 20 years of monthly data.

The Granger Causality tests to decide the predictive interactions of the geopolitical risk indices and the stock market returns. Fluctuations in geopolitical risks are also established by help of this test which is useful for determining whether shifts in these indicators are predicting fluctuations in stock market indices or are resulting from them. Causality patterns can either be bidirectional, unidirectional, or even lacking, and such patterns give an understanding of the relationships between bid, unit, and given variables.

The current study incorporates the GARCH model to assess the effects of geopolitical risks on stock market risk. of volatility clusters and its measure of persistence make the GARCH model most applicable to financial time series data. The GARCH model which holds the conditional variance of stock market returns as function of past errors as well as past volatility enables one to assess the persistence of volatility shocks as provoked by geopolitical risks. Moreover, the significance or otherwise and the strength of the relationship between the indices of the GPR set, the independent variables and the stock market return, the dependent variable is conducted. Although machine learning techniques such as Random Forests, Support Vector Machines, and deep learning models have gained prominence in recent years for financial forecasting and volatility analysis, this study opts for the GARCH model due to its strong theoretical foundation in econometrics and its proven effectiveness in capturing volatility clustering and heteroskedasticity in financial time series. Unlike ML models, GARCH provides interpretable parameters directly related to market risk and persistence, making it especially suitable for studies focusing on the dynamics of volatility over time rather than mere predictive accuracy. Additionally, the primary objective of this study is to explore volatility behavior in response to geopolitical risk, for which GARCH remains a robust and widely accepted method.

Correlation analysis measures the strength and direction of linear relationship between global and regional GPR indices and BRICS stock market indices. This analysis highlights interconnections and dependence and how the global and regional markets are vulnerable to geopolitical risks.

Analysis and Interpretation

For testing stationarity, the Augmented Dickey-Fuller (ADF) test was used in this research. The null hypothesis (H0) suggests that there is a unit root; it means the data is non-stationary and (H1) alternative hypothesis suggests stationarity of the data.

The p value of the Geopolitical risk index (GPR), Historic geopolitical risk Acts (GPRHA), are 0.000, which is less than 0.05

below the significant level, it means the null hypothesis is rejected and the data is stationary. The p value of the geopolitical risk of Brazil (GPRC_BRA) is 0.000 it shows that the null hypothesis is rejected, and the data is stationary. The p value of the geopolitical risk of China (GPRC_CHN) is 0.028 it is less than the critical value 0.05 so it is stationary. The p value of the geopolitical risk index of India (GPRC_IND), geopolitical risk of Russia (GPRHC_RUS), geopolitical risk of South Africa (GPRHC_ZAF) are 0.00, so it is stationary. In the initial test the p value of BVSP (Brazil stock index) was 0.703, it is greater than 0.05 and accept the null hypothesis, it means the data is non - stationary. Then level 1% test was done and the p value in that test was 0.000 and it rejected and made the series stationary. The p value of the ADF on FTSE/JSE was 0.840 at the initial test and it accepted the null hypothesis, then level 1% test was done, and the p value is 0.000 made the series stationary. The p value of ADF on MOEX, ADF on NSEI, ADF on SS was 0.160, 0.999, 0.109 respectively, all the p values are greater than 0.05 and it accepts the null hypothesis in the initial test. Then level 1% test was done and made MOEX, NSEI and SS the p value is 0.000, it is less than 0.05 , so it rejects the null hypothesis and made the series stationary. The non- stationary data is changed to stationary data and the time series data becomes efficient for further test analysis.

Results of the Augmented Dickey-Fuller (ADF test are given below in the table.

Table 1: Augmented Dicky Fuller Test Results

Augmented Dicky Fuller Test	t-Statistic	Prob	Result
ADF Test for GPR	-6.898	0.000	Reject
ADF Test for GPRHA	-5.838	0.000	Reject
ADF Test for GPRC_BRA	-10.028	0.000	Reject
ADF Test for GPRC_CHN	-3.093	0.028	Reject
ADF Test for GPRC_IND	-9.623	0.000	Reject
ADF Test for GPRC_RUS	-4.634	0.000	Reject
ADF Test for GPRC_ZAF	-3.596	0.006	Reject
ADF Test for BVSP	-1.131	0.703	Accept
ADF Test for BVSP	-13.843	0.000	Reject
ADF on FTSE	-0.711	0.840	Accept

ADF on FTSE	-16.495	0.000	Reject
ADF on MOEX	-1.408	0.160	Accept
ADF on MOEX	-14.500	0.000	Reject
ADF on NSEI	1.850	0.999	Accept
ADF on NSEI	-15.132	0.000	Reject
ADF on SS	-2.531	0.109	Accept
ADF on SS	-14.412	0.000	Reject

Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

The results of the Granger Causality Test Result are given below in the table.

Table 2: Granger Causality Test Result

Granger Causality Test	f - Statistic	p value	Result
GPR to BVSP	0.738	0.479	Accept
GPRC_BRA to BVSP	0.309	0.734	Accept
Historic geopolitical risk Acts (GPRHA) to BVSP	0.659	0.518	Accept
GPR to FTSE__JSE	1.509	0.223	Accept
Historic geopolitical risk Acts (GPRHA) to FTSE__JSE	1.303	0.273	Accept
GPRC_ZAF to FTSE__JSE	1.061	0.347	Accept
GPR to MOEX_CLS	2.013	0.135	Accept
GPRC_RUS to MOEX_CLS	1.618	0.200	Accept
Historic geopolitical risk Acts (GPRHA) to MOEX_CLS	0.256	0.776	Accept
GPR to NSEI_CLS	1.267	0.283	Accept

Historic geopolitical risk Acts (GPRHA) to NSEI_CLS	1.401	0.248	Accept
GPRC_IND to NSEI_CLS	0.003	0.996	Accept
GPR to SS_CLS	0.559	0.572	Accept
Historic geopolitical risk Acts (GPRHA) to SS_CLS	0.504	0.604	Accept
GPRC_CHN to SS_CLS	0.655	0.520	Accept

Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Table 3: GARCH Result

Variable	**z-Statistic**	**Prob.**	**Result**
BVSP	0.357	0.811	Accept
FTSE__JSE	-0.139	0.864	Accept
MOEX	0.740	0.117	Accept
NSEI	1.202	0.386	Accept
SS	-0.462	0.393	Accept

Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Table 4: GARCH Model Regression Statistics

R-squared	0.780
Adjusted R-squared	0.771
Durbin-Watson stat	0.702

The p value of GPR to BVSP is 0.479, it is above the significant level so it accepts the null hypothesis. There is no causal relationship between GPR and BVSP. Brazil's stock market is not very sensitive to geopolitical risks. The p value of GPRC_BRA to BVS and GPRHA to BVSP is 0.734 and 0.518 respectively which is above the significant level 0.05 and failed to reject the null hypothesis.

The p value of GPR to MOEX is 0.135 which is above the significance level of 0.05, thus it implies that we have sound evidence to fail to reject the null hypothesis. This suggests that lagged values of GPR are not useful in forecasting the movement of the MOEX. The p value of GPRC_RUS to MOEX is 0.200 and GPRHA to MOEX is 0.776. This means that the past values of GPRC_RUS and GPRHA cannot predict MOEX. A low causality between GPR and MOEX indicates that the stock market fluctuations in Russia do not depend on geopolitical risk.

The p-value of GPR to NSE is 0.2834, it is above the typical significance level of 0.05 which means there is inadequate evidence to reject the null hypothesis. This means that historical values of GPR do not indeed help in determining movements of the NSE India Index. The p value of GPRHA to NSEI and GPRC_IND to NSEI is 0.031 and 0.996, respectively which is above the significant level 0.05 and failed to reject the null hypothesis.

The p-value of GPR to SS is 0.572 indicating no statistically significant evidence to reject the null hypothesis. The p value of GPRHA to SS and GPRC_CHN to SS is 0.604 and 0.520, respectively which is above the significant level 0.05 and failed to reject the null hypothesis. This suggests that past values of GPR do not significantly influence SS China's stock market Index.

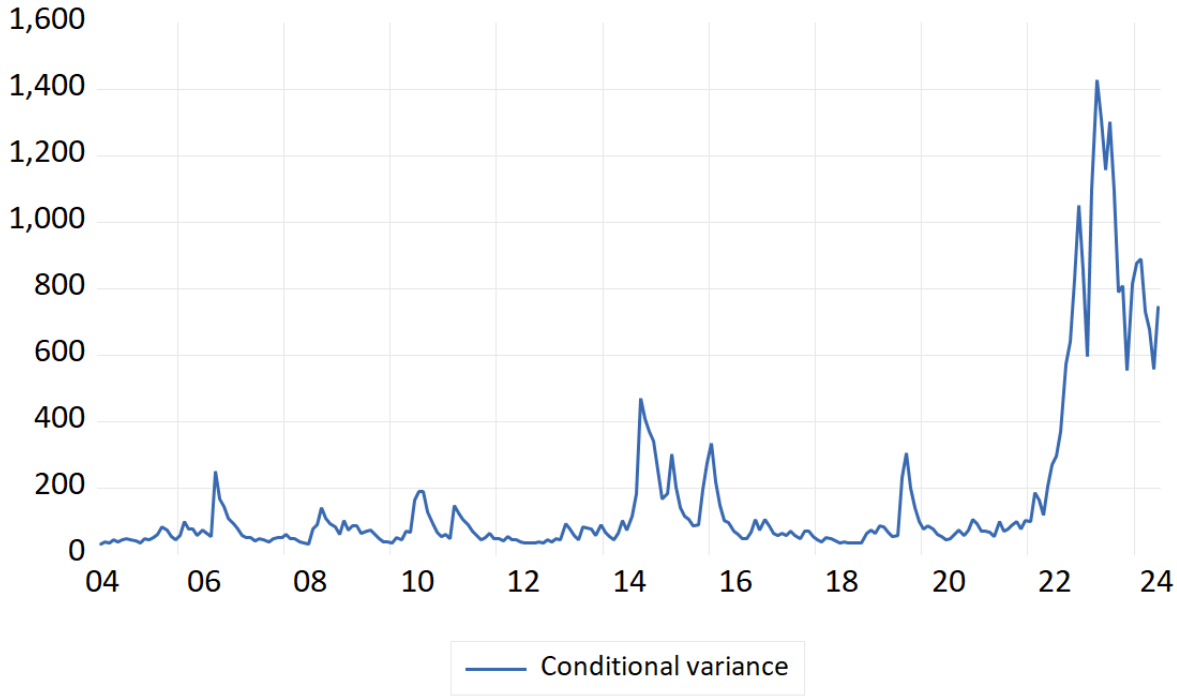
In the result the p value is 0.223, which is greater than the significant level (0.05), it shows that there is no significant causality relation between Geopolitical Risk (GPR) and South Africa's stock market. The p value of GPRHA to FTSE__JSE and GPRC_ZAF to FTSE__JSE is 0.273 and 0.347, respectively which is above the significant level 0.05 and failed to reject the null hypothesis. Changes in GPR do not precede or predict the FTSE/JSE index.

Using the ARCH model, we find that high R-squared 0.780 indicates excellent model fit and Durbin-Watson statistic of 0.702 suggests strong positive autocorrelation in the residuals.

From this we can conclude that none of the BRICS countries' stock market indices has a significant correlation with GPR at the conventional 5% level of significance.

The p value of GPR to BVSP is 0.811, it is above the significance level 0.05 it fails to reject the null hypothesis. The p value of GPR to FTSE__JSE is 0.864, GPR to MOEX is 0.117, GPR to NSEI is 0.386 and GPS to SS is 0.393 all the p values are above the significance level 0.05, so it fails to reject the null hypothesis. It shows that GPR does not have any impact on the volatility of BRICS countries' stock market.

Figure 1: Graph showing Conditional Variance

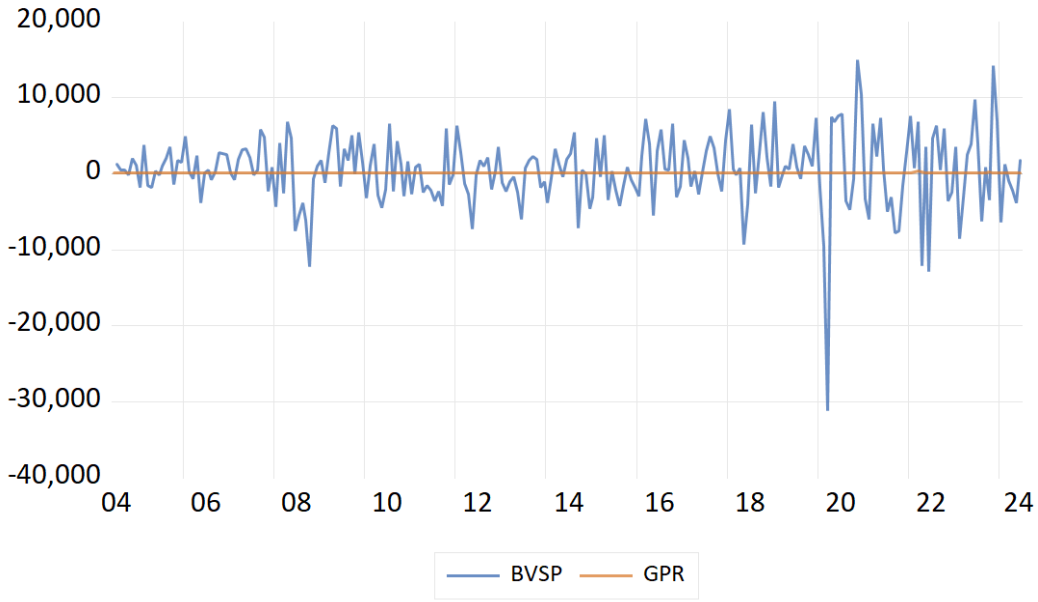


Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

The above figure shows the conditional variance of the GARCH model. The shows that there is a volatility cluster, in 2022 April onwards there was a huge volatility in the market.

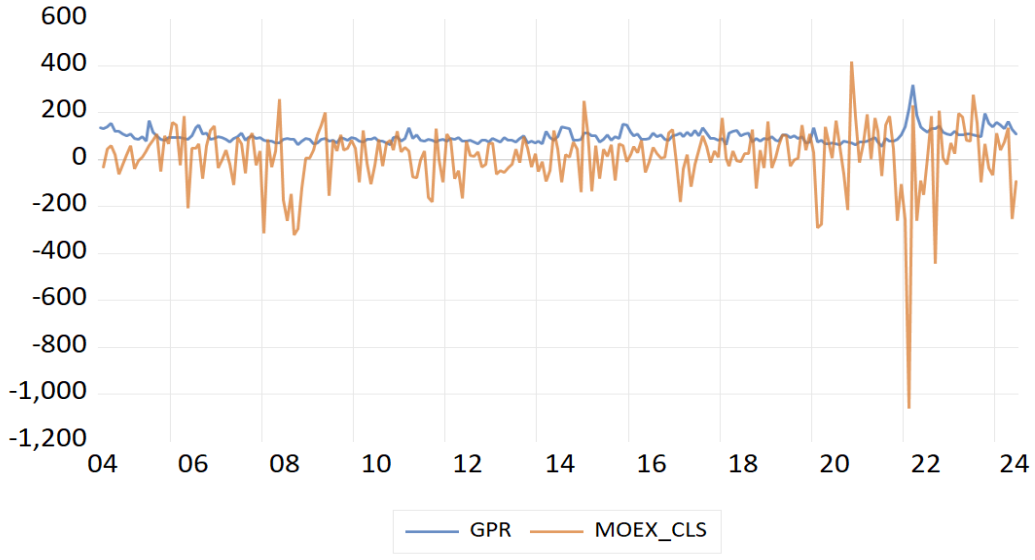
Geopolitical risks and Market responses based on correlation, there are negative correlations with most of the stock markers including FTSE/JSE (-4.631), MOEX (-0.011) and S&P South Africa (6.521). This implies that these markets may not be sensitive to global geopolitical risks or may indeed respond otherwise given hedging activities. NSE (India's Nifty 50) Evidence from a value of 0.05 means that there is a very weak positive relationship between global risks and the Indian market. Brazil (BVSP)Very low (0.03), which means that Brazil is not affected at all by geopolitical risks elsewhere in the world in terms of its markets.

Figure 2: Showing correlation between Brazil stock Index and geopolitical risk (GPR)



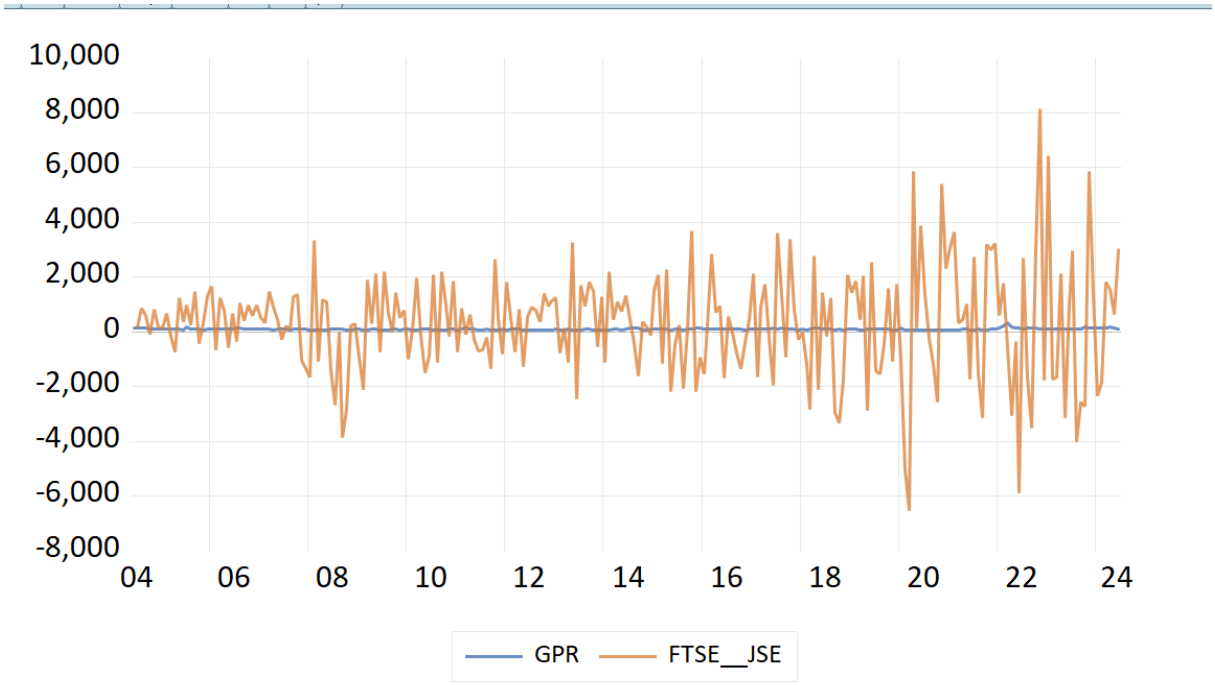
Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Figure 3: Showing correlation between Russia stock Index and geopolitical risk (GPR)



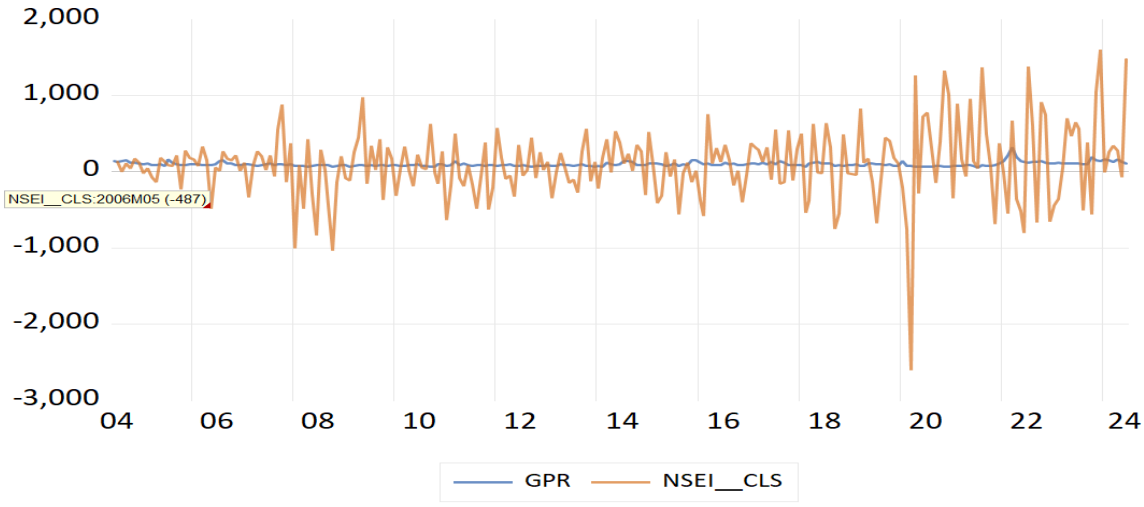
Sources - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Figure 4: Showing correlation between South Africa stock Index and geopolitical risk (GPR)



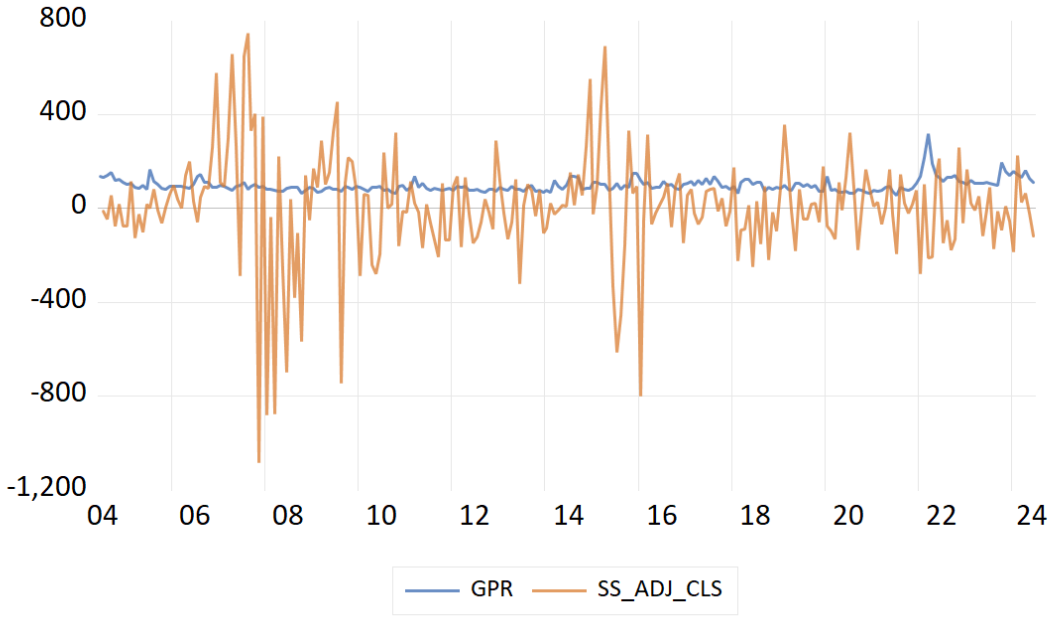
Sources - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Figure 5: Showing correlation between Indian stock Index and geopolitical risk (GPR)



Sources - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Figure 6: Showing correlation between China stock Index and geopolitical risk(GPR)



Source - Author's own computation using data from Yahoo Finance and EPU Index (Baker et al., 2016)

Empirical findings

The research finds that the GPR and Brazil's stock index BVSP has no causality between them. It indicates that the global political risk broadly only affects Brazil's stock market, it may be mostly affected by the local factors.

The results show that Granger causality test suggests that there is no causality between MOEX (Russia stock market) and GPR. Similarly, no sensitivity is reflected in South Africa, India, and Chinese stock markets by geopolitical risk factors. The findings shown here suggest that geopolitical risks from around the world are not very sensitive to the stock indices of BRICS countries as weak or negative correlation has been established here for maybe because this country has been exposed to more severe geopolitical conflicts from across the world. All relationships show p-values greater than 0.05, indicating no significant causal effect of geopolitical risk indices on stock market indices in Brazil (BVSP), South Africa (FTSE_JSE), Russia (MOEX), China (SS), and India (NSE).

All variables (BVSP, FTSE_JSE, MOEX, NSEI, SS) have p-values greater than 0.05, indicating no significant volatility persistence due to geopolitical risks.

The results for the BRICS countries' stock markets demonstrate a very low level of correlation with GPR variations, which would indicate that GPR does not have an impact on BRICS Countries stock market.

Limitations of the Study

Although the findings are very insightful in terms of this study, some limitations are necessary to mention. The following analysis is focused on the traditional GARCH models and lacks more modern and able to adapt to the non-linear trends in the financial time series machine learning models. Additionally, the study focuses solely on BRICS nations, which limits the generalizability of the findings to other emerging or developed economies. Moreover, there may potentially be some structural break, regime shift or persisting global crises like the COVID-19 pandemic that one may not explicitly model in and would impact the robustness of the findings. It limits the dataset as well because it only provides monthly data that may not account for sensitive volatility spikes in the short run. Lastly, the test of normality of the residuals was not mad but considering that GARCH models are capable enough of working on data with leptokurtic distributions, but this could have influence on the model diagnosis.

Scope for Further Study

Conclusion

Geopolitical risk has weak to negative correlations with most of the BRICS countries' stock indices. The result shows that the level of association between the geopolitical risks and stock markets in the five countries differs. There is no sensitivity reflected in South Africa, and Brazil by geopolitical risk factors. The Indian equity market has its exposure to geopolitical risks is minimal; the evidence provides a confidence that the Indian market is largely insulated from these global geopolitical shocks. While no direct causality exists between GPR indices and seasonally adjusted consumption expenditure in China, significant interdependencies among GPR sub-indices suggest a nuanced structure of geopolitical risk propagation. From the study we can find that the impact of geopolitical risk has only minimal impact on the BRICS countries' stock market return and volatility. In the long term the geopolitical risk will not affect the stock market much, panic and the market volatility are only for the short term, the market will overcome its returns in the long term. Investors can use these findings to make informed market decisions and manage portfolios, addressing location-specific business risks and geopolitical uncertainties. The results underscore the importance of global stability for investor confidence and financial growth in emerging markets, guiding policymakers and international organizations in strategic planning and diplomacy to mitigate geopolitical risks.
To overcome these limitations, future studies can be conducted based on high-frequency data which are weekly or daily observations to give a better understanding of the short-term effect of the geopolitical event. Incorporating other emerging and developed markets to the study would help increase the comparative analysis of the level of geopolitical risk sensitivity amongst different regions. In addition to that, extending the proposed model by adding more indices of uncertainty such as Economic Policy Uncertainty (EPU) or Global Risk Index (GRI) would give a more well-rounded picture of the impact of different types of uncertainty on financial market. More complex econometric models, such as the ones using regime-switching, nonlinear, or machine learning could be evolved to detect complex dynamics and make the forecast more

accurate. Finally, analysis of the sector-level impacts on the stock markets can indicate whether geopolitical risks affect the various industries differently.

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A SYSTEMATIC REVIEW ON INDEPENDENCE OF INTERNAL AUDITORS

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ABSTRACT

In this article, the literature on the independence of internal auditors is systematically studied, a prominent area of research in accounting that has been understudied in various aspects in recent times. The study has taken into account articles from 2015 forward, including academic works and reports. The literature was searched using pertinent keywords, and after meeting a few inclusion and exclusion criteria, it was selected. A quality assessment has been conducted based on the review evidence. The results have been systematically mapped, and a thematic synthesis was done to combine the results. The findings from studies taken widely represent the corporate governance dimensions, various factors of audit, internal auditors, their independence, and audit quality globally. The article's objective is to present the various characteristics of the independence of internal auditors that can be researched. The paper shows the literature evidence of how internal auditors are the backbone of the internal structure of an organization, and that their independence will enhance the growth of an organization.

Keywords: Internal audit, auditor independence, governance, systematic review, compliance.

INTRODUCTION

Corporate governance (CG) is the resolution for the firms, which guides and directs the business to run efficiently. The outline of CG is influenced in India by the structure framed by the Companies Act, 2013, and is regulated by the Ministry of Corporate Affairs (MCA) and the Securities and Exchange Board of India (SEBI) (Governance 101, n.d.). The framework differs for each category of companies based on their capital. As per the corporate governance framework, firms need to align their financial functions, employee management, communication channels, social engagements, and so on, in a manner that benefits all their stakeholders. Traditionally, businesses focus on the economic aspects of a company, but corporate governance requires that firms give equal focus to social responsibility. The CG framework of a firm should consider the three important dimensions of CG: the board of directors, internal auditors, and external auditors (Mariana Nedelcu (Bunea), 2015). India, corporate governance emerged in 1966 (Nair, n.d.). It was a general framework applicable to all types of companies. Over the years, corporate governance has been improving and becoming more transparent worldwide. The Indian government, which gets its major share of GDP from small-scale sectors (Reserve Bank of India - Database,

n.d.), started to encourage small firms to issue IPOs to raise funds from the year 2012 (Pareek, 2023) and required that the listed SMEs must adhere to corporate governance mandatorily for their firms. Meanwhile, small firms were not able to achieve the corporate governance agenda due to regulations framed higher than their capacity; hence, to solve this issue, specific modifications were allowed to the corporate governance framework of SMEs. Worldwide, research studies started to encourage the independent internal audit function in SMEs as per corporate governance framework.

When we see the three CG dimensions and their focus in previous literature, there are considerably more studies on the 'board of directors' and 'external auditors' dimensions than on 'internal auditors'. Independence is one of the significant features of CG, which is applicable for all three dimensions of CG, but as evident from various research studies, 'independence of auditing' is largely associated only with "external audit work". The present study's focus on the independence of internal auditors is seemingly under-researched.

RESEARCH OBJECTIVE:

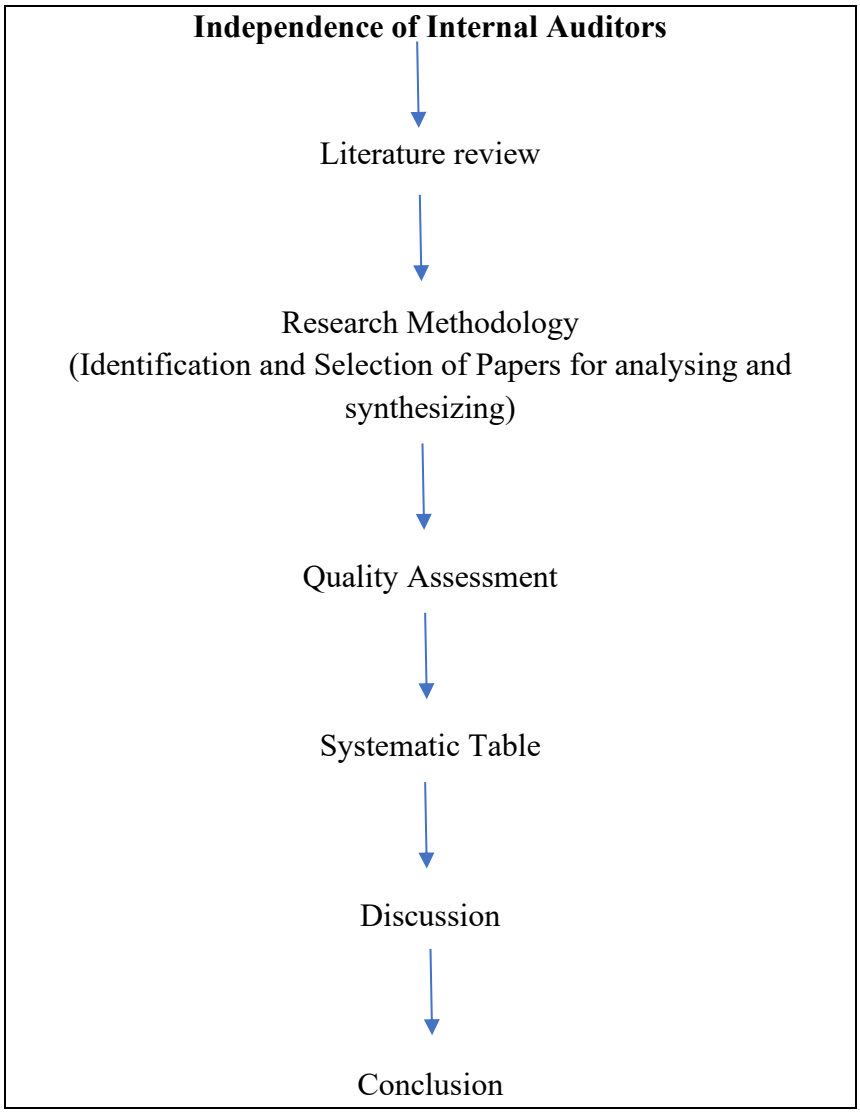
- To systematically review the previous research studies on the independence of internal auditors and their effect on the performance of a business.
- To synthesize the existing research literature on the independence of internal auditors.
- To identify key determinants, challenges, and their implications on audit quality and corporate governance.

RESEARCH GAP:

Most of the studies include data that is geographically limited; there is no study concluding the findings globally. Due to this, the synthesis of results of different economies and regulatory policies is not available. The financial performance, which is a quantitative aspect of a firm, is affected by internal auditing characteristics, which need to be more clearly explored with proper analytical and case evidence. To clarify the ways in which specific internal audit attributes affect financial outcomes, more analytical research supported by empirical and case-based data is needed. The study focuses on identifying the gaps for future studies from the previous research on internal audit.

Stages of Systematic Review:

Figure 1: Stages of Systematic Review



Source: Author's own compilation (2025)

LITERATURE REVIEW

Internal auditors are those who give assurance and consulting services to the firm on a continuous basis (Jagongo, 2017), whose focus is on improving the operating and financial activities of the firm with appropriate risk management, financial data, management reporting style, compliance with laws and regulations, and so on (Aikins, 2011). Internal auditors are superior to management and have control over management (Jan Svanberga, 2018). As per corporate governance, internal auditors, external auditors, and the board of directors are the three departments that need to follow up on the firm's activities and align them as per the regulations in order to benefit the interests of various stakeholders with accurate information.

Independent auditors refer to both internal auditors and external auditors (Saidin, 2014), denoting that their role is based on an honest and objective system towards auditing that is without being influenced by the management or auditing favourably of the company. The internal auditors usually assume themselves

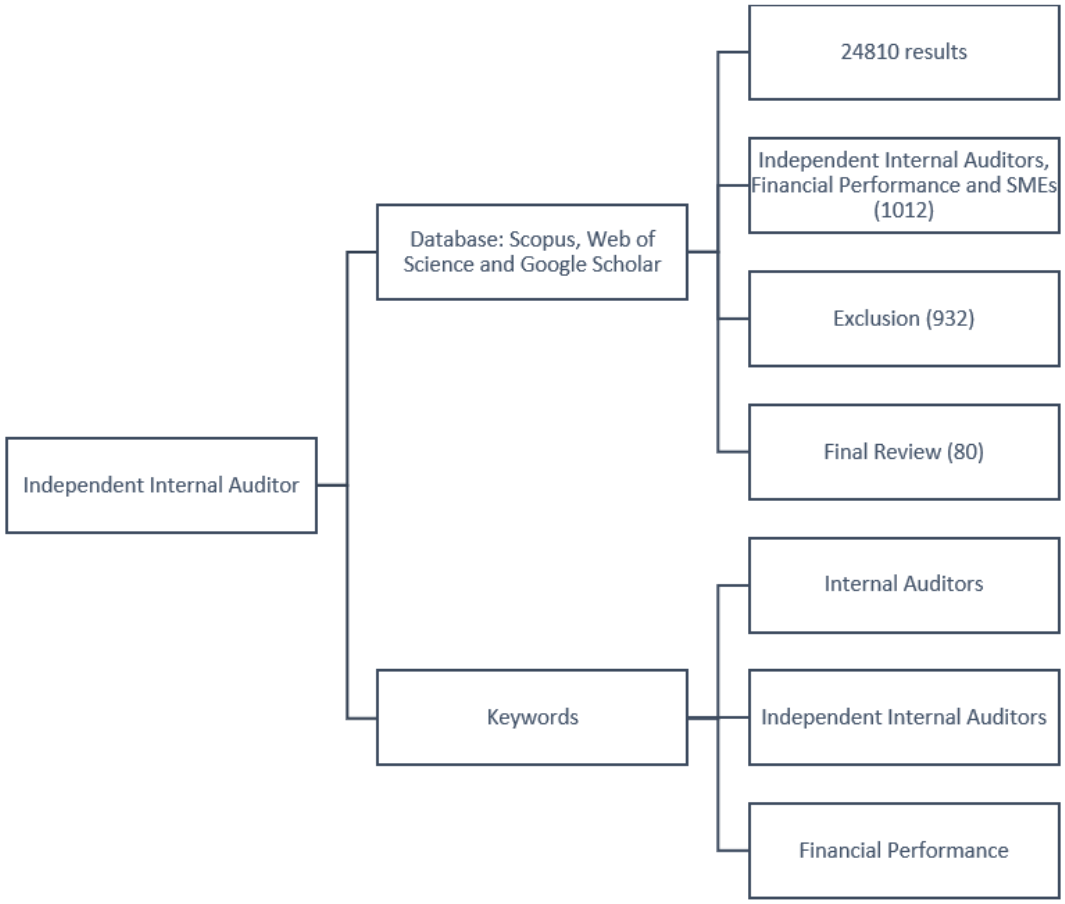
to be independent, whereas their independence is assessed by independent external auditors based on their objectivity and competence (Ward & Robertson, 1980). An internal auditor, being himself an insider of the company with financial benefits, their independence will affect themselves and also affect others with financial interest in the company. This raises a question on earnings management in the financial records of the firm (Alzoubi, 2017). An independent audit function that is independent is said to return a company better financially, according to many researchers. External auditors' opinion can impact the company qualitatively, whereas internal auditing can impact the company financially (Ewald Aschauer, 2015). Most stakeholders are not aware of the influential role of internal auditors. If this information is made aware to the companies, they will be more serious towards the internal audit function (Ewald Aschauer, 2015; Booker, 2018).

RESEARCH METHODOLOGY

The study surveys a Systematic Literature Review (SLR) as a research design to collect, evaluate, and synthesize previous literature on the independence of internal auditors.

Identification and Selection of Papers to Review

Figure 2: Methodological Approach



Source: (Chandan R Honavar, 2020)

Figure 2 is adapted from the article "Application of Framing in Leadership Communication: A Systematic Review and Research Agenda" by Chandan R Honavar, Krishna Bhargav K L, and Dr Theresa Nithila Vincent (Chandan R Honavar, 2020). One of the key topics in accounting research is Internal audit (Eulerich, 2019), hence the study strived to research specific aspects of internal auditing, and understood there is a gap in the concept of 'independence' among the internal auditors, and literature on 'Independent Internal Auditor' was reviewed systematically. Further to narrow down our perspective and variables, we increased our search terms and categorized them into three main terms: 'Internal Auditor', 'Independent Internal Auditor', and 'Financial Performance'.

Initially, we got the search result as 24810 articles from the three databases: Scopus, Web of Science, and Google Scholar. When we specified our search terms with added keywords, the result was reduced to 1012, and after various exclusions, we got around 80 articles to review.

Quality Assessment

Weight of evidence is used to assess the quality of the literature considered for reviewing, based on the article "Weight of Evidence: A Framework for the Appraisal of the Quality and Relevance of Evidence" by Gough, David (2007). The following is the model of the framework:

Table 1: Inclusion and Exclusion Criteria

Features	**Inclusion Criteria**	**Exclusion Criteria**
Publication Category	Peer Reviewed Journals, Scholarly Journals, reports, dissertations and thesis	Books, Magazines, Conference reports.
Publication Language	English	Except English
Key Words	Title, abstract	Reference
Year of Publication	Years from 2015 to 2024.	Years before 2015

Source: Author's own compilation (2025)

Figure 3: Weight of Evidence Framework.

Weight of Evidence A

This is based on generics, that is, without review, the judgment on the quality of the paper is passed. The quality focuses on honesty, a strong moral principle, logic, and consistency of the evidence. This is the most basic and generally used concept of assessing an evidence's quality.

Weight of Evidence B

This judgment is passed based on the review of the entire evidence, focusing on the answer for the research question. Which is directed based on the relevance of information.

Weight of Evidence C

This judgment is also passed based on the review of the evidence. This quality assessment also gives answers to other major parts of the research question, specifically the relevance of the evidence.

Weight of Evidence D

Complete assessment by combining the quality assessed of the evidence under weights A, B, and C. So, this weight of evidence will show the extent to which an item of evidence answers the research question by reviewing it.

Source: Gough, David (2007)

Table 2: Application of WoE Framework (George, 2016)

Criteria for WoE	Implication in the Reviews
A - Quality of Research	Here, the quality of literature is weighted on the model of the study.
B - Research Design	Research design is weighed based on the review of an evidence's variables, sample, and methodology.
C - Research Relevance	Relevance of the literature weighed as per the review of the evidence answering the research question of this study.

Source: Table 2 is as per the model given in "Subjective well-being of children in India: A systematic review" by Alka Ranjan and Tony Sam George.

The quality assessment is carried out and evaluated according to Gough's (2007) model (Gough, 2007); each literature was given a ranking under the three WoE (A, B and C), the ranking for each WoE were ranging from 1 to 3; the ranks for all three weights were added, the maximum ranking total is 9 and minimum ranking total is 3: the literature with total rank ranging from 6 to 9 were considered as good quality. Most of the studies had a weight denoting good quality, but a few studies with low quality were also included in order to understand the incomplete aspects of the studies. Out of the 80 articles, 21 articles are classified for the literature review; the rest, 59, are used for the empirical analysis as presented in Table 3.

Data Extraction and Analysis

Table 3: Systematic Table of Empirical Analysis

Category	Subcategory	Findings
Internal Auditors (Abdulaziz Alzeban, 2015), (Razimah Abdullah, 2018), (Elias Gebrayel, 2018) (Ardianingsih, A. R., Setiawan, D., Widarjo, W., & Payamta, P., 2024)	Corporate Governance, Audit Committee, Internal Audit Function and Internal Management	For better independence in internal audit work, there should be high support from internal management and the audit committee, which will also impact financial performance positively. But if management competes with internal auditors, they will try to influence internal auditors for their own benefits, and independence will be difficult and the relationship between auditors and auditors will not hold good. The audit committee should control internal auditors with proper guidelines and continuous supervision for good audit quality to impact financial performance positively.
	External Auditor's Reliance on Internal Auditors	When external auditors depend on internal auditors' work, it is said to have a positive effect on the external auditor's style of work. In the opinion of internal auditors on reliance, the work burden of external auditors is reduced, whereas external auditors' opinions contrast this. Another study likewise shows reliance on internal auditors' work can reduce external auditors' workload and the fee paid to them. The Institution of Internal Auditors encourages for the better objectivity and competence of independent internal auditors and their audit quality.

	Internal Control System	Internal control systems are said to have good knowledge and assessment skills about fraud risk factors, which is also the key role of internal auditors (IA); therefore, a good connection between the Internal Control System (ICS) and IA will help in effective measures on fraud risk assessment.
	Tenure, Distance, Non-Audit Service and Outsourcing	When the Internal Audit Function (IAF) is outsourced, it indicates the low efficiency of the ICS and the loss of confidentiality, but it enables transparency of information favourable to investors. When auditors are at a long distance from the client's location, it is better to have a rotation of auditors so as to reduce the internal control weaknesses and it is said to lose the independence in auditors' work when non-audit services are offered.
	Information Technology	Information Technology in Internal Audit Function can be effective and efficient towards the performance of the firm.
Independent Auditors (Internal Auditor) (Iman Sarwokoa, 2014), (Huanmin Yan, 2016), (Alzoubi, 2017) (Liston-Heyes, J., & Juillet, L., 2024).	External Auditors Reliance on Internal Auditor's Independence	External auditors will fix their degree of reliance on the internal auditor's work based on the evaluation conducted by external auditors in respect to work performance, competence, and objectivity, which are indicators for the quality of the Internal Audit Function (IAF). With external auditors' support and management's concern, the IAF will be effective towards financial performance. The external auditor's trustworthiness on the information for audit is higher if it's collected from internal auditors. Though both auditors' functions are different for a firm, a healthy relationship between both auditors can impact independence in their works.
	Small Firms and Related Party Transaction	The independence of auditors is said to be low in the case of small audit firms, as they can be influenced easily by management and internal party transactions. Hence, many qualified auditors have no interest in being part of small audit firms.

	Corporate Governance, Objectivity, Tenure, Joint-Audit, Non-Audit Fees and other factors influencing Independence	In a joint audit, it is always better to have a continuous rotation of auditors. An auditor's objectivity is determined by their knowledge of accounting policies and their ability to develop their own. Independence in the internal auditors is questioned as they are the employees of the firm, but a clear corporate governance framework can enable independence and objectivity among the internal auditors. Similarly, the Audit Committee (AC) and the Internal Audit Function (IAF) are two important pillars of corporate governance; if there is good interaction between them, the chances of fraud reduction will be high, which will also help in internal control quality, adding to the advantage when internal auditors are considered for management training.
	Audit Quality (Accurate Fraud Detection)	Independence among the internal auditors can reduce fraud and likewise increase audit quality, whereas work stress is one of the parameters that can affect the audit quality. Therefore, fraud detection is more likely to be effective when carried out independently by internal auditors. And when there is no gap between the executive's and internal auditor's communication, the quality of auditing will hold up well.
Association between Audit, Auditor's Independence and Financial Performance (Medhat Endrawes, 2018), (Mohammad Mustafa Dakhlallh, 2020), (Alqatamin, 2018) (El Fakir, M, 2023) (Wahhab, A., & Al Saadi, F. M. B., 2024)	Roles, Competency, Fees, Firm Size and Earnings Management affecting Financial Performance	Internal audit is one of the best functions for government undertakings as their main function is cost cutting, and internal auditors control over financial information, independence in audit, getting normal fees, and so on can impact positive financial performance.

	Corporate Governance and Audit Committee	The audit committee (AC) can help in the proper handling of legal issues related to auditing and can control over internal auditors. AC includes independent members; it is one of the key departments in a firm with more power than management. There is a positive relationship between the audit committee's size, independence, expertise and financial performance, but a few other characteristics of the committee can negatively impact financial performance.
	Internal Control System (ICS)	An effective internal control system will have a good impact on financial performance (FP) when internal auditors supervise the ICS.
	Audit Quality and Effective Financial Management	Audit quality is ensured when there is independence, which is believed to be achieved only by the Big 4 firms, with the audit team being frequently changed, having normal fees, no non-audit service, and so on. Internal auditor independence combined with management support will result in Audit Quality (AQ) and good FP.

Source: Author's own compilation (2025)

DISCUSSION

Internal Auditors

Audit and corporate governance's importance was raised as and when the financial crisis took place (University, 2014). The internal audit department is indeed an extra cost to the company (Saidin, 2014), but with well-established characteristics of the audit committee company can derive quality auditing from internal auditors (Abdulaziz Alzeban, 2015; Razimah Abdullah, 2018; Elias Gebrayel, 2018). If the internal auditors are performing at high quality, it is said that external auditors will depend on them (Halil Painoa, 2015) (Julie Petherbridge, 2015), with helpful steps taken to guide each type of auditor's process (David Breger, 2020) (Hazami-Ammar, 2019), based on work performance, competence and objectivity (Renu Desai, 2017). The judgment by both internal and external type of auditors has similar ability on fraud risk assessment but do vary on client motives, as client's character is understood by internal auditors more comparatively (Zuraidah Mohd-Sanusi, 2015) (Kirsten Fanning, 2014), hence most of the past researchers have taken the side of internal audit and internal control when it comes to the prevention and detection of fraud (Rohana Othmana, 2015). In case of external auditors' role on fraud risk assessment, it is better to have auditors' rotation, if its joint auditors and if auditor is in long geographical distance (Yangyang Chen, 2016) (Abhijeet Singh, 2019) (Reiner Quick, 2018), but the constraint of distance can be invalid when most of the audit function is through IT (Aidi Ahmi, 2014) (He Lia, 2018).

The internal audit function is not used as a competition platform to train the management; if it is used so, then management will highly influence internal

auditors while reporting issues (Florian Hoos, 2018). The management recommendations are considered in the audit function, and the management uses audit functional requirements as a benchmark; hence, relationships between the auditors and auditees are influenced by management (Sarens, 2017).

The Institute of Internal Auditors (IIA) understand the difficulties on application of required skills by the employees for internal audit as it involves high cost of training, therefore currently, Institute of Internal Auditors allows companies to outsource the internal audit function (Dije Muhammad Suleimana, 2014), there are studies contrasting this, that internal audit service should not be outsourced it will reduce the independency due to the existing threat of losing the contract or reduction in the fees etc. (Roger Meuwissen, 2019).

Independence of the auditors (internal auditors)

The internal auditors usually assume themselves as independent, whereas the independence of the internal auditor is evaluated by the independent external auditor (Ward & Robertson, 1980), (Renu Desai, 2017). The higher the interaction between internal and external auditors, will show a good level of independence in auditing (Grace Mubako, 2019). Also, the level of relationship between internal auditors and audit executives will affect the level of independence (Alzeban, 2015; Putri Kamal, C. N., 2023). Independence is more important for the Internal Audit to show the appropriate growth towards a company's financial performance (Hamza Mohammad Alqudah, 2019). As per behavioural theory, interaction between the audit committee and Internal Audit Function (IAF) will enable the chief audit executive to boldly report the frauds irrespective of threats from the management (Imen KHELI, 2016). Internal auditors usually hesitate to report financial fraud to management in order to please them the independence is When such a relationship exists, when the audit committee is a watchdog, the chances of such a relationship might reduce (LAWRENCE J. ABBOTT, 2016). Fraud detection will be better if it is investigated by IAF (Internal Audit Function) rather than other departments or management, and the CAE (Chief Audit Executive) should ensure independence in the IAF to prove reliability in the function (Hazami-Ammar, 2019). Also, internal auditors recruited for management training ground can practically increase the ability of the audit function (Joseph V. Carcello, 2018) (Ramdani, S., Widyastuti, T., Darmansyah, D., & Rito, R., 2025).

As stated in Economic Theory of Auditors' Independence, there is lack of independency in the work of external auditor when there is quasi-rent (Abhijeet Singh, 2019), (ANTONIO LOPO MARTINEZ, 2017); auditors' size and client's recognition are usually considered as main criteria for the audit quality, many ignore the independence of auditors while evaluating the audit quality. Political influence on the external auditors' work for those firms that are related to the political party (usually audited by Big 4 firms) can weaken the independence of auditors (Ahsan Habib, 2017). Auditor specialization and other various psychological factors are influencing the auditors' independence (Iman Sarwokoa, 2014; Huanmin Yan, 2016; Alzoubi, 2017) (Liston-Heyes, J., & Juillet, L., 2024).

Importance of internal audit function is being encouraged by CG over past 20 years and recently steps taken to make auditors'

independency mandatory (Florin DOBRE, 2013),(Milica Đorđević, 2017), CG features have very important part in enhancing the quality of internal audit (Geoffrey D. Bartlett, 2017); such as audit committee and executives, which will be top hierarchy to the internal auditors to ensure independency and objectivity(Milica Đorđević, 2017), (Ahmed Atef Oussii, 2018). There is an absence of equality in the information obtained by the outsider and insider of the company; hence, it is very important to disclose the internal control audit report (Ye Sun, 2012) (Hazaea, S. A., Al-Matari, E. M., Khatib, S. F., Albitar, K., & Zhu, J., 2023).

Association between audit, auditors' independence, and financial performance

There is a direct and indirect effect of internal audit on financial performance. The companies must concentrate on the principles of accounting; hence, it is necessary to include a permanent audit unit in the company to avoid various legal issues (Küçükçolak & Özer, 2007). Internal auditors play various roles and are considered to be experts and skilled employees of an organization (Jagongo, 2017). The role of internal audit is most important as it assist in effective application of financial resources as internal audit has a clear knowledge on waste, inefficiencies, frauds, errors etc., internal audit not only utilizes the financial resources but also makes an effort to increase operational activities which will result in positive financial performance and efficiently improve the operations, cost cutting methods, and overall financial management(Aikins, 2011). Internal auditors have various functions and activities that impact financial performance (Mafiana, 2013). The financial performance of a company is impacted positively by the audit quality (AQ), but when the relationship between AQ and FP is controlled by Product Market Competition, then high competition leads AQ to positively impact FP and Vice Versa (Usman Sattar, 2020). It is said that high quality of audit is encountered in large firms and not small firms (Mariana Nedelcu (Bunea), 2015; David Okelue Ugwunta, 2018).

The audit quality and its effectiveness on financial management are ensured when management allows independence to the internal auditors (Desmond Ziniyel, 2018). The internal auditor must have independence to oversee each functional department to rectify the error, and can give this overview report to the external auditor (Gal, 2017). The external auditor is the guarantee for the financial statement to the stakeholders, whereas the internal auditor is the guarantee for the financial information to the external auditor (Alzoubi, 2017). Auditor's independence will be lacking if the auditors are favourable to the clients (Florin DOBRE, 2013). With strict guidelines on auditing and ensuring transparency in the firm's financial information presented to the public, there will be no question raised against the trust of financial information (Abdullahi Bala Ado, 2020).

A firm that holds on to corporate governance and has a good structure of internal systems is said to have a positive overall performance (Haiyan Zhou, 2018). CG likewise has made way for quality audit under the guidance of the audit committee (Vasile Dinu, 2015). Having many members in the audit committee usually results in good comparability with financial statements. Expert auditors in the audit committee are essential for quality tracking of financial performance (Medhat Endrawes, 2018; Mohammad Mustafa Dakhlallh, 2020), (Alqatamin, 2018) (El Fakir, M, 2023).

Theoretical Implications

One of the important elements of corporate governance and organizational accountability is the internal auditors' independence, and the study focuses on theoretical evidence of it. As a theoretical foundation for agency theory, stewardship theory, and stakeholder perspectives on governance effectiveness, the findings confirm that independence in the internal audit function is more than just a procedural one.

The majority of the existing literature has ignored the function of internal auditor independence and its impact on firm performance in favour of examining audit quality through the prism of external audit firm size or client recognition (Booker, 2018). This review highlights the potential role of internal auditor independence as a mediating factor between financial outcomes and governance mechanisms, thereby enhancing current theoretical models of audit quality and organizational performance.

Additionally, behavioural and psychological factors like stress levels, professional scepticism, and the perceived value of independence should be included in theoretical work when developing models of internal audit effectiveness (Yan, 2016; Bartlett, 2017). By including these components, researchers can develop a thorough independence framework (Ward & Robertson, 1980) that takes into account the structural and behavioural elements that affect auditor objectivity.

Future theoretical research should also consider contextual factors such as gender, sociocultural influences, firm ownership type (family versus non-family), and audit tenure (Dobre, 2013; Alqatamin, 2018). Such an expanded theoretical scope will allow for more intricate explanations of how independence functions in different industrial and organizational contexts.

Managerial Implications

Management says that this review shows how important it is for businesses to make their internal auditing processes more independent and trustworthy as part of a strong governance framework. Real independence in internal auditing will not only make audits better, but it will also promote accountability, transparency, and long-term success.

Management should be pushed to hire certified auditors who are good at what they do (Dobre, 2013) and to work hard to fix problems that affect auditor independence (Gal, 2017).

Small and medium-sized businesses' (SMEs') governance frameworks should be customized to meet their unique operational constraints. Independent audit departments can positively impact a company's finances and reputation, even for small businesses. The review also recommends that external auditors have a clear relationship with internal audit outputs in order to guarantee accountability across various areas.

When creating internal auditing systems, public sector lawmakers and government managers can benefit from these insights. These kinds of systems can foster fiscal restraint, enhance resource management, and increase public trust. Improving independence at all auditing levels can result in more dependable decision-making and improved organizational performance.

CONCLUSION

The literature on internal auditor independence and its relationship to audit

quality and financial performance is comprehensively reviewed in this systematic review. It assesses the calibre of past research using the Weight of Evidence (WoE) framework. To identify the primary determinants of auditor independence, the review thematically arranges its findings.

The results demonstrate that when internal auditors successfully uphold their independence, they play a critical role in bolstering an organization's internal control framework and enhancing financial outcomes (Svanberga, 2018). Nonetheless, there is still a great deal of ambiguity in the literature regarding the contextual, structural, and behavioural elements that influence independence.

Future research ought to examine the relationship between internal audit independence and financial outcomes across different kinds of businesses. This covers public organizations, small businesses, and non-listed entities. Mixed-method approaches may also be beneficial for future research. These approaches would integrate qualitative insights into governance practices with quantitative performance data, including capital adequacy, market risks, and operational risks (Nedelcu, 2015).

There are some limitations to this review, despite the fact that it provides insightful theoretical and practical information. Linguistic and publication biases may have been introduced by concentrating solely on peer-reviewed, English-language publications. Furthermore, it is difficult to make direct comparisons because different studies use different definitions of "independence" and have different methods. Notwithstanding these issues, the review lays a strong basis for future research on internal audit independence and its significance for financial performance and corporate governance.

FUTURE SCOPE

Future studies may follow a number of possibilities. Empirical studies with underdeveloped regions and transition markets would increase the international applicability of studies on internal auditor independence. Cross-industry or cross-regulatory framework studies would help to further understand the influence of environmental factors. Lastly, studies on the influence of new and changing technologies (e.g., artificial intelligence, data analytics) and governance arrangements would be an exciting area for future research, where internal auditor independence could be influenced. Longitudinal data that tracked independence over time would be useful when studying the influence of regulatory reform or changes in corporate governance.

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Author Declaration

I, S Hephzibah, hereby declare that the research article titled "A Systematic Review on Independence of Internal Auditors" is my original work and has not been submitted for publication elsewhere, either in whole or in part. All sources of information used in the study have been duly acknowledged and referenced. The study was conducted ethically, and all data presented are accurate to the best of my knowledge.

I further declare that there are no conflicts of interest, financial or otherwise, that could have influenced the results or interpretation of this research. My co-author has contributed significantly to the work, reviewed the final manuscript, and agreed to its submission for publication.

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CRUDE OIL PRICE INDEX, FEDERAL FUNDS RATE AND GEOPOLITICAL RISK: THE TRILOGY THAT MOVES THE GLOBAL EMERGING ECONOMIES

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ABSTRACT

The interrelated dynamics of geopolitical risk, crude oil prices, and the federal funds rate are pivotal in influencing global economic and financial stability. Based on the importance of the fact, the current article aims to find out an interrelation among crude oil price index, federal funds rate and geopolitical risk of the economies. Global economic and financial stability are significantly impacted by the interrelated dynamics of crude oil prices, geopolitical risk, and the federal funds rate. Crude oil prices are susceptible to volatility as a result of geopolitical risks, including conflicts, sanctions, and political tensions, which disrupt oil supply chains. This volatility has a global impact on economic growth and inflation. The federal funds rate, which is determined by the Federal Reserve, is a critical monetary policy instrument that is used to regulate inflation and impact economic activity by adjusting interest rates. Borrowing costs and currency values are influenced by fluctuations in the federal funds rate, which in turn affects crude oil prices. The objective of this investigation is to investigate the intricate interactions between these three variables in order to comprehend the joint influence of geopolitical shocks, monetary policy, and energy market fluctuations on macroeconomic outcomes and financial market stability. In order to develop effective strategies to mitigate risk and preserve economic resilience in the face of global uncertainties, it is imperative that policymakers and investors comprehend these connections. The article measures the contribution of federal funds rate to indicate an inflationary situation in the economies. The variables considered here as Federal Reserve Rate, West Texas Intermediate (WTI), a benchmark grade of crude oil, and The GPR Index that measures geopolitical tensions by tracking the frequency of related articles in major newspapers. By analysing twenty-three years of daily data, the study aims to analyse Auto Regressive Distributed Lag (ARDL) Modelling Approach to identify patterns that explain why oil prices change so often and dramatically. It proves the federal funds rate as a mediator variable to influence the crude oil price index. The study tries to emphasise the role of federal funds rate to influence the crude oil primarily that creates the uniqueness of it. The federal funds rate substantially impacts crude oil prices by affecting the U.S. dollar, inflation expectations, and economic growth. Nonetheless, supply-side factors as OPEC decisions and geopolitical risks can occasionally take over this federal fund-crude oil relation, introducing complexity to market dynamics of the countries.

Key Words: Crude Oil Price Index, Geopolitical Risk, Federal Funds Rate, ARDL

INTRODUCTION

Crude oil is one of the most essential resources in the world, powering industries, transportation, and energy production. However, its price often changes dramatically due to a variety of factors. Understanding what drives these price changes is essential for governments, businesses, and investors. This study focuses on how geopolitical risks, trade wars, and the U.S. Federal Reserve's (FED) fund rate impact crude oil price volatility from January 5, 2000, to December 29, 2023, Zhao,et. Al, (2024). By using daily data, this research captures frequent changes to provide a clear picture of what causes oil prices to fluctuate. Geopolitical risks, assessed through tools like the Geopolitical Risk (GPR) Index, often trigger sudden shifts in oil prices. Significant events such as wars, political tensions, or acts of terrorism can disrupt oil supply, leading to uncertainty. For instance, events like the Gulf War or the recent conflict in Ukraine have resulted in significant increases or decreases in oil prices. These risks contribute to the unpredictability of oil markets and can have far-reaching global effects.

Similarly, trade wars between major nations, such as the United States and China, impact oil prices by affecting global trade and economic growth. This study employs the Trade Policy Uncertainty (TPU) Index to evaluate how trade disputes influence oil demand and market confidence. When trade relations are unstable, businesses and investors tend to be more cautious, which can result in decreased energy demand and subsequent price fluctuations.

The FED fund rate, which reflects U.S. monetary policy, is another critical factor in this analysis. Changes in the FED fund rate affect borrowing costs and economic activity, influencing energy consumption. For example, shifts in interest rates significantly shaped oil prices during the 2008 financial crisis and the COVID-19 pandemic. This study explores how this monetary policy changes interact with crude oil markets over time. The research utilizes the Autoregressive Distributed Lag (ARDL) method to analyse these relationships.

By analysing 23 years of daily data, the study aims to identify patterns that explain why oil prices change so often and dramatically. The results will provide valuable insights for policymakers, investors, and industries dependent on stable energy markets. These findings can also help design better risk management strategies and make informed decisions in a complex global economy.

The structure of the paper is as follows: section two analyses the review of literature. Section three focuses on the data description and data analysis. Section four explains the discussion and policy recommendation. Section five concludes the paper.

LITERATURE REVIEW

The volatility of crude oil prices has been a significant topic of study in economics and finance due to its wide-reaching implications on global markets and economies. Researchers have extensively examined the factors driving crude oil price dynamics, such as geopolitical risks, economic shocks, and monetary policy, to understand and predict these fluctuations better.

Hamilton (2009), Islam, et al, (2025) analyzed the oil shock of 2007–08, emphasizing how geopolitical tensions and macroeconomic factors influence oil prices and their subsequent effects on the global

economy. Similarly, Kilian (2009) stressed the importance of distinguishing between supply and demand shocks in crude oil markets, providing a nuanced understanding of their impact on price movements.

Geopolitical risks have emerged as a critical factor affecting oil price volatility. Caldara and Iacoviello (2018), Zhou and Liang (2025) developed the Geopolitical Risk (GPR) Index, which quantifies geopolitical tensions and their economic effects. This tool has become pivotal in understanding the link between geopolitical events and crude oil price fluctuations. Ren et al, (2023) extended this research by investigating the asymmetric effects of geopolitical risks on China's crude oil prices through a Quantile Autoregressive Distributed Lag (QARDL) approach, uncovering new insights into the non-linear impacts of such risks.

The role of trade policy uncertainty in influencing economic activity and commodity markets has also been explored. Caldara et al. (2019) examined the macroeconomic implications of trade policy uncertainty, particularly its effects on global trade and market stability. Their findings highlight the interconnectedness between policy uncertainty and crude oil price movements.

Macroeconomic factors, including monetary policy, remain central to understanding oil price volatility. Filis and Chatziantoniou (2014), Liu and Zhang (2024) analyzed the influence of financial and economic policies, such as interest rate adjustments, on crude oil prices. Similarly, Kaufmann and Ullman (2009) explored the relationship between oil prices and exchange rate dynamics, shedding light on the interaction between global financial markets and energy prices.

Research has also addressed the broader economic consequences of oil price volatility. Aloui, Gupta, and Roubaud (2016), Niu, et al , (2025) investigated the relationship between oil price shocks and economic growth in emerging markets, emphasizing the vulnerability of these economies to energy price changes. Jo (2014) further explored the macroeconomic impacts of oil price uncertainty, focusing on its potential to destabilize global economies.

Supply and demand shocks are integral to understanding oil price volatility. Barsky and Kilian (2004) examined the historical significance of oil price shocks since the 1970s, emphasizing their complex drivers. Rahman and Serletis (2010) highlighted the asymmetric effects of oil price shocks, demonstrating how responses vary based on the type of shock.

The integration of global energy markets has also been extensively studied. Bachmeier and Griffin (2006), Zhou (2025) tested for market integration across crude oil, coal, and natural gas markets, illustrating the interconnectedness of energy commodities. Fattouh (2007) examined the role of political economy in shaping oil market dynamics, focusing on the influence of policy and market structures.

Lastly, uncertainty and its broader economic impacts on crude oil prices remain a recurring theme in the literature. Bloom (2009) analysed the effects of uncertainty shocks on the global economy, demonstrating how fluctuations in economic confidence propagate through financial and energy markets.

The existing literature underscores the multifaceted drivers of crude oil price volatility, including geopolitical risks, trade policy uncertainty, monetary policy, and macroeconomic factors. These studies provide a solid foundation for further research, particularly in exploring the interplay between these factors and their combined effects on global energy markets.

Also, the literature review indicates a necessity for integrated models that account for the nonlinear, asymmetric, and interactive effects of geopolitical risk, trade policy uncertainty, and monetary policy on crude oil prices. Additionally, there is a lack of dynamic event-specific modelling, cross-country and sectoral analyses, and broader policy perspectives that extend beyond traditional inflation targeting. The predictive understanding and policy responses to oil price volatility could be improved, particularly for emerging economies, by addressing these gaps.

Thus, this current study identifies a concrete model for addressing all the necessary variables and constructs the objectives of the paper as follows:

- To find the interconnection between crude oil price index, federal funds rate and geopolitical risk
- To find the long run impact of federal funds rate on crude oil price index considering geopolitical risk as a control variable.
- To find out the short run impact of federal funds rate on crude oil price index considering geopolitical risk as a control variable.

RESEARCH METHODOLOGY

West Texas Intermediate (WTI) is a benchmark grade of crude oil known for its low sulfur content and low density. WTI is a key pricing standard for global oil markets, which is based primarily on the NYMEX. Supply-demand dynamics, geopolitical risks, and storage capacities influence the price of WTI. A notable event in WTI's history occurred in April 2020, when the May contract briefly traded at negative prices due to the COVID-19 pandemic, signaling severe disruptions in global oil markets.

The TPU Index quantifies uncertainty in trade policy by measuring the frequency of trade-related terms in major newspapers. Spikes in TPU have historically occurred during significant trade events, such as the Nixon-Ford shocks, NAFTA negotiations, and the 2016 U.S. election. The index captures how trade policy uncertainty affects economic activity, with higher TPU correlating with reduced investment and economic slowdown. Utilizing information contained in newspapers, corporate earnings calls, and tariff rates, it draws valuable insights into how trade uncertainty is affecting global markets.

The GPR Index measures geopolitical tensions by tracking the frequency of related articles in major newspapers. It captures spikes in geopolitical risk during significant global events, such as the World Wars, the Cuban Missile Crisis, and 9/11, Jalkh and Bouri(2024). The GPR Index was constructed using automated text searches, which reflects the level of global instability, with higher values often correlating with reduced investment and economic uncertainty. It is very sensitive to understand how geopolitical risks affect global markets and economic activities.

The Federal Funds Rate is the rate of interest used for US depository institutions in overnight loans, one another, using reserve balances. It is established by the FOMC, Yilmazkuday(2025). This influences other economic conditions powerfully in real-time, including inflation, employment, and investment. The rate is changed with open-market operations-that's when the FOMC raises rates to combat inflation or lowers them to foster growth. It is perceived to be a prime tool for the monetary policy of the United States, besides serving as a benchmark for other interest rates such as

loans and mortgages, Al Mustofa and Risyad (2025).

The rationale behind this inclusion of variables is summarized as follows: West Texas Intermediate is taken as a dependent variable because this has been identified as one of the global benchmarks regarding oil pricing, reflecting some dynamics within the market. Geopolitical risks are then incorporated into the analysis because the risks often disrupt oil supplies and cause significant price fluctuations on the Geopolitical Risk GPR Index. Generally, trade wars and policy shifts significantly influence both global demand and supply, as captured in the TPU Index. Economic factors are portrayed in the Federal Funds Rate that subsequently impacts global economic activities further influencing consumption, volumes of production, and pricing mechanisms of oil.

The ARDL (Autoregressive Distributed Lag) model is employed in this research to examine the short-run and long-run relationships between WTI crude oil prices and the selected regressors, including geopolitical risks, trade policy uncertainty, and economic factors, data ranging from 05/1/2000 to 29/12/2023. This model is beneficial for handling variables with different levels of integration, allowing for the inclusion of both short-term dynamics and long-term equilibrium relationships. By considering the lags of the independent variables, ARDL helps address potential collinearity issues and provides insights into how these factors influence oil price volatility over time.

DATA ANALYSIS AND DISCUSSION

Before analysing the data, we have organised the hypothesis as follows:

H_{01}: There remains no cointegration among the variables

H_{02}: There is no long run impact present in the study

H_{03}: There is no short run causality found in the study.

The descriptive statistics highlight distinct characteristics of the variables. WTI has a mean of 1.760520, a median of 1.787177, and low variability (SD = 0.195212), with a nearly symmetric distribution (slightly negative skewness) and moderate range, though the Jarque-Bera test strongly rejects normality (p = 0.000000). TPU, with a mean of 1.952269 and a wider range than WTI, shows moderate variability (SD = 0.286052) and a nearly symmetric distribution, but normality is also rejected (p = 0.000000). FEDERAL exhibits the largest range, the highest variability (SD = 0.686555), and significant asymmetry between the mean (-0.157061) and median (0.041393), with a flatter distribution (kurtosis = 1.459891) and non-normality confirmed (p = 0.000000). GPRD has the highest mean (2.009224), moderate variability (SD = 0.200474), and a slightly positive skew, with the highest kurtosis (4.695897) indicating significant outliers; normality is again rejected (p = 0.000000). Overall, all variables deviate significantly from normality despite differing distribution characteristics.

Table 1: DESCRIPTIVE STATISTICS

Statistics	WTI	TPU	FEDERAL RATE	GPRD
Mean	1.760520	1.952269	(0.157061)	2.009224
Median	1.787177	1.954049	0.041393	2.006060

Maximum	2.162296	2.907226	0.836324	3.019367
Minimum	0.949878	0.521138	(1.397940)	0.977339
Std. Dev.	0.195212	0.286052	0.686555	0.200474
Skewness	(0.461308)	(0.131133)	(0.143067)	0.330821
kurtosis	2.389674	3.442642	1.459891	4.695897
Jarque-Bera	306.8985	66.38820	615.3949	831.0826
Probability	0.000000	0.000000	0.000000	0.000000
Sum	10596.57	11750.71	(945.3507)	12093.52
sum sq. Dev-	229.3331	492.4265	2836.628	241.8621
Observations	6019	6019	6019	6019

Source: Authors owns calculation from Eviews

Table 2: JOHANSEN COINTEGRATION TEST

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
None*	0.048365	539.8773	55.94578	0.0000
Almost 1*	0.037013	241.8922	35.01090	0.0000
Almost 2*	0.002211	15.18485	18.29771	0.1331
Almost 3*	0.000313	1.880139	3.841465	0.1703

Source: Authors' own calculation from Eviews

Table 3: ARDL MODEL OUTPUT

R-squared	0.996360	Mean dependent var	1.761193
Adjusted R-squared	0.996354	S.D. dependent var	0.194386
S.E. of regression	0.011738	Akaike info criterion	(6.049957)
Sum squared resid	0.826562	Schwarz criterion	(6.036579)
Log likelihood	18195.15	Hannan-Quinn criterion	(6.045312)
F-statistic	149290.1	Durbin-Watson stat	1.976564
Prob(F-statistic)	0.000000		

Source: Authors' own calculation from Eviews

Table 4: F-BOUND TEST

F-Bound Test		Null Hypothesis: No Levels relationship		
Test Statistic	Value	Significance	I(0)	I(1)
F-statistic	3.262480	10%	2.37	3.2
k	3	5%	2.79	3.67
		1%	3.65	4.66

Source: Authors' own calculation from Eviews

Table 5: ARDL LONG RUN and SHORT RUN ERROR CORRECTION

Long Run Analysis			
Variable	**Coefficient**	**t-Statistic**	**Probability**
TPU	(0.130915)	(0.684103)	0.4939
GPRD	(0.418782)	(1.510807)	0.1309
FED_FUNDS	(0.162459)	(1.990035)	0.0466
C	2.864944	4.235546	0.0000

ECM Regression Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**prob.**
D(WTI(-1))	(0.038936)	0.012875	(3.024157)	0.0025
D(WTI(-2))	0.016948	0.012859	1.318037	0.1875
D(WTI(-3))	(0.042801)	0.012598	(3.297375)	0.0007
D(FFER(-1))	0.006682	0.004161	1.606031	0.1083
D(FFER(-2))	0.006102	0.004270	1.429140	0.1530
D(FFER(-3))	0.012881	0.004267	3.018982	0.0025
D(FFER(-4))	0.011903	0.004160	2.861518	0.0042
CointEq(-1)*	(0.002943)	0.000728	(4.040208)	0.0001

Source: Authors' own calculation from Eviews

The Johansen cointegration test results indicate the presence of long-term equilibrium relationships among the variables in the system. The null hypothesis of no cointegration ("None") is rejected as the trace statistic (539.8773) exceeds the critical value (55.24578) with a p-value of 0.0000, confirming at least one cointegration relationship (acceptance of H_{11}). Similarly, the null hypothesis of at most one cointegration relationship is also rejected since the trace statistic (241.8922) is greater than the critical value (35.01090) with a p-value of 0.0000, indicating the existence of more than one cointegration relationship. However, for the null hypothesis of at most two cointegration relationships, the trace statistic (15.18485) is less than the critical value (18.39771) with a p-value of 0.1331, leading to the conclusion that no more than two cointegration relationships exist. Likewise, the null hypothesis of at most three cointegration relationships is not rejected, as the trace statistic (1.880139) is less than the critical value (3.841465) with a p-value of 0.1703. Therefore, the test confirms the existence of two cointegrating relationships among the variables at the 5% significance level

The model demonstrates an excellent fit, with an R-squared of 0.996360, explaining 99.63% of the variation in WTI, and an adjusted R-squared of 0.996354, confirming the model's robustness. The F-statistic (149290.1) is highly significant (p-value = 0.0000), validating the model overall, and the Durbin-Watson statistic (1.976564) suggests no significant autocorrelation in the residuals. While the model highlights the dominant autoregressive nature of WTI, the other variables do not show significant direct effects.

The F-Bounds Test results assess the presence of a long-run relationship between variables in the ARDL framework. The null hypothesis assumes no levels (long-run) relationship. The F-statistic value is 3.262480, and at the 10% significance level, the critical bounds are I(0) = 2.37 and I(1) = 3.20. Since the F-statistic exceeds the upper bound critical value (I(1) = 3.20) at the 10% level, the null hypothesis can be rejected, indicating evidence of a long-run relationship between the variables at this significance level (acceptance of H_{12}). However, at the 5% level and below, the result is inconclusive, requiring caution in interpreting the findings and possibly further validation.

The ARDL ECM regression results highlight significant short-run dynamics (acceptance of H_{13}), with certain lagged values of WTI and the federal funds rate impacting WTI. The error correction term is statistically significant (p-value = 0.0001) and negative (-0.002943), confirming the presence of a long-run equilibrium relationship. The coefficient value indicates a slow adjustment rate, with 0.29% of the disequilibrium corrected in each period.

CUSUM Test

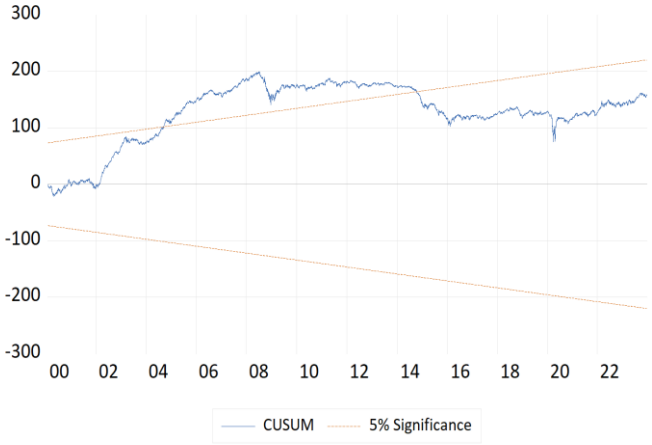

Figure 1: Result of CUSUM at 5 percent significance
Source: Authors' own calculation from Eviews

CUSUM OF SQUARES

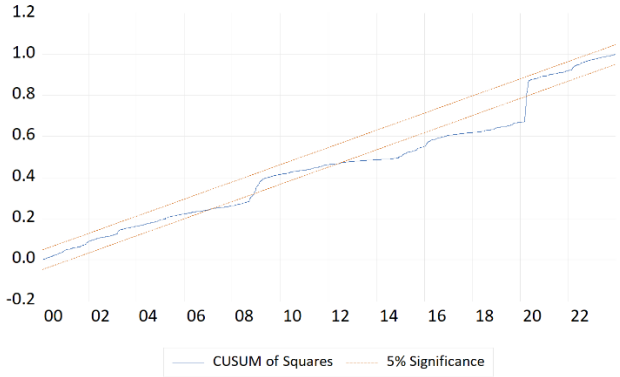

Figure 2: Result of CUSUMQ at 5 percent significance
Source: Authors' own calculation from Eviews

The CUSUM (Cumulative Sum) test graph (figure 1) shows the stability of the model over time, with the CUSUM line representing the cumulative sum of residuals and the orange lines denoting the 5% significance boundaries. As the CUSUM line remains entirely within the 5% significance boundaries throughout the period, it indicates that the model is structurally stable and does not exhibit any significant structural breaks. This confirms that the model is well-specified and reliable over the given time frame.

The CUSUM of Squares test graph (figure 2) illustrates the stability of the model's variance over time, with the blue line representing the cumulative sum of squared residuals and the orange lines indicating the 5% significance boundaries. As the CUSUM of Squares line remains entirely within the significance boundaries throughout the period, it demonstrates that the model does not exhibit structural breaks or instability in the variance of residuals. This confirms that the model is structurally stable, consistent, and reliable over the observed timeframe.

The interplay of global political risk, Federal Reserve policy, and crude oil prices is profoundly connected. Geopolitical disturbances can impact oil supply and prices, hence influencing inflation and economic growth, which subsequently infer Federal Reserve policy. Comprehending study, thus, is essential for mitigating risk in international markets. Based on the underlying data, the current study measures the impact of federal funds rate on crude oil price index with considering geopolitical risk as a control variable. It finds that the past spillover influences of crude oil price index will influence the present situation of the index, implying the necessity towards considering the past values for future estimation of the same. Apart from this outcome, the federal funds rate also influences the crude oil index positively. Hence, as the Johansen cointegration suggested for a minimum cointegrating equation, this outcome substantiates the same in output proving there remains at least one influential variable, federal fund rate to create an impact on crude oil prices.

Also, as per managerial implications, the paper demonstrates how the federal funds rate influences inflation and economic stability by mediating the impact of geopolitical risk on crude oil prices. Policymakers and managers acquire instruments for risk management and investment timing, while theorists acquire a comprehensive macroeconomic framework. The study emphasises inflation dynamics, recommending further investigation of nonlinear market effects. The federal funds rate influences crude oil prices mainly via its effects on the U.S. dollar, inflation, and economic growth. Higher interest rates typically depress oil prices due to an appreciating dollar and diminished demand, whereas lower rates generally elevate prices by stimulating economic activity. However, our outcome of the study proves federal funds rate to influence the crude oil price index positively, implying inflation persisting in the economy. Thus, we can infer based on our results to keep the federal fund rate to be under control to tighten inflation rate in the countries. Thus, primarily the need to control inflation is the main policy implication of the current article. And it justifies the output by confirming the base level federal fund rate to be promoted for curbing the inflation sensitivity in the economies.

CONCLUSION

The interplay of geopolitical risk, the federal funds rate, and crude oil price index is

essential as these factors collectively affect global economic stability, financial markets, and policymaking. Stable oil prices are essential for global economic stability. Disruptions might precipitate inflation and recession risks. Policymakers must reconcile monetary policy with geopolitical circumstances, maintaining inflation control while fostering growth. Comprehending these dynamics enables investors to mitigate risks and exploit opportunities in energy markets and related sectors. Thus, the interrelated significance of geopolitical risk, the federal funds rate, and crude oil price index resides in their combined influence on inflation, global economic stability, and financial markets. Though the current study specifically proves the federal funds rate increment implies inflation through enhancing crude oil price index, in general, it is found that geopolitical tensions impede supply and elevate prices, affecting central bank policy. Conversely, the Federal Reserve's interest rate decisions influence oil demand and overall market mood, establishing a feedback chain that highlights the strategic importance of these major factor in economies' subsequent developments.

LIMITATIONS

The study includes three variables, whereas, there can be other influential variables contributing to the scenario. Also, the non-linear dynamics of the model needs to be checked for future references. Other potentially influential factors, such as OPEC decisions, exchange rates, and financial market volatility, are the future scopes of the study. The analysis, which is primarily focused on U.S.-based benchmarks, may not be generalizable to other countries or emerging economies. This could be addressed in future research. Sectoral disaggregation and event-specific impacts on oil prices are not taken into account in the study, which could have yielded more detailed insights.

FUTURE SCOPE:

The future scope of the study lies in analysing the same with other countries and finding the relevance of the outcomes accordingly. The paper's future scope encompasses the following: also, testing the relevance and applicability of the findings across various economic environments by extending the analysis to other developed countries can be the future scope of the study. Utilizing sophisticated methodologies such as Quantile ARDL (QARDL) or machine learning techniques, asymmetric and intricate dynamic relationships can also be considered for the future scope of the current study.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest while writing the current article.

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EVALUATING INDIA'S PROGRESS TOWARDS SDG 7: ENSURING AFFORDABLE AND CLEAN ENERGY FOR ALL

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ABSTRACT

Achieving Sustainable Development Goal (SDG)-7 which deals with Affordable and Clean Energy is critical for ensuring universal access to modern energy services, increasing the share of renewable energy in the energy mix, improving energy efficiency, and expanding infrastructure for sustainable energy services. SDG 7 aims to ensure universal access to modern energy services, enhance the share of renewable energy in the global energy mix, improve energy efficiency, and strengthen infrastructure for sustainable energy services. India, with its ambitious renewable energy targets and policies, has made significant progress toward achieving this goal. Over the past two decades, the country has implemented substantial policy and institutional reforms to expand energy access and promote renewable energy technologies. Despite these advancements, considerable disparities remain between urban and rural regions, as millions of households continue to lack access to affordable and clean sources of energy for both cooking and electricity. The current study thus, analyses the progress and trends toward achieving Sustainable Development Goal (SDG) 7: Affordable and Clean Energy in India by analysing the data from 2000 to 2021 a secondary source drawn from national and international energy database. The analysis focuses on four key indicators representing the core dimensions of SDG 7 such as household access to clean cooking fuel, the share of renewable energy in electricity generation, energy intensity, and renewable energy capacity per capita. Both descriptive and regression analyses have been employed to explore temporal changes, inter-variable relationships, and the economic implications of renewable energy expansion. Using such descriptive analysis and regression analysis the study found that there exists an increasing trend in renewable energy expansion significant improvements in installed renewable capacity but persistent challenges in equitable clean fuel adoption. The findings reveal a clear upward trend in renewable energy deployment, driven by ambitious national targets and supportive policies such as the National Solar Mission and renewable purchase obligations. Installed renewable capacity, particularly from solar and wind sources, has expanded significantly since 2010, positioning India among the world's leading renewable energy markets. The analysis also indicates a steady decline in energy intensity, suggesting progress in energy efficiency and technological adoption across industries. However, despite these advancements, challenges remain in achieving equitable access to clean cooking fuels, particularly in rural and low-income households, where dependence on traditional biomass continues to pose health and environmental risks. Regional and income-based disparities hinder the inclusivity of the clean energy transition, underscoring the need for targeted interventions. The study concludes that while India's renewable energy policies have yielded commendable progress toward SDG

7, the pace of transition must be accelerated to ensure universal access and affordability. Policy recommendations emerging from this research emphasize the need for financial incentives, concessional credit facilities, investment in decentralized renewable systems, and stronger institutional frameworks for energy governance. Additionally, promoting public awareness, enhancing technological innovation, and integrating clean energy objectives into broader economic and social policies are crucial for achieving long-term sustainability. By linking energy access with development outcomes, this study contributes to a deeper understanding of the economic and policy dynamics shaping India's pathway toward SDG 7 and provides insights for policymakers seeking to balance growth with environmental responsibility.

Keywords- SDG 7- Affordable and Clean Energy, Renewable Energy, Energy Efficiency, Clean Cooking Fuel, Energy Access, India.

JEL Code- Q01, Q2, and Q5.

INTRODUCTION

Sustainable development (SD) is a multidimensional approach defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland & Khalid, 1987). It emerged as a global priority following recognition of the adverse consequences of unregulated industrial expansion on both human welfare and environmental stability. Over time, unchecked human actions have disrupted the equilibrium of economic, social, and environmental systems, leading to widespread risks and challenges that hinder sustainable growth agendas (Stanton & Ackerman, 2009). Sustainable development revolves around three interdependent pillars: economic growth, social inclusion, and environmental protection. The integration of these elements seeks to address inequities and mitigate environmental degradation while ensuring long-term economic prosperity. Achieving this balance, however, has proven to be one of the most complex challenges for policymakers globally, as they strive to align economic development with ecological sustainability (Barbier, 2011). Monitoring sustainable development (SD) is a critical process to ensure its effective realization. This monitoring is primarily facilitated through the use of various indicators that represent each of SD's core dimensions: economic, social, and environmental. Numerous global institutions, including the United Nations (UN), World Bank, and OECD, as well as researchers like Van de Kerk and Manuel (2008), have developed comprehensive indices and frameworks to track progress and provide actionable insights as shown in Table 1 (Khalid et al., 2018).

Table 1- Key sustainable development indicators with its institution and description used globally.

Index/Indicator	Institution	Description
Human Development Index (HDI)	United Nations (UN)	Average achievement of a country based on key dimensions of human development.

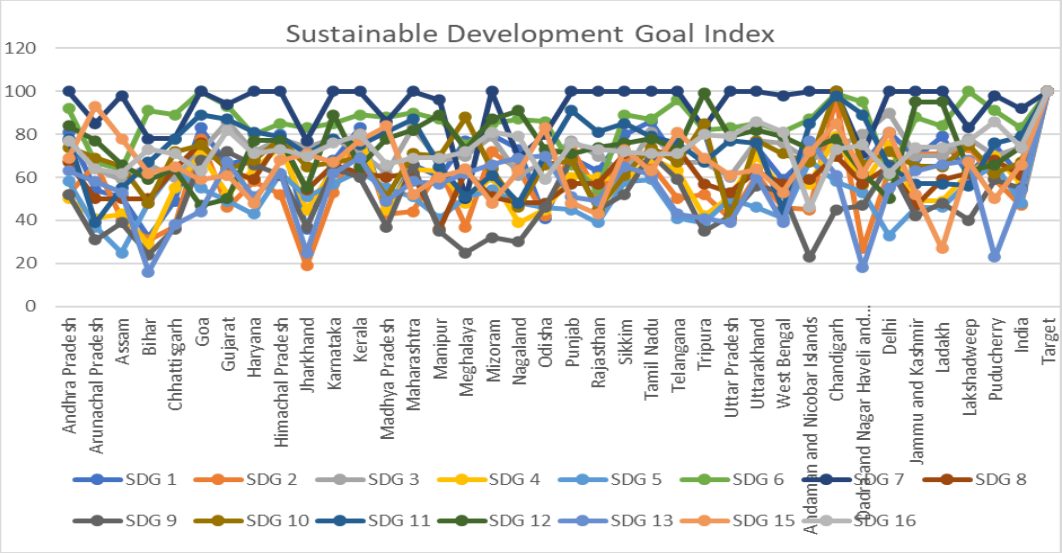
World Development Indicators (WDI)	World Bank	Most recent global development data with national, regional, and global estimates.
Eurostat SD Indicators	Eurostat	Tracks progress towards sustainable development by European Union member countries.
Ecological Footprint (EF)	Global Footprint Network	Measures a nation's human impact on Earth's ecosystem using ecological accounting methods.
Environmental Performance Index (EPI)	Yale University, Columbia University, World Economic Forum	Tracks a country's progress towards achieving environmental sustainability.
Sustainable Society Index (SSI)	Van de Kerk and Manuel	Evaluates a nation's progress in sustainability, integrating human wellbeing and environmental factors.

Source- (Khalid et al., 2018)

In 2000, the United Nations launched the Millennium Development Goals (MDGs), a set of eight targets aimed at addressing pressing issues such as poverty, hunger, gender inequality, illiteracy, and health challenges. While the Millennium Development Goals succeeded in drawing attention to critical developmental issues, their overall outcomes were uneven, with significant disparities in achieving final targets across regions. Furthermore, researchers critiqued the Millennium Development Goals for their narrow scope and limited focus on systemic and long-term sustainability challenges (Fehling et al., 2013; Fukuda-Parr, 2016; and Kumar et al., 2016). Based on the lesson the UN General Assembly introduced Agenda 2030 in 2015, establishing a transformative and holistic framework for sustainable development. This agenda encompasses 17 Sustainable Development Goals (SDGs), supported by 169 specific targets and over 230 associated indicators (United Nations General Assembly, 2015). The Sustainable Development Goals encompasses all key developmental sectors like health, education, sanitation, employment, infrastructure, energy, and environment, and it is a global blueprint for a better and more sustainable future. Therefore, sustainable development serves as a comprehensive framework for promoting societal progress while safeguarding the environment and ensuring well-being of present and future generation.

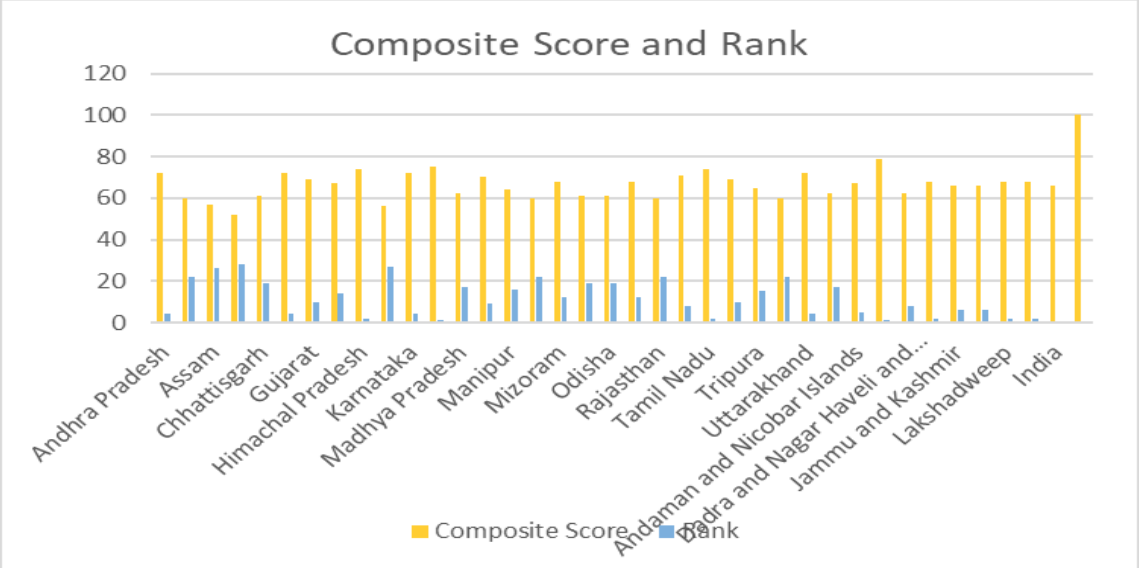
India also committed to Sustainable Development Goals (SDGs) in 2015. The progress of the world in meeting SDGs largely depends on India's progress, and the federal structure of the Indian government helps a lot in achieving this step. NITI Aayog is the nodal institution to encourage and supports SDGs in India. India constructed Sustainable Development Goal (SDG) India Index in 2018, which comprises 13 out of 17 targets (leaving goals- 12, 13, 14, and17). The index provides a holistic view of the country's social, economic, and environmental status of state and union territories. The individual states and union territory-wise achievement of different sustainable development goals India index is shown below-

Figure 1- Sustainable Development Goal Index of India.



Source- SDG India Index 2023-24

Figure 2- Composite score and rank of states and union territories.



Source- SDG India Index 2023-24

The data clearly signifies that the SDG India index and Dashboard have become a powerful tool to bring SDGs into the policy arena of states and union territories since 2018. This tool help in identifying the issues and areas which need improvement and point out strategies and interventions that could be a source of solution (SDG India Index and Dashboard, 2023-24). The Sustainable Development Goal (SDG) India Index also classified states and union territories into four different categories that are- Aspirant (SDGI= 0-49), Performer (SDGI= 50-64), Front-Runner (SDGI= 65-99), and Achievers (SDGI= 100).

Among different SDGs, the SDG-7 (Affordable and Clean Energy) aims to ensure access to energy sources that are affordable, reliable, sustainable, and modern energy. It consists of five main targets, which are supported by five indicators to measure progress. These targets focus on achieving

universal access to affordable, reliable, and modern energy services (7.1); substantially increasing the share of renewable energy in the global energy mix (7.2); and doubling the global rate of improvement in energy efficiency (7.3). However, access to affordable, reliable, and sustainable energy remains a significant challenge in India, especially in rural and underserved regions. While the country has made notable advancements in renewable energy and modern energy access, however disparities in infrastructure, affordability, and awareness persist. Millions of households, particularly in rural and remote areas, still rely on traditional energy sources for cooking and lighting, reflecting disparities in affordability, infrastructure, and awareness. Balancing the goals of universal access, rising energy demand, and environmental sustainability remains a major policy challenge for India's clean energy transition. In Indian context energy access has improved considerably due to various government initiatives promoting renewable energy adoption and rural electrification. However, the problem persists in the form of uneven progress across regions and income groups. Thus, the main objective of this study is to assess India's progress toward achieving the key targets of SDG-7 from 2015-16 to 2023-24 by analysing trends in access to clean cooking fuel, renewable energy share, and energy efficiency. The study further aims to provide evidence-based policy recommendations for accelerating the country's transition to sustainable and inclusive energy systems. The research gap addressed in this paper lies in the limited empirical assessment of India's progress toward SDG-7 using an integrated, multi-indicator approach over time. While existing studies often focus on specific aspects such as renewable capacity expansion or energy policy outcomes, few have comprehensively evaluated India's performance across the main SDG-7 dimensions using recent data. This study therefore contributes to filling that gap by linking empirical evidence with policy implications for sustainable energy development.

LITERATURE REVIEW

The global assessment of renewable energy shows us a comprehensive analysis of existing research on the current state of renewable energy worldwide. It includes analysing the global renewable potential countries, factors affecting consumption patterns of different renewable energy products, and the prospects, challenges, and opportunities of adopting such technology. A Special Report on Renewable Energy Sources (SRREN), analyse the interaction between sustainable development and renewable energy, and they concluded that among different renewable energy sources, solar energy offers the opportunity to contribute to several important sustainable goals such as renewable energy helps us in clean energy access, climate change, socioeconomic development, energy security and reducing the impact on health and environment. The report also finds that the lessening of dangerous anthropogenic climate change is seen as one of the physically powerful lashing forces behind the increasing use of renewable energy worldwide.

As per the British Petroleum (BP) Energy Outlook report (2019), the world is facing a dual challenge of rising energy demand and rising carbon emissions, and to tackle such challenges, renewable energy sources are the best alternative available. The report emphasizes the importance of renewable energy. It foresees renewable energy as potentially evolving into a global power

source by the year 2040, thereby reshaping the trajectory of the global energy market. Further within the realm of renewable energy, both solar and wind power are experiencing rapid expansion, a growth trajectory facilitated by a marked reduction in their costs of solar products by nearly 82 per cent over the past decade makes it more competitive with fossil fuel over the years (Bloomberg NEF, 2022). According to the International Energy Agency (IEA), solar energy accounted for 1.5 per cent of total global electricity generation in 2019, which surged to 4.5 per cent in 2022. The global solar market is also expected to expand from 720 gigawatts (GW) of deployment in 2020-to-1.2-terawatt (TW) deployment by 2025 (Wood Mackenzie, 2022). According to IRENA (2023) the global solar potential is 10 times more than the current energy demand; countries like China, the United States, India, Brazil, Japan, Germany, France, Italy, Spain, and Australia are the top ten countries with the highest solar energy potential.

For the development of renewable energy, various factors, like the role of artificial intelligence (AI), cost of solar products, subsidies, etc, were reviewed. Regarding the role of artificial intelligence, Zhao et al., (2024) analysed the impact of AI on renewable energy progress using data from 63 countries between 2000 and 2019, employing the Instrumental Variable Generalized Method of Moments model, and it was found that AI's significant contribution to renewable energy development, an asymmetric relationship where AI has a more substantial impact in countries with lower renewable energy levels, and the role of AI through technology and innovation effects. Additionally, climate finance directly supports renewable energy and moderates the AI-renewable energy relationship, leading to policy recommendations for enhancing renewable energy development.

Focusing on the Evolution of renewable energy in the world, Yolcan (2023), in his article, discusses a decade evolution of world energy from 2012 to 2021 and concludes that in primary energy consumption, the share of renewable energy is increasing from 0.24 gigatonne of oil equivalent (Gtoe) to 0.95 gigatonne of oil equivalent (Gtoe) and in terms of electricity production the share of solar energy is the highest. Thus, the share of renewable energy is increasing in world primary consumption and by 2050, every country will focus on making renewable energy dominant in primary energy consumption. Further, the growing usage of renewable energy in primary fuel consumption contributes to sustainable development (Special Report on Renewable Energy Source, 2018), environmental security (Burgohain, 2012), economic development (Caglar, 2020) and reducing climate change (IPCC, 2018). Thus, renewable energy studies are essential for a growth that is sustainable in nature and the current study try to focus on India's sustainable development path as a key participant in global climate action. However, despite India's commitment to climate action there found a gap where a comprehensive evaluation of all SDG-7 targets using long run regression analysis from 2000 to 2021 is missing. So, the current research try to bridge the gap by providing a data-driven evaluation of India's clean energy transition, linking it to economic performance and offering policy insights to accelerate SDG-7 growth.

RESEARCH METHODOLOGY

A mixed-method approach is employed to describe the data which integrates descriptive statistics and econometric

analysis such as regression analysis to assess India's progress toward SDG 7 (Affordable and Clean Energy) from 2000 to 2021. Before performing the regression analysis, diagnostic tests were conducted to validate key assumptions. Linearity between dependent and independent variables was checked through scatter plots and partial regression plots. Multicollinearity was tested using the Variance Inflation Factor (VIF), ensuring that no variable exceeded the critical threshold. The Durbin-Watson statistic was used to test for autocorrelation, given the time series nature of the data. Normality of residuals was assessed using Q-Q plots and the Shapiro-Wilk test. Homoscedasticity was examined through residual plots and the Breusch-Pagan test. Additionally, the Augmented Dickey-Fuller (ADF) test was applied to ensure the stationarity of all-time series variables. Only after confirming that the regression assumptions were met, the final regression model was estimated. The data utilizes are mainly from secondary source that is World Bank development indicator with key variables like GDP Growth (annual %) which measures economic performance over time; Access to Clean Fuels and Technologies for Cooking (%) which reflects progress in clean energy accessibility; Renewable Electricity Output (%) indicating the share of renewable energy in total electricity generation; Energy Intensity (MJ/$2017 PPP GDP) which helps in evaluates energy efficiency improvements; and Installed Renewable Energy Capacity (GW) which assesses the expansion of renewable energy infrastructure. Further, results are interpreted based on the sign and significance of the trend coefficient (β). A positive significant coefficient suggests an increasing trend, while a negative significant coefficient indicates a declining trend.

Table 2: Summary of Regression Diagnostic Test Results for SDG-7 Indicators

Test Name	Test Statistic	Interpretation
Variance Inflation Factor (VIF)	Clean Fuel = 10.19; Renewable Output = 4.59; Energy Intensity = 10.08; Renewable Capacity = 10.58	No multicollinearity detected
Durbin–Watson Test	DW = 1.98	No autocorrelation ($p > 0.05$)
Shapiro–Wilk Test	W = 0.9256, p = 0.099	Residuals approximately normal
Breusch–Pagan Test	BP = 4.16, p = 0.384	Homoscedasticity satisfied
Augmented Dickey–Fuller (ADF) Test	GDP Growth = −2.23; Clean Fuel = −0.50; Renewable Output = −2.86; Energy Intensity = −2.96; Renewable Capacity = 3.77	Non-stationary series ($p > 0.05$)

To perform simple linear regression, each indicator is regressed on time (Year) to determine whether the indicators exhibit a positive, negative, or stable trend. The general form of the regression equation is:

$$Yt = \alpha + \beta \times Yeart + \varepsilon t$$

where:

- Yt represents the dependent variable (indicator) at time t.
- α is the intercept.
- β represents the trend coefficient, indicating the rate of change over time.
- ϵt is the error term.

Data Analysis and Discussion

The descriptive analysis provides an overview of the key indicators used in the analysis. Below table shows the descriptive statistics of the data of various sub-targets of SDG-7 from 2000 to 2021.

Table 3- Descriptive Statistics

Variable	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis	SE
Year	2010.50	6.49	2010.50	2000	2021	21.00	0.00	-1.36	1.38
GDP growth	6.05	3.21	7.10	-5.78	9.69	15.47	-2.19	5.56	0.68
Clean Fuel	40.32	14.6	36.25	22.60	70.50	47.90	0.62	-0.97	3.12
Renewable output	16.65	2.58	16.50	12.06	21.62	9.56	0.36	-0.50	0.55
Energy intensity	5.40	0.86	5.35	4.21	7.01	2.80	0.25	-1.13	0.18
Renewable capacity	32.60	36.67	18.80	3.56	150.00	146.44	1.64	2.30	7.82

Source- Own Calculation (2025).

Table 4: Regression Results for SDG-7 Indicators (2000–2021)

Variable	GDP (1)	Clean Fuel (2)	RE (3)	EI (4)	Install RE (5)
Year	-0.060 (0.110)	2.186*** (0.126)	0.325*** (0.051)	-0.131*** (0.005)	4.814*** (0.660)
Constant	126.238 (220.739)	-4354.682*** (252.547)	-637.349*** (102.256)	268.805*** (9.882)	-9645.715*** (1327.883)
Observations	22	22	22	22	22
R^2	0.015	0.938	0.672	0.973	0.726
Adjusted R^2	-0.035	0.935	0.655	0.971	0.713
Residual Std. Error (df = 20)	3.267	3.738	1.513	0.146	19.654
F Statistic (df = 1; 20)	0.296	302.858***	40.905***	710.585***	53.123***

Note: *p < 0.1; **p < 0.05; ***p < 0.01

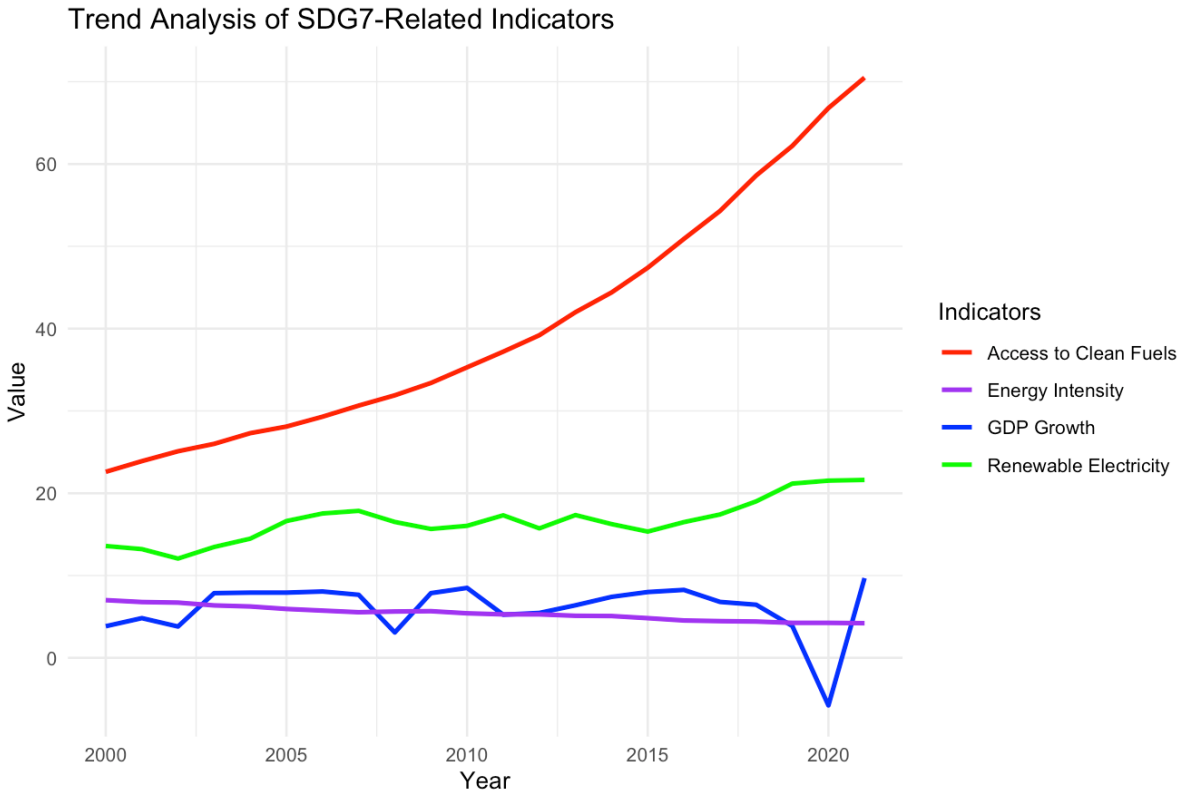
Source- Own calculation (2025).

From the table it is found that the growth rate of GDP has a mean of 6.05% with a standard deviation of 3.21%**,** indicating moderate variation over the years. The access to clean fuels and technologies for cooking has increased significantly, with a mean value of 40.32% and a maximum of 70.5%**,** reflecting advancements in energy accessibility. The renewable electricity output has an average of 16.65% of total electricity generation, ranging from 12.06% to 21.62%**,** showing gradual growth. The energy intensity level of primary energy has a mean of 5.40 MJ/$2017 PPP GDP, with a standard deviation of 0.86 MJ, indicating moderate variation in energy efficiency. A key observation is the rapid expansion of installed renewable energy capacity**,** which has grown from 3.56 GW in 2000 to 150 GW in 2021, with an average of 32.6 GW**.** However, the high standard deviation (36.67 GW) and positive skewness indicate uneven progress over the years, with significant acceleration in recent times. The descriptive statistics indicate that access to clean fuels has a wide variation across the years, suggesting potential disparities in adoption. Similarly, renewable electricity output appears relatively stable, while installed renewable energy capacity has increased significantly, showing rapid expansion in later years. While these trends provide initial insights, they do not reveal the relationships between renewable energy indicators and economic growth. To examine these relationships, we proceed with a regression analysis.

To evaluate the relationship between SDG-7 sub-targets over time, a simple linear regression model was applied with Year as the independent variable and GDP Growth, Access to Clean Fuels, Renewable Electricity Output, Energy Intensity, and Installed Renewable Energy Capacity as dependent variables. The results of the regression analysis are summarized in Table 3, while the graphical representation of trends is illustrated in Figures 3.

The key findings shows that for Target 7.1- universal energy access the coefficient for year on access to clean fuels and technologies is 2.186 and highly significant **(**$p < 0.01$**),** indicating a strong positive trend over time. Further high R^2 value (0.938) suggests that time explains most of the variation in access to clean fuels, aligning with India's efforts in expanding LPG and clean cooking solutions. For Target 7.2- increase share of renewable energy in electricity generation the coefficient for year on renewable electricity output is 0.325 and significant ($p < 0.01$), confirming a consistent increase in the share of renewables in total electricity generation. The R^2 value (0.672) suggests a moderately strong correlation, reflecting India's rapid expansion of solar and wind energy. For Target 7.3- Improve energy efficiency, the coefficient for year on energy intensity is **-** 0.131 and highly significant ($p < 0.01$), showing a declining trend, which indicates an improvement in energy efficiency over time. The high R^2 (0.973) highlights that year explains most of the variation in energy intensity, supporting India's progress in reducing energy consumption per unit of GDP. Lastly, for Target 7.b- Expand infrastructure for clean energy service, the coefficient for year on installed renewable energy capacity is 4.814 and highly significant ($p < 0.01$), confirming rapid expansion in renewable energy installations. The R^2 value (0.726) reflects a strong relationship, consistent with India's large-scale renewable energy projects and international investments in clean energy infrastructure.

Figure 3: Trends in GDP Growth, Clean Fuel Access, Renewable Electricity, Energy Intensity, and Installed Renewable Energy Capacity



Source- Own calculation (2025).

Figure above illustrates a steady increase in access to clean fuels, renewable electricity output and installed renewable capacity confirming the positive regression coefficient observed in Table 2**.** Conversely, the declining trend in energy intensity, reflecting improvements in efficiency and a shift toward sustainable energy use. Thus, these findings underscore the substantial progress made in achieving SDG-7 (Affordable and Clean Energy) and its sub-goals over the period of time. The rapid growth in renewable energy adoption and efficiency improvements highlight the effectiveness of government policies and investments in the sector.

However, the fluctuating GDP trend suggests the need for a balanced approach that integrates economic growth with sustainable energy development**.**

Policy Recommendations

The findings from Table 3 indicate significant progress in achieving SDG 7: Affordable and Clean Energy, particularly in clean fuel access, renewable energy adoption, and energy efficiency. However, to sustain and accelerate this progress, the following policy recommendations should be considered specific to the targets. For Enhancing Clean Fuel Access (Target 7.1) as there exist a strong positive trend in clean fuel access highlights the success of initiatives and to further improve additional subsidies on LPG refills and low-cost financing for clean cooking solutions, encourage solar, biogas and electric

induction stoves in rural area to reduce reliance on LPG alone, and ensure efficient distribution should be done. For Increasing Renewable Energy Share (Target 7.2) the positive relationship again suggest ongoing progress. To further improve, incentives for off-grid solar system, mini-grids and community based solar projects should be encouraged. In addition public-private partnerships (PPPs) and foreign direct investment (FDI) in renewable energy to drive large-scale solar and wind projects. To Improving Energy Efficiency (Target 7.3) mandatory energy efficiency labelling for appliances, industrial efficiency programs, and energy audits for businesses and Public awareness campaigns on efficient energy use, adoption of LED lighting, and smart metering systems can further reduce consumption. For Expanding Renewable Energy Capacity (Target 7.a & 7.b) continued investment in solar parks, wind farms, and hybrid energy projects is crucial. Special focus should be on floating solar farms and offshore wind energy to diversify energy sources. Thus, the findings indicates that India is making strong progress toward SDG 7, but regional disparities, financial constraints, and grid integration challenges remain key barriers. Addressing these issues through policy incentives, technology advancements, and inclusive energy programs will ensure a sustainable and equitable energy transition for all.

CONCLUSION

The analysis of the data across various targets for SDG 7: Affordable and Clean Energy demonstrates significant progress towards achieving clean and sustainable energy goals in India. The data for each target reveals a steady improvement in key areas, reflecting India's ongoing commitment to enhancing energy access, increasing the share of renewable energy, and improving energy efficiency. The Access to Clean Fuels **(**$\beta = 2.186$, $p < 0.01$**);** Renewable Electricity Output **(**$\beta = 0.325$, $p < 0.01$**);** Installed Renewable Energy Capacity **(**$\beta = 4.814$, $p < 0.01$**)** exhibits a strong positive trend, reflecting significant progress in expanding clean energy access, continuous growth in renewable energy contribution, and highlighting India's commitment to renewable energy expansion over time. The Energy Intensity **(**$\beta = -0.131$, $p < 0.01$**)** demonstrates a declining trend, signifying improvements in energy efficiency and lastly, the GDP growth **(**$\beta = -0.060$, $p > 0.1$**)** does not show a statistically significant trend, implying that economic growth fluctuates over time and is influenced by broader macroeconomic conditions. Further the higher value of R^2 for clean fuel access (0.938), renewable electricity (0.672), energy intensity (0.973), and installed renewable energy capacity (0.726) indicates that majority of variation in these variables are explained by time. The strong increasing in these variables suggest that the sustainable development goal 7 has improved significantly over the year and is largely driven by systematic policies and technological advancements. These trends thus, suggest that India has made significant progress towards SDG-7, particularly increasing clean fuel access, renewable energy output, and installed renewable capacity. The strong statistical significance across most targets underscores India's commitment to sustainable energy policies. However, achieving SDG-7 by 2030 will require continuous efforts and further investments in clean energy technologies, infrastructure, and policy frameworks. Hence, government must focuses on a continuous investment in renewable energy infrastructure including solar, wind and

hydro is crucial for the transition to low carbon economy, strengthening energy efficiency measure, especially in industry and transportation, should be prioritized, more investment in research and development, upgrading grid to support renewable energy, awareness campaigns and educational programs on the benefits of renewable energy and energy efficiency should be expanded. By implementing these recommendations, India can accelerate its progress towards SDG-7, ensuring sustainable and equitable access to affordable and clean energy for all by 2030, while simultaneously contributing to global climate action goals.

LIMITATION AND FUTURE SCOPE

However, the study has certain limitations that must be acknowledged. It relies primarily on national-level secondary time-series data from 2000 to 2021, which may contain inconsistencies or gaps across different data sources. The analysis focuses on selected variables such as renewable electricity output, clean fuel access, energy intensity, and installed renewable capacity, excluding other potentially relevant factors like regional disparities, policy implementation effectiveness, and behavioural dimensions. Moreover, the application of regression assumes linearity and independence, which may not fully capture the complex interactions within the energy sector. The use of differencing for ensuring stationarity may also have led to a loss of long-term trend information. Despite these limitations, the study opens avenues for future research. Future studies can incorporate a broader range of variables, utilize state- or district-level panel data to account for regional variations, and adopt more sophisticated econometric models such as ARDL or VAR to explore causal relationships. Additionally, forecasting models such as ARIMA (Auto-Regressive Integrated Moving Average) and GARCH (Generalized Autoregressive Conditional Heteroskedasticity) can be applied to predict future trends in clean energy indicators and assess volatility in renewable energy growth. Integrating qualitative methods and examining the interlinkages between SDG-7 and other Sustainable Development Goals could further enrich the analysis and support more targeted and effective policy interventions.

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DECLARATION

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FINANCIAL INCLUSION, RURAL ENTREPRENEURSHIP AND WOMEN'S EMPOWERMENT: INSIGHTS FROM THE SVEP EXPERIENCE IN KERALA

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ABSTRACT

The Start-up Village Entrepreneurship Programme (SVEP), implemented under the Deendayal Antyodaya Yojana - National Rural Livelihoods Mission (DAY-NRLM), is one of India's most ambitious efforts to encourage rural entrepreneurship and inclusive economic growth. SVEP is a national strategy to improve people's lives through self-employment. It focuses on helping rural households, especially women, start small enterprises by improving access to credit, business knowledge, incubation, and mentoring support. The programme seeks to address the persistent challenges of informal employment, limited financial literacy, and gendered barriers to enterprise creation that characterise many rural economies.

This study assesses the influence of SVEP in Kerala, where the program is executed via the Kudumbashree Mission. Wayanad, Thiruvananthapuram, and Kottayam were purposively selected to represent diverse social, economic, and geographic contexts, such as highland, coastal, and midland areas. The analysis employs a structured quantitative survey administered to 364 women entrepreneurs, examining variations in financial inclusion, enterprise development, income generation, and empowerment outcomes. Descriptive and percentage-based analyses were employed to interpret variations across districts and to assess programme achievements against the conceptual propositions derived from SVEP's theory of change.

The findings indicate SVEP has made significant progress in helping women feel more confident about handling business finances and making financial inclusion more common. The Community Enterprise Fund (CEF) has served as the principal credit mechanism, linking women with credit access and reducing dependence on informal moneylenders. More than 90% of women demonstrate strong credit discipline and validate the community-based lending model. Financial literacy scores improved markedly across districts, most notably in Kottayam, showing how well Community Resource Persons' financial training and mentoring worked.

Beyond financial access, SVEP has also enhanced entrepreneurial capability. Respondents reported measurable improvements in their business knowledge, record-keeping, and problem-solving skills, as well as a more positive attitude toward entrepreneurship. These results are in line with SVEP's main design principles, which stress building capacity and providing ongoing support rather than mere financial support. . In Wayanad, a majority of enterprises surpassed aspirational income benchmarks, reflecting higher business maturity and effective market linkages. Kottayam, on the other hand, had lower income outcomes but better financial management and literacy, which suggests that enterprise ecosystems can be different in different places.

On a larger scale, SVEP has contributed to multidimensional empowerment. Women

entrepreneurs reported greater autonomy in household decision-making, enhanced social recognition, and improved well-being. The transition from working for wages and farming to owning a business is a structural change in women's roles in the rural economy. Nonetheless, some gaps remain. Young people still do not have many opportunities to participate, and there are still differences in who can get bigger credit investments and more advanced business training. The uneven growth of local financial ecosystems also has an effect on the size and long-term viability of businesses in different districts.

The study underscores the significance of targeted interventions to enhance credit utilisation, foster sector-specific mentoring, and expand outreach to younger and marginalised women. Combining digital financial tools with advanced business management modules could further consolidate gains in entrepreneurial performance and empowerment. Future research employing longitudinal designs and cross-state comparisons is advised to assess long-term outcomes and to enhance policy strategies for replicating SVEP's inclusive entrepreneurship model at the national level.

Key Words: *financial inclusion, rural entrepreneurship, women empowerment, micro-enterprise development, SVEP, microfinance*

Implications: *The study offers policy insights for advancing rural development, gender equity, and inclusive financial systems through evidence-based entrepreneurship promotion.*

INTRODUCTION

The Deendayal Antyodaya Yojana-National Rural Livelihood Mission (DAY-NRLM), launched in 2011 by the Ministry of Rural Development, Government of India, is a flagship programme aimed at poverty alleviation (https://aajeevika.gov.in/). It seeks to enable poor households to access gainful self-employment and thereby stabilising and enhancing livelihoods.

The Start-up Village Entrepreneurship Programme (SVEP), a sub-scheme under DAY-NRLM, was launched in 2015 to promote rural entrepreneurship in non-farm sectors. (Master circular for the Start-Up Village Entrepreneurship Programme, Ministry of Rural Development, 2016) It seeks to address gaps in knowledge, incubation, and finance ecosystems, particularly for first-generation entrepreneurs. Key features of SVEP include:

- Comprehensive training for entrepreneurs to help them establish and sustain enterprises
- Facilitating start-up funding (Community Enterprise Fund) through Block Level Community Based Organisations of Self-Help Groups (SHGs) and linking entrepreneurs with banks for additional financial support
- Providing handholding support during the critical initial six months of enterprise establishment
- Developing a cadre of Community Resource Persons for Enterprise Promotion (CRP-EPs) to provide grassroots-level business advisory and support.

The programme focuses on developing sustainable rural enterprises across manufacturing, trading, and services, leveraging ICT tools for capacity building, enterprise advisory services, and financial facilitation. The SVEP Programme is implemented in selected blocks across India

over a duration of 4–5 years, with an average financial allocation of Rs. 5–6 crore per block. Of this, approximately Rs. 2.5 crore is designated as Community Enterprise Funds (CEF) to support the establishment of around 2,000 rural micro-enterprises during the implementation period.

SVEP IN KERALA

Kudumbashree is the poverty eradication and women empowerment programme implemented by the State Poverty Eradication Mission (SPEM) of the Government of Kerala. Kudumbashree functions as the State Rural Livelihood Mission under DAY-NRLM and serves as the nodal agency for implementing the SVEP project in the State. In the first phase, Kudumbashree has successfully executed the SVEP program in 14 blocks of the State in two batches. The first batch initiated during 2016-17 included Vadavukode (Ernakulam) and Parakode (Pathanamthitta) blocks. The second batch initiated in preceding years and included Vaikom (Kottayam), Panamaram (Wayanad), Nenmara (Palakkad), Neeleswaram (Kasargod), Thycattussery (Alappuzha), Vamanapuram (Trivandrum), Perambra (Kozhikode), Idukki(Idukki), Pathanapuran (Kollam), Kodakara (Trissur), Kuthuparamba (Kannur) and Nilambur (Malappuram) blocks. Over the years, SVEP has empowered women entrepreneurs in Kerala by providing essential training for setting up rural enterprises and by facilitating financial support through Self Help Groups (SHGs) and banking institutions. The program has successfully promoted more than 30,000 micro enterprises (https://www.kudumbashree.org/pages/443) in the State by 2025, contributing significantly to economic opportunities at the grassroots level. With this importance, a study was conducted to assess the impact of the interventions implemented under the SVEP programme in Kerala State.

OBJECTIVES

The study aims to assess the impact of Start-up Village Entrepreneurship Programme (SVEP) in advancing financial inclusion, fostering entrepreneurship, and promoting socioeconomic transformation among rural women in Kerala. The specific objectives are:

- To examine the socio-economic and demographic characteristics of rural women entrepreneurs supported under SVEP in Kerala.
- To evaluate the extent of financial inclusion achieved through SVEP, with particular focus on access to microfinance, credit utilisation and financial literacy.
- To assess the livelihood transitions, economic outcomes, and empowerment gains, both personal and entrepreneurial, resulting from SVEP interventions.
- To derive policy-relevant recommendations for strengthening the design and effectiveness of SVEP in Kerala.

ANALYTICAL FRAMEWORK

Although this study was not designed as a hypothesis-driven evaluation, its descriptive analysis is guided by key conceptual propositions drawn from programme theory and prior empirical literature. These propositions provide a structured lens for interpreting observed patterns and assessing the perceived outcomes of the Start-up Village Entrepreneurship Programme (SVEP) in Kerala.

The study primarily employs aggregate, percentage-based analysis, thereby excluding the application of inferential statistical tests,

such as t-tests or regression models. Instead, the following guiding propositions provide analytical coherence to the descriptive inquiry and delineate potential avenues for future hypothesis-driven research.

Guiding Propositions

- SVEP participation is associated with measurable improvements in the income levels of rural women entrepreneurs.
- SVEP participation contributes to enhanced financial literacy, improved credit access, and increased confidence in financial management among women entrepreneurs.
- SVEP participation fosters entrepreneurial skill development, business knowledge, and attitudinal shifts towards self-employment.
- The impact of SVEP on income, empowerment, and enterprise performance varies across districts due to demographic, geographic, and institutional differences.

These propositions are not statistically tested but are assessed descriptively through comparative trends across the three study districts - Wayanad, Thiruvananthapuram, and Kottayam. The analysis interprets these trends in light of the propositions, providing policy-relevant insights and conceptual grounding for future hypothesis-based evaluations.

LITERATURE REVIEW

Previous Studies on SVEP

India's focus on rural development has led to the implementation of numerous entrepreneurship programs aimed at fostering self-employment and financial independence among rural populations. Some key programs include Pradhan Mantri MUDRA Yojana (PMMY), Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDUGKY), RSETI (Rural Self Employment Training Institutes) scheme, Make in India, Skill India, Start-Up India, Pradhan Mantri Van Dhan Yojana (PMVDY), NABARD, Rajiv Gandhi Udyami Mitra Yojana (RGUMY) and One District One Product (ODOP). The Start-up Village Entrepreneurship Programme (SVEP), launched in 2015 under DAY-NRLM, targets rural entrepreneurship by addressing gaps in knowledge, incubation, and financing ecosystems. The SVEP programme has been evaluated across various blocks and states by different organisations, revealing the following findings:

SVEP has been instrumental in connecting entrepreneurs to financial resources such as SHG-linked loans, community enterprise funds, and institutional credit. However, access to MUDRA loans remains limited, and first-generation entrepreneurs face challenges in securing financial support (Quality Council of India).

The evaluation of Dhupguri, Manikchak and Dinhata Blocks in West Bengal highlights SVEP's effectiveness in promoting rural entrepreneurship and generating employment. The program improved financial access through CRP-EPs, enabling better credit sourcing and financial management among entrepreneurs. However, barriers like limited market linkages and inadequate branding opportunities persist. Studies have documented significant improvements in income levels and employment generation among SVEP beneficiaries. (Wangjing Women and Girls Society (WWAGS))

According to the studies by Indian Institute of Entrepreneurship, women constitute a significant portion of SVEP beneficiaries, with studies showing 53–75% of enterprises

led by women. This has enhanced their financial independence and social standing, although cultural barriers persist (Indian Institute of Entrepreneurship).

Most enterprises established under SVEP demonstrate profitability and growth potential. However, limited market access and branding opportunities restrict scalability. Community Resource Persons for Enterprise Promotion (CRP-EPs) have played a vital role in mentoring and providing business advisory services (Indian Institute of Entrepreneurship).

Despite its success, SVEP faces challenges such as inadequate infrastructure, limited financial literacy, and difficulties in maintaining operational sustainability for Block Resource Centres (BRCs). (Indian Institute of Entrepreneurship).

SVEP created an incubation ecosystem that helps first-time entrepreneurs with aspects like business planning, risk assessment, and working capital management. This peer-to-peer learning among entrepreneurs is a notable mechanism for reducing the high failure rate of start-ups in rural context. (Council For Social Development, 2023)

As per the study (Atal Bihari Vajpayee Institute of Good Governance and Policy Analysis), the programme has demonstrated significant improvements in household incomes, employment generation, and social empowerment, particularly among marginalized communities. However, regional disparities highlight the need for localized strategies and policies.

The Literature Review indicates that SVEP has played a significant role in improving financial access and management for rural entrepreneurs, with a particular focus on women-led enterprises. The programme has contributed to enhancing household incomes, fostering enterprise growth, and strengthening institutional credit linkages through mechanisms such as the Community Enterprise Fund (CEF). However, challenges like low levels of financial literacy, inadequate market linkages, and the operational sustainability of Block Resource Centres remain, pointing to the need for focused interventions. While evaluations of SVEP have been conducted in states such as West Bengal, Telangana, and Assam, a comprehensive study examining its impact in Kerala has been lacking. This highlights the relevance of the present study.

Rural Women Entrepreneurship in Kerala

While Kerala State is known for its high literacy rates, achieving rural economic empowerment remains a significant task. Initiatives like Kudumbashree have played a crucial role in promoting entrepreneurship. Although no studies have been conducted specifically to evaluate the SVEP programme in Kerala, various general studies have highlighted key obstacles and supportive factors in promoting rural entrepreneurship. These findings provide valuable insights into the challenges and enablers of such initiatives, as detailed below.

Early studies by Anna and Pillai (1989) noted a reliance on state financial aid among women entrepreneurs, underscoring the importance of family encouragement while highlighting reluctance toward dynamic ventures. Studies such as those by Narayana and Gopakumar (2013) revealed a lack of professional training, limited knowledge of financial management, and poor marketing skills as persistent barriers. Entrepreneurs often prefer home-based activities due to space constraints, further limiting scalability. Research by John (2009) found that over 60% of Kudumbashree microenterprises were unsustainable, primarily due to

insufficient entrepreneurial traits among SHG members and intense market competition. Additionally, subpar product quality, inadequate advertising, and lack of branding were significant challenges.

Abraham (2013) highlighted Kudumbashree's strategy of identifying social needs and converting them into viable business opportunities, which significantly enhanced the success of microenterprises. SHGs play a vital role in facilitating access to capital, training, and networking opportunities, empowering women entrepreneurs (Anackal, Singh, & Hamsa, 2017). Participation in SHGs has led to greater financial inclusion, social acceptance, and leadership skills (Shehnaz & Kumar, 2018).

Studies by Mathew (2010) and Sunandha (2015) emphasized the importance of entrepreneurial competency, motivation, and education in determining the success of women-led enterprises. Entrepreneurs with semi-urban backgrounds, direct raw material sourcing, and professional management approaches exhibited higher success rates. Recent studies by Bonny, Lokesh, and Smitha (2022) and Thamizhvel and Shambu (2023) stressed the importance of adopting technology, digital marketing skills, and standardized processes in achieving entrepreneurial success.

The literature on Kudumbashree highlights its key role in promoting rural entrepreneurship and empowering women in Kerala. Studies have pointed out challenges like inadequate financial management, lack of professional training, and limited market access, which hinder the sustainability of microenterprises. At the same time, initiatives such as using SHGs to improve financial inclusion and identifying social needs as business opportunities have shown positive outcomes. Recent research has also stressed the importance of adopting technology and improving marketing practices to enhance enterprise success.

Despite the state's unique socio-economic context and initiatives like Kudumbashree, there has been limited research on the specific challenges and opportunities faced by rural women entrepreneurs under SVEP. The present study addresses a critical gap by evaluating the impact of the Start-up Village Entrepreneurship Programme (SVEP) on rural women entrepreneurship in Kerala.

METHODOLOGY

Research Design and Context

This research is part of a larger state-level end-term evaluation of the Start-up Village Entrepreneurship Programme (SVEP) conducted by the Centre for Management Development (CMD) for Kudumbashree Mission, the State Rural Livelihoods Mission (SRLM) of Kerala. The evaluation was conducted in accordance with the Terms of Reference (ToR) established by the Ministry of Rural Development (MoRD), Government of India, which delineated the standardised framework for all state-level assessments under the Deendayal Antyodaya Yojana – National Rural Livelihoods Mission (DAY–NRLM).

While the larger CMD study evaluates the implementation of the SVEP in all fourteen blocks in Kerala, this paper, on the other hand, only looks at the numbers related to certain indicators like financial inclusion and women empowerment from three representative districts: Wayanad, Thiruvananthapuram, and Kottayam. These districts were intentionally selected to exemplify the state’s regional diversity (northern, southern, and central Kerala) and to reflect variations in demographic, geographic, and enterprise characteristics.

The study utilises a quantitative descriptive evaluation design, concentrating on quantifiable program outcomes associated with financial inclusion, enterprise performance, and women's empowerment.

Study Area

SVEP in Kerala is implemented through Kudumbashree's network of community-based organisations and Block Resource Centres (BRCs). The three selected Blocks - Panamaram Block in Wayanad, Vamanapuram Block in Thiruvananthapuram, and Vaikom Block in Kottayam, were chosen to reflect varied socio-economic conditions and enterprise profiles.

- Wayanad, a highland and tribal-dominated district, represents economically vulnerable and geographically remote areas where access to financial institutions is relatively limited.
- Thiruvananthapuram, a coastal and semi-urban district, reflects service-oriented enterprise ecosystems.
- Kottayam, a central midland district with relatively higher literacy and financial inclusion levels, represents diversified trading and service enterprises.

This stratified geographical representation guarantees that the findings reflect Kerala's regional diversity and provide insights pertinent to the state.

Sampling Technique and Sample Size

The Terms of Reference (ToR) framework of Ministry of Rural Development (MoRD) guided the sampling process. It called for stratified proportional random sampling to make sure that all geographic and enterprise variables were fairly represented. Within each chosen district, businesses were divided into groups based on their Gram Panchayat, type of business (manufacturing, trade, or services), and age. This made sure that both new and old businesses were represented equally.

Using Cochran's formula for large populations, a statistically valid sample was taken from the number of active SVEP enterprises in each block. This gave enough accuracy for descriptive evaluation. The final sample consisted of 364 women entrepreneurs, allocated as follows:

- Wayanad (Panamaram Block) – 96 respondents
- Thiruvananthapuram (Vamanapuram Block) – 139 respondents
- Kottayam (Vaikom Block) – 129 respondents

The sample size and its proportional distribution across blocks ensured representation that aligned with the ToR's stipulations for geographical diversity, enterprise variety and operational scale.

Data Collection Tools and Sources

The primary data for the study were collected through a structured questionnaire developed and administered by CMD. The questionnaire was developed based on the indicator framework and areas of inquiry specified in the MoRD Terms of Reference for the End-Term Evaluation of SVEP (2019). It included the three thematic ecosystems that support the design of SVEP's programs:

- Knowledge ecosystem – assessing training, business knowledge, and entrepreneurial skills;
- Incubation ecosystem – assessing enterprise support, mentoring, and performance; and

- Financial ecosystem – assessing credit access, loan repayment, and financial literacy.

The survey captured the entrepreneurs' self-reported changes in income and empowerment, as well as their socio-economic status. It was tested beforehand in similar SVEP blocks to ensure clarity, cultural appropriateness, and validity of responses. Trained field investigators who were familiar with livelihoods and micro-enterprises surveys administered the questionnaire in Malayalam through in-person interviews during field visits that took place between January and March 2024.

Secondary data from Detailed Project Reports (DPRs), programme MIS, and internal review documents were also used for validation and contextual understanding.

Reliability and Validity of the Instrument

To check for reliability, Cronbach's alpha was used to look at the responses from all three districts and see how consistent the major constructs were with each other. The values were higher than the usual cut-off of 0.70, which meant that the internal consistency and measurement reliability were both good. (Cronbach's alpha values of various constructs provided as annexure – 2) The MoRD ToR indicators and expert review by CMD's evaluation specialists and Kudumbashree officials ensured that the questionnaire's structure and content were valid.

Data Analysis Procedures

The quantitative data collected were encoded and input into SPSS for examination. Descriptive statistics and percentage analyses were used to look at entrepreneurs' socio-economic traits, their access to finance, changes in their income, how well their businesses performed, and how empowered they felt personally.

No inferential or causal statistical tests were utilised, as the study sought to elucidate descriptive trends and patterns rather than to evaluate hypotheses. The analysis framework adhered to the programme's theory of change, correlating enhancements in financial access, business acumen, and empowerment outcomes to SVEP participation.

Limitations

The study is confined to quantitative data obtained from structured surveys administered to SVEP-supported women entrepreneurs in three districts of Kerala. Self-reported responses may exhibit recall or social desirability bias; however, field verification and cross-checks were implemented to improve reliability. Because the design is descriptive instead of causal, the results provide evidence of program impact that is more indicative than generalisable.

ANALYSIS

Socio-economic Profile of Entrepreneurs

Understanding the socio-economic traits of SVEP beneficiaries sheds light on the program's primary audience and its effectiveness in incorporating women from various demographic and educational backgrounds. The information from Wayanad, Thiruvananthapuram, and Kottayam presented in the following tables shows clear patterns in each area and show the typical profile of the women entrepreneurs under SVEP in Kerala.

Table 1: Age Distribution of Women Entrepreneurs under SVEP

Age & Block	18-24 (%)	25-34 (%)	35-44 (%)	45-54 (%)	55 & above (%)
Panamaram	1	9	40	32	17
Vamanapuram	1	11	32	36	21
Vaikom	0	5	30	41	23

Source: Compiled from primary data

Table 2 **Educational Attainment of Women Entrepreneurs under SVEP**

Educational qualification & Block	Middle/High School Education	10^{th} Std. Pass (%)	12^{th} Std. (%)	ITI/ Vocational	Graduation	Post Graduation & above
Panamaram	17	45	22	1	13	3
Vamanapuram	13	40	31	2	9	5
Vaikom	14	44	27	1	13	2

Source: Compiled from primary data

Table 3 Category of Women Entrepreneurs under SVEP

Category & Block	OBC (%)	General (%)	SC/ST (%)
Panamaram	50	46	4
Vamanapuram	72	25	3
Vaikom	47	48	6

Source: Compiled from primary data

Table 4 Ownership Pattern of SVEP Enterprises

Ownership pattern & District	Sole Proprietorship (%)	Group Enterprises (%)
Wayanad	91	9
Thiruvananthapuram	94	6
Kottayam	99	1

Source: Compiled from primary data

Women between the ages of 35 and 54 make up more than two-thirds of SVEP participants in all three districts, making them the most common type of entrepreneur. This pattern shows that the program mostly involves women in their middle ages who are socially stable and have worked in the household or informal sector before. In contrast, the participation of younger women (under 25 years) is still very low (about 1%), showing that it is still hard to get young people interested in starting their own businesses in rural areas.

Most of the respondents have finished secondary school (10th to 12th grade), and only a small number have gone on to higher or vocational education. This indicates that SVEP has successfully engaged women with limited educational backgrounds, a demographic frequently overlooked by conventional entrepreneurship development programs. The fact that Wayanad and Kottayam have a higher percentage of graduates (13% each) shows inclusion of educated women, through limited.

Other Backward Classes (OBCs) make up the majority of entrepreneurs in Wayanad and Thiruvananthapuram (50% and 72%, respectively). In Kottayam, however, General-category women are slightly high in numbers than others (48%). The representation of Scheduled Castes and Tribes is still low (3-6 percent), which shows that there is room for more outreach to marginalised groups, especially in Wayanad, where tribal populations make up a large part of the district's population.

The socio-economic profile shows that SVEP in Kerala has been successful in mobilising middle-aged, moderately educated women from OBC backgrounds, but it still has challenges in expanding participation among younger, highly educated, and socially disadvantaged women. The pattern alligns with the program's community-based implementation model, which relies more on the Kudumbashree network's existing members than on new entrants who are not already part of the SHG ecosystem.

Enterprise Characteristics

This section examines the key features of enterprises that were started as part of the Start-up Village Entrepreneurship Programme (SVEP) in the three study districts. The analysis presented in the tables below includes ownership type, age of enterprise and sectoral distribution to learn more about how mature, structured, and nature of business activities promoted among women entrepreneurs.

The enterprise profile shows that sole proprietorship is the most common type of business, making up more than 90% of enterprises in every district and almost all enterprises in Kottayam (99%). This pattern shows that SVEP is focused on helping women become self-employed. The program mainly helps women move from informal jobs to small-scale businesses. This approach promotes autonomy and income control, but it also suggests restricted collective enterprise development - an opportunity for growth through group-based or cooperative business models.

Table 5 Age of Enterprises

Age of enterprises & District	Under 5 Years (%)	5-10 Years (%)	10-15 Years (%)	Above 15 years
Wayanad	58	34	3	5
Thiruvananthapuram	46	39	7	8
Kottayam	45	29	19	7

Source: Compiled from primary data

Table 6 Sector of SVEP Enterprises

Sector & District	Trade (%)	Services (%)	Manufacturing (%)
Wayanad	45	42	13
Thiruvananthapuram	36	31	33
Kottayam	33	36	31

Source: Compiled from primary data

Table 7 Credit Sourcing Status among SVEP Entrepreneurs

Loan availed & District	Loan Availed (%)	Loan Not Availed (%)
Wayanad	52	48
Thiruvananthapuram	46	54
Kottayam	12	88

Source: Compiled from primary data

Most of the enterprises in all three districts are still young, having been in business for less than five years. This finding aligns with the implementation timeline of SVEP, which began in Kerala during 2016-17. Wayanad has the highest percentage of new businesses (58%), which shows that many people have started new businesses in the recent project cycles. Kottayam, on the other hand, has a significant percentage of older businesses (19% in the 10–15-year range), which suggests that SVEP has also helped existing micro-enterprises grow and consolidate. In Wayanad, trade-based activities like retail, small shops, and selling small goods make up 45% of the economy. This shows that the district's market is more consumer oriented. Thiruvananthapuram, on the other hand, has a more even mix of manufacturing (33%), trade (36%), and services (31%), which suggests a more developed entrepreneurial ecosystem linked to urban markets. Kottayam also has a mixed structure, with similar representation across sectors.

However, service businesses (36 percent) slightly outnumber manufacturing and trading businesses.

Evidence indicates that SVEP has helped people branch out into non-farm rural businesses in all three regions. However, the scale is still mostly micro-level and individual. Strengthening market connections, encouraging value addition, and supporting group entrepreneurship could make these women-led businesses more sustainable and profitable.

Financial Inclusion and Credit Access

The Start-up Village Entrepreneurship Programme (SVEP) is based on the idea of financial inclusion. Its goal is to help women get institutional credit and feel more confident about managing their finance. This section as depicted in the following tables looks at how entrepreneurs use credit, such as how much they take out, where they get their finance, and how they pay it back. It also looks at how their financial literacy and access to money have improved since the program. The data show that women entrepreneurs are making clear but uneven progress in getting credit. In Wayanad, a little more than half of the entrepreneurs (52 percent) had taken out loans, which shows that they were actively using financial institutions. Thiruvananthapuram came in second with 46 percent, while Kottayam had a much lower uptake (12 percent). This could mean that there is not much demand for loans or that there are problems with getting loans, despite a more developed financial environment in the State.

The Community Enterprise Fund (CEF), which was set up by SVEP, became the most popular and most accessible credit across districts. It helped more than three-quarters of borrowers in Thiruvananthapuram and about half in Wayanad and Kottayam. This underscores the centrality of the CEF as a bridge between self-help group-based credit and formal banking. Cooperative and nationalized banks made up 30% of loans in Wayanad, but much smaller percentages in other places. Private or informal sources, like moneylenders or personal networks, did not play a big role, which shows that people are moving toward institutional finance

Table 8 Primary Sources of Credit for SVEP Enterprises

Loan source & District	Wayanad (%)	Thiruvananthapuram (%)	Kottayam (%)
Community Enterprise Fund	55	77	50
Loan from Cooperative	28	8	3
Mudra Loan	2	6	8
NHG Internal Loan	5	3	11
Loan from Private Sector	4	1	3
Loan from Nationalised	4	3	24
Loan from Private Money	0	0	3
Loan from State	3	3	0

Source: Compiled from primary data

Table 9 Loan Repayment Performance by Source

Type of Loan	Wayanad			Thiruvananthapuram			Kottayam		
	Timely Paying (%)	Closed (%)	Default (%)	Timely Paying (%)	Closed (%)	Default (%)	Timely Paying (%)	Closed (%)	Default (%)
Community Enterprise Fund	48	51	1	48	51	1	79	19	2
Community Investment Fund/NHG	67	33	0	0	100	0	100	0	0
Mudra Loan	56	44	0	56	44	0	67	33	0
Loan from Cooperative Banks	82	18	0	91	9	0	100	0	0
Loan from Private Sector	40	60	0	40	60	0	100	0	0
Loan from Nationalised Banks	100	0	0	100	0	0	89	11	0
Loan from State Government	25	75	0	25	75	0	0	0	0
Loan from Private Money	0	0	0	0	0	0	100	0	0

Source: Compiled from primary data

Table 10 Financial Literacy and Accessibility before and after SVEP (Mean Scores)

Indicators & Districts	Wayanad		Thiruvananthapuram		Kottayam	
	Pre SVEP	Post SVEP	Pre SVEP	Post SVEP	Pre SVEP	Post SVEP
Financial Literacy (Mean Score)	3.86	4.04	3.5	3.88	3.48	4.2
Accessibility to Credit Sources (Mean Score)	3.81	4	3.48	3.89	3.49	4.21
Availability of Loan (Mean Score)	3.81	3.97	3.51	3.9	3.48	4.2

Source: Compiled from primary data

The repayment performance across all sources was very good, with rates of timely or completed repayment above 90 percent in almost all categories and default levels below 2 percent. These results show that borrowers are responsible and that it is possible to give micro-enterprise credit through community-linked systems.

Mean-score analysis of financial literacy and accessibility indicators further emphasises SVEP's developmental impact. Post-programme, scores went up in every district, with Kottayam showing the biggest improvements (Financial Literacy 3.48 → 4.20; Credit Accessibility 3.49 → 4.21). Wayanad and Thiruvananthapuram have seen improvements, though they are smaller, that show that structured training and exposure through SVEP helped women better understand, access, and manage financial services.

These results show that SVEP has played a decisive role in in promoting financial inclusion and responsible credit behaviour among rural women and include women in the financial system. The regional differences in loan uptake, especially the low borrowing in Kottayam, show that more training and credit counselling are needed to ensure that women in all districts utilise financial opportunities more equally.

Income and Livelihood Impact

A key objective of the Start-up Village Entrepreneurship Programme (SVEP) is to help women move from shift from low-income, wage-based, or agricultural livelihoods toward enterprise-based self-employment. This section looks at how SVEP has changed the income levels and livelihoods of women entrepreneurs in the three study districts. It compares the pre- and post-programme outcomes and checks their alignment with aspirational income targets.

In all study districts, SVEP have become the principal source for most respondents to make a living. Almost all of the women entrepreneurs in Wayanad (96 percent) reported that SVEP enterprises was their main source of income, and they did not rely much on farming or wage work. Thiruvananthapuram (84 percent) and Kottayam (86 percent) had similar but slightly lower patterns, showing a shift from traditional jobs to being self-reliant as an entrepreneur

Table 11 Primary Source of Livelihood after SVEP

Source of livelihood & District	SVEP Enterprise (%)	Wages from other sources (%)	Agriculture & Allied activities (%)	Rent/Remittances /Other income (%)
Wayanad	96	1	3	0
Thiruvananthapuram	84	10	5	1
Kottayam	86	11	3	0

Source: Compiled from primary data

Table 12 Average Annual Enterprise Income Compared with Aspirational Income Benchmarks

Income & District	Higher Than Aspirational Income (%)	Lower Than Aspirational Income (%)
Wayanad	68.64	31.36
Thiruvananthapuram	52.11	47.89
Kottayam	1.36	98.64

Source: Compiled from primary data

Table 13 Distribution of Annual Enterprise Income

Annual Income Range & Districts	Wayanad (%)	Thiruvananthapuram (%)	Kottayam (%)
Less than Rs. 25,000	17	30	9
Rs.25,000 - Rs.50,000	17	18	13
Rs.50,000-Rs.1 Lakh	21	16	33
Rs.1 Lakh-Rs.3 Lakh	29	25	25
Rs.3 Lakh-Rs. 5 Lakh	8	7	9
Rs.5 Lakh- Rs.10 Lakh	6	3	8
Above Rs.10 Lakh	3	2	1

Source: Compiled from primary data

Comparing the performance of enterprises to aspirational income benchmarks (₹10,000 per month according to DPR targets) shows that there is a lot of variation between districts. More than two-thirds (68.6 percent) of enterprises in Wayanad exceeded their

aspirational income, which shows that they had good business outcomes and effective project support. In Thiruvananthapuram, a little over half (52 percent) of businesses met or exceeded their goals. In Kottayam, on the other hand, only 1 percent of businesses met or exceeded their goals. This suggests that enterprises are growing at different rates and that the dynamics of institutions or markets may be different in different areas.

The overall distribution of income makes sharp differences. Wayanad has a good mix of income levels, with most businesses making between Rs. 1 lakh and Rs. 3 lakh a year. Thiruvananthapuram has a polarised pattern, with a lot of low-income businesses (less than Rs. 25,000) coexisting with moderate-income businesses. Kottayam, despite its underperformance relative to aspirations, it has a higher concentration of businesses in the middle-income range (Rs. 50,000 – Rs. 1 lakh).

Table 14 Monthly Income of Entrepreneurs before and after SVEP

Monthly income range & Districts	Wayanad		Thiruvananthapuram		Kottayam	
	Pre-SVEP (%)	Post-SVEP (%)	Pre-SVEP (%)	Post-SVEP (%)	Pre-SVEP (%)	Post-SVEP (%)
Rs. 0-	63	29	70	56	72	44
Rs.5,000-	9	23	11	18	12	22
Rs.10,000	10	19	10	13	7	15
Rs.20,000	11	15	6	10	6	11
Rs.50,000	4	9	2	2	2	5
Above	3	4	1	1	1	2

Source: Compiled from primary data

Table 15 Perceived Income Contribution of SVEP

Income & District	Income of Entrepreneur attributed to SVEP (%)	Income of Enterprise attributed to SVEP (%)	Household Income attributed to SVEP (%)
Wayanad	98.6	99	98
Thiruvananthapuram	80.2	80.3	79.2
Kottayam	96.7	94.9	96.9

Source: Compiled from primary data

Comparing women's incomes before and after the program shows a clear upward trend in all districts. The number of women who earned very little (less than Rs. 5,000 per month) fell sharply. In Wayanad, it went from 63% to 29%, in Thiruvananthapuram, it went from 70% to 56%, and in Kottayam, it went from 72% to 44%. In every district, the percentage of entrepreneurs making more than Rs. 10,000 per month more than doubled, which shows that SVEP has a real effect on the economy.

Perceptual data further corroborate that nearly all respondents in Wayanad and Kottayam, and over 80 percent in Thiruvananthapuram, directly attributed their income enhancements to SVEP interventions. This shows strong beneficiary confidence in the programme's role in enhancing both individual and household incomes.

The evidence collectively indicates that SVEP has played a substantial role in income augmentation and livelihood diversification, facilitating women's transition from unstable, low-wage employment to more sustainable entrepreneurial ventures. The differences between districts, on the other hand, show how important local market factors, credit utilisation, and ongoing business mentoring are for ensuring consistent income growth across all regions.

Entrepreneurial Knowledge and Skills

The Start-up Village Entrepreneurship Programme (SVEP) also aims to improve the business skills of rural women by enhancing their knowledge of business operations, financial management, and record-keeping practices. This section looks at how being a part of SVEP has changed the knowledge, skills, and attitudes of women business owners in the three study districts.

The findings indicate that SVEP-supported women in all three districts consistently improved their entrepreneurial knowledge and skills, with mean scores between 3.85 and 4.20. Most of the women agreed that the program enhanced their understanding of business operations, financial management, and record-keeping. Wayanad made big strides in both business knowledge and attitude (means above 4.0), reflecting effective training and mentoring support from CRP-EPs. Thiruvananthapuram, on the other hand, made moderate but steady progress, which means that business advisory help is still needed. Kottayam had the highest overall scores (about 4.2), which means that the training was better understood and used in real life. This is probably because the district has a higher literacy rate and more exposure to the market. SVEP has clearly made both the cognitive and attitudinal aspects of entrepreneurship stronger in all districts. It has taught women professionalism, confidence, and a more positive view of self-employment as a viable and sustainable way to make a living.

Table 16 Improvements in Entrepreneurial Knowledge, Skills, and Attitude (Mean Scores)

Indicators & Districts	Wayanad (Mean)	Thiruvananthapuram (Mean)	Kottayam (Mean)
Knowledge about industry, entrepreneurship, and running a business improved	4.15	3.85	4.2

Business skills have improved	3.94	3.9	4.18
Positive attitude toward entrepreneurship	3.98	3.85	4.2
Confidence in maintaining financial records	3.94	3.86	4.15

Source: Compiled from primary data

Table 17 Financial Management Competency Level

Financial Management Competency Level	Wayanad (%)	Thiruvananthapuram (%)	Kottayam (%)
Basic Financial Awareness	31	46	52
Functional Financial Understanding for Daily	50	32	13
Proficient Financial	18	15	31
Advanced Strategic Financial Planning Skills	1	8	5

Source: Compiled from primary data

The results show that SVEP-supported women are getting better at financial management competencies, which is a good sign for financial empowerment across districts. In Wayanad, half of the women showed that they had a good financial understanding. Eighteen percent were good at budgeting, and a small group (1 percent) was starting to show advanced planning skills. Thiruvananthapuram had the most women with advanced financial skills (8%), as well as 32% who managed their finance independently and 46% who needed more help with basic money management. In Kottayam, financial literacy was still in its early stages, with 52% needing help. However, 31% were good at budgeting, and 5% had learned how to plan strategically. Overall, many entrepreneurs still need structured help with financial planning. However, the presence of women with progressively higher financial competencies shows SVEP's effectiveness in helping rural women entrepreneurs to become more confident and better at managing their finance.

Personal Empowerment Outcomes

The Start-up Village Entrepreneurship Programme (SVEP) has been instrumental in improving women's social status, self-confidence, and overall well-being, beyond economic and financial achievements. SVEP entrepreneurship not only gives women only provides an income source, but it also changes how they see their roles in their families and communities. This section looks at important signs of personal empowerment, such as better quality of life, social status, social skills, and overall life satisfaction.

Table 18 Impact of SVEP on Personal Empowerment

Indicator & Districts	Wayanad (Mean)	Thiruvananthapuram (Mean)	Kottayam (Mean)
Quality of life has improved	4.35	4	3.9
Social status/acceptance has increased	4.35	4.03	3.83
Social Skills have developed	4.22	3.99	3.73
Overall well-being and life satisfaction have improved	4.37	3.96	3.94

Source: Compiled from primary data

The findings indicate that SVEP has significantly and positively influenced women's personal empowerment in all three districts, with mean scores between 3.73 and 4.37, signifying a consensus that their quality of life, social status, and confidence have enhanced through entrepreneurship. Women in Wayanad saw the notable progress, with improvements in well-being (4.37) and social recognition (4.35), which meant that their living standards and mental health got better. Thiruvananthapuram showed steady but moderate progress across all indicators, with improvements in social skills, self-efficacy, and decision-making ability. Kottayam also had positive outcomes, respondents acknowledging a better quality of life. However, there was less change in leadership visibility, which may be because they were already in a better position. The findings collectively affirm that SVEP has facilitated multidimensional empowerment encompassing self-esteem, autonomy, and community participation, thereby enabling women to assume more active roles in financial decisions, and in household while attaining respect and mobility.

DISCUSSION AND INTERPRETATION OF KEY FINDINGS

Financial Empowerment and Inclusion

The results show that SVEP has improved women's financial inclusion in Kerala by expanding access to institutional credit and boosting their confidence in managing their finance. The Community Enterprise Fund (CEF) functioned as the main credit channel, effectively bridging the gap between women start-ups with community banking systems. High repayment rates (exceeding 90 per cent) reflect responsible borrowing behaviour and validate the community-linked lending model promoted nationally under SVEP (Indian Institute of Entrepreneurship [IIE], 2019; Ministry of Rural Development [MoRD], 2019). Across districts, especially in Kottayam, scores for financial literacy and accessibility have gone up. This suggests that Community Resource Persons' financial training and mentoring have helped women plan and manage their business finances better. Overall, SVEP has shifted rural women from limited, consumption-based borrowing to productive, enterprise-oriented financial engagement, reinforcing the broader goals of Kudumbashree's inclusive financial ecosystem (Kudumbashree Mission, 2021).

Entrepreneurial Development and Performance

The study reveals that SVEP has contributed substantially to strengthening women's

entrepreneurial capacities and improving enterprise performance across the study districts. The prevalence of sole proprietorships and the increasing diversity of trade, service, and manufacturing entities suggest that the program has cultivated a sustainable ecosystem for individual entrepreneurship within the Kudumbashree framework. The steady increase in average scores for business knowledge and confidence in managing finance shows that the Community Resource Persons – Enterprise Promotion (CRP-EPs) network's structured training and mentoring have improved both cognitive and practical skills. These outcomes align with the objectives of the Ministry of Rural Development's (MoRD, 2019) SVEP guidelines, which emphasise knowledge incubation and local capacity-building as key determinants of micro-enterprise sustainability. The present study validates that higher levels of business skill and confidence correspond with better enterprise performance, particularly in Kottayam and Wayanad. However, the differences between districts in performance level show that different strategies are needed to deal with differences in how well enterprises do in different districts. Improving market connections, digital marketing skills, and cluster-based business models could help businesses make more profit in the long run. Overall, SVEP has grown from a credit-linked program into a capacity-building platform that helps women become better entrepreneurs, makes micro-enterprise operations more professional, and sets the stage for long-term growth of rural businesses in Kerala.

Income Enhancement and Livelihood Transition

The results confirm that SVEP has led to measurable income enhancement and livelihood diversification among rural women entrepreneurs in Kerala. The fact that the number of ultra-low earners has dropped sharply and the number of people earning more than Rs. 10,000 per month has risen at the same time in all districts shows that household income levels are rising. These gains are most evident in Wayanad, where a majority of enterprises exceeded aspirational income benchmarks, which suggests that business maturity and mentoring support have led to higher profits. This pattern aligns with findings from the Indian Institute of Entrepreneurship (IIE, 2019) national evaluation, which reported that sustained handholding and follow-up support significantly improve enterprise survival and income stability under SVEP.

The fact that most respondents' main source of income is from enterprises shows that the economy is moving from relying on farming or wage labour to self-employment. Such transformation is consistent with the Ministry of Rural Development's (MoRD, 2019) emphasis on developing non-farm livelihood opportunities to strengthen rural economic resilience. The differences in income levels between districts show how market reach and local demand can vary from one place to another. However, the overall evidence shows that SVEP has successfully promoted income security, self-reliance, and sustainable livelihoods, especially for women who previously confined to subsistence-based activities.

Social and Personal Empowerment

The study findings highlight that SVEP's impact extends beyond economic gains, contributing significantly to women's social recognition, self-confidence, and overall empowerment. The fact that women have more control over their lives and decisions in families and communities shows how

entrepreneurship has improved their quality of life and social acceptance. Women in all three districts reported greater control over their household finances and were more involved in community activities. This shows a shift from dependency to leadership, indicating that SVEP enhanced women's visibility in local governance and augmented their participation in collective decision-making.

In Kerala's context, where Kudumbashree already provides a strong platform for women's participation, SVEP has deepened this empowerment process by linking financial independence with social mobility. The most obvious benefits were seen in Wayanad, where entrepreneurs from poor and socially vulnerable backgrounds reported higher improvements in well-being and community respect. In general, SVEP has fostered multidimensional empowerment, including economically, socially, and psychologically. This shows that giving people access to finance and support for community-based enterprises can be a powerful instrument for gender roles transformation in rural areas.

CONCLUSION AND IMPLICATIONS

Conclusion

The study concludes that the Start-up Village Entrepreneurship Programme (SVEP) has brought about significant economic and social advantages for women entrepreneurs in Kerala. The program has helped women move from informal or subsistence jobs to viable micro-enterprises by giving them access to low-cost credit, teaching them new skills, and providing community-based support through the Kudumbashree network. The analysis across three districts demonstrates a consistent enhancement in financial inclusion, enterprise performance, income levels, and multidimensional empowerment. Although variations exist in scale and outcomes across district, the overall evidence shows that SVEP has helped women become more financially independent, better at starting their own businesses, and able to move up in society, which supports Kerala's goal of inclusive growth.

The descriptive findings broadly support the conceptual propositions that guided this study. Across all three districts, improvements in income, financial literacy, and entrepreneurial confidence among women entrepreneurs affirm the positive association between SVEP participation and economic empowerment (Propositions 1 and 2). Proposition 3 is supported by better business knowledge, skills, and self-perception, which confirmed the programme's role in strengthening entrepreneurial capability. Proposition 4, which expects differences between districts, is also supported: enterprise income was much higher in Wayanad, while financial literacy gains were highest in Kottayam, showing how the program's results were affected by the context. While these results do not demonstrate causality without inferential testing, they furnish indicative empirical support for the guiding propositions and present a coherent interpretive framework for policy-oriented conclusions.

Policy and Practice Implications

The results show that SVEP needs to build on its successes while also filling in the gaps in outreach and business support. First, inclusivity needs to be expanded by getting more younger, better-educated, and socially marginalised women (SC/ST and OBC groups) to take part. To get a more balanced group of participants, there could be outreach campaigns at the district level, partnerships

with schools, and youth-focused incubation programs.

Second, mentoring that is specific to a sector and the promotion of collective or group enterprises can improve business performance. This is especially true in service and trade oriented sectors where working together makes businesses more visible and resilient in the market. Low-income businesses could grow by strengthening their connections to the market, getting help with branding, and joining local value chains.

Third, the financial ecosystem requires further deepening. Making the Community Enterprise Fund (CEF) easier to use, offering more credit counselling, and encouraging cooperation between cooperative and commercial banks would all help women get more credit and invest more. Fourth, adding structured training in digital finance and financial literacy to SVEP's capacity-building modules would help women feel more confident about budgeting, making digital payments, and keeping track of their business finances. These are all important skills for Kerala's increasingly digital economy.

Fifth, it is important to keep investing in advanced entrepreneurship and leadership training. Customised training modules in business planning, digital marketing, and strategic management would enhance women's capacity to grow businesses and take on leadership positions in community organisations. These measures will ensure that the empowerment gained through SVEP evolves into institutional leadership.

Limitations and Future Research

This study is based on cross-sectional, survey-based data from three districts and focuses primarily on descriptive analysis. Although the results offer strong evidence of SVEP's efficacy, causal links between particular interventions and outcomes could not be statistically verified. Future research should adopt longitudinal or mixed-method designs to examine enterprise survival, income progression, and empowerment trajectories over time. Comparative assessments among states and experimental investigations into financial literacy or mentoring interventions could elucidate the determinants affecting women's entrepreneurial performance and the scalability of programs.

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Conflict of Interest Statement

The author declares that there is no conflict of interest regarding the publication of this paper. The research was conducted independently, and no financial, institutional, or personal relationships have influenced the analysis, interpretation, or presentation of the findings.

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Management Development (CMD), Kerala, where the author has the professional freedom and institutional permission to conduct independent studies and publish their outcomes.

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GREEN FINTECH: LEVERAGING BLOCKCHAIN, IOT, AND BIG DATA FOR SUSTAINABLE INVESTMENTS FROM AN INTRAPRENEURIAL PERSPECTIVE

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ABSTRACT

The combination of Green FinTech and sustainable investments is transformative to achieving environmental and social goals. Different organizations can align financial performance with sustainability objectives by leveraging Block chain Technology(BCT), the Internet of Things (IoT), and Big Data Analytics (BDA). Here, the role of intrapreneurship is to drive the adoption and innovation of these various technologies within the corporate structures. This study highlights how intrapreneurial initiatives can foster a positive sustainability culture, address significant challenges, and create ample opportunities for an impactful quality environment, financial opportunities, and decisions. Various components of Green FinTech leverage advanced technologies like AI, blockchain, IoT, and big data to enhance sustainability in financial services, driving both environmental and economic benefits. The study was conducted to know the effect of these technologies on building circular economy and to whether regulatory constraints do affect the implementation of these technologies. Factor analysis was conducted to simplify the data for more focused analysis. The components derived from this was used to study the impact of these on circular economy using regression analysis. Technology adoption and environmental protection should align with the organization's sustainability goals. Bridging gaps between financial, technical, and environmental sustainability teams, rapidly deploying solutions to address

dynamic market needs, leveraging blockchain for sustainable investments, immutable ledgers, enables the traceability of funds and verification of environmental, social, and governance compliance.

RESEARCH PROBLEM

This study investigates how various technologies viz., BCT, IOT and BDA enable the implementation of green fintech. Further the study examines the impact of BCT, IOT and BDA on data privacy & security and circular economy.

Sampling plan

Purposive and Snowball Sampling method was adopted. Data was collected from a total of 158 respondents.

FINDINGS:

The study was conducted to know how Block chain, IOT and Big data are supporting or empowering green fin tech initiatives. Green FinTech is the primary focus. Technologies like Blockchain, IoT, and Big Data are tools or enablers being utilized to achieve the goals of Green FinTech. The perspective is intrapreneurial, meaning the focus is on innovation and sustainability initiatives driven from within organizations rather than external entrepreneurship. Multiple hypotheses were generated to know how these predictor variables influence the numerous dependent variables. Green fintech promotes circular economy. Banks and other financial institutions have to promote green fintech in order to enable sustainable economic system. Block chain technology, IOT and Big data analytics are tools or enablers being utilized to achieve the goals of Green FinTech. Proper management of these would benefit the economy at a bigger scale. Multiple regulatory challenges also are associated with the proper usage of these technologies and there exists system loop holes and data security and safety challenges which needs to be addressed properly for enabling sustainable circular economy. To conclude Various components of Green FinTech leverage advanced technologies like AI, blockchain, IoT, and big data to enhance sustainability in financial services, driving both environmental and economic benefits.

Keywords: Block chain technology (BCT), Internet of things (IOT), Big Data Analytics (BDA), Green Fintech, Circular Economy, Economic growth

INTRODUCTION

Background

It is no secret that the world's climate is facing environmental challenges. Global climate change is a critical issue in all aspects. Green Fintech has emerged as a dynamic force in finance and environmental sustainability. Green Fin Tech Sustainable investments have gained as global stakeholders prioritize considerations. Green FinTech offers a transformative path to an emerging domain that integrates financial technology with sustainability, is highly efficient, fully transparent, and has a powerful impact on investment processes. Blockchain ensures data immutability and transparency, IoT provides real-time monitoring of environmental metrics, and big data analytics facilitates informed decision-making. This paper examines how intrapreneurship fosters entrepreneurial innovation within organizations and how it can drive the

adoption of these technologies, enabling businesses to lead in sustainable finance. Intrapreneurship involves strategically leveraging internal resources and fostering innovation to address emerging challenges. In the context of Green FinTech, intrapreneurs act as catalysts for integrating advanced technologies into sustainable investment frameworks.

Digital assets, such as carbon credits or green bonds, can be tokenized to allow shared ownership and improve liquidity. Automated innovative agreements ensure adherence to sustainability criteria and reduce administrative overhead costs.

Problem Statement: Green finance is one of the main root for enabling green economy. This is achievable by enabling BCT, IOT and BDA. The study examines the impact of BCT, IOT and BDA on data privacy & security and circular economy.

OBJECTIVES:

- To study the various technologies (BCT, IOT and BDA) which enable the implementation of green fintech.
- To study the impact of BCT, IOT and BDA on data privacy & security and circular economy.
- To study the impact of regulatory constraints on the implementation of BCT.

RESEARCH GAP

This Study explores how blockchain, big data, and IOT mutually impact sustainable investments. Big data analysis is one the important component for enabling circular economy (Stanković, M. et.al. (2024)). IOT is another major factor which enables the fullest implementation of fintech which enables circular economy (Jum'a, L. et.al. (2024)). Much studies are undertaken to explain that these factors influence circular economy. But still much research has to be undertaken to identify the linkage between green fintech and its impact on circular economy. Also there aren't many techniques and frameworks that justify how intrapreneurs can effectively promote the implementation of Green FinTech. This research was undertaken to fill this gap.

LITERATURE REVIEW

Intrapreneurial Activities for Technological Innovations

Sustainable innovations have been of paramount importance within the organisations in the current times. In this evolving landscape it is the intrapreneurial activities within the organisations that have been the catalysts for technological advancements in the organisations. has been evolving. (Jones and Smith, 2019) explored that cross-functional collaboration and leadership support play crucial role in sustainable innovations and solutions. They found that the intrapreneurial activities are fostering technological innovation within the firms.

Emerging Digital Technologies for Sustainable Solutions

(Chen et al., 2020) found that big data analytics can be merged into evaluating Environamental Social and Governance (ESG) assessments. This helps firms to make important operational decisions and to maintain important sustainability benchmarks by forecasting and assessing climate risks using big data models.

Study by (Kumar and Singh, 2020) further expands on the role of emerging digital technologies as they explore the transformative potential of tokenizing assets such as carbon credits and renewable energy certificates. Blockchain technology has enabled hared ownership and liquidity in sustainable financial markets by increasing the investors' access green investment opportunities. (Roberts, C., & Evans, J., 2020) underscores and emphasizes on the importance of collaboration between financial, technical, and environmental teams in achieving sustainability goals. They have particularly highlighted importance of the intrapreneurial leadership which helps in bridging the gaps between different teams and stimulates the culture of innovation.

Further, (Smith and Lee, 2021) state that integration of blockchain technology enhances operational efficiency and transparency with respect to green finance. Green fintech is a comprehensive framework that facilitates sustainability-focused investment strategies. This is attained by increasing the use of tokenized assets such as blockchain green bonds and carbon credits. The authors also have hhighlighted in their study, the purpose of absolute ledgers in verifying environmental, social, and governance accordance. Even, (Zhang, Y., & Wu, L, 2021) highlight the potential of ggreen fintech in addressing climate challenges by integrating blockchain, IoT, and big data into investment strategies. They also emphasize in their study on how these technologies improve transparency, accountability, and efficiency in sustainable investments.

Fintech Innovations - Challenges and Opportunities

Smart Contracts are another innovation in this space. (Jones, P., & Brown, L, 2021) in their study delve into the role of smart contracts in automating and enforcing sustainability criteria in financial agreements. They also highlight on how these contracts reduce administrative costs and ensure adherence to the principle of green finance. While adopting green fintech has it's own advantages, it has certain challenges as well. (Ahmed, M., & Khan, N, 2022) mention that regulatory challenges, high initial costs, and technical complexities are the key barriers in adopting green fintech. However, the authors speak about the intrapreneurial initiatives and how such initiatives can drive opportunities for innovation and market growth. According to a study by (Patel, 2021), prominent implementation expenditures and aversion to change are two complications to adopting green fintech. The study proposed resolving these concerns by engaging stakeholders and forming skills. (Lee and Park, 2022) investigated the application of blockchain in carbon credit trading practices and found that intelligent contracts enhance market efficiency by streamlining credit authentication and trade. Echoing similar thoughts (Addy et al., 2024) state that FinTech innovations are drivers of sustainability as they facilitate green investments and empower in informed decision making. Moreover, Fintech innovations have contributed to creation of sustainable investment platforms. They create resilient, transformative and low-carbon economy.

Intrapreneurship and Fintech

(Ignatyuk et al., 2020) observe that intrapreneurship within fintech fosters innovation by enabling employees to develop

sustainable financial solutions. Green Fintech aligns with Sustainable Development Goals (SDGs) and fosters financial inclusion as well (Nassiry, 2018). (Macchiavello & Siri, 2020) mention that the integration of these technologies enhances the impact of financial institutions in promoting green initiatives and thereby SDGs. Collaborative approach between fintech companies and traditional financial institutions can together enhance reach and impact of sustainable investments. Intrepreneurship with fintech can bring synergy between fintech innovations and traditional finance. This synergy can overcome the barriers to sustainable investment and fair and equitable financial ecosystem (Al Hammadi et al., 2019). This alignment and synergy is essential for fostering a sustainable future, as it promotes ethical investment strategies and supports the transition to a greener economy (O'Sullivan, 2024).

RESEARCH METHODOLOGY

Research Problem

This study investigates how various technologies viz., BCT, IOT and BDA enable the implementation of green fintech. Further the study examines the impact of BCT, IOT and BDA on data privacy & security and circular economy. The study also examines the impact of regulatory constraints on the implementation of BCT.

Research Plan

Primary research was conducted to study the perception of the intrapreneurial people about green fintech. A well-structured questionnaire was developed to study the various factors which leverage the green fin tech

Sampling plan

Purposive and Snowball Sampling method was adopted. Data was collected from a total of 158 respondents. The respondents are from different educational background occupying different positions in the organization. Only the intrapreneurial perception were collected.

Data collection instruments

The components used for the questionnaire were partially taken from the study under taken by Honar Pajooh. et. al. (2021) and remaining from various internet sources which speaks about big data analysis and IOT. This study investigates how various technologies viz., BCT (Block chain technology), IOT (Internet of Things) and BDA(Big Data Analytics) enable the implementation of green fintech.

Data processing and analysis plan

The perception of the respondents was analysed using SPSS software applying different statistical tests . Hypothesis was developed to proceed with the analysis. KMO Bartlett's test, Factor analysis, Reg. Analysis and ANOVA test were conducted to analyze the data.

Scope of the Study

The study's scope incorporates how Green FinTech integrates cutting-edge technologies like blockchain, IoT, and big data to foster sustainable financing. The significance of intrapreneurship in promoting the acceptance and invention of these technologies in business settings is also accentuated.

Limitations of the Study

The study relies on intrapreneurs' perceptions, which are inherently subjective and may not accurately reflect actual organizational practices or technological feasibility. Not all intrapreneurs may possess the same depth of knowledge regarding emerging technologies like IoT or blockchain, potentially influencing

the accuracy or depth of their responses. Green FinTech, IoT, and blockchain technologies are evolving rapidly. Insights based on current perceptions may become outdated quickly, limiting the long-term relevance of the findings.

Data Analysis and Discuss:

The study was conducted to know how Block chain, IOT and Big data are supporting or empowering green fin tech initiatives. **Green FinTech** is the primary focus. Technologies like Blockchain, IoT, and Big Data are tools or enablers being utilized to achieve the goals of Green FinTech. The perspective is **intrapreneurial**, meaning the focus is on innovation and sustainability initiatives driven from within organizations rather than external entrepreneurship.

Multiple parameters were developed to assess the intrapreneurial perspectives about Green fin tech and how the above-mentioned factors do leverage it. To reduce these dimensions into different components, factor analysis was proposed to be conducted. KMO and Bartlett's test was conducted to know whether the sample is adequate enough to conduct the Factor analysis.

Table-1 KMO and Bartlett's Test

KMO measure of sample Adequacy		0.880
Bartlett's Test of Sphericity	Chi square	1097.969
	DF	105
	Sig.	.000

Source: Authors Calculation

Table-2 Factor Analysis (Rotated Component Matrix)

	Component		
	BCT	IOT	BDA
Blockchain enhances transparency and accountability in green financial transactions.	.774		
Tokenized carbon credits on blockchain improve efficiency in carbon trading.	.816		
Blockchain reduces fraud in sustainability-linked financial products.	.752		
The energy consumption of blockchain networks is a concern for green fintech.	.781		
Blockchain enables decentralized funding for eco-friendly projects.	.820		
IoT devices provide real-time data to improve sustainability in green finance.			.734
IoT-enabled smart meters optimize energy usage in funded projects.			.679
IoT facilitates peer-to-peer energy trading effectively.			.711
IoT supports risk assessment for green insurance products.			.755
High costs of IoT infrastructure limit its adoption in green fintech.			.656

Big data analytics improves decision-making for sustainable investments.		.743	
Big data enables accurate tracking of ESG metrics for green financial products.		.786	
Predictive analytics supports risk mitigation in green projects.		.757	
Big data drives innovation in eco-friendly financial products.		.786	
Big data enhances transparency and accountability in sustainability reporting.		.724	

Source: Authors Calculation

Table-3 Regression Model

Model	R	R Square	Adjusted R Square	Error of the Estimate
1	0.751	0.511	0.501	0.94610

Source: Authors Calculation

Table-1, indicates the KMO test value is 0.880 which is 88% which is explaining sufficient evidence that the sample is adequate enough to proceed with factor analysis. Also bartlett's test of sphericity is less than 5% which explains that the correlation matrix is a non-identity matrix. Hence Factor analysis was conducted. The total variance explained is 63%. Hence the total variance explained by the three components is 63% and it is generally considered good as these three components capture a significant portion of the data set's variability. This statement is validated in these by these research works.

From Table-2, rotated component matrix, it is evident that the different components developed for the study is grouped into three components. Those components are named as:

Component 1: Block chain technology

Component 2: Internet of Things

Component 3: Big data analytics

Further analysis was conducted to know how these components influence the green fintech and its corresponding effects. One of the effects of green fintech is circular economy. (Grégoire, V., & Guay, K. (2023), Pizzi, S. et.al. (2021), Agarwal, R. et.al. (2025), Arefmanesh, Z. et.al. (2024), Tamasiga, P. et.al.(2024)). The three components derived out of factor analysis will help in building circular economy. These three components will enhance the efficiency of the fintech processes as well as reduce the paper consumption. Numerous factors will be influenced by these factors. Hence these components were taken as predictor variables and others as dependent ones. To know the effect of these on the dependent variables, regression analysis was conducted.

H0: Circular economy is independent of big data analytics, IOT and block chain technology

As can be seen in Table-3, the predictor variables in this are Block chain technology, Internet of Things, Big data analysis. These components were regressed on circular economy which is the dependent variable to know whether these are impacting it. The R value in the above table is 0.751, which explains the relationship between predictors

and the dependent variable. The value being 75% is explaining a high correlation between these variables. The R^2 value is 0.511 which explains that the predictor variable is explaining a variance of 51% on the dependent variable which is circular economy. The variance is moderate enough to explain the impact. Though the variance is moderate, the predictors are explaining influence on the dependent one. The adjusted R Square explains how well the predictor variables are together explaining the variance in the dependent variable after adjusting for the number of predictors in the model. The value of adjusted R square is 0.501 which means that about 50% of variation in circular economy, is explained by the predictor variables after penalizing the number of predictors and this was considered as a moderate level of explanatory power.

Table-4 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	144.009	3	48.003	53.628	.000
	Residual	137.848	154	.895		
	Total	281.857	157			

Source: Authors Calculation

Table-5 Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Constant	.148	.109		1.360	.176
	Block_Chain_Technology	.486	.070	.394	6.960	.000
	Internet_Of_Things	.338	.060	.320	5.661	.000
	Big_Data_Analytics	.648	.070	.524	9.270	.000

Source: Authors Calculation

Table-6 Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777[a]	.603	.596	.74131

Source: Authors Calculation

The impact was considered to be moderate by looking at the values from the regression table. The significance of the impact was to be analysed. To know the significance of the influence, ANOVA test was conducted. In Table-4, we can see high F-value(53.628) and low P-value (<5%). This is explaining that the influence of predictor variable on the dependent variable is significant and hence the null hypothesis was rejected. From this it was concluded that the predictor variables namely, BCT, IOT and BDA significantly influence the dependent variable which is circular economy. Table-5 explains the respective influence of each of the predictor variables on the dependent one. The extent of the influence and significance of the impact can be understood from this table. With the help of the beta coefficients, a regression equation can be formed which explains the extent of influence of each of the predictor variable on circular economy.

Circular economy = 0.148 + 0.486 * BCT + 0.338 * IOT + 0.648 * BDA

Big data analytics is placing a higher influence (64.8%) on circular economy, explaining that out of all other predictor variables, BDA is placing more impact on Circular economy. The other variable block chain technology is explaining an influence of 48.6% of influence on the circular economy and Internet of things is also explaining an influence of 33.8%.

Major construct of green fintech is security of transactions (Hwang, Y. et.al.(2021), Liu, J . et.al. (2023), Hidayat-ur-Rehman et.al. (2024), Ding, H. (2023)) and Block chain technology, IOT and Big data analytics act as mediating agents for data security and privacy (Ng, S. C. H(2023), Dhingra. Et.al. (2024), Shin, D. et.al. (2020), Rana, N. P. et.al. (2022), Lakshmanan, M. et.al.(2024)). There is a need to understand how these predictors influence the security concerns of the fintech transactions. Hence regression analysis was conducted to know the extent of these predictor variables impact data security and privacy from the intrapreneurial perspectives.

H02: Block chain technology, IOT and Big data analytics does not affect data security and privacy

Block chain technology, Internet of Things and Big data analysis are taken as the predictor variables for the next hypothesis. The security and privacy concern is taken as dependent variable. From Table-6, model summary, the R value is 0.777 which is explaining a relationship of 77.7% between the independent variable and dependent variable and R square is 0.603. This is explaining a variance of 60.3% from these above mentioned predictor variable on the dependent variables which is taken as ‘data security and privacy’. The impact is moderate, and it was concluded that these predictor variables place a moderate influence on the dependent variable

Table-7 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	128.667	3	42.889	78.045	.000
	Residual	84.629	154	.550		
	Total	213.296	157			

Source: Authors Calculation

Table-8 Coefficients Table

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Constant	.341	.083		4.087	.000
	Block Chain Technology	.841	.055	.778	15.256	.000
	Internet Of Things	-.085	.047	-.093	-1.832	.069
	Big data Analytics	-.033	.055	-.030	-.597	.552

Source: Authors Calculation

Table-9 Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.687[a]	.472	.469	.84608

Source: Authors Calculation

From the regression table, it was concluded that there is a moderate impact of predictors on the dependent variables. To know the significance of impact, ANOVA test was conducted. As we can see in Table-7, the P-value is less than 5%. This is explaining a a significant impact of these predictors variables on data privacy and security. It was concluded that though the impact was moderate, it is significant enough to say that these predictor variables do influence the dependent variable significantly and hence null hypothesis was rejected.

From Table-8, the respective influence of each of the predictor variable on the dependent one. Block chain technology is showing a high positive influence on the data security and privacy with a Beta coefficient of 0.841. Whereas the other two variables namely, IOT showing a negative influence of -0.085 and Big data analytics with a beta coefficient of -0.033 are negatively influencing the data privacy and security. From these a regression equation can be formed.

Data privacy and security= 0.341 + 0.841 * BCT + (-0.085) * IOT + (-0.033) * BDA

From the above equation it is evident that block chain technology is enabling higher data privacy and security and other two things i.e. Internet of Things and Big data analytics are showing a negative coefficient stating that these two lack in providing data security and privacy.

H03: Block chain technology is impacted by regulatory uncertainty.

Regulatory constraints restrict the usage of the different technology. To study the impact of regulatory constraints on the implementation of block chain technology as an instrument for green fintech implementation, regression analysis was conducted. As in Table-9, R value is showing a correlation of 68.7% and R^2 is 0.472 explaining a variance of 47.2% on BCT from the independent variable which is regulatory uncertainties. This is showing an impact of 47.2% of impact of regulatory constraints on the implementation of block chain technology which is moderate.

Table-10 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	99.801	1	99.801	139.416	.000[b]
	Residual	111.673	156	.716		
	Total	211.475	157			

Source: Authors Calculation

Table-11 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	Constant	4.743	.203		23.416	.000
	Regulatory uncertainity	-.869	.074	-.687	-11.807	.000

Source: Authors Calculation

The impact was seen to be moderate from the above regression table. To know the whether the impact is significance or not, ANOVA table was analysed. Table-10 shows the high F-value (139.146) and low P-value(<5%), is explaining that block chain technology is significantly being impacted by the regulatory uncertainty. It was concluded that Block chain technology is being influenced by regulatory uncertainty and hence null hypothesis was rejected.

The beta coefficient as seen in Table-11, is (-0.869) which is explaining a negative impact of the regulatory constraint on the implementation of block chain technology. Hence it can be said that regulatory constraints act as significant constraints for the implementation of block chain technology.

FINDINGS:

The study was conducted to know how Block chain, IOT and Big data are supporting or empowering green fin tech initiatives. Green FinTech is the primary focus. Technologies like Blockchain, IoT, and Big Data are tools or enablers being utilized to achieve the goals of Green FinTech. The perspective is intrapreneurial, meaning the focus is on innovation and sustainability initiatives driven from within organizations rather than external entrepreneurship. Multiple hypotheses were generated to know how these predictor variables influence the numerous dependent variables. KMO test was conducted to know the sample adequacy and to proceed with the factor analysis. The KMO test results were feasible to proceed with factor analysis and hence, factor analysis was conducted. On the basis of the correlation between the various components which were used to assess the perception of the respondents, were classified into 3 components. From the cumulative variance value, it was concluded that these 3 components fairly explain the variance among the variables and hence these three components were retained for further analysis. They were respectively named as Block chain technology (BCT), Internet of Things (IOT) and Big data analytics (BDA). These were

used to predict the impact on various dependent variables. These components influence green fintech and enable to build circular economy. Regression analysis was conducted to know how these 3 components influence circular economy. With the R square value and adjusted R square value, it was concluded that the influence is moderate and with P-value it was confirmed that the influence is significant.

BCT, IOT and BDA might influence data privacy and security. Regression analysis was conducted. The impact was moderate enough to say that there is an impact of these predictors on the dependent variable. ANOVA test was conducted to know the significance of impact. The P-value being less than 5% explained that there is a significant of these predictors' variables on data privacy and security. Null hypothesis was rejected.

Regulatory constraints restrict the usage of the different technology. To study the impact of regulatory constraints on the implementation of block chain technology as an instrument for green fintech implementation, regression analysis was conducted. The R^2 showed an impact of 47.2% on regulatory constraints on the implementation of block chain technology. This impact is moderate. To know the significance of impact, ANOVA test was conducted. With P-value, null hypothesis was rejected and concluded that regulatory uncertainty pose challenge for the implementation of block chain technology implementation.

CONCLUSION:

Green fintech promotes circular economy. Banks and other financial institutions have to promote green fintech in order to enable sustainable economic system. Block chain technology, IOT and Big data analytics are tools or enablers being utilized to achieve the goals of Green FinTech. Proper management of these would benefit the economy at a bigger scale. Multiple regulatory challenges also are associated with the proper usage of these technologies and there exists system loop holes and data security and safety challenges which needs to be addressed properly for enabling sustainable circular economy. To conclude Various components of Green FinTech leverage advanced technologies like AI, blockchain, IoT, and big data to enhance sustainability in financial services, driving both environmental and economic benefits.

SCOPE FOR FUTURE RESEARCH

Future research can expand the present study by incorporating a broader and more diverse sample across industries, geographies, and organizational sizes to enhance generalizability. Longitudinal studies could track changes in intrapreneurial perceptions over time as green technologies and FinTech practices evolve. Integrating customer or policymaker perspectives could also offer a multi-stakeholder view of green FinTech adoption. Furthermore, future studies may validate perceived insights through case studies or performance metrics to assess the actual implementation and impact of IoT, blockchain, and related technologies in achieving sustainable finance goals. Finally, comparative studies across traditional financial institutions and emerging FinTech firms can reveal differences in innovation readiness and green technology integration.

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APPENDIX:

Questionnaire:

- Blockchain enhances transparency and accountability in green financial transactions.
- IoT supports risk assessment for green insurance products.
- Big data enhances transparency and accountability in sustainability reporting.
- Compliance requirements increase operational costs for fintech startups.

- AI and data-driven tools facilitate the measurement of circular economy performance.
- Organizations using IoT in green finance adopt strong data privacy measures.
- Lack of clear policies creates uncertainty in implementing digital green finance solutions.
- Big data analytics improves decision-making for sustainable investments.
- Investment in green technologies helps transition toward a circular economy.
- Blockchain ensures secure and tamper-proof recording of green financial data.
- IoT-enabled smart meters optimize energy usage in funded projects.
- Regulatory support is insufficient for integrating emerging technologies in sustainable finance.
- Tokenized carbon credits on blockchain improve efficiency in carbon trading.
- Customers are confident in the security of their personal and transactional data in green fintech.
- Big data enables accurate tracking of ESG metrics for green financial products.
- Blockchain reduces fraud in sustainability-linked financial products.
- High costs of IoT infrastructure limit its adoption in green fintech. (reverse-coded)
- Big data drives innovation in eco-friendly financial products.
- Ambiguity in data protection laws limits innovation in blockchain and IoT-based green finance.
- Green fintech solutions contribute to reducing resource waste and promoting reuse.
- Predictive analytics supports risk mitigation in green projects.
- Blockchain enables decentralized funding for eco-friendly projects.
- IoT facilitates peer-to-peer energy trading effectively.
- Financial institutions use digital tools to promote recycling and sustainable consumption.
- Stringent financial regulations slow down the adoption of green fintech innovations.
- Blockchain and IoT enhance traceability across product life cycles, supporting circular economy goals.
- The energy consumption of blockchain networks is a concern for green fintech. (reverse-coded)
- Big data analytics platforms maintain confidentiality and integrity of user data.
- IoT devices provide real-time data to improve sustainability in green finance.
- Effective data governance frameworks enhance trust in technology-driven sustainable finance.

  Response Format:

  1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

AUTHOR DECLARATIONS

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INDIAN STOCK MARKET EFFICIENCY AND DAY OF THE WEEK EFFECT: EVIDENCE FROM NIFTY 50 INDEX

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ABSTRACT

Investors analyse security prices to maximize profits. One phenomenon often discussed in this context is the day-of-the-week effect, which suggests that stock returns follow a predictable pattern based on the trading day. For this purpose, we investigated the day-of-the-week anomaly in the Indian market. We analysed the daily closing prices of the Nifty 50 index from April 1, 2012, to March 31, 2024. In our study, we employed the Student's t-test and the Ordinary Least Squares (OLS) regression model. The results revealed that Tuesday exhibited statistically significant higher returns compared to other weekdays, implying that investors could potentially achieve abnormal profits by focusing on securities traded on Tuesdays. The study concluded that the Indian stock market is not fully efficient, as the presence of the day-of-the-week effect anomaly indicates that investors can capitalize on strategic trading days to generate excess returns.

Keywords*:* Calendar anomaly; Day of Week Effect; Random Walk Hypothesis; Efficient Market Hypothesis; Indian Stock Market.

JEL Classification: G10, G14, G17

INTRODUCTION

Investors analyse security prices to maximize profits by using technical analysis, which relies on past trends. However, this approach may not always be effective for investors. In an efficient market, stocks are assumed to be fairly valued, with their prices closely reflecting their actual value (Fama, 1970). As a result, stock price behaviour in such markets tends to be random, responding only to new information, which makes them unpredictable (Chavarkar & Nayak, 2022; Hayek, 1945). Nevertheless, the efficiency of the stock market is often debated. Some argue that it is not always efficient due to various influencing factors, such as market anomalies, speculation, and irrational investor behaviour (Panda & Dey, 2022). In this context, we attempt to understand the market anomaly behaviour of the Indian stock market. Anomalies can be directly transformed into profitable investment strategies. Anomaly research is one of the key drivers propelling the development of finance (Zaremba et al., 2020). The term "anomaly" can be traced back to Thomas Kuhn, who described it as any discovery that, despite repeated efforts, cannot be aligned with the expectations governing normal

science (Kuhn, 1970). One of the most documented financial market anomalies is calendar anomalies (Pincus et al., 2007). Calendar anomalies indicate the existence of consistent seasonal patterns in stock returns depending on time periods, such as daily, monthly, or yearly movements in stock prices. These include phenomena like the day-of-the-week effect, the turn-of-the-month effect, and the year-end effect (Arora & Bajaj, 2017). Among these, the Day-of-the-Week (DOW) effect is a well-studied regularity observed in financial markets, suggesting that Friday returns are higher than Monday returns (French, 1980). This anomaly challenges the Efficient Market Hypothesis (EMH) (Pincus et al., 2007). The EMH, introduced by Fama (1970), posits that current stock prices fully reflect all publicly available information and respond instantaneously to new information, which arrives randomly.

In our study, we aim to examine the day-of-the-week effect in the Indian stock market. The Indian stock market experiences significant growth in recent years, attracting attention from both domestic and international investors (Bhattacharjee et al., 2016). However, the efficiency of the Indian stock market remains a topic of debate, as some argue that it is not always efficient due to the influence of various factors such as market anomalies, speculation, and irrational investor behaviour (Mallesha & Archana, 2023; Panda & Dey, 2022). Hence, analysing the efficiency of the Indian stock market is crucial (Tripathi & Sethi, 2010). In this context, the present study aims to investigate the presence or absence of the day-of-the-week anomaly in the Indian context. Furthermore, this research contributes to the existing literature in two key ways: first, by examining the day-of-the-week effect anomaly in the Indian stock market, and second, by evaluating the efficiency of the Indian stock market. The study's findings may have significant implications for investors and policymakers.

The structure of this article is as follows: Section 2 provides a brief review of the literature. Section 3 discusses the data and methodology. Section 4 presents the results and discussion. Section 5 presents findings of the study. Section 6 provides the limitations and further scope of the study. Finally, Section 7 summarizes the findings and offers a conclusion.

LITERATURE REVIEW

Recent empirical studies have investigated the Day-of-the-Week (DOW) effect in both developed and emerging markets, utilising various econometric models and datasets to analyse stock return patterns and market efficiency. Derbali and Hallara (2016) examined the Tunisian stock market employing GARCH (1,1), EGARCH (1,1), and TGARCH (1,1) models, revealing that Thursdays consistently produced positive returns, whereas Tuesdays exhibited negative returns, indicating the existence of day-specific anomalies in emerging economies. Shahid and Sattar (2017) investigated calendar anomalies in the Pakistani stock market utilising a GARCH (1,1) framework and discovered that market efficiency developed dynamically, consistent with the Adaptive Market Hypothesis. Zhang et al. (2017) investigated Day-of-the-Week (DOW) effect anomalies in various capital markets utilising GARCH models and rolling sample tests, revealing consistent day-specific return patterns across multiple indices, indicating the existence of DOW anomalies in the different markets. Rossi and Gunardi (2018) examined Day-of-the-Week (DOW) effect anomalies in four European markets using GARCH and OLS regression models, revealing conflicting results that

suggest anomalies differ by country and may change over time. Bolek et al. (2023) examined the impact of COVID-19 on market efficiency and the day-of-the-week effect using OMX Exchange indices. The research indicated that prior to the epidemic, only the OMX Baltic All-Share Index demonstrated efficiency; however, following the pandemic, the Copenhagen market (OMXCPI) displayed no DOW anomaly. The findings indicate that COVID-19 altered market efficiency across various periods and weekdays, yet did not affect trading quality, suggesting that market structures remained stable despite behavioural changes. In the Indian context, numerous research has yielded inconclusive data on the DOW effect. Sharma (2011) investigated the Day-of-the-Week (DOW) effect in the Indian stock market using Sensex and Nifty data from January 2008 to December 2009. The study found no significant Day of the Week, Monday, or Friday effects, indicating that the Indian market maintained informational efficiency during this period. Malavalli and Sathyanarayana (2015) investigated the Day-of-the-Week (DOW) effect on the Indian stock market by analysing BSE Sensex data from 2004 to 2014, employing a dummy variable regression technique. The analysis revealed an absence of DOW anomalies or seasonal trends in stock returns, indicating that the Indian market demonstrated efficiency throughout the examined time frame. Sahoo (2021) examined multiple Nifty indexes from April 2005 to May 2020, differentiating between pre-COVID-19 and COVID-19 periods, and found that no DOW effects existed before the crisis; instead, these effects manifested during the pandemic, marked by negative returns on Mondays and positive returns on other weekdays. Khan et al. (2021) examined the Sensex 30 and NSE Nifty from July 2013 to March 2019 and discovered no significant DOW effect on returns; nonetheless, they observed that trading volumes were minimal on Mondays and increased steadily over the week. Swetha and Jegadeeswari (2023) investigated the influence of the Day-of-the-Week (DOW) on stock returns of selected scheduled commercial banks in India. The study utilised mean return analysis and regression models to investigate if particular weekdays consistently exhibited higher or lower returns. The findings indicated the existence of enduring trends across several days, thereby enhancing the literature on market anomalies and behavioural finance. Aggarwal and Jha (2023) examined the day-of-the-week (DOW) effect and volatility in the Indian stock market utilising data from 1990 to 2022. Utilising GARCH (1,1), EGARCH (1,1), and TGARCH (1,1) models, they identified substantial day-of-the-week impacts on both returns and volatility in the NSE-Nifty index. The findings indicated that all weekdays had positive and significant returns, with stock performance influenced in various manners (leverage). The analysis revealed that the Indian market remains inefficient, allowing traders to speculate on pricing and generate substantial profits.

DATA AND METHODOLOGY

Data

In order to investigate the day-of-the-week effect in the Indian stock market, we performed T-statistic and Ordinary Least Squares (OLS) regression analyses. This study utilized daily closing prices of the Nifty 50 index, which is listed on the National Stock Exchange, covering the period from April 1, 2012, to March 31, 2024. The data for daily closing prices was sourced from Yahoo Finance. The daily returns of the Nifty 50 index were determined by using a specified formula:

$$R_n = ln\left(\frac{P_t}{P_{t-1}}\right)$$

R_n signifies returns of index; ln represents logarithm returns; P_t is the index closing price at time t, P_{t-1} is the index closing price at time t-1.

Figure 1. Nifty 50 Market Price, 2012-2024

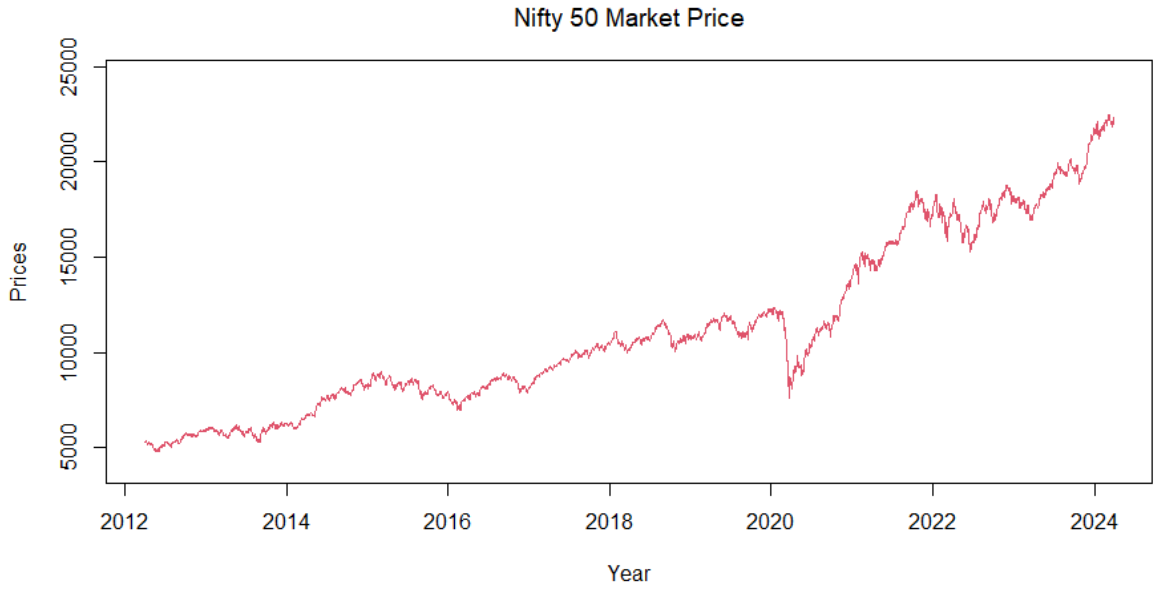
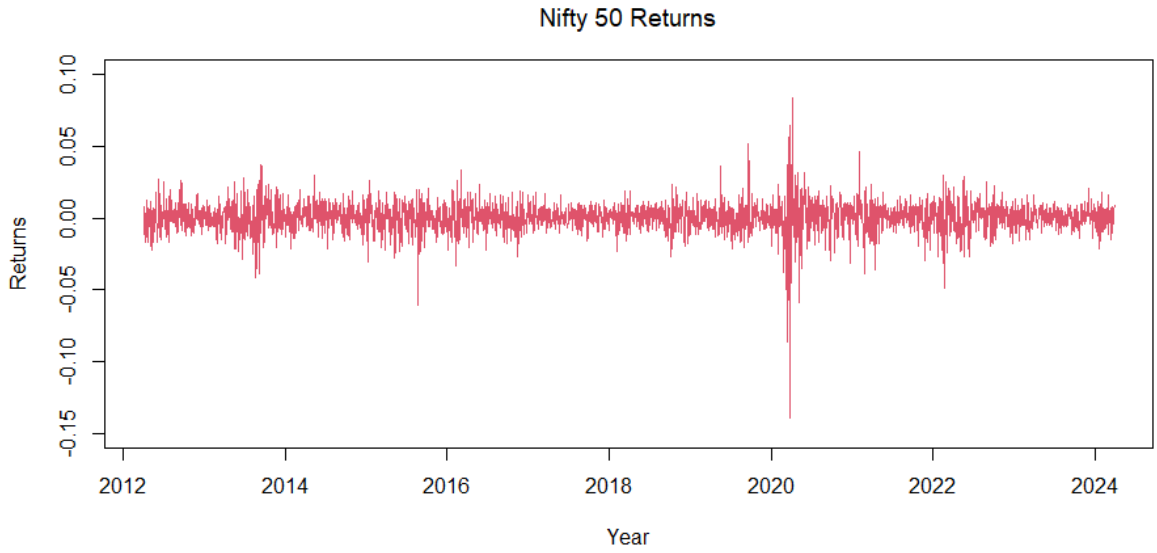


Figure 2. Nifty 50 Returns, 2012-2024



METHODOLOGY

In order to evaluate the day-of-the-week effect in the Indian stock market, we utilized both the Student's t-statistic and the Ordinary Least Squares (OLS) regression model. The methodologies are described in detail below.

Comparing Means with a T-test

A T-test is used to determine whether the daily mean return on specific weekdays is substantially different from zero (Caporale & Plastun, 2019; Jaffe & Westerfield, 1985). The T-statistic, a key component of the

Student's t-test, is widely used in statistical analysis to compare two groups' means and determine whether the difference is statistically significant (Dubois & Louvet, 1996). We applied this test to investigate the mean difference related to the day-of-the-week effect. The Student's t-test formula is as follows:

Where: $\bar{x} - \mu_0$: Mean return of the dataset. μ_0: Hypothesized mean return. s: Standard deviation of the dataset. n: Sample size.

Ordinary Least Square Regression Model

We used OLS regression to examine the day-of-week effect. The analysis' dependent variable was daily index returns, while the independent variables were four dummy variables indicating distinct weekdays and an intercept for Mondays (Swetha & Jegadeeswari, 2023). Each dummy variable was assigned a value of one on the relevant day (for example, the Tuesday dummy is one on Tuesdays and zero on other days). The intercept represented the average returns for Mondays, but the dummy variables represented the deviation in returns on other weekdays relative to Monday (Bolek et al., 2023; Malavalli & Sathyanarayana, 2015). The regression model was constructed as follows:

Where, R_t represents the daily index return, while D_{Tue} to D_{Wed} denotes the dummy variable for the days from Tuesday to Friday. The term e_t captures the error component. This equation is instrumental in determining whether significant market returns occur on specific days of the week.

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

$$R_t = c + \beta_1 D_{Tue} + \beta_2 D_{Wed} + \beta_3 D_{Thu} + \beta_4 D_{Fri} + e_t$$

Table 1: Summary of Descriptive Statistics

Day	All Days	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	0.0005	-0.0002	0.0011	0.0005	0.0003	0.0008
Median	0.0008	0.0012	0.0010	0.0003	0.0006	0.0008
Maximum	0.0840	0.0463	0.0840	0.0641	0.0407	0.0567
Minimum	-0.1390	-0.1390	-0.0384	-0.0572	-0.0867	-0.0417
Std. Dev.	0.0104	0.0126	0.0097	0.0088	0.0102	0.0102
Skewness	-1.1865	-3.19	0.893	0.141	-1.16	0.25
Kurtosis	20.9503	31.3	13.3	10.9	13.4	6.58
Jarque Bera	40557.13	20724	2694	1545	2801	317
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	2969	590	592	597	596	582

Note: * represents significant @ 5% level

Source: Authors' estimation

Table 2. Results of Nifty 50 Returns using Student's T-test

Days	T-value	P-value
Monday	-0.4418	0.6588
Tuesday	2.6887	0.0074*
Wednesday	1.2586	0.2087
Thursday	0.8377	0.4025
Friday	1.8608	0.0633

Note: * represents significant @ 5% level
Source: Authors' estimation

Table 3. Results of Nifty 50 Returns using the OLS Regression Model

Days	Estimate	Std. Error	T-value	P-value
Monday	-0.0002	0.0004	-0.539	0.5901
Tuesday	0.0013	0.0006	2.156	0.0312*
Wednesday	0.0007	0.0006	1.137	0.2555
Thursday	0.0006	0.0006	0.961	0.3366
Friday	0.0010	0.0006	1.676	0.0938

Note: * represents significant @ 5% level
Source: Authors' estimation

RESULTS AND DISCUSSION

We computed several measures to examine the day-of-the-week effect in the Indian stock market using Nifty returns. Comprehending descriptive statistics is essential before doing the tests (Challa et al., 2020). The analysis utilised RStudio version 2023.06.2+561, a statistical software. The Jarque-Bera normality test is a widely utilised method that serves as a diagnostic instrument for assessing the distribution of observed returns (Jarque & Bera, 1980), facilitating the evaluation of conformity to a normal distribution pattern.

The summary of descriptive statistics presented in Table 1. The descriptive statistics indicate significant variability in Nifty returns during weekdays. Overall returns are somewhat positive, with better performance in the middle of the week and worse returns in the beginning of the week. Volatility is highest on Mondays and lowest in the middle of the week, which means that there is more uncertainty at the start of trading weeks. Most days skewness and kurtosis values are not equal to 0 and 3, respectively, signifying an asymmetric, fat-tailed distribution with a higher probability of extreme losses. The results of the Jarque-Bera test show a value that is much higher than the normality threshold. This means that the null hypothesis that the observed returns follow a normal distribution is not true.

Table 2 presented the t-statistics for Nifty 50 returns across all weekdays. The results indicate that average returns are positive on all days except Monday. Tuesday demonstrates the highest average return among the weekdays. The t-test for Tuesday demonstrates statistical significance at the 5% level, while no significant differences were found for the other weekdays. This

results in the null hypothesis being rejected for Tuesday. This indicates a potential arbitrage opportunity for investors to achieve excess profits through trading strategies, especially on Tuesdays, by engaging in the buying and selling of securities. The findings suggest that the Indian stock market may display weak-form inefficiency, as the return series shows evidence of a day-of-the-week effect. An Ordinary Least Squares (OLS) regression model was utilised to enhance the validation of these results, a method commonly used in empirical research on calendar anomalies (Caporale & Plastun, 2019).

Table 3 illustrates the OLS regression analysis for Nifty 50 returns. The intercept (Monday) has an estimated coefficient is negative, indicating statistical insignificance. On Tuesday, a positive and statistically significant coefficient is observed at the significance level, resulting in the rejection of the null hypothesis for this day. Conversely, Wednesday, Thursday, and Friday exhibit positive coefficients. However, none of the days are statistically significant. Consequently, only Tuesday demonstrates a significant positive effect on returns, while the other days do not reject the null hypothesis. This finding suggests the potential for abnormal returns on Tuesdays, presenting opportunities for investors to achieve excess profits through timely trading strategies.

FINDINGS OF THE STUDY

The study examined the day-of-the-week effect in the Indian stock market using T-test and OLS regression techniques. The T-test results indicated that average returns were positive on the majority of weekdays, with the exception of Monday. Tuesday had a statistically significant greater return, indicating the potential for atypical gains on that day. The OLS regression analysis confirmed this finding, indicating that Tuesday had a significant beneficial impact on returns, while the other weekdays had no substantial effects. The results indicate that although Tuesday may present opportunities for abnormal returns, returns on other weekdays often conform to the null hypothesis of no day-of-the-week effect, suggesting that the Indian stock market may not efficient during observation period.

LIMITATIONS AND FURTHER SCOPE OF THE STUDY

The study exclusively examines the Nifty 50 index over a 12-year period, hence limiting its market breadth and the variety of calendar anomalies analysed. Subsequent study may broaden this approach to encompass various indices, sector-specific equities, or even international comparisons to yield a more thorough comprehension of calendar effects. Furthermore, the integration of sophisticated econometric models, such as GARCH variants, might provide enhanced understanding of the volatility dynamics linked to day-of-the-week impacts.

CONCLUSION AND POLICY IMPLICATION

This study examined the day-of-the-week (DOW) effect in the Indian stock market by analysing daily closing prices of the Nifty 50 index from April 1, 2012, to March 31, 2024. Both the Student's t-test and Ordinary Least Squares (OLS) regression were employed to identify potential anomalies in returns across different weekdays. The results consistently indicated that Tuesday exhibits a statistically significant positive effect on returns, while other weekdays showed no meaningful impact. These findings suggest that the Indian stock market demonstrates signs of the day-of-the-week anomaly during the

sample period, providing potential opportunities for investors to earn abnormal gains through strategic trading. The identification of this anomaly challenges the weak-form Efficient Market Hypothesis (EMH), highlighting that markets may not always fully incorporate all available information into stock prices. For investors, this implies that careful timing of trades particularly around Tuesdays could enhance returns. For policymakers and regulators, the findings offer valuable insights into market behavior, potentially aiding in the formulation of more effective market oversight and trading regulations.

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OPTIMAL FINANCIAL PLANNING TACTICS AND EFFECTIVE ASSET OVERSIGHT

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ABSTRACT

The purpose of this research is to analyze and comprehend the investment tactics and preferences of investors, their knowledge about the products and services offered by the company, and how to effectively manage their wealth for long-term financial success. The current fluctuations in the economy have made it challenging for average individuals or inexperienced investors to make sound investment decisions and safeguard their finances against potential crises. An investment strategy serves as a roadmap for investors to select the most suitable investment portfolio that aligns with their financial objectives over a specific time frame. By growing personal wealth through strategic investments, individuals can contribute to overall economic growth and prosperity. Different types of investments offer various advantages for both the investor, businesses, and society as a whole.

KEYWORDS: Financial planning, asset management, personal finance, investment strategy, financial literacy

INTRODUCTION

In developing countries with high levels of debt, such as India, a key factor for economic growth is the revitalization of private investment. In recent years, there has been a noticeable increase in understanding investors' behaviors through research. Many individuals in our country have the knowledge to earn money, but lack the skills to effectively invest and manage their wealth. This often leads to financial crises during critical times, causing regret for not making better choices. Financial literacy plays a crucial role in helping investors grasp financial concepts, products, markets, and risks. Investing wisely is a top priority for individual investors, as their savings today will fund their expenses tomorrow. The financial services sector now offers a wide array of investment opportunities, allowing investors to grow their personal wealth with strategic planning. By making informed investment decisions and creating financial plans, investors can not only increase their wealth but also contribute to overall economic growth. The field of wealth management revolves around catering to clients with distinct short and long-term investment objectives and financial needs. It is crucial for these clients to feel appreciated and distinctive, as they place immense value on exceptional investment performance. Investment plays a significant role as a macroeconomic factor, with its fluctuations dependent on the volatility of output and income. Many economists associate high levels of investment with sustained economic growth over time. In today's economic landscape, individuals are increasingly prioritizing investing as a means to secure their financial future, recognizing its significance in both current lifestyle choices and long-term sustainability

LITERATURE REVIEW

PwC "Asset & Wealth Management Corporate Governance Survey 2023" This study speaks directly to asset oversight: it highlights governance, board competencies, committee structures, and oversight practices in asset/wealth management firms. For your topic, this shows that "effective asset oversight" depends not just on asset allocation but also on governance and oversight structure.

Valuation oversight in the spotlight: scaling new heights in the alternative asset management industry" (EY-Parthenon, Jul 2023. The paper discusses the rapid growth of alternative assets (expected to exceed US $23 trillion by 2026), the increasing complexity of valuations, and how valuation/oversight professionals face operational adaptation challenges.

The Impact of Audit Oversight Quality on the Financial Performance of U.S. Firms: A Subjective Assessment" (2024).This empirical study examines how audit committee oversight quality (as a proxy for oversight/monitoring) relates to firm financial performance. Stronger oversight links to better performance.

Dynamic Portfolio Optimization with Machine Learning Techniques," Journal of Financial Economics, 2022. Has contributed on Merton's continuous-time portfolio choice models and their recent extensions.

Behavioral Biases in Financial Planning: A Review," Journal of Behavioral Finance, 2021 have explored the behavioral finance impacts on financial planning, addressing how cognitive biases affect optimal decision-making.

AI-Driven Asset Allocation: A Survey of Methods and Applications," Expert Systems with Applications, 2022. In this journal articles on algorithmic and AI-driven financial planning tools that optimize asset allocation and risk management have been discussed.

In a study conducted by Gnana Desigan C in 2006, the focus was on understanding how female investors perceive different investment opportunities. It was found that women investors have a unique approach to investing compared to men. Interestingly, the age of women investors does not necessarily determine their knowledge about various investment options. Similarly, the level of education among women also does not influence their investment choices.

On the other hand, according to Jamshidinavid, Chavoshani, and Amiri (2012), investors' preferences are influenced by a variety of factors including age, gender, income, and education. These factors play a crucial role in shaping their investment decisions. The research also explores how individual investors' personal characteristics and certain demographic variables impact their investment choices.

In the study by Dharamsi (2010), various investment strategies were explored, highlighting the increasing popularity of mutual funds as a favored investment option among individuals. This surge in popularity can be attributed to the efforts of the Association of Mutual Funds in India (AMFI) in raising awareness through educational programs. Not only have these initiatives helped in enhancing understanding about investing in mutual funds, but they have also promoted them as efficient tax-saving tools.

On a related note, Totala (2016) conducted a thorough examination of different investment instruments to assist salaried individuals in making informed decisions based on factors such as revenue potential, risk levels, maturity periods, portfolio

assets, salaries, return security, and safety. The findings emphasized the importance of tailor-made investment strategies to align with the diverse needs and preferences of individual investors.

Moreover, Vaidehi and Vijayakumar's study in 2016 affirmed the existence of varied investor preferences when considering investment opportunities across different avenues. The research stressed the significance of analyzing the investment patterns of individuals to gain deeper insights into their behavior towards market fluctuations. This insight can help in devising customized approaches that cater to the unique requirements of different investors.

OBJECTIVE OF STUDY

The objective of the study is

- To Discover the top investment choices favoured by novice investors in India.
- Analyze the factors that shape investment decisions of inexperienced investors.
- Investigate how different factors influence the investment strategies of new investors in India.
- Study and analyze the reasons behind saving and investment patterns among investors.

RESEARCH METHODOLOGY

The research methodology selected for this study is descriptive research, aiming to gather in-depth and precise data. The study included 200 participants, who were selected through a structured questionnaire distributed via Google Forms in various cities. A method used to gather data involved sending a Google form with a structured questionnaire to investors. The instruments used for the project were questionnaires, and the analysis technique employed was the Chi Square test.

Data Collection

The survey involved 200 participants selected through random sampling. Primary data was gathered from a diverse range of individuals, including entrepreneurs, students, housewives, working professionals, retired individuals, businessmen, businesswomen, and more. Independent respondents were also approached for their input. Information gathered from secondary sources comprises a wide range of academic literature pertaining to the specific area of study.

DATA ANALYSIS AND INTERPRETATION

The following tables displays the Frequency Distribution of Demographic Attributes for the participants.

Table.1 Gender of Investor

		Percent	Cumulative Percent
Valid	Female	40	40
	Male	60	100.0
	Total	100.0	

Table.2 Age of Investor

		Percent	Cumulative Percent
Valid	18 to 29 years	35	35
	30 to 41 years	15	50.0
	42 to 53 years	27	77
	54 years and above	23	100.0
	Total	100.0	

Table. 3 Education Qualification of Investor

		Percent	Cumulative Percent
Valid	High School	19.0	19.0
	Non Graduate	17	36
	Graduate	52.0	88
	Post Graduate	12	100.0
	Total	100.0	

Table.4 Annual Income of Investor

		Percent	Cumulative Percent
Valid	Up to Rs. 150000	22.0	22.0
	Rs 150001 to Rs 300000	13.5	35.5
	Rs 300001 to Rs 500000	31.5	67.0
	Above Rs 500001	33.0	100.0
	Total	100.0	

Interpretation:

A demographic analysis reveals that male participants make up 60.5% of the total, while female participants account for 40%. The largest portion of respondents, amounting to 35%, fall within the 18-29 age bracket. Following closely behind are respondents in the 30-41 age group, comprising 15% of the total. Those in the 42-53 age bracket make up 27 % of the respondents. 23 % of the participants are aged 58 years and older. It is noteworthy that a significant portion of the respondents, equalling 19%, are students. Businessmen and businesswomen represent 22%, followed by salaried workers at 21.5%, housewives at 18.5%, and retired individuals at 14%.

Table 5: NORMALITY TEST

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Bank Fixed Deposits	.255	200	.000	.812	200	.000

Post Office Savings	.231	200	.000	.871	200	.000
Mutual Funds	.213	200	.000	.890	200	.000
Life Insurance	.221	200	.000	.885	200	.000
Equity Share Market	.215	200	.000	.905	200	.000
Commodity Market	.239	200	.000	.893	200	.000
Real Estate(Property)	.191	200	.000	.914	200	.000
Gold/Silver	.223	200	.000	.888	200	.000
Crypto Currency	.207	200	.000	.897	200	.000
a. Lilliefors Significance Correction						

(Source data: Research Data)

Table.6 Reliability Statistics

Reliability Statistics	
Cronbach's Alpha	N of Items
.792	9

(Source: Primary Data)

Interpretation:

After analyzing the Normality table, it is evident that the P values for all components are below 0.05. This suggests that the Null Hypothesis should be rejected as they are not normally distributed. Consequently, it is necessary to utilize a Non-Parametric approach for further inferential statistical analysis regarding the level of importance of investment avenues for Investors demography profile towards investors preference.

Reliability Test:

The most frequently utilized test to assess the reliability of responses obtained from various Likert scale questions is known as the test of internal consistency. It is generally considered acceptable if the value exceeds 0.7.

After analyzing the data presented in the table, it was found that the overall reliability of the 9 factors was 0.792 based on the examination of all 200 responses. This indicates that each individual item is reliable.

Chi-Square Test

When conducting the Chi-Square Test for Inferential Analysis,

The null hypothesis (H0) states that there is no significant relationship among the variables. If the 'p' value is greater than 0.5, it is not statistically significant and therefore the null hypothesis will be rejected. This implies that there is no significant association between the variables.

On the other hand, the alternative hypothesis (H1) suggests that there is a significant relationship among the variables. If the 'p' value is less than 0.5, it indicates statistical significance and the alternative hypothesis will be accepted. This implies

that there is indeed a significant association between the variables.

In this scenario, the Chi-square P value/Likelihood ratio (0.027) is found to be lower than the alpha value of 0.05. As a result, the null hypothesis (H0) is rejected. This implies that the percentage of respondent's savings for investment correlates with the annual income of the respondent.

There is no significant relationship between the occupation of the respondent and their preferred time period for investment, according to the null hypothesis. Conversely, the alternative hypothesis suggests that the occupation of the respondent does influence their preferred time period for investment.

Table.7 Annual Income and savings

		What percentage of your savings do you invest in Mutual Funds?				
		Up to 25%	25%-50%	50%-75%	More than 75%	Total
Annual Income (INR)	Up to Rs. 150000	6	1	10	5	22
	Rs 150001 to Rs 300000	38	37	11	6	92
	Rs 300001 to Rs 500000	26	14	5	2	47
	Above Rs 500001	20	12	4	3	
Total		90	64	30	16	200

Table.8 Chi-Square Test

	Value	**df**	**Asymptotic Significance(2-sided)**
Pearson Chi-Square	19.000[a]	3	0.026
Likelihood Ratio	23.080	3	**0.027**
N of Valid Cases	200		
Assumption: 1)20 cells(50%) have expected count less than5.The minimum expected countis.02.			

Table.9 Occupation and preferred time period for investment.

		preferred Time Period for investment			
		Short term (0-1 Years)	Medium term (1-5 Years)	Long term (More than	Total
Occupation	Salaried	13	17	16	46
	Businessman/women	14	4	30	48
	Student	15	13	12	40
	Housewives	9	7	10	26
	Retired	15	15	10	40

Total	66	56	78	200

Assumption: 10 cells(32.1%)have expected count less than 5.The minimum expected count is40.

Table.10 Chi-Square Test

	Value	df	Asymptotic Significance(2-sided)
PearsonChi-Square	6.050[a]	4	0.023
LikelihoodRatio	29.830	4	0.021

In this analysis, the Chi-square P-value/Likelihood ratio of 0.021 is lower than the alpha value of 0.05. Consequently, we reject the null hypothesis (H0). This suggests that the choice of Time Period for investment is influenced by the occupation of the respondent. The Chi-Square Test examines the percentage of respondent's savings allocated for investment in Mutual Fund and the consultation received from a Financial advisor prior to investing.

The Null Hypothesis (H0) states that there is no relationship between seeking advice from a financial advisor before investing in Mutual Fund and the percentage of savings for investment in Mutual Fund by the respondent. On the other hand, the Alternate Hypothesis (H1) posits that the consultation from a financial advisor is not dependent on the percentage of respondent's savings allocated for investment in Mutual Fund.

Table.11 respondent's savings for investment and the consultation received from a financial advisor before investing

		Do you have Financial Advisor ?		
		No	Yes	Total
How much of your income do you invest/save? (Approximately)	Up to 25%	43	47	90
	25% to 50%	19	30	49
	50% to 75%	16	26	42
	More than 75%	10	9	19
Total		88	112	200

Table.12 Chi-Square Test

	Value	**df**	**Asymptotic Significance(2-sided)**
PearsonChi-Square	3.983[a]	8	0.011
LikelihoodRatio	3.043	8	**0.015**
NofValidCases	200		

Assumption: 1)5cells(23%)have expected count less than 5.The minimum expected count is.15.

In this case, the Chi-square P-value/Likelihood ratio value of 0.015 is lower than the alpha value of 0.05. Therefore, the null hypothesis (H0) is rejected. This indicates that there is no dependence on the percentage of respondent's savings for investment when seeking consultation from a financial advisor before making an investment decision.

FINDINGS:

The primary focus of this project revolves around examining how investors perceive investment strategies and wealth management practices. A vast majority of investors rely on various sources such as online service providers, the Internet, recommendations from family and friends, financial planners, or advisors before making investment decisions. Factors such as safety, income generation, capital growth, and future utility are carefully assessed before committing to any investment opportunity. There is no dependence on the percentage of respondent's savings for investment when seeking consultation from a financial advisor before making an investment decision.

Limitations

The study may has a limited sample size and lack of diversity in participants, that affects the generalizability of the findings. Financial markets are inherently volatile, and tactics effective during the study period may not perform similarly under different market conditions. Changes in financial regulations during or after the study period could influence the applicability of the findings.

Managerial Implications

The results of this research give financial executives and managers data-driven information to make well-informed decisions regarding budgeting, resource allocation, and long-term financial planning. This enables better linking of organizational goals with financial strategies and make a strong Strategic Decision-Making. With the implementation of optimal financial planning strategies, managers can apply proactive risk identification and mitigation practices. This provides financial resiliency and stability, particularly during times of economic instability or market volatility. Effective asset monitoring promotes frequent review of asset performance, divesting underperforming investments, and redirecting resources effectively. This optimizes returns and enhances operational effectiveness. The systems support the assurance that financial activities are aligned with applicable regulations and internal controls. This minimizes the risk of legal disputes, audits, and reputational harm.

Practical Implications

Individuals will be able to apply the guidelines of the study to formulate definite financial objectives, prepare effective budgets, and practice disciplined saving and investment patterns, resulting in enhanced personal financial health. The research encourages long-term planning approaches that enable individuals and institutions to anticipate future financial requirements, for example, retirement or business growth, through systematic investment and savings schemes. Small and medium-sized businesses (SMEs) can gain from

uncomplicated and affordable financial planning models that enhance cash flow management, investment choices, and profitability. The study promotes utilization of financial management programs and software for real-time monitoring, forecasting, and reporting. This becomes easier and more efficient for both organizations and individuals.

Scope of the Study

This research is concerned with investigating and assessing the best financial planning strategies and the effective oversight mechanisms for assets with the view to offering a strategic guidance framework for individuals and organizations that want to enhance their financial well-being and long-term wealth viability. The study includes an in-depth study of financial planning strategies such as budgeting, savings, diversification of investments, tax planning, managing risks, retirement planning, and managing debt. It also includes asset supervision practices like asset diversification, management of portfolios, monitoring performance, and adhering to financial regulations. The research focus mainly on financial strategies which can be used in both personal finance and corporate finance, with a focus on the practice of maximizing returns and reducing risks. It will incorporate existing financial models, case studies, and ongoing industry practices to find out what 'optimal' in different economic conditions entails. The research leaves out highly complex financial products (e.g., hedge fund derivatives trading) and addresses instead conventional financial planning and asset management products employed by typical households, SMEs, and mid-level institutions. The aim of this research is to formulate actionable suggestions on how to attain financial objectives using properly designed planning and monitoring, bridging theoretical underpinnings and real-world applications.

CONCLUSION

By identifying optimal tactics, individuals and organizations can make more informed and strategic financial decisions, potentially leading to better resource allocation and increased financial stability. Effective asset oversight will help in monitoring and maintaining asset performance, reducing risks, and maximizing returns. The study provides frameworks to identify and moderate financial risks associated with asset management. Insights from the study advise the development of best practices and policies within financial institutions or corporate finance departments. The study also improves financial literacy frameworks and investor preparedness for future financial security. The main objective of this research is to examine the investment preferences of individual investors, their preferred strategies, risk tolerance, liquidity needs, and tax implications. The study also aims to uncover any behavioral biases that would influence their decision-making process. Moreover, it seeks to promote a culture of saving and investing among novice investors and encourage them to diversify their wealth in order to generate additional income and ensure financial security in the long run.

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OPTIMUM PORTFOLIO CONSTRUCTION OF SELECTED SECURITIES AND PREDICTION OF STOCK PRICE BASED ON ARIMA

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ABSTRACT

The current analysis focuses on the importance and economic performance of portfolio construction of selected BSE organisations. The BSE-listed companies being very popular and highly successful companies. Daily closing values of 10 companies from 5 sectors has been utilized for the study. Sharpe Single Index Model has been utilized for the portfolio and research qualified 9 scripts out of 10, the rejected scrip is Reliance Industries because as it is high risk oriented. Among the popularly adopted model for finding the economic indicators is ARIMA. For the proposed model, Future Lifestyle Fashion, the scrip which secured the first rank, time-series data of closing value is considered between 01st January 2024 to 1st December 2024, covering 248 observations. The ADF unit root test at original data was insignificant, data was transformed to stationarity by applying the first difference and finding that the ADF test was significant. ARIMA (1,0,1) model was systematically performed to attain the best-fitted model. The study confirmed that the ARIMA model predicts the future time series in the short run and would help the investors make timely investment decisions. The result of this analysis will help current and existing investment decision-makers, even research work, to spread their risk and to gain an excessive yield.

Keywords: Portfolio, Sharpe Single Index Model, ARIMA Modelling, Forecasting

INTRODUCTION

Portfolio is the series or the collection of a stocks which is held by an institutions or by a person. Portfolio holding is the component of the investment and risk reduction strategy which is known as diversification. Unsystematic risk can be reduced by owning a large number of securities. Portfolio that results in a combination of risk-return is such that under current and anticipated circumstances it generates maximum returns as possible. The main purpose of every rational investor is to increase the returns and minimize the risk. Diversification is the method adopted for reducing risk. The Optimal Portfolio is known in this way.

- While developing the investment portfolio two important variables to be considered:
- Asset allocation- how investments are distributed among various asset types and regions.
- Fund selection- the decision is made to select fund managers and funds to represent each of the chosen asset classes and sectors.

To develop an optimum portfolio of investments, we have to follow 5 essential steps through a conscious and accurate planning process.

- **Asset current financial situation and goals:** For future planning, it is necessary to be clear about the current situation of an investors, and where they want to be. The most important objectives of investors is to have a through evaluation of current asset, current liability, cash and investments.
- **Set the investment goals:** This focuses on the risk-return profile of the investors. The key in formulating the portfolio strategy that can yield the necessary returns at the acceptable level is depends on how much risk a recipient can bear and how much volatility an investor can withstand.
- **Determine the asset allocation:** An investor can develop an asset allocation through the risk return profile. The investors can allocate funds in a way that achieves optimal while targeting the expected returns through the selection from diverse asset classes and investment options.
- **Choose investment options:** Selection of individual investments is based on the asset allocation strategy parameters. The particular type of investment selection is based on the preference of the investor for active and passive management.
- **Monitoring, measuring and rebalance:** The management process starts after the execution of a portfolio plan. This includes investment monitoring and performance measurement of the portfolio relative to the nine benchmarks.

The current analysis focuses on the importance and economic performance of building a portfolio of selected BSE organisations. Single Index Model suggested by Sharpe is able to successfully accomplish the determination of the optimum portfolio within an asset class i.e., stocks. It assumes that changes in the stock value in a portfolio rely on a certain prevalent variable that is merely the index. The time-series Autoregressive Integrated Moving Average (ARIMA) model has been used to forecast social, political, economic, engineering, foreign exchange, stock, and other problems since it was initially proposed by Box and Jenkins in 1976. The ARIMA (p d q) model is churn of autoregressive (AR) and moving average (MA) models show that there is a relation between observed value and expected value and residuals respectively.

LITERATURE REVIEW

Application of ARIMA

Rahi et. al (2025), have conducted a comprehensive analysis of financial markets using ARIMA, linear regression model along with option chain data and other technical user interfaces. To check the accuracy of the model fit, accuracy metrics have been applied. The combined model explained 98.5% of the variance of stock/index prices.

Simge et. al (2024), attempted to develop a forecasting model for retirement investment fund of the S&P 500 basket in the aggressive risk category by using ARIMA. The previous four years data pertaining to retirement investment fund offered to customers by a pension company in Turkey was used for analysis. The first order differenced data series model consisting of one autoregressive term and five moving averages (1,1,5) were considered. The outcome came in handy for planning an efficiently managing high-yield retirement investment funds.

Boye P & Zigga (2020) developed a short-term stock exchange forecasting model using the Box-Jenkins approach. Monthly data from the Ghana Stock Exchange, spanning 2013 to 2018, was used to build the model. The forecast for the next six months indicated a positive trend for the Ghana Stock

Exchange.

The Box-Jenkins methodology was also employed by **Gupta et al. (2015)** to predict exchange rates in India. Using historical data, they applied the ARIMA model to predict patterns for various factors, which were then used to forecast future values. This process generated forecasts for the US dollar, Euro, Japanese Yen, and GBP.

Work related to Sharpe Single Index Model and Portfolio Construction

Debasish (2021), In their research have analysed how risk and return play a pivotal role in taking choices on investment by using, Sharpe Single Index model. **Sen et al. (2014)** They analysed the development and application of Single Index Model. The outcome of the research was that it is easier to use Sharpe Single Index model when compared to Markowitz's mean-variance Model. **Apurva (2014**), in her analysis showed the Sharpe directed the construction of optimal portfolio. The research demonstrates that cut-backs play a pivotal role in building the best portfolio. The outcome also conveyed that investors should monitor their portfolios continually, as the condition on the market continues to change, so that investors should revise their portfolios accordingly. **Shubashree (2017),** in their study considered treasury bills for 3 objectives relating to risk and return for 3 various holding period of 1,5,10. "Portfolio Selection" by **H. Markowitz (1952)** Markowitz's pioneering work laid the foundation for Modern Portfolio Theory (MPT), which introduced the concept of diversification as a strategy for optimizing portfolios. His mean-variance optimization approach remains crucial for constructing portfolios that effectively balance risk and return. This concept has been extensively applied to BSE securities to develop portfolios that maximize returns for a specified level of risk. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk" by **W. F. Sharpe (1964)**,Sharpe developed the Capital Asset Pricing Model (CAPM), providing a method to estimate an asset's expected return based on its systematic risk. The CAPM has been used to evaluate the risk-return profiles of BSE-listed securities, aiding in the creation of portfolios aligned with market equilibrium. **French, K. R., and Fama, E. F. (1992).** "The Cross-Section of Expected Stock Returns": Fama and French expanded the CAPM by introducing the Three-Factor Model, which includes size and value factors. This approach has enhanced the development of optimized portfolios by identifying new sources of return on BSE securities.

OBJECTIVES OF THE STUDY:

- To construct portfolio by utilising Sharpe Single Index Model in order to optimize the returns.
- Forecast the price of the top performing scrip, that has secured the first place by using ARIMA model.

METHODOLOGY:

This study is an Analytical Research, that incorporates quantitative data from Bombay Stock Exchange. The daily prices of the chosen 10 companies have been collected from January 2021 to June 2024. The time series data of the top performing company that is Future Lifestyle Fashion Limited has been considered for the ARIMA Model. The closing price has been taken from June 2024 to December 2024 and the stock price is predicted for the next five days.

ANALYSIS

Table 1: Table showing the rearranged returns

Sl No	STOCKS	REARRANGED RETURN	RANK
9	FUTURE LIFESTYLE FASHION LTD	17.66	1
3	ULTRATECHCEMENT LTD	17.22	2
8	LARSEN & TAUBRO LTD	14.11	3
1	MRPL	12.73	4
6	SUNPHARMACEUTICAL INDUSTRIES LTD	12.3	5
5	SANOFI INDIA LTD	9.88	6
4	ORIENT CEMENT LTD	8.21	7
7	NCC LTD	6.60	8
10	BATA INDIA LTD	5.13	9
2	RELIANCEINDUSTRIES LTD	1.4	10

Table depicts the ranking on the basis of excess of return to beta ratio.

TABLE-2: Table showing the calculated Cut-off Value:

STOCKS	EXCESS RETURN	BETA	UNSYSTEMMATIC RISK	(ri-rf)*β/σ2ei	∑(ri-rf)*β/σ2ei	β2/σ2ei	∑β2/σ2ei	C
FUTURE LIFESTYLE FASHION LTD	17.66	0.99	68.81	0.2537	0.2537	0.0142	0.0142	0.5148
ULTRATECH CEMENT LTD	17.22	0.28	65.99	0.0204	0.2740	0.0012	0.0154	0.5548
LARSEN & TAUBRO LTD	14.11	1.19	54.68	0.4098	0.6838	0.0259	0.0413	1.3155
MRPL	12.73	0.92	126.64	0.0734	0.7572	0.0067	0.0480	1.4382
SUN PHARMACEUTICAL INDUSTRIES LTD	12.3	0.24	37.85	0.0151	0.7723	0.0015	0.0495	1.4626
SANOFI INDIA LTD	9.88	1.26	52.98	0.2312	1.0034	0.0300	0.0795	1.7984
ORIENT CEMENT LTD	8.21	1.34	202.55	0.0554	1.0588	0.0089	0.0884	1.8679

NCC LTD	6.60	1.29	44.73	0.1903	1.2492	0.0372	0.1256	2.0680
BATA INDIA LTD	5.13	1.24	140.50	0.0416	1.2907	0.0109	0.1365	2.0988
RELIANCE INDUSTRIES LTD	1.4	1.45	58.04	0.0372	1.3280	0.0362	0.1727	2.0392

Source: Author's calculation

TABLE-3: Portfolio Construction

STOCKS	(ri-rf)/β	BETA	UNSYSTEMMATIC RISK	C	Zi	WEIGHT T (%)
FUTURE LIFESTYLE FASHION LTD	17.66	0.99	65.71	0.5148	0.226	23.409
ULTRATECH CEMENT LTD	17.22	0.28	52.54	0.5548	0.064	6.609
LARSEN & TAUBRO LTD	14.11	1.19	42.73	1.3155	0.299	30.924
MRPL	12.73	0.92	61.10	1.4382	0.065	6.681
SUN PHARMACEUTICAL INDUSTRIES LTD	12.3	0.24	66.09	1.4626	0.050	5.136
SANOFI INDIA LTD	9.8	1.26	37.85	1.7984	0.133	13.820
ORIENT CEMENT LTD	8.21	1.34	50.55	1.8679	0.027	2.844
NCC LTD	6.6	1.29	53.71	2.0680	0.087	9.023
BATA INDIA LTD	5.13	1.24	58.69	2.0988	0.015	1.555

Source: Author's calculation

The table 3 highlights composition of the portfolio consisting of nine stocks based on the cutoff value.

Table 4: Testing and Calculation of ARIMA Model for Future Lifestyle Fashions Limited

Testing with difference 1

Diff Data:	1	Autocorrelation		ADF Test		
time	*data*	*lag*	*acf*		criteria	none
1	0.05	1	0.188513		drift	no
2	-0.05	2	0.240444		trend	no
3	0.05	3	-0.04568		lag	10
4	-0.05	4	-0.03526		alpha	0.05
5	0	5	-0.11378			
6	0	6	-0.13907		tau-stat	-5.13326
7	0	7	-0.20144		tau-crit	-1.94214
8	-0.1	8	-0.10032		stationary	yes

Table 5: ARIMA Model Statistics

Model statistics			Phi roots	
index	*phi*	*theta*	*real*	*imag*
1	0.189264	0	5.283625	0
const	-0.00246	-0.00304		
			Theta roots	
	SSE	0.943022		
			real	*imag*
	p	1		
	q	0	Psi coefficients	
	d	1		
	res mean	1.84E-12	*index*	*psi*
	res s.d.	0.062041	0	1
	sqrt mse	0.062168	1	0.189264
	data mean	-9.5E-06	2	0.035821
	data s.d.	0.063181	3	0.00678
	size	246	4	0.001283
	LL	335.3128		
	AIC	-1364.74		
	BIC	-1357.73		
	AIC aug	-666.626		
	BIC aug	-659.615		

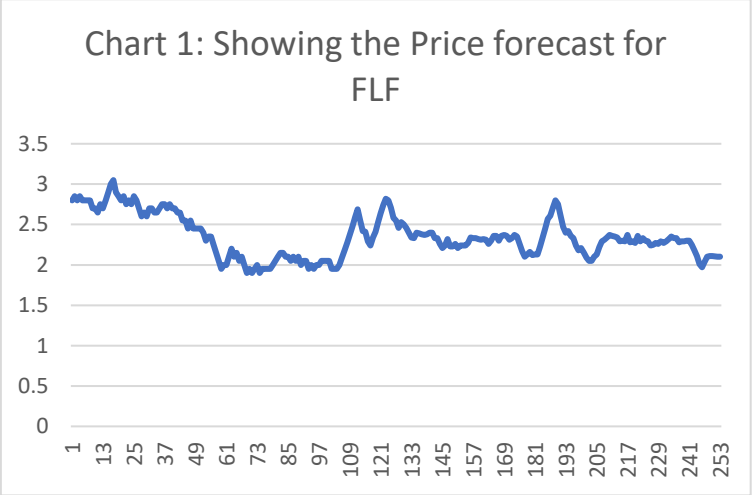
Table 6: ARIMA Model Parameters

param	*coeff*	*s.e.*	*t-stat*	*p-value*
const	-0.00246	0.003968	-0.62091	0.535235
phi 1	0.189264	0.0629	3.00896	0.002896

Table 7: Table Showing the forecasted Values

249	2.108892
250	2.108111
251	2.105499
252	2.10254
253	2.099516

Figure 1



Source: Author's computation

FINDINGS AND IMPLICATION OF THE STUDY

The analysis is focused on identifying the 5 sectors of BSE like Refineries, Cement & Construction materials, Pharmaceutical & Drugs, Engineering construction and retailing scrip's for optimum portfolio construction, analysing the closing price of 10 scrip's from July 2014 to May 2019 each month based on five years performance. The research qualified 9 scrip's out of 10 to construct the ideal portfolio and one scrip is rejected that is Reliance Industries because it is characterized by increased risk. Utilising these parameters, the investors can definitely arrive at informed solutions about the potential performance and reliability of various investment options. On the basis of the data, we can analyze that using the AIC (Akaike Information Criterion), MAPE (Mean Absolute Percentage Error), and R-squared values. Based on the output of ARIMA forecast it can be observed that the price of Future Lifestyle Fashions Limited

has shown an increasing trend. ARIMA output shows an increasing trend in the price of Future Lifestyle Fashions Limited. The AIC is a crucial parameter in model selection as it balances the model's goodness of fit with its complexity. MAPE, on the other hand, measures the correctness of the model's predictions by calculating the average-absolute % error amongst predicted and actual values. A lower MAPE value indicates more accurate predictions. R-squared is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model.

LIMITATIONS OF THE STUDY

The study has depended only secondary data whereas primary data could have provided deeper insights. The study period is limited to 5 years only; longitudinal study would yield more accurate conclusion. The number of sectors chosen is restricted to five and from those sectors, the count of companies chosen is ten companies, as a result of which the findings may not be generalized. The accuracy of the predicted values of ARIMA model has not been checked with the actual values.

CONCLUSION AND SCOPE FOR FURTHER RESEARCH

Sharpe Single Index Model is fine-tuned for opting the ideal stocks and constructing the optimum portfolio. The raw data analysis test for ARIMA indicated AR to be a better model compared to MA. ARIMA is a powerful tool for forecasting and providing ideal investment options among various funds. By leveraging historical data, it can capture the underlying patterns and trends in the time-series data, providing accurate predictions of future performance. When combined with evaluation parameters such as AIC, MAPE, and R-squared, investors can assess the model's fit, accuracy, and explanatory power.

The study is limited to 5 sectors; further research can cover the other sectors. The Time period chosen for the study is only five years, this is can be increased to conduct a detailed longitudinal study. Three factor model proposed by Fama and French can be considered for portfolio evaluation and construction. Forecasting financial market movements is a vital task and always helps investors, policymakers, and other stakeholders to make financial decisions.

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THEORETICAL FRAMEWORK OF CONVENTIONAL FINANCE, BEHAVIOURAL FINANCE, AND ROBO-ADVISORS: INSIGHTS INTO INVESTMENT DECISION-MAKING

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ABSTRACT

The key objective of this theoretical paper is to highlight the theoretical underpinnings of conventional finance, behavioural finance and robo-advisors in the context of investment decision-making. This article first assesses the value of conventional finance theories, determining scenarios where they may no longer be sufficient. Secondly, Behavioural finance theories confirm the existence of biases, their psychological foundations, and their effects on investment decision-making in stock markets. Furthermore, this paper provides an overview of robo-advisors in wealth management and advising services. The findings of this study symbolised the assistance of behavioural finance theories in addressing the gap between conventional finance and actual market truths. Additionally, the results also offer a deeper understanding of robo-advisors' ability to reduce behavioural biases by supporting investors' decisions and risk tolerance. Therefore, this article makes a theoretical contribution to the domains of conventional finance, behavioural finance and robo-advisors by exploring their impact on investment decision-making. Hence, the study will be helpful for financial institutions, practitioners, wealth-management companies, financial technological companies, stock brokers, investors, regulators, policymakers, researchers and academicians in the development of a more comprehensive model in these areas by increasing awareness to improve their investment decision-making and strategies.

Keywords: Conventional finance; Behavioural finance; Robo-Advisors; Investment decision-making; Theoretical underpinnings; Investor behaviour.

INTRODUCTION

According to conventional finance theories, investors make rational investment decisions and stock markets are efficient (Quaicoe & Eleke-Aboagye, 2021). The belief of most conventional finance theories is that every investor secures all accessible details and employs them to make rational investment decisions (Ritika & Kishor, 2022; Shaheen et al., 2023a). This theory was considered the basis for investment decision-making (Copur, 2015a). However, practical experience has indicated that investors do not constantly make rational investment decisions (Ritika & Kishor, 2022). As an outcome, well-studied and highly recognised conventional finance offers a path to a new and fascinating subject called behavioural finance (Quaicoe & Eleke-Aboagye, 2021).

The domains of psychology, sociology and finance offer insights into why investment decisions frequently deviate from a rational approach. These domains constitute the solid foundation of behavioural finance (Ritika & Kishor, 2022; Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018; Shah & Butt, 2024). It inspects how investors behave and how they apply financial information to make informed investment decisions on stock markets (Copur, 2015b). The behaviours of investors influence market and asset pricing movements. Consequently, it is essential to absorb investor behaviour (Shaheen et al., 2023a). Psychological research has recognised a range of investment decision-making behaviours known as biases (Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018). Various cognitive ("how investors think") and emotional ("how investors feel") biases affect investment decision-making (Ritika & Kishor, 2022). Although all types of decision-making are subject to these biases, investment decisions are specifically affected (Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018). In addition, several demographic, social and economic elements impact investors' decision-making (Shaheen et al., 2023a). Therefore, investors in conventional finance are rational, while those in behavioural finance are irrational (Copur, 2015b).

Innovation plays a central role in the advancement of society and the overall economic success of a country through the evolution and renovation practices focused on superior and efficient systems (Bhatia et al., 2022). The routine of investors is surrounded by several technologies employed in decision-making (Shah & Butt, 2024). Because wealth managers are humans, there is a high probability that their instructions will be biased (Bhatia et al., 2022). Modern innovations, such as robo-advisors, help investors make decisions without human involvement. Robo-advisors provide investors with simple and fairly priced financial advice. It can intuitively evaluate the risk of financial assets and suggest investment portfolios to investors based on statistical standards and machine learning algorithms (Xia et al., 2023a). Additionally, robo-advisors manage investors' cognitive and emotional states and assist them in investment decision-making by confirming detailed sources with transparent guidelines. However, as robo-advisors are machines, they help investors resolve behavioural biases adequately (Bhatia et al., 2022).

Rationale of the Study

It is significant to conduct a theoretical framework study because it provides a disciplined foundation for grasping and analysing sophisticated ideas or situations in a particular realm. It presents clarity into current knowledge gaps and assists in handling research by highlighting the critical theories and models. Additionally, a solid theoretical groundwork strengthens the area's validity and reliability. This served as an inspiration for our research, which endeavours to reconsider the efforts made by conventional finance, behavioural finance, and robo-advisory theories in the recognition of investors' investment decision-making processes. Various review studies have been carried out in the past to understand the notions of conventional finance and behavioural finance domains, which were further generated in narrower themes. However, our work has engaged conventional finance theories, behavioural finance theories that provide knowledge of previously unobserved elements, and robo-advisory theories to close the gap in the literature. In particular, the scope and depth

of the theoretical themes and principles addressed in this study differ. It offers the theoretical underpinnings of all three fields with respect to investment decision-making and discovers future research directions.

OBJECTIVES OF THE STUDY

RO1. To explore the theoretical underpinnings of conventional finance, behavioural finance and robo-advisors concerning investment decision-making.

RO2. To analyse conventional finance notions, behavioural biases influence investment decision-making and robo-advisor's assistance in minimising the biases.

Theoretical Framework of Conventional Finance

Conventional finance is rooted in unrealistic beliefs and in standards directing how ideal investors should behave in a given situation, not in standards explaining how real investors actually behave (Ahmad, 2024).

Foundation of Conventional Finance

In economics, the middle of the 18th century is viewed as the beginning of the classical phase. John Stuart Mill first presented the notion of a rational economic man, or homo economicus, in 1844. This person strives to enhance his/her economic well-being within the confines he/she faces (Copur, 2015b).

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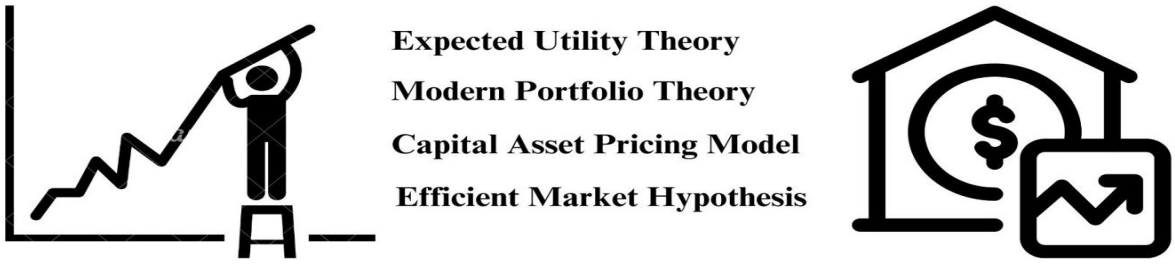
Perfect rationality, perfect self-interest and perfect information are the three premises regarded as the foundation of conventional finance (Copur, 2015b). In the 1960s and 1970s, the foundation of conventional finance was revised (S. U. Ahmed et al., 2022). Conventional finance is the field of expertise formed on the support of expected utility theory, the modern portfolio theory, the capital asset pricing model and efficient market hypothesis (Ahmad, 2024; Ogunlusi & Obademi, 2021). These theories have been developed over the past several decades with the aim of gaining a better understanding of financial markets that define investors as "rational" (Areiqat et al., 2019a).

Theoretical Underpinnings of Conventional Finance

According to conventional finance theories, a stock price perfectly conveys all knowledge, and the stock market is efficient (Almansour et al., 2023). The four theoretical underpinnings of conventional finance are illustrated in Figure 1, and investors use these theories to estimate stock values (Ahmad, 2021; S. U. Ahmed et al., 2022; Almansour & Arabyat, 2017a; Jain et al., 2019a; Khan et al., 2021a; Ogunlusi & Obademi, 2021; Zahera & Bansal, 2018)

Figure 1. Conventional finance theories.



Source: Author's own creation.

Expected Utility Theory

Rationality has two things: first, agents need to renew their current insights with the latest intelligence according to Bayes' law. Second, employing this intelligence, agents make decisions to maximise their expected utility (Copur, 2015b; Kapoor & Prosad, 2017; Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018). In this context, utility is considered to determine investors' satisfaction with the goods or services they use (Kapoor & Prosad, 2017). The expected utility theory proposed by Louise Sommer addresses how to select substitutions that have unpredictable outcomes (Zahera & Bansal, 2018). It states that market agents assess the expected utility values of several possibilities before making risky decisions (Kapoor & Prosad, 2017). Figure 2 classifies decision-makers into three clusters: risk-averse, risk-neutral and risk-loving. This explains that a risk-averse investor's utility function is concave. It indicates that the utility function of a risk-averse investor falls with a rise in expected wealth. In other words, risk-averse investors would prefer to select less risky investments than risk-loving investors for the same level of utility. This describes changes in investor behaviour related to risk tolerance. Hence, Savage states that this theory has been the foremost accepted theory for many years in the financial literature on investment decision-making under risk (Copur, 2015b).

Modern Portfolio Theory

Modern portfolio theory believes that investors face slight obstacles when making stock investment decisions, because they are more knowledgeable, reliable and cautious in nature (Areiqat et al., 2019a). Proponents of this theory believe that all available information should be valued as stocks (Mittal, 2022). According to Markowitz, investor desires and security markets are unpredictable and cannot be revealed in terms of choices (Zahera & Bansal, 2018). It is built upon the idea that investors react to new facts and update prices promptly according to the standard of authorised techniques (Ogunlusi & Obademi, 2021). This indicates that investors' obtained information has not been impacted by their behavioural biases and they are not confused by it (Areiqat et al., 2019a). Nevertheless, this theory assists stock investors in fulfilling their optimal portfolio positions and describes how the diversification lowers the risk (Copur, 2015b; Zahera & Bansal, 2018).

Capital Asset Pricing Model

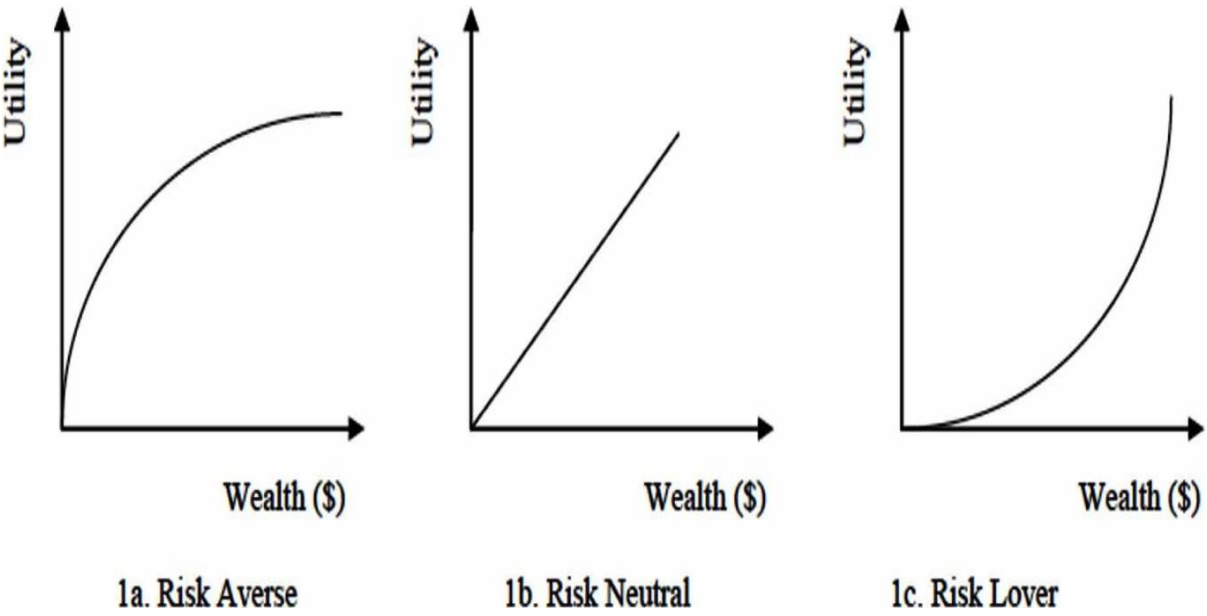
Markowitz's modern portfolio theory has established the foundation for one of the main asset pricing models in finance - the capital asset pricing model (CAPM) (Copur, 2015b) by Sharpe, which identifies the association between estimated asset return and systematic risk (Almansour & Arabyat, 2017a; Copur, 2015b; Ogunlusi & Obademi, 2021; Zahera & Bansal, 2018). This return is perceived as a benchmark return (Kapoor & Prosad, 2017). In addition, it facilitates investors in guessing by relying on the estimated return of securities that have not previously been traded on the stock market (Copur, 2015b). Therefore, the capital asset pricing model believes that investors make reliable and sophisticated investment decisions and are not impacted by behavioural biases (Quaicoe & Eleke-Aboagye, 2021).

Efficient Market Hypothesis

The efficient market hypothesis (EMH) theory was seen as a crucial framework for investment decision-making (Din et al., 2021a). According to Fama, the foundational theories of conventional finance maintain that markets are efficient (Ahmad, 2021; Almansour & Arabyat, 2017b; Khan et al., 2021b; Ogunlusi & Obademi, 2021). The

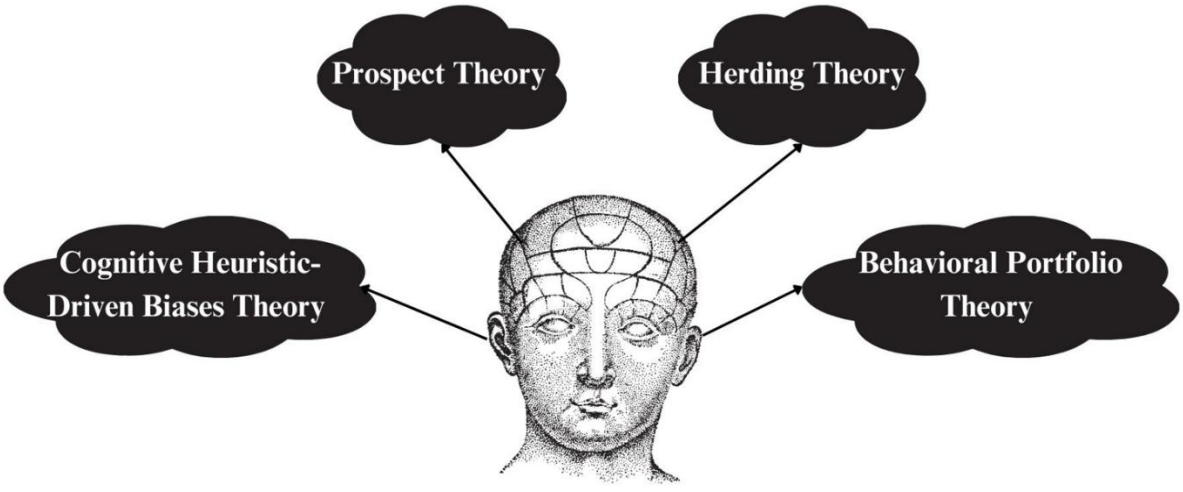
efficient market hypothesis states that stock markets are efficient and that stock prices integrate all available information (Ahmad, 2021; Khan et al., 2021b; Zahera & Bansal, 2018). It states that an investor's intelligence and information-processing abilities cannot offer abnormal returns that beat average market returns (Ahmad, 2024; Din et al., 2021a). As a result, a stock's actual price provides solid evidence of its intrinsic value (Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018).

Figure 2. Three clusters of risk attitudes under expected utility theory functions.



Source: Adopted from the study (Copur, 2015b).

Figure 3. Behavioural finance theories.



Behavioral Finance Theories

Source: Author's own creation.

THEORETICAL FRAMEWORK OF BEHAVIOURAL FINANCE

Behavioural finance is a recent approach to the study of financial markets that developed as an examination of the challenges encountered by conventional finance theories, because few financial events can be easily understood by employing theories where investors are not entirely rational (Valcanover et al., 2020).

Foundation of Behavioural Finance

Behavioural finance is a standard move from conventional finance (Jain et al., 2019b). Its growing realm challenges the assumptions of perfect rationality and market efficiency, evaluating investment decisions as an ongoing process that is affected by cognitive and emotional biases (Jain et al., 2019b; Khan et al., 2021b). It is fundamentally a study of psychology, sociology and finance. Therefore, its basic attention is on how investors' desires, beliefs and opinions influence their investment decision-making on financial markets (Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018).

In 1912, Selden published his book: "Psychology of the Stock Market", which was the initial push to join investment decisions to human behaviour. Herbert Simon published his theory of 'Bounded Rationality' in 1955, and Festinger implemented the theory of 'Cognitive Dissonance' in 1956. In 1964, Pratt addressed relating to 'Risk Aversion and the Utility Function' (Ahmad, 2024). The realm of behavioural finance was established in the 1970s with the publication of empirical studies by Kahneman and Tversky. They both published two articles in that decade: "Judgement under Uncertainty: Heuristics and Biases" in 1974 and "Prospect Theory: a study of Decision-making under Risk" in 1979 (Ahmad, 2024; Jain et al., 2019b; Valcanover et al., 2020). In 1980, Richard Thaler supported the prospect theory established by Kahneman and Tversky as the groundwork for an "Alternative Descriptive Theory" in his article "Towards a Positive Theory of Consumer Choice". De Bondt and Thaler released a major article: "Does the Stock Market Overreact?" in 1985. Besides, in 1994, Shefrin and Statman released "Behavioural Asset Pricing Theory" and "Behavioural Portfolio Theory" in 2000. In the same year, the publication of Andrei Shleifer's book, "Inefficient Market: an Introduction to Behavioural Finance", strengthened behavioural finance's status as a separate domain within finance and a substitute to conventional finance (Ahmad, 2024).

The behavioural scientists Richard Thaler, Amos Tversky and Daniel Kahneman are designated as the 'Fathers of Behavioural Finance' due to their major contributions to the realm (Ahmad, 2024; Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018). The two pioneers of this field are Daniel Kahneman and Vernon Smith, who obtained the Nobel Prize in Economics in October 2002 for their study in experimental economics and psychology for the scope of investment decision-making (Quaicoe & Eleke-Aboagye, 2021). In 2017, Richard Thaler also obtained the Nobel Prize in Economic Sciences. Therefore, the domain of behavioural finance has earned importance in research in recent years and has generated empirical studies supporting the irrationality and irregularity of investors' decision-making (Ahmad, 2024).

Theoretical Underpinnings of Behavioural Finance

In the stock market, behavioural finance unbinds the conventional financial notions (Rupinder Kaur Gill , Rubeena Bajwa & TJPRC, 2018). It is a subdivision of

sociology and psychology that emphasises the human aspects of decision-making (Copur, 2015b). Figure 3 displays the four theoretical underpinnings of behavioural finance. These theories are most often studied and have proved that stock market investors act irrationally (Khan et al., 2021b; Vuković & Pivac, 2024a).

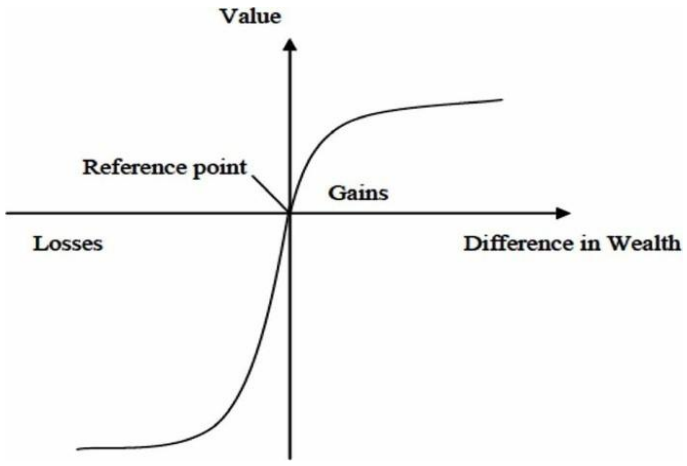
Cognitive Heuristic-Driven Biases Theory

The cognitive, heuristic-driven biases theory is one of the well-known theories in the realm of behavioural finance (Ogunlusi & Obademi, 2021). In 1974, Kahneman and Tversky proposed the notion of cognitive heuristics (Copur, 2015b; Jain et al., 2022), which are rules of thumb or mental shortcuts, when investors employ complicated and unstable conditions to make decisions smoothly, by minimising the complexity, assessing possibilities and estimating values to take easy decisions (Ahmad, 2021, 2024; Copur, 2015b; Rupinder Kaur Gill, Rubeena Bajwa & TJPRC, 2018). It generally impacts investment decision-making with the notion of "Past achievement is the best indicator of future achievement" (Antony & Joseph, 2017; Copur, 2015b). It is very supportive and productive when there is a time limit, but sometimes it may result in systematic errors that generate unexpected outcomes; these systematic errors are called cognitive, heuristic-driven biases (Almansour & Arabyat, 2017b; Khan et al., 2021b; Singh & Kumar, 2022).

Prospect Theory

In 1979, two esteemed psychologists, Kahneman and Tversky, published an article named "Prospect theory: An analysis of decision under risk". This article became prominent in the realm of behavioural finance, as the idea of prospect theory was launched (Zahera & Bansal, 2018). It outlines how investors behave when there is a possibility of profits and losses (Vuković & Pivac, 2024b). It has evolved as an alternate paradigm for the expected utility theory by employing decision significances indicating a role of probability (Copur, 2015b). Therefore, the value function of this theory is displayed in Figure 4.

Figure 4. The prospect theory's value function.



Source: Adopted from the study (Copur, 2015b).

The value function displayed in the above figure is S-shaped, moving through the reference point. It shows the truth that losses are more accurate than gains and upholds the notion that investors prevail over their losses. This function is also regarded as concave for gains and convex for losses. The outcomes are given in the explanation of the four-fold risk attitude pattern in investors, as given below (Copur, 2015b):

- Risk-taker interested in gains with low probability.
- Risk-avoider interested in gains with high probability.
- Risk-avoider interested in losses with low probability.
- Risk-taker interested in losses with high probability.

Herding Bias Theory

Behavioural finance theory establishes herding bias as among the predominant irrational behaviours (Peng et al., 2023). According to Devenow and Welch, herding bias means an association within an investor's behavioural propensities (Raut & Kumar, 2018). It is the habit of making investment decisions by replicating the supervision of other investors instead of employing one's own opinions (Sarwar & Afaf, 2016b; Vuković & Pivac, 2024b), because of investors' insecurity, limited knowledge and hesitation in handling information (Din et al., 2021b). This bias emerges from risk perception that impacts stock returns and frequently grows in times of high market volatility and instability (Almansour et al., 2023). Therefore, in the stock markets, this bias inclines investors to neglect related information that is impacted by others in investment decision-making. Investors incorporate this habit of replicating others to reduce time and effort when exploring for information, and not because other investors' decisions are excellent (S. U. Ahmed et al., 2022; Vuković & Pivac, 2024b).

Behavioural Portfolio Theory

Behavioural portfolio theory (BPT) was launched by Shefrin and Statman as an alternative to modern portfolio theory (Saivasan & Lokhande, 2022b). According to it, investors form their portfolios as per their own opinions, behaviour and judgements of the stock markets' output (Gavrilakis & Floros, 2022). Maslow's notion of the hierarchy of needs acts as an inspiration for the establishment of this theory (Saivasan & Lokhande, 2022b). Under BPT, investors develop their portfolios sequentially, like asset pyramids as displayed in Figure 5, with each sequence parallel to a definite goal and acceptable risk (Copur, 2015b). As an illustration, a root sequence of low-risk assets may be regarded to fulfil as "protection from poverty", despite a higher sequence of the riskier assets indicating "hopes for riches". Therefore, this theory highlights the purpose of behavioural inclinations in investors' portfolio selections (Gavrilakis & Floros, 2022).

Figure 5. The pyramid of portfolio assets under behavioural portfolio theory.

Source: Author's own creation.

THEORETICAL FRAMEWORK OF ROBO-ADVISORS

A robo-advisor is an algorithm-based service that delivers investment instructions to investors without human involvement (Nain et al., 2024).

Foundation of Robo-Advisors

Financial technology is currently in competition with conventional advising services (Hou et al., 2023). The 2008 global financial crisis was said to be an ideal scenario that gave rise to several financial technologies, comprising robo-advisors that disturbed conventional advising services, as investors began searching for alternative approaches to eliminate irrational decision-making in portfolio management (Nguyen et al., 2023). This technological development has moved essentially to each business firm and is presently taking root towards investment decision-making (Bhatia et al., 2020b). Robo-advisors are innovations of advising services that have made wealth management convenient. They employ machine learning algorithms to examine past data on investment goals, such as stocks and exchange-traded funds (Bhatia et al., 2022; Hou et al., 2023). Betterment and Wealthfront are the first robo-advisors, which originated in the United States in 2008 by Jon Stein (Belanche et al., 2023; Bhatia et al., 2022). From 2013 onwards, robo-advisory services made a major development in the stock markets (Shanmuganathan, 2020). Subsequently, they advanced to 4.0 and have been exceptional in the present world (Bhatia et al., 2022). Despite having been utilised for over a decade in developed countries, they have lately entered emerging countries (Bhatia et al., 2020b). Hence, they were operated as tools for investment analysis by several wealth management firms (Nain & Rajan, 2023).

Behavioural Finance in Robo-Advisors

Investors who have fears about possible disputes with human advisors might want to employ robo-advisors (Bhatia et al., 2020b). Behavioural finance theories have shown that behavioural biases impact investors' decision-making (Nain & Rajan, 2023). Behavioural biases are an arrangement of variations in investment decisions that take place in specific circumstances, which may lead investors to take up irrational decisions. Minimising these biases may be relatively easy once investors become aware of them. Robo-advisors assist investors ultimately to mitigate their behavioural biases in contrast to conventional advising services by wealth managers (Bhatia et al., 2020b). To effectively deal with behavioural biases in investment decision-making, robo-advisors enable investors to obtain a robust understanding of behavioural finance (Nain & Rajan, 2023).

Investment Decision-Making in Robo-Advisors

Investment decision-making is a way of choosing the perfect from the available options (Bhatia et al., 2020b). Robo-advisors are essential because they assist investors by offering them relevant information concerning investment decisions. They are provided as superior services by many financial institutions, mutual fund firms, fintech start-ups and banking institutions. Primarily, they follow investors' risk acceptance levels and assist them in making more efficient decisions. This technological approach assists new and young investors by providing sound investment advice. Therefore, the key advantage of robo-advisors lies in their effective allocation strategies, employing mathematical algorithms to enhance investment decision-making (Bhatia et al., 2022).

Comparison between Robo-Advisors and Conventional Advisors

Robo-advisors are outstanding compared to conventional advisors, who are human, with the possibility of biases in their advice (Bhatia et al., 2022). Robo-advisors assist investors in obtaining better investment advice through systematic calculations without human involvement (Hou et al., 2023). Therefore, Table 1 illustrates the services between robo-advisors and conventional advisors.

Application of Robo-Advisors

The Microsoft bots' system is the platform for robo-advisors connected with web chat functions. Through a web chat window, investors can engage with robo-advisors and obtain investment suggestions. Figure 6 displays a human-like avatar, employing personal pronouns like "I" and "me" and introducing itself as Charles. It is capable of replying to questions such as "How are you?" "What can you do?" and "How much is my Portfolio worth?" In addition, the investor asks questions like "Can you help me?" and "I need some advice" concerning a better investment option. Its advice regularly endorses investing in the portfolio with the highest value. If investors hold other portfolios with the lowest value, it also advises selling them. It determines which shares to purchase and sell based on the unified method aimed at enhancing profits. The advice matters, and how it is derived remains stable in both outcomes. Additionally, Figure 7 displays robo-advisors with and without social design elements. The one with social design elements has a name, interacts employing common language and provides investment suggestions through questions like "Can you help me?" and "What assets should I buy?" On the other hand, the robo-advisors without social design elements only permit investors to click a button to explore investment advice (Back et al., 2023a).

Table 1. Services between robo-advisors and conventional advisors.

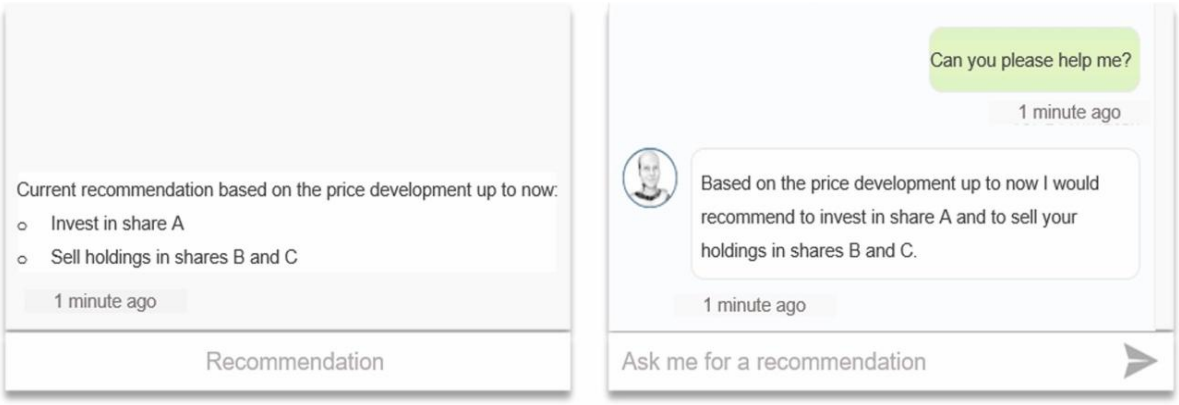
Services	**Robo-Advisors**	**Conventional Advisors**
Operational hours	24/7	Contingent upon the advisors' time
Minimum Investment	Small	Huge
Processing Fee	Less fee	More fee
Financial targets	AI-driven suggestions offered by algorithms	Advice delivered by financial experts
Human involvement	Highly neutralized	Distracting aspects, such as the likes or dislikes of the advisors
Service place and duration	Infinite	Finite

Source: Adopted from the study (Hou et al., 2023).

Figure 6. Users' interface with the experimental groups model, portfolio layout and price path.

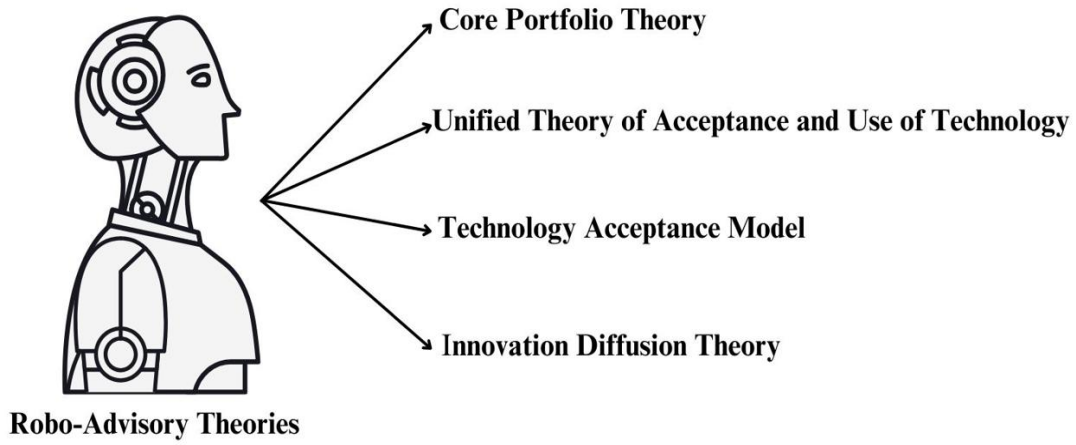
Source: Adopted from the study (Back et al., 2023b).

Figure 7. Robo-advisors and users interface with social design elements (right) and without social design elements (left).



Source: Adopted from the study (Back et al., 2023a).

Figure 8. Robo-advisory theories.



Source: Author's own creation.

Challenges of Adopting Robo-Advisors in Developing Markets

Employing robo-advisors for investment decisions in developing markets faces various complications. First, insufficient financial literacy and mindfulness can lead to mistrust of computerised financial services. Many investors in developing markets still depend on conventional face-to-face conversations with financial advisors or analysts, which may make it complex to shift toward a technological, robotic model. Besides, low internet penetration and poor facilities in a few regions restrict access to robo-advisory systems. Regulatory frameworks also occur, as many developing markets lack proper frameworks for automated financial services, possibly complicating compliance. Also, cultural elements can cause contradiction to completely technological systems, such as a desire for expertized advice and a need for social or family networks for investment decisions. Lastly, the instability and distinct risks associated with developing markets, such as political unpredictability or changes in currencies, generate further problems that robo-advisors may struggle to manage without local adaptations (D'Acunto et al., 2019).

Theoretical Underpinnings of Robo-Advisors

The modern portfolio theory, which has been formed on the outstanding portfolios for a specific investor's risk acceptance, is the foundation of most of the robo-advisors' theories in today's artificial intelligence-driven technological realm (Shanmuganathan, 2020). The four theoretical underpinnings of robo-advisors are shown in Figure 8. These theories play an essential role in venturing towards the technological elements concerning robo-advisors in investment decisions (Yeh et al., 2023).

Core Portfolio Theory

Markowitz's portfolio theory is the origin of the core portfolio theory employed in robo-advisors' wealth management. This theory explains how robo-advisors can provide the highest rate of return for investors at an optimal risk (Xia et al., 2023b).

Unified Theory of Acceptance and Use of Technology

The unified theory of acceptance and use of technology (UTAUT) targets the adoption of users' plans for implementing information system and their usage behaviour, by combining recent innovations (Yeh et al., 2023). The Theory of Planned Behaviour (TPB), the Theory of Reasoned Action (TRA), the Model of PC Utilisation (MPCU), the Technology Acceptance Model (TAM), the Combined form of TAM and TPB (C-TAM-TPB), the Motivational Model (MM), the Innovation Diffusion Theory (IDT) and the Social Cognitive Theory (SCT) are the special features of the oldest theories and models that makeup UTAUT, a unified theory on technology acceptance. The implementation of distinct technologies in between organisational and non-organisational situations has been examined all over the periods by researchers employing UTAUT as a foundation framework (Nain et al., 2024). As per this theory, effort expectancy means the degree of simplicity connected to the application of technology. Effort expectancy is interconnected with performance expectancy because users observe the technology as having increased significance when it is easier to employ. Hence, the incorporation of an innovation can be significantly influenced by the user interfaces, designs and aspects that affect user accessibility (Nguyen et al., 2023).

Technology Acceptance Model

The technology acceptance model (TAM) was built upon by the UTAUT theory, to better understand integral components that impact users' determined behaviour in implementing recent technologies and the ability to interpret. It extends the range of the conventional theories of behavioural intention (Yeh et al., 2023).

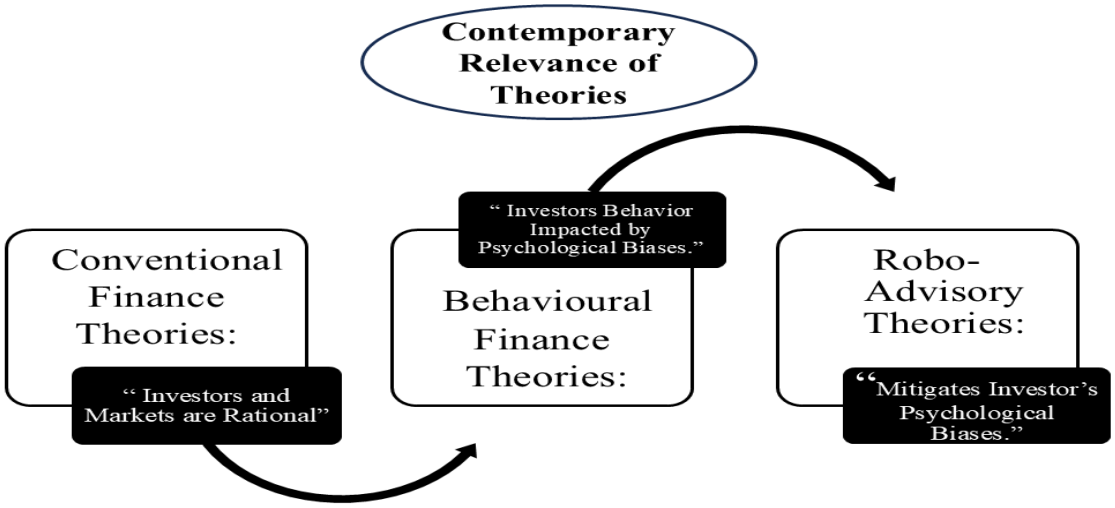
Innovation Diffusion Theory

Innovation diffusion theory (IDT), as proposed by Rogers, indicates that a technology that is noticed as more excellent than the modern approaches has a greater opportunity of gaining ground, either economically or subjectively. Hence, investors are inclined to accept an innovation that furnishes large, comparative benefits (Nguyen et al., 2023).

Theoretical Framework for Integrating Conventional Finance, Behavioural Finance and Robo-Advisors in Investment Decision-Making

Conventional finance is based on traditional investment techniques that are based on rational investment decisions and market theories. In addition, behavioural finance challenges this by involving cognitive insights, identifying that investors frequently make irrational investment decisions impacted by cognitive and emotional biases. Both approaches are merged by robo-advisors, which employ machine-learning algorithm-driven tools to furnish computerised, less costly financial advice while considering behavioural trends to enhance portfolios. These systems provide designed, data-supported investing techniques that correspond to both logical and illogical investor propensities by integrating the competence of conventional finance with behavioural notions. As a result, by emphasising the connections between the thoughts from the three distinct domains, this study provides an integrated theoretical model that has contemporary relevance. As shown in Figure 9, the theoretical model serves as a foundation for future empirical studies in the realm of investment decision-making.

Figure 9. Integrated theoretical model of conventional finance, behavioural finance and robo-advisors.



Source: Authors' own creation.

RESULTS

Extensively, conventional finance theories were reflected as the absolute descriptions of investor and market behaviour. On the other hand, researchers have newly identified that under actual market conditions, these theories are shattered. Investors now accept that these theories are based on basic assumptions. The framework is built on how investors are thought to behave instead of how they behave in reality. This sheds light on the development of behavioural finance theories that account for investors' biases and irrationalities in the settings of uncertain financial markets. The assumption of irrationality fills the place of rationality in behavioural finance. As an outcome, the behavioural finance theories are critical in analysing stock markets, the justifications supporting them and the ways in which behavioural biases impact investors' proficiency to make investment decisions. Almost everything is computerised in today's high-speed, digital world. The employment of robo-advisors in investment decision-making is flourishing. It assists in the minimisation of behavioural biases that impact investors' decisions. Robo-advisors have been enabled by the theoretical and technological upgrades in the financial services realm. Hence, this theoretical paper provides an exhaustive overview of psychological standards and their applications to finance and has discovered modern perspectives and innovations in investment decision-making on financial markets and institutions. Table 2 presents an overall summary of areas concerning their theoretical and empirical assumptions.

Table 2. Summary of the theories and literature review.

Areas	Theoretical Assumptions	Empirical Assumptions
1. Conventional Finance Theories		
Expected Utility Theory	Agents are in the essence of perfect rationality, perfect self-interest, and perfect information.	Marketers make investment decisions under risk by assessing the expected utility values of several possibilities.
Modern Portfolio Theory	This theory offers the law of one price, in line with the prices that fully show all available information.	To mitigate risk, investors either continue under-diversified portfolios or trade regularly without considering transaction costs, taxes, and other hidden expenses.

Capital Asset Pricing Model	Investors in capital asset exchanges make various critical decisions, such as whether to enhance their wealth or minimise their risk exposure.	The CAPM computes the expected returns of securities at a specific moment in time, but it fails to record those returns over a lengthy timeframe, which could describe stock market bubbles.
Efficient Market Hypothesis	In financial markets, irrational investors are countered by rational arbitrageurs.	Market efficiencies divide the old information into three groups: weak, semi-strong and strong.
2. Behavioural Finance Theories		
Cognitive Heuristic-Driven Biases Theory	Cognitive heuristics-driven biases are employed by investors to accomplish easier decision-making in a limited time.	Investors' short- and long-term investment decisions are influenced by these biases, which lead them to make irrational decisions.
Prospect Theory	Investors are inclined to take risks at the time of particular gains rather than the losses; hence, it indicates that losses have a high emotional impact on investors compared to gains.	Prospect theory describes the irregularity in investor behaviour when estimating risk under uncertainty.
Herding Theory	Herding bias occurs when investors' own information is suppressed by the impact of others' information concerning investment decisions.	Herding bias has an intense connection with risk and return that directs investors to irrationality.
Behavioural Portfolio Theory	Under behavioural portfolio theory, investors develop their portfolios sequentially, such as asset pyramids in relation to goals and risks.	As investors climb the investment pyramid, their risk outlook motivates them to distribute more funds to riskier assets.
3. Robo-Advisory Theories		
Core Portfolio Theory	Core portfolio theory employs modern portfolio theory standards to adjust distributions based on investor choices and stock market conditions.	Previous market behaviour is a constant measure for future investment decision-making,

		which is primary to the robo-advisor's algorithms.
Unified Theory of Acceptance and Use of Technology	Effort expectancy, performance expectancy, social impact, and favourable conditions are some elements that influence the acceptance and employment of robo-advisors.	Perceived ease of use and observed usefulness instantly impact investors' intention to accept and always employ robo-advisors.
Technology Acceptance Model	If investors trust that robo-advisors are simple to use and helpful for handling investments, they are more likely to adopt and continue employing them.	The willingness of investors to rely on robo-advisors is positively associated with perceived usefulness and simplicity of use.
Innovation Diffusion Theory	The incorporation of robo-advisors is impacted by elements such as relative advantage, complication, compatibility, feasibility, and transparency.	Robo-Advisors are highly impacted by the perceived relative advantage and consistency with their current financial behaviours, which will accelerate to faster diffusion of the technology in the stock market.

Source: Authors' own creation.

Critiques of Conventional Notions and Limitations of Robo-Advisors on Behavioural Biases in Investment Decision-Making

Conventional finance, behavioural finance, and robo-advisors each face diverse but interrelated problems. Conventional finance depends heavily on market efficiency and logical decision-making, yet it struggles with the real-world intricacy of illogical behaviours, such as those recognised by behavioural finance. Behavioural finance brings attention to the cognitive biases that impact investor behaviour, making it difficult for experts and investors to arrive at appropriate investment decisions. However, this theory's overgeneralization did not provide a path to mitigate investor behavioural biases, which are generally ignored to take into consideration the difficulty of social elements, human emotions or active decision-making over the years. Consequently, this enriches the establishment of robo-advisory theories in the process of investment decisions. Robo-advisors, while developed to minimise some biases through machine-learning algorithms, can still underperform in addressing the sophisticated behavioural biases that impact investors. When decisions cannot be adequately anticipated or clarified by behavioural finance. It is possible that robo-advisors cannot accurately adjust their techniques. Furthermore, performance and

automated decision-making are constantly given importance over investor understanding in robo-advisors, which can result in an absence of insights for cognitive elements like stress, fear, or personal beliefs. Because investors may feel disinterested or unhappy with algorithmic systems that do not entirely understand or cater to their specific behavioural features, these limitations may prevent robo-advisors from becoming widely employed. Moreover, all three domains have to cope with the rapid trend of technical advancements, the unreliability of world markets, and regulatory ambiguity, all of which can decrease the impact of automated systems or conventional approaches. Although merging knowledge from all three areas can result in a wider approach, surpassing these barriers to furnish financial services that are highly flexible, personalised, and successful is the challenging aspect.

CONCLUSION

This theoretical paper covered the theoretical underpinnings of conventional finance, behavioural finance and robo-advisors in investment decision-making. It addressed several conventional finance theories, such as the expected utility theory, the modern portfolio theory, the capital asset pricing model and the efficient market hypothesis. These theories were grounded on a few underlying assumptions, factoring in the efficiency of the market and the rationality of investors. However, their relevance was doubted when these theories failed to offer satisfactory responses in real-world events. In addition, alternative theories gave rise to the realm of behavioural finance, stating that investors make biased decisions and are irrational. It furnished more practical theories, such as the cognitive heuristic-driven biases theory, the prospect theory, the herding theory and the behavioural portfolio theory. They caused potential shortcomings in the stock markets. Furthermore, the study established the role of robo-advisors in investment decision-making.

Robo-advisors are already familiar tools for automated financial planning. They employ technology and algorithms to serve impactful and personalised investment advice to investors. They cover the latest theories like the core portfolio theory, the unified theory of acceptance and the use of technology, the technology acceptance model and the innovation diffusion theory. This new service is projected to outcome in economies of scale since technology can help investors to minimise their behavioural biases and offer various investors without augmenting expenditure. Therefore, the theories of conventional, behavioural and robo-advisors have offered insights to investors in decision-making that is more natural and exhibits true depictions.

LIMITATIONS AND THE SCOPE FOR FUTURE RESEARCH DIRECTIONS

The material used in this research is drawn from previous literature in the field. Under the fundamentals of the TCCM framework, we categorised future research directions into theory, context, characteristics, and methodology. Table 3 assembles sample research questions for future research paths.

Aside from generating notable theoretical perspectives, a few shortcomings may be considered in future studies. This study's primary limitation is that it only explores the frameworks of a few selected theories based on the area's literature review. As such, the results are grounded on theoretical standpoints and assumptions that are prone to generalisation issues. To determine convergences and divergences, future researchers in the same domains can recreate

this model globally and with several theoretical components. Second, this study only used a limited number of major theories and selected theories from the field. Future research studies could incorporate more theories, such as conventional finance (Arbitrage Pricing Theory, Modigliani-Miller Theory, Dividend Discount Model), behavioural finance (Mental Accounting and Framing Theory, Endowment Effect Theory, Behavioural Asset Pricing Theory) and robo-advisors (Trust Transfer Theory, Innovation Resistance Theory, Network Effect Theory). As this work is theoretical in nature, methodology is not considered. However, it might be feasible to perform the same work in the future by using qualitative approaches with some case studies. Future studies may be able to incorporate a variety of biases, like herding bias, home bias, representativeness bias, overconfidence bias, availability bias, anchoring bias, conservatism bias, gambler's fallacy bias, emotional bias, mental accounting bias, framing bias, hindsight bias, and illusion of control bias, to investigate their impact on investment decisions for deeper insights. The role of robo-advisor advancement tools in mitigating the influence of behavioural biases on investment decision-making should therefore be examined by a theory-based quantitative approach. Plenty of studies have focused on developed countries, and strong surveys in emerging countries are quite essential.

Table 3. TCCM framework for future research paths on conventional finance, behavioural finance, and robo-advisors on investment decision-making.

SL No.	TCCM Component	Important Future Research Paths
1	Theory	• Studies should investigate Modern Portfolio Theory by combining it with artificial-intelligence-driven robo-advisory theories to enrich optimal portfolio diversification. • Studies should consider the Prospect Theory to model stock investor behaviour when engaging with robo-advisors. • Studies should identify new cognitive heuristic-driven biases that influence stock investors who rely on digital applications rather than human advisors.
2	Context	• Studies should outline the legal framework for conventional investment practices. • Studies should assess the cultural and religious factors that impact the exhibition of cognitive biases in investment decisions. • Studies should examine the evolutionary rate and trust level in robo-advisors across distinct socio-economic and demographic groups.

3	Characteristics	• Studies should determine the stock investor and advisor connections that develop over a long-term investment decision view. • Studies should find out whether the emotional conditions during market fluctuations influence real-time investment decision-making. • Studies should analyse the impact of robo-advisors on stock investor trust and involvement.
4	Methodology	• Studies should empirically investigate the impact of big data and robo-advisors on conventional finance theories using real-time stock market information. • Studies should employ eye-tracking and biometric data, such as EEG, to assess investment decision-making during stock investors' stress. • Studies should use experimental designs, such as portfolio testing of robo-advisor interfaces, and disclose advancements in investor experience.

Source: Authors' own creation.

IMPLICATIONS

This theoretical paper with updated horizons can be essential for financial institutions, financial practitioners, wealth management companies, financial technological companies, stock brokers, investors, regulators, policy-makers, academicians and researchers.

Managerial Implications

The study offers guidance to financial institutions on prevailing behavioural biases to handle their investors and give greater returns on their investments. Financial practitioners may supervise their investments by opting for specific stocks in the markets and acquiring knowledge from these theories. It also assists wealth management companies by offering a formal framework that enables them to meet the obligations of their investors. It mentors financial technological companies for better digital innovations in advisory services by establishing automated and high-tech preferences for their clients. It directs investors and stock brokers to mitigate the influence of biases on their investment decisions. It sheds light on regulators and policymakers to assess the stock effectiveness in the markets by forming policies, strategies, rules and regulations.

Theoretical Implications

Academicians and researchers can also gain updated theories and literature through this article. It enhances financial resilience and knowledge, saves money on behavioural failures, and opens up to investment advice. This study benefits the new scholars who are researching these combined domains in comprehending the role that they play in investment decision-making to further elaborate on the existing theories. Therefore, these theoretical frameworks offer an in-depth knowledge of the connection between human behaviour and technological investment strategies in investors' decision-making by combining theories from conventional finance, behavioural finance and robo-advisors for the advantage of several financial stakeholders.

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