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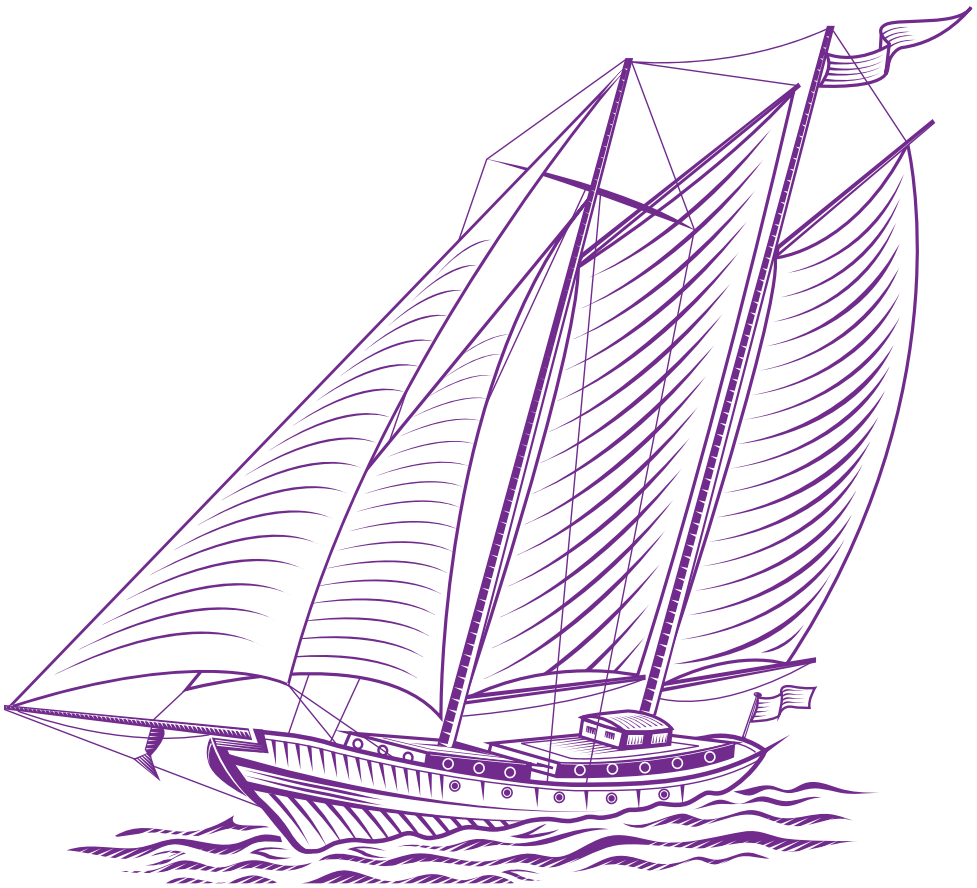

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BIBLIOMETRIC ANALYSIS EXPLORING REAL EARNINGS MANAGEMENT PRACTICES: A GLOBAL REVIEW

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ABSTRACT. Real Earnings Management (REM) represents a significant area of research within financial studies, having been thoroughly explored over time alongside accrual earnings management techniques as part of the broader issue of intentional financial reporting manipulation. This study analyses 339 articles published in journals indexed by the Web of Science (WOS) database from 2006 to 2024, aiming to provide a comprehensive review of the key findings and emerging research trends in this field. The results reveal that REM is becoming increasingly pertinent, with nearly 40% of the literature on this topic published in the past three years (2022-2024). The United States emerges as the leading contributor to research in this area. We conclude that REM is closely associated with accrual earnings management, corporate governance, and auditing practices. Furthermore, the manipulation of accounting choices in various institutional contexts, particularly in Pakistan, China, and India, has

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gained prominence in recent years. Future research should direct its attention toward REM in emerging markets and family-owned enterprises, as these areas present vital avenues for further exploration.

Keywords: Real earnings management, Bibliometrics analysis, Citation analysis, Keyword analysis, Bibliometrix R

JEL classification: M40, M41

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Introduction

Earnings are essential to the process of economic decision-making. Given their significance, the practice of earnings management (EM) may occasionally arise. This phenomenon results from the inherent flexibility within accounting standards (Healy, 1985) and occurs when managers exercise their discretion in the accounting reports to deceive stakeholders about the company's profitability or to affect contractual outcomes in line with the reported figures (Healy and Whalen, 1999). EM is defined as the intentional efforts made within the framework of GAAP to achieve optimal reported earnings (Schipper, 1989). Despite the vast body of literature on EM a more comprehensive understanding of this phenomenon remains essential. EM continues to garner attention from both scholars and practitioners, and ongoing research suggests that it is only partially understood. Manipulative practices can obscure a company's actual economic performance and conceal critical information that stakeholders require for informed decision-making. Consequently, EM represents a significant concern for the global economy (Bui, 2024). EM has increasingly captured the attention of scholars, practitioners, and regulators, primarily due to its potential to erode confidence and transparency in financial markets (Nguyen et al., 2021). Pioneering research, especially by Healy in 1985, played a crucial role in developing methods for measuring EM through discretionary accruals. Subsequent studies, including those by DeAngelo (1986) and Jones (1991), further honed models for identifying EM behavior, establishing a robust foundation in accrual-based earnings management. More recently, the focus of research has shifted towards analyzing real activities as alternative measures of EM (Zang, 2012; Cohen and Zarowin, 2010; Roychowdhury, 2006).

The field of EM is extensive and encompasses a substantial body of literature. Literature reviews hold particular significance in this domain, as they can illuminate emerging trends and systematically organize a diverse range of information. Notable bibliometric studies on EM have been conducted by scholars including Vagner et al. (2021), Teixeira and Rodrigues (2022), Ahmad et al. (2023), Bansal (2023), and, more recently, Bui (2024).

Vagner et al. (2021) conducted an analysis of 1,547 articles on EM sourced from the Web of Science (WoS) database, highlighting significant advancements across four key periods from 1988 to the present. They identified the global financial crisis as a pivotal factor driving the increase in EM research. Teixeira and Rodrigues (2022) analyzed 4,343 papers within the WoS database covering the years 1900 to 2020. They found a strong correlation between EM, corporate governance, and information quality, suggesting that further investigation into Real Earnings Management (hereunder REM) would be a fruitful area for research. Additionally, Ahmad et al. (2023) examined 1,383 papers from the Scopus Core Collection and reported a marked growth in EM publications in 2020, primarily from USA, China, Australia, and the United Kingdom. Their analysis points to a rising interest in EM and underscores the potential for further research, especially in emerging economies.

Bansal (2023) conducted a review comprising 2,775 papers examining EM published from 1992 to 2022, utilizing data from Scopus. The review identified three primary themes: EM constructs operationalization; trade-offs among various EM tools, and influence of corporate governance mechanisms on EM examined in emerging markets. Notable emerging research areas include advancements in technology, cross-cultural research, non-financial indicators used to examine EM and others.

Bui (2024) analyzed 1,981 Scopus-indexed publications from 1993 to 2021, highlighting a significant increase in knowledge regarding EM in recent years. Like Teixeira and Rodrigues (2022), Bui (2024) emphasized REM as a crucial area for future research.

Our paper uses the Web of Science (WoS) database in response to calls from Teixeira and Rodrigues (2022) and Bui (2024) for a greater focus on REM in future research. To identify areas in REM scholarship that need further development, we conducted a bibliometric analysis to uncover existing gaps in the literature. As a result, our research is both timely and relevant.

Our study is motivated by two key factors. First, as emphasized by Teixeira and Rodrigues (2022) and Bui (2024), REM deserves greater research focus due to its resemblance to legitimate business decisions, which complicates detection for auditors and regulators. As managers typically manipulate accruals within a limited range, they may turn to REM to meet their earnings targets,

highlighting the importance of closely examining this practice. Second, while there are several bibliometric studies on EM, none specifically address REM on a global scale, pointing to a significant gap in systematic research in this area. We intend to contribute to the academic community by systematically reviewing the literature on REM and identifying both current and emerging research trends through bibliometric methods. This approach is highly regarded in the fields of business and economics for its effectiveness in analyzing data and assessing the productivity and impact of various publications. Ultimately, our research aims to broaden the existing literature and deepen the understanding of REM.

This paper is categorized as follows: After the introduction, the second section reviews the current state of the art and establishes the research questions. Third section outlines the methodology employed, while the fourth presents the findings. Finally, the last section concludes the paper by discussing research limitations and exploring suggested avenues for future research.

State of the art

Cohen and Zarowin (2010) categorized EM into two primary forms: EM through accrual accounting variables (hereunder AEM) and EM through the manipulation of actual transactions, best known as real earnings management (REM). REM encompasses strategies such as accelerating sales, adjusting shipment schedules or deferring research and development expenditures or maintenance expenditures (Dechow and Skinner, 2000). This method presents a notable alternative to AEM as documented in the studies conducted by Roychowdhury (2006); Cohen et al. (2008) or Zang (2012).

In a study conducted in 2006, Roychowdhury characterized REM as a deviation from standard operational practices, where managers attempt to deceive shareholders into believing that financial targets have been achieved in a conventional manner. This practice may involve actions such as adjusting the timing or structure of transactions (Zang, 2012) to manipulate earnings, which can lead to suboptimal outcomes.

This manipulative strategy adversely affects long-term business value by impacting future cash flows. The study of Bhojraj et al. (2009) documented that firms exceeding short-term earnings targets through discretionary expense cuts tend to underperform compared to those missing targets but maintaining high earnings quality.

Both studies conducted by Gupta et al. (2010) and Gunny (2010) noted the conclusion that REM can lead to poor long-term performance and lower return on assets. Khurana et al. (2018) emphasized that short-term earnings pressures

may result in suboptimal long-term decisions. Despite its negative long-term consequences, REM is commonly used by managers due to market reactions to missed targets and internal pressures, as highlighted by both Dichev et al. (2013) and earlier by Graham et al. (2005) in their review.

Managers often prefer REM over AEM for two main reasons: it generally faces less scrutiny from regulators and offers greater flexibility for achieving desired outcomes. Research, such as Roychowdhury's (2006), indicates that managers engage in REM by inflating short-term sales, cutting discretionary expenses, and overproducing. Dechow and Sloan (1991) found that CEOs also adjust real activities, like reducing research and development spending, as they approach retirement. Additionally, compensation-related incentives further motivate these adjustments (Cheng, 2004). Given these various factors, it is evident why REM has become more important in recent years (Bui et al., 2024).

To analyze trends in REM research, we conducted a bibliometric review of 339 publications indexed in the Web of Science (WoS) between 2006 and 2024. This study addresses a significant gap in the systematic review of REM literature. Through this research, we seek to enhance our cognizance of the intricate REM field and provide valuable insights for researchers, practitioners, and policymakers.

In the light of the findings documented by Vagner et al. (2021), Teixeira and Rodrigues (2022), Ahmad et al. (2023), Bansal (2023), and Bui (2024), this study utilizes various measures and indicators through bibliometric analysis and intends to address four research questions as follows:

Research Question 1: What is the magnitude and publication trend of research on REM?

Research Question 2: Which authors have emerged as the most productive contributors to the REM literature?

Research Question 3: Which papers are the most cited, and which countries and journals have the most significant publications related to REM?

Research Question 4: What are the key themes in REM research, and what future research avenues can be explored?

Methodology

We conducted a bibliometric analysis of REM using Web of Science (WoS) data, one of the largest and most respected scientific citation databases managed by Thomson Reuters. Our analysis involved creating a comprehensive database and applying bibliometric methodologies to map citation patterns, identify frequently used keywords, and trace the main topics related to REM research.

The literature search was conducted in October 2024 and included studies published up to that time. We began by performing a title search in the Web of Science (WoS) database, targeting articles that featured the keywords "Real Activities Manipulation", "Real Earnings Management", "Real Activity Earning Management". This initial search yielded a list of 416 articles.

To refine our selection, we focused on articles published in English and categorized under Business Finance, Economics, and Business and Management from 1900 to 2024. This targeted approach resulted in a final dataset of 339 articles, sourced from 133 journals and conference proceedings, with contributions from a total of 807 authors, as summarized in Table 1. The findings were then exported in BibTeX format. As stated above, we performed a bibliometric analysis using R Studio and the package from Bibliometrix. For enhanced interactive analysis, Shiny package developed by the RStudio Team was used.

Results and Discussions

As stated above, the WoS database comprises a total of 339 articles collected using the keywords "Real Activities Manipulation", "Real Earnings Management" and "Real Activity Earnings Management" classified under the categories of Business Finance, Economics, and Business and Management, spanning from 1900 to 2024.

First table below disclose the descriptive statistics for the REM papers. Remarkably, there were 339 articles on REM in the WoS database between 2006 and 2024, with an average of 40.18 citations per article and an annual growth rate of 23.85%. Among the 807 authors, 39 contributed single-authored works. On average, each author produced 2.86 documents, and the rate of international co-authorship was 39.82%.

Table 1. Descriptive analysis of articles

Description of data	**Number**
Main information regarding data	
DOCUMENTS (total number of manuscripts)	339
Sources (journals, Books, etc.)	133
Period	2006-2024
Annual Growth Rate	23.85%
References	10074

Description of data	Number
Average citations per doc	40.18
Document Average Age	4.28
Articles keywords and key word plus	
Keywords selected by authors (DE)	846
Key word plus (ID)	631
Information regarding the authors	
Number of authors	807
Number of authors of single-authored documents	39
Information regarding the authors collaboration	
Number of single authored papers	43
Number of co-authors per papers	2.86
International co-authorship %	39.82
Information regarding the document type	
Number of articles	317
Number of articles, book chapters	2
Number of articles, early access	18
Number of articles, proceedings papers	2

Source: Authors' work

Research Question 1: What is the magnitude and publication trend of research on REM?

The number of publications in the field of REM has experienced a significant increase since 2014 (refer to Figure 1). In 2006, there was only one publication, but this figure rose to 47 by 2024. From 2006 to 2015, the total number of REM publications did not surpass 20, suggesting that research in this area was still relatively nascent, with publication counts ranging from just one paper to a maximum of 13 in a single year. Beginning in 2016, the volume of publications began to rise notably, reflecting an increasing interest among scholars in the topic of REM. As illustrated in Figure 1, there is a discernible upward trend in the number of papers published each year. The peak in REM publications has occurred in the last three years (2022-2024), during which nearly 40% of all literature on the subject has been produced.

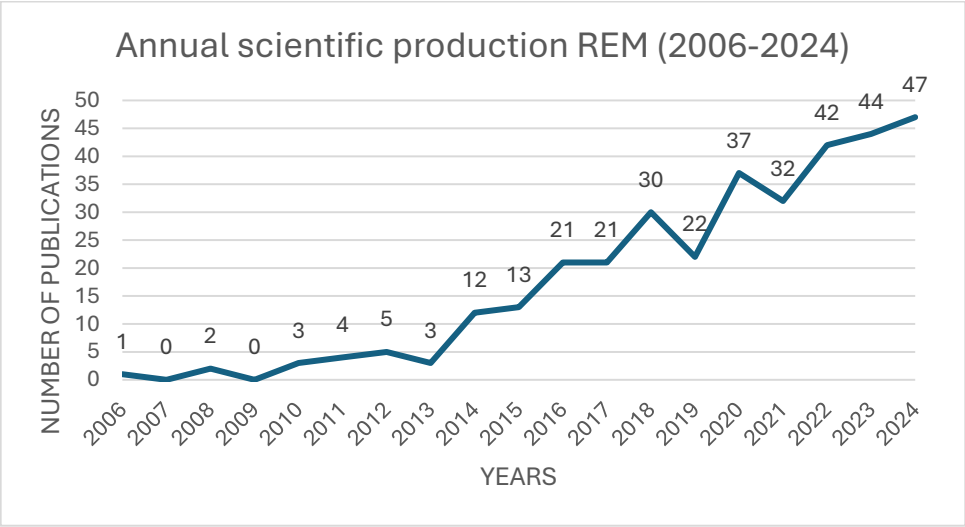

Figure 1. Yearly Trends in the Number of Publications on the REM Topic (2006-2024)

Source: Authors' work

Research Question 2: Which authors have emerged as the most productive contributors to the REM literature?

Table 2 showcases the most productive scholars in the field of REM. A minimum threshold of four documents authored was established for inclusion. Leading the list, Zhang Y has published the most articles, totaling six, followed by Alhadab M with five. Ghaleb M., Li L., Sohn B., Sung H., and Thanh N. each contributed four papers.

Regarding citations, Sohn has achieved the highest total, with 347 citations, while Li follows with 226 citations. In contrast, Sung has received the fewest citations, with only nine for the four papers published.

Table 2. Most Productive Authors on the REM Topic (2006-2024)

Author	Country	No. of papers	Citations	First paper
Zhang Y.	USA	6	179	2012
Alhadab M.	JORDAN	5	179	2015
Ghaleb B.A.A.	MALAYSIA	4	148	2020
Li L.	NEW ZEALAND	4	226	2016
Sohn B.C.	CHINA	4	347	2013
Sung H.C.	TAIWAN	4	9	2012
Thanh Ngo T.N.	USA	4	64	2016

Source: Authors' work

Research Question 3: Which papers are the most cited, and which countries and journals have the most significant publications related to REM?

Table 3 illustrates the top 10 most cited papers, highlighting Roychowdhury's (2006) influential study, which has garnered 2,306 citations for the paper titled "*Earnings Management through Real Activities Manipulation*". In this study, the author delineates various strategies employed by managers to boost sales, including offering price discounts, overproducing to reduce the cost of goods sold, and minimizing expenditures that are discretionary to enhance reported profit margins. In addition to this empirical investigation, the field of EM has increasingly shifted its focus toward REM activities, which are utilized to circumvent the reporting of losses.

Cohen et al. (2008) stands as the second most cited paper, garnering 1,471 citations with their work "*Real and Accrual-Based Earnings Management in the Pre- and Post-Sarbanes-Oxley Periods*" In this study, they highlighted that companies shifted between AEM and REM after the enactment of the Sarbanes-Oxley Act (hereunder SOX). Following closely, the third most cited paper, authored by Cohen and Zarowin (2010), has received 1,119 citations. This research revealed that firms engaging in seasoned equity offerings (SEOs) tend to utilize REM, which can have detrimental long-term effects on the companies. Notably, the decrease in post-SEO performance attributed to real earnings manipulation is more accentuated compared to that resulting from AEM.

Lastly, Zang (2012) published a paper that has accumulated 1,117 citations, documenting how managers employ REM as a substitute for AEM. Zang's findings suggest that the trade-off between these two manipulative practices is influenced by their associated costs, with managers adjusting their use of AEM based on their levels of REM.

The remaining papers received considerably fewer citations compared to those previously mentioned, with citation counts ranging from 663 for Gunny (2010) to 161 for Achleitner et al. (2014). In her paper, "*The Relation Between Earnings Management Using Real Activities Manipulation and Future Performance: Evidence from Meeting Earnings Benchmarks*" Gunny (2010) demonstrated that firms use REM practices to achieve earnings benchmarks. Furthermore, Kothari et al. (2016) noted that managers show a greater propensity for REM during seasoned equity offerings (SEOs), despite the long-term costs associated with such practices.

Cheng et al. (2016) made a significant contribution to the literature on REM by demonstrating that internal governance influences the extent of REM. Their findings indicated that the level of REM diminishes as both influence and horizon of the most important subordinate executives increase. Earlier, Kim and Sohn (2013) revealed that REM adversely affects the quality of earnings

information available to outside investors, prompting the market to demand a higher risk premium for these activities. This additional risk premium is separate from the risk premium associated with AEM.

Chi et al. (2011) investigated whether companies turn to REM once their capability to manage accruals is limited by high-quality auditors. Their research revealed a connection between auditor expertise and higher fees with increased levels of REM. The authors suggested that employing higher-quality auditors may unintentionally prompt firms to adopt more costly REM strategies due to constraints on AEM. Finally, Achleitner et al. (2014) found in their empirical work that family businesses use REM and AEM as substitutes instead of complementary tools for EM.

Table 3. Most Influential Publications by Number of Citations

Authors (year)	**Article title/DOI**	**Source Title**	**Total citations**
Roychowdhury S., (2006)	Earnings management through real activities manipulation	Journal of Accounting and Economics	**2,306**
Cohen, D.A., Dey, A., Lys, T.Z., (2008)	Real and accrual-based earnings management in the pre- and post Sarbanes-Oxley periods	The Accounting Review	**1,471**
Cohen, D.A., Zarowin, P., (2010)	Accrual-based and real earnings management activities around seasoned equity offerings	Journal of Accounting and Economics	**1,119**
Zang, A.Y., (2012)	Evidence on the trade-off between real activities manipulation and accrual-based earnings management	The Accounting Review	**1,117**
Gunny, K.A., (2010)	The relation between earnings management using real activities manipulation and future performance: evidence from meeting earnings benchmarks	Contemporary Accounting Research	**663**
Kothari, S.P., Mizik, N., Roychowdhury, S., (2016)	Managing for the moment: The role of earnings management via real activities versus accruals in SEO valuation	The Accounting Review	**280**
Cheng, Q., Lee, J., Shevlin, T., (2016)	Internal governance and real earnings management	The Accounting Review	**201**

Authors (year)	Article title/DOI	Source Title	Total citations
Kim, J.B., Sohn, B.C., (2013)	Real earnings management and cost of capital	Journal of Accounting and Public Policy	**178**
Chi, W., Lisic, L.L., Pevzner , M., (2011)	Is enhanced audit quality associated with greater real earnings management?	Accounting Horizons	**175**
Achleitner, A.K., Günther, N., Kaserer, C., Siciliano, G., (2014)	Real earnings management and accrual-based earnings management in family firms	European Accounting Review	**161**

Source: Authors' work

The information presented in Table 3 reveals that the most influential papers, as determined by citation frequency, have been published in esteemed accounting journals such as the Journal of Accounting and Economics (Impact factor: 5.82), The Accounting Review (Impact factor: 5.45), and Contemporary Accounting Research (Impact factor: 2.21).

When analyzing the number of publications on Real Earnings Management (REM) by country, the top five are as follows: the USA (293 publications), China (240), the UK (92), Malaysia (42), and Tunisia (35).

In terms of citations in the REM field, the leading three countries remain consistent: the USA (7,873 citations), China (2,240 citations), and the UK (422 citations). The fourth and fifth positions are held by Canada (386 citations) and Singapore (295 citations), respectively.

Research Question 4: What are the key themes in REM research, and what future research avenues can be explored?

As stated by Comerio and Strozzi (2019), the themes of research publications are represented by the authors' keywords. An analysis of these keywords was conducted in our study using Bibliometrix R to identify the most common themes in REM research. Figures 2 and 3 illustrate the frequency of referenced keywords in papers examining REM across the years, respectively a word cloud representation. Notably, the most frequently found keyword is "real earnings management," followed by "earnings management," "management," "corporate governance," "real earnings," and "real activities manipulation," which is a synonym for REM.

The keyword "earnings management" follows "real earnings management" not by coincidence, as the latter is a subset of the former. As previously mentioned, EM practices are grouped into AEM and REM. Since it is managers

who engage in these manipulative practices, the term "management" is frequently associated with such actions in the EM literature, which accounts for its high prevalence. To mitigate manipulative practices, various factors have been identified in the literature, with corporate governance being one of the key elements.

Analyzing the keywords prevalent in the literature on REM, it is clear that the primary focus is on real activities manipulation, which is often explored in conjunction with Accrual Earnings Management (AEM) and corporate governance. The keyword "M41" (Accounting in JEL Code) appears frequently in REM literature, underscoring its importance in examining these manipulative practices. Since many of the most highly cited papers in this field have been published in accounting journals, the significant presence of the keyword "M41" in the literature is readily understandable.

Further, the *word cloud* below is a visual depiction comprising text data. In this representation, the size of each word analyzed is depicted in accordance with its frequency or significance. As such, Figure 3 presents a word cloud in the context of bibliometric analysis of REM research. This word cloud prominently feature terms such as "real earnings management," "earnings management," "real earnings," and "corporate governance." As observed above, these key terms underscore the most important themes and topics that have been widely examined within the REM literature.

Additionally, Figure 4 below illustrates the evolution of the most commonly used keywords within REM literature over time. It is noteworthy that, until 2008, none of the prevalent keywords associated with REM were employed. Beginning in 2008, "real earnings management" was introduced as a keyword in a paper by Cohen et al. (2008). From 2010 onwards, both "real earnings management" and "real activities manipulation" began to appear systematically in REM literature. Although "real activities manipulation", "real earnings management" or "real activity earnings management" all refer to the same underlying concept, "real earnings management" remains the term most frequently utilized in the REM literature.

The advancement of research in the area of REM has been accompanied by a notable increase in related keywords. In the past three years, an important rise in publications within this field compared to the entire analysis period was observed. One of the most compelling associations is between REM, EM, and AEM. This correlation was expected, as both REM and AEM, along with EM practices, have been thoroughly examined in the literature. Managers often implement AEM and REM either in conjunction or as a trade-off, which leads to these practices being frequently discussed together in a considerable number of the reviewed papers. Additionally, corporate governance is closely tied to REM, with its role in mitigating manipulative practices being a topic of extensive discussion.

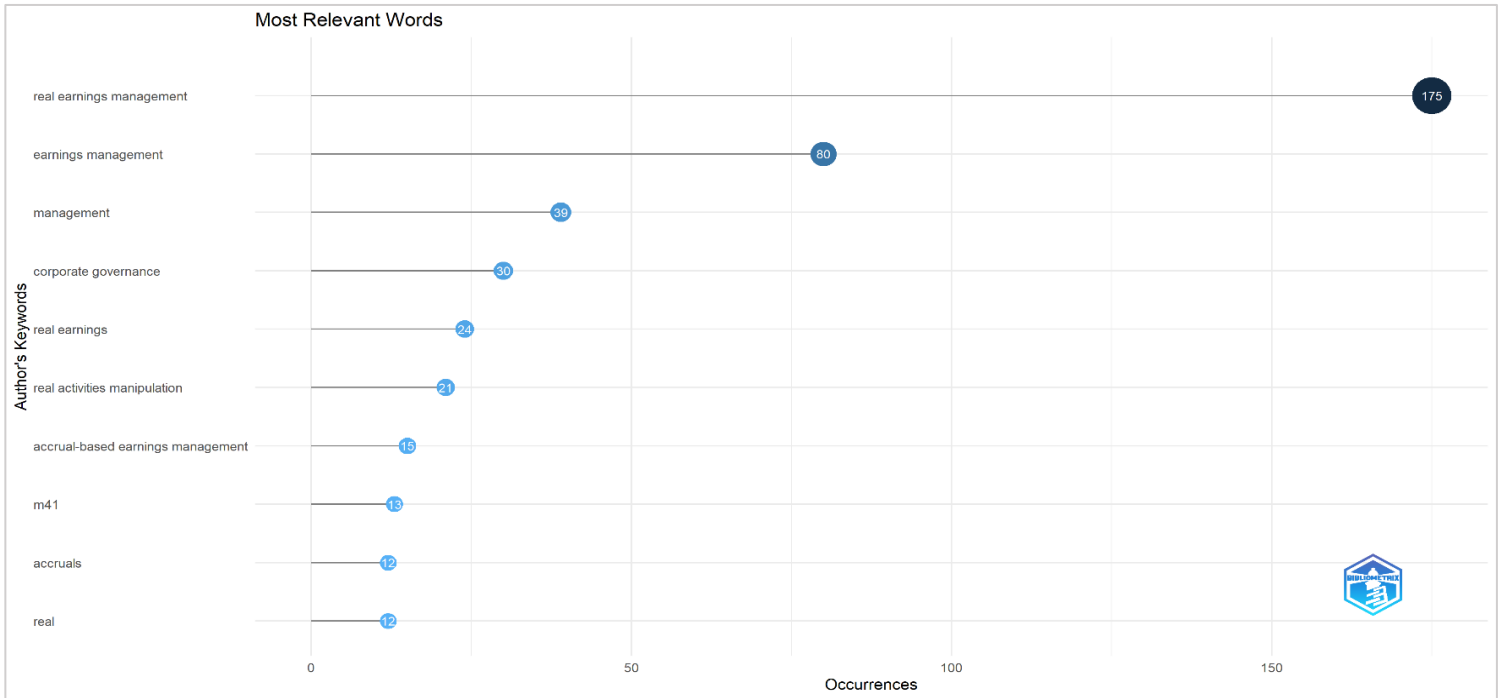

Figure 2. Frequency of Commonly Used Keywords
Source: Authors' work

Figure 3. Word cloud
Source: Authors' work

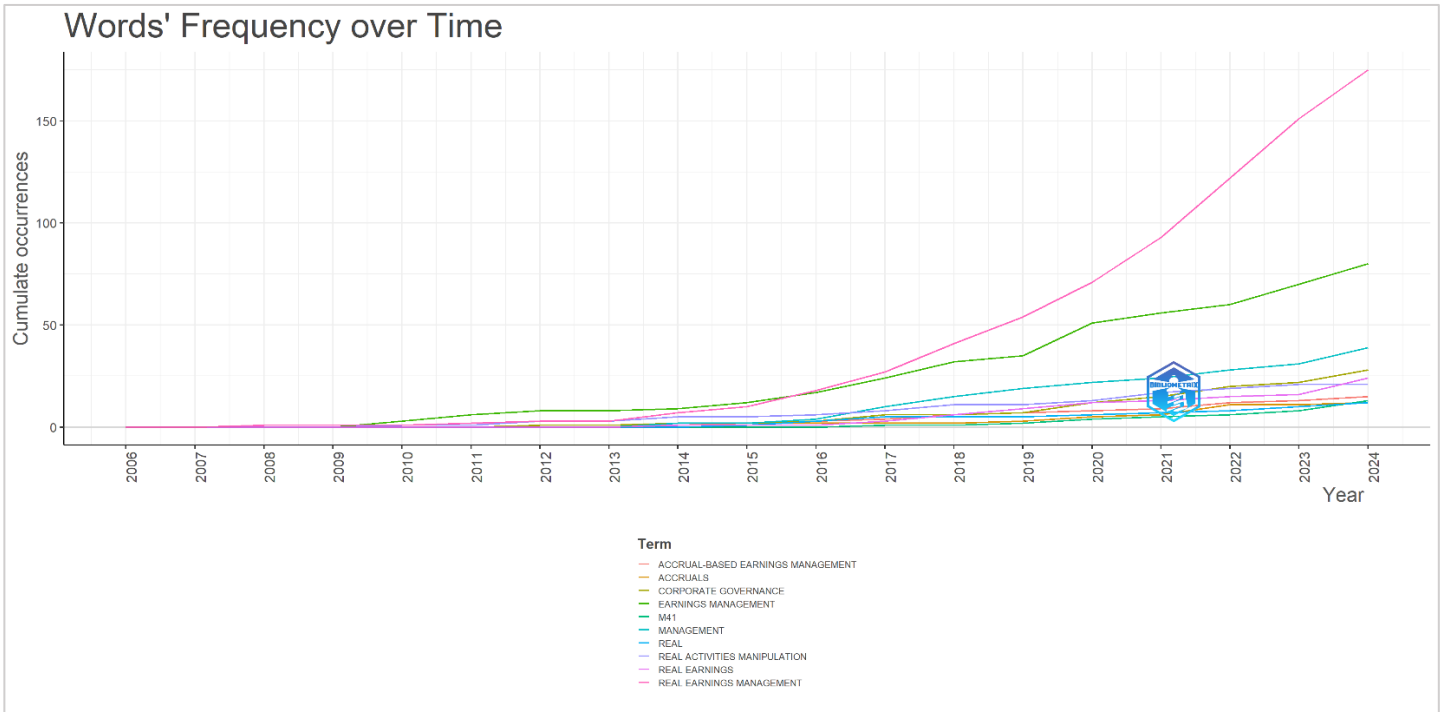

Figure 4. Timeline of the most frequently used keywords in REM literature
Source: Authors' work

The analysis of author keyword co-occurrence presented here highlights the key elements of the articles in our database. Keyword co-occurrence refers to the simultaneous appearance of keywords and conveys important meanings to the audience, as it reflects the primary topics of the research (Donthu et al., 2021). This data visualization illustrates the relationships among authors' keywords within a large text corpus. Keywords are shown as nodes, with edges representing their co-occurrence frequency as explained by Linnenluecke et al. (2020). The strength of the edges reflects how often the keywords appear together, their proximity, or the significance of their relationship, while node size indicates each keyword's usage frequency.

Figure 5 presents below the primary keywords in REM research and their interconnections, generated through a keyword co-occurrence analysis using Bibliometrix software. This analysis identified five clusters of frequently used keywords that correspond to significant research topics.

Cluster 1 (highlighted in blue) primarily encompasses a variety of elements, including AEM, accruals, earnings quality, emerging markets, India, China, audit quality and audit fees, market competition, firm performance, information asymmetry, Agency Theory, IFRS, litigation risk, persistence, leverage, management monitoring, and firm value. These elements all center around the keyword "Real earnings management," which is prominently featured in the middle of the map. It is clear that this keyword is strongly connected to the major keywords present across all clusters. REM practices appear often as being connected with accruals and accrual earnings management, indicating that both practices (AEM and REM) are frequently examined together in the literature as methods for detecting earnings management.

Keywords such as "India" and "China" reflects the growing focus on research concerning emerging markets (Bui, 2024) despite the fact that earlier research has primarily targeted developed countries.

Additionally, "audit quality" and "audit fees" are essential aspects to consider in REM research, as auditors must ensure proper handling of financial reports to mitigate REM risks.

The keyword "information asymmetry" is also found connected to REM practices given to the challenges brought within agency theory, where one may possess much more information compared to the other, leading to exploitation (Bansal, 2024). The implementation of International Financial Reporting Standards (IFRS) aims to intensify global consistency and increase the value given to accounting data, facilitating informed decision-making among stakeholders. Research often examines the relationship between IFRS and both AEM and REM — to understand how regulatory changes impact manipulative behaviors. Adopting IFRS is recognized to improve transparency, accountability, and reporting efficiency (Bansal, 2024).

The analysis of corporate debt levels was conducted in relation to REM, taking into account that prior studies have investigated the potential effects of EM on a firm's leverage, yielding inconclusive results (Bui, 2024). Nevertheless, the keywords above provide important insights into the predominant themes and research directions within the REM research field.

Cluster 2, highlighted in red, is strongly connected to Cluster 1 and can be viewed as an extension of it. The keyword "earnings management" is prominently featured at the center of Cluster 2 and is closely associated with terms such as REM, AEM, manipulation, accounting choices, earnings benchmarks, firm performance, institutional ownership, institutional investors, and ownership structure. The presence of the "Earnings Management" keyword at the heart of the second cluster underscores its relationship with REM, indicating the significance of REM in identifying instances of earnings management. EM is closely related to firm performance, indicating that manipulative practices can impact a company's performance and are, in turn, influenced by its ownership structure. In summary, this cluster underscores that EM is thoroughly examined in connection with REM. This suggests the necessity of considering various measurements of EM to reduce earnings manipulations, as highlighted by Bui (2024) in their paper. Moreover, the strong correlation between EM and REM emphasizes the increasing significance of REM as a research topic within the domain of EM, which calls for further investigation in future studies.

The keyword "Management" is most prominently featured in the green cluster (Cluster 3), which is linked to Corporate Social Responsibility (CSR) and AEM. AEM is driven by a range of incentives and CSR can play a crucial role in mitigating these potentially manipulative practices.

Cluster 4 (purple) highlights a significant connection between corporate governance and governance mechanisms. In recent years, research has focused on how these governance mechanisms can effectively reduce REM.

Cluster 5 (yellow) showcases a strong relationship between accounting, financial reporting, and EM. Research has demonstrated that both accounting and financial reporting are impacted by EM.

Summarizing the above, the various clusters underline different aspects related to financial reporting, accruals, corporate governance, auditing, stock markets, and REM. The focus is on corporate governance, accounting quality, discretionary accruals, and REM practices.

Furthermore, by utilizing a network approach, such as a thematic map, we can visually represent scientific papers based on their themes and citations. Figure 6 shows that between 2006 and 2024, the relationship between REM and AEM attracted the most scholarly attention, providing insights into various aspects, including techniques, corporate governance influences, audit quality, and the impact of IFRS on REM practices.

On the other hand, within the niche and emerging or declining themes, emerging markets emerge as a significant trend, as well as family firms' studies and special operations as mergers and acquisitions.

As previously noted, the majority of studies assessing EM have primarily focused on developed countries. However, recent years have indicated a shift in this focus, with scholars increasingly exploring emerging markets as well. Notably, China and India stand out as important institutional settings.

Family businesses are of central concern in the global economy, which is why the extent to which they engage in REM needs to be further investigated (Bui, 2024). Eng et al. (2019) noted that REM levels differ between family and non-family businesses across countries and during different economic periods. Although research on family firms is growing, the impact of earnings management, particularly REM, remains unclear despite the fact that empirical studies documented that REM is affecting the earnings quality in such firms. An example is the empirical study conducted by Alhebri and Al-Duais (2020) that found that family businesses often have lower earnings quality due to both AEM and REM. Additionally, Alhebri et al. (2021) identified a positive link connecting family firms with REM practices, while a higher proportion of independent directors and greater director compensation are associated with reduced REM in these firms.

Special operations, such as mergers and acquisitions, should be examined more closely in future studies regarding potential manipulation. Empirical research shows that these operations can lead managers to engage in manipulative practices. In this regard, Chang and Pan (2020) found that companies engaged in stock-for-stock acquisitions often increase credit sales and overproduction in the quarter before merger announcements.

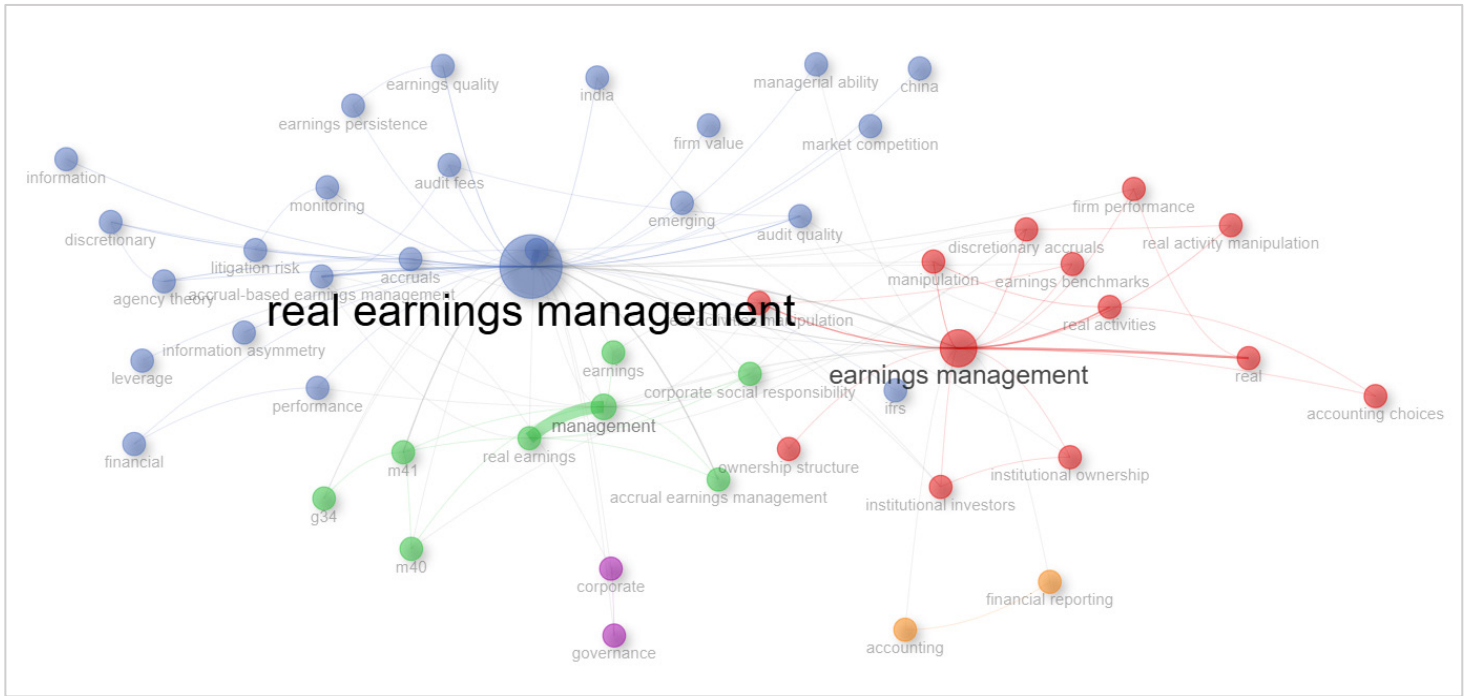

Figure 5. Map of Co-occurring Keywords
Source: Authors' work

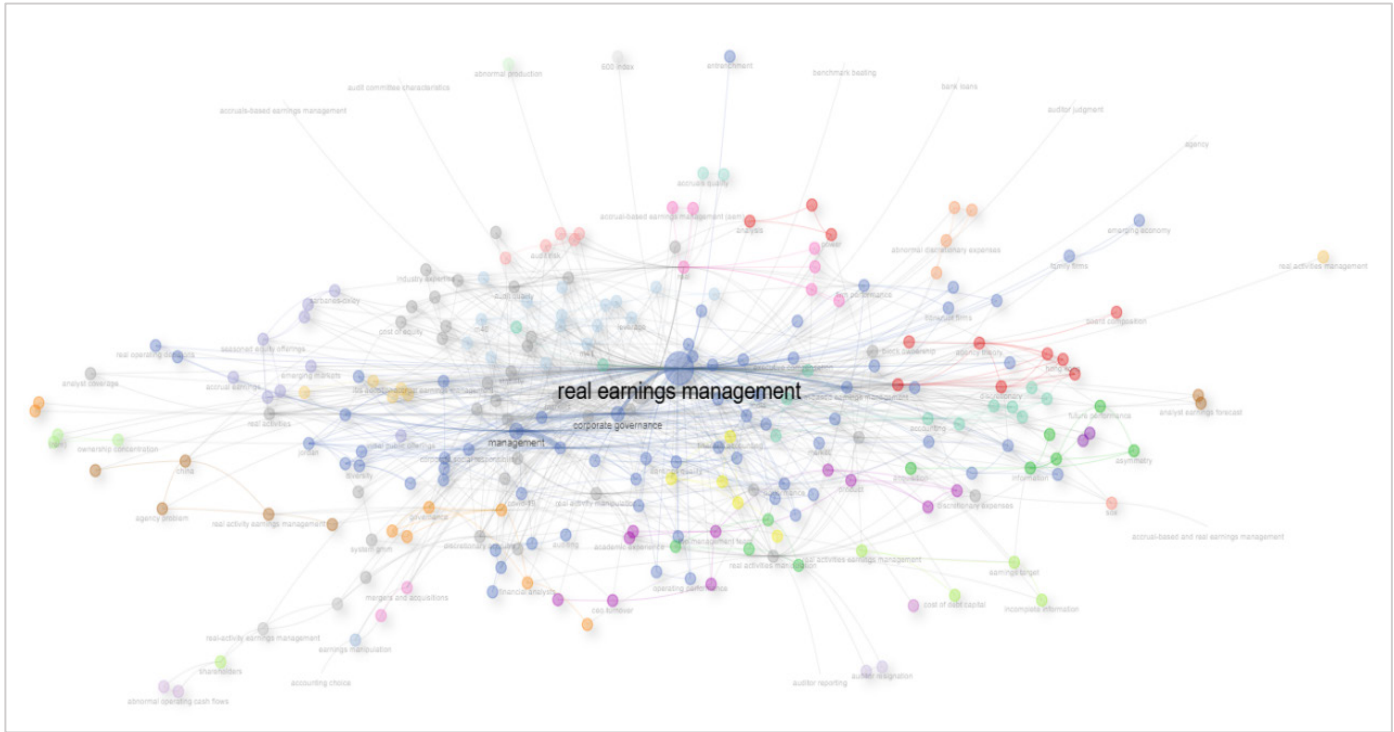

Figure 6. Thematic map
Source: Authors' work

Conclusions

Our study seeks to assess the evolution of the REM research field and to outline future directions for this area of inquiry. It provides a comprehensive overview of 339 articles published in journals indexed by the WOS database from 2006 to 2024.

The main conclusion drawn from the analysis is that REM is emerging as an increasingly significant topic of interest, with scholars actively exploring new methods for measuring EM. The relationship between AEM and REM, as well as the broader interaction between EM and REM, has attracted considerable attention in the reviewed literature, particularly given that these concepts are often used in tandem or involve a trade-off, as indicated by various empirical findings.

The most significant body of research on REM has emerged in the past three years (2022-2024), with nearly 40% of the existing literature produced during this period. The USA stands out as the leading country in terms of the number of papers published within REM literature.

The three most cited authors in the REM field are Roychowdhury (2006), followed by Cohen et al. (2008), and Cohen and Zarowin (2010), all of whom are affiliated with institutions in the United States. Within REM research, the relationship between REM and AEM has garnered considerable scholarly interest, with a large proportion of published papers examining this relationship across various themes such as corporate governance, audit impact, IFRS adoption, emerging markets, and family firms. Furthermore, accounting choices have been investigated in the context of manipulation across different institutional settings, with Pakistan, China, and India being the most frequently cited examples. Agency Theory has been the predominant theoretical framework guiding this research.

A particularly promising avenue for future research is the study of REM in emerging markets and family-owned firms. Additionally, our research has identified the most pertinent keywords related to REM research.

Our research carries important implications for regulators and practitioners, as it clarifies how REM contributes to the emergence of new EM practices, some of which may be harmful to investors. By providing valuable insights into the scholarly work on REM, bibliometric analysis can empower researchers, institutions, and policymakers to make well-informed decisions and formulate effective strategies. Lastly, understanding the current state of this topic is crucial. An analysis of the most cited publications on REM indicates that it has attracted considerable interest from scholars across the years, largely because of the significant impact these manipulative practices have.

This study does have some limitations. Firstly, our analysis relies exclusively on the WOS database. Additionally, we employed bibliometric and network analysis tools, which may have constrained our approach. Moreover, by focusing solely on "articles," we may have overlooked valuable insights from other types of publications. We encourage further research to complement these findings through the use of diverse methodologies for a more comprehensive understanding of the REM topic in a broader academic context. It is essential to take these limitations into account when interpreting the conclusions presented here.

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DETERMINANTS OF SMALL BUSINESS TAX COMPLIANCE BEHAVIOUR: EVIDENCE FROM ZIMBABWEAN SMALL BUSINESSES

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ABSTRACT. Many developing countries have implemented tax regulations for small enterprises and the simplification of tax systems in recent times. Tax compliance attitudes within this sector vary significantly due to the high cost to comply and the technical nature of tax law. Many different factors influence presumptive tax compliance and previous research did not necessarily identify the determinants of this phenomenon. Two hundred and nineteen small business owners/managers participated in the study. The validation of the measurement model and the structural model was performed using the Partial-Least Squares Structural Equation Model.

The study evaluated the impact of tax morale, corruption and taxpayer/tax office relationships on presumptive tax compliance in the Zimbabwean context. It was found that corruption significantly influences small business operators' compliance levels under a presumptive tax system. Significant differences were found in small business owners and managers who differed in their perceptions of their relationships with the tax office. The results of this study would assist tax authorities in understanding small businesses' perceptions when reviewing the current presumptive tax systems.

Keywords: tax morale, tax compliance, corruption, tax office relationships, presumptive taxation

JEL classification: **H20, H29**

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Introduction

This study intends to evaluate the determinants of presumptive tax compliance by small businesses. Cultural, societal and political considerations are some of the many facets of tax compliance (Bertinelli et al., 2020). Among these factors, corruption and tax morale seem to play a pivotal role in developing countries (Bertinelli et al., 2020; Schlenther, 2017; Sebele-Mpofu, 2020). Corruption exerts a negative impact on how the tax system is administered. As a result, some individuals or businesses may be tempted to pay bribes to lower or avoid paying taxes. In this regard, both Schlenther (2017) and Ogembo (2018) examined the connection between corruption and tax morale. Taxpayers tend to evaluate the state's legitimacy, credibility, and political ratification while deciding whether or not to comply with taxes (Sebele-Mpofu, 2020). In this regard, the political readiness to register and pay taxes is ultimately influenced by how the government utilises tax proceeds (Sebele-Mpofu, 2020).

Concerns regarding tax compliance are common in developing countries (Aina et al., 2017). The reduction of compliance and collection costs is one of the primary purposes of a presumptive tax system (Workneh & Mulugeta, 2019). Moreover, presumptive taxation serves as an incentive for small firms to comply. It entails using indirect methods as opposed to conventional approaches based on taxpayer accounts to determine the tax liability (Ogembo, 2018). This type of tax is typically utilised when the tax authority cannot determine a taxpayer's income or cannot confirm the accuracy of such information (Ogembo, 2018).

This research makes contributions in two ways. Firstly, it contributes to the relatively limited body of literature about presumptive taxation. In particular, there is a gap in the literature about the aspects influencing tax compliance in a presumptive tax system. It is essential that tax policymakers should understand the different variables involved in a presumptive tax system. This study, therefore, sheds more light on the key attributes of a presumptive tax system and answers the call for research on the determinants of tax compliance under a presumptive tax regime. Secondly, the research could be useful to tax authorities who seek to implement or review existing presumptive tax systems. In addition, the findings would be relevant to government, policymakers, and academics interested in pursuing further research about the tax compliance behaviour of small businesses and the re-assessment of current presumptive tax systems.

This study is organised as follows: Section 1 presents the introduction of the study and its overall goal. Section 2 provides a brief literature review of a presumptive tax system. This is followed by a discussion of the methodology in section 3. Section 4 presents the data analysis, and section 5 outlines the research conclusions and recommendations. Finally, section 6 discusses the implications and limitations of the study.

Literature Review

This section presents a review of relevant literature about presumptive tax. The section starts by reviewing concepts pertinent to tax compliance. Furthermore, it critically examines different studies related to tax morale, corruption, and taxpayer/tax office relationships. The section also provides a conceptual model of presumptive tax compliance as well as the proposed hypotheses.

Presumptive tax compliance

The concept of tax compliance has been defined in various ways (Saad, 2009). Tax compliance is assumed when tax returns are filed in a timely manner and when tax obligations are accurately stated (Saad, 2009; Adekoya & Akintoye, 2019). Palil & Mustapha (2011) noted that in complying with tax laws, taxpayers should declare all income, claim correct deductions and rebates, and pay all taxes on time. Tax compliance can be interpreted as the ability and willingness of taxpayers to comply with the law and to pay the correct amount of tax to the appropriate authority or jurisdiction on time (Ayuba & Saad, 2016). Furthermore, tax compliance implies that taxpayers can prepare tax information based on established norms and practices and submit it to the relevant tax authorities (Adekoya & Akintoye, 2019). There is, however, a conflicting interest whereby taxpayers wish to minimise taxes while the tax authority aims to maximise tax revenue through enhanced tax compliance (Gitaru, 2017).

Tax morale

Aina et al. (2017) argue that small business owners engage in informal activities out of distrust of the government. The problem of non-compliance by small businesses is further exacerbated in an environment of weak taxpayer culture (Ogembo, 2018). Moreover, small businesses are more willing to pay tax if they consider the government as considerate and prudent rather than being wasteful (Torgler & Schaltegger, 2006 as cited by Sebele-Mpofu, 2020).

Several authors have attempted to define tax morale in the small business environment. Luttmer & Singhal (2014) interpreted tax morale as the motivation for tax compliance. For example, small businesses may comply due to reciprocal motivations, peer behaviour and social recognition (Luttmer & Singhal, 2014). Mutual motivations cause small businesses to pay taxes in exchange for benefits such as credit, market access and increased productivity (Luttmer & Singhal, 2014). Moreover, the commonly accepted use of the term refers to the intrinsic motivation to pay taxes (Nakku & Nabaweesi, 2013). This means that tax morale can explain why people voluntarily meet their tax obligations (Nakku & Nabaweesi, 2013).

Taxpayer and tax office relationship

Relationships between taxpayers, governments and tax authorities are subject to interactions that influence the tax compliance behaviour of small businesses (Kaplanoglou et al., 2016). Tan & Eva (2016) found that trust in the tax authorities is closely related to taxpayers' willingness to comply or cooperate. Citizens who trust governments and tax authorities are more likely to cooperate with them because they believe that their rights and interests will not be violated (De Cremer, 2007, cited in Tan & Eva, 2016, Kaplanoglou et al., 2016). Prihandini et al. (2019) argue that this relationship begins with the interaction between tax authorities and taxpayers. Small businesses tend to believe that they carry a higher tax burden, especially compliance costs, receive fewer government benefits than other groups, and consider the tax system to be unfair (Tan & Eva, 2016). According to Adekoya & Akintoye (2019), trust is built between small businesses and tax authorities through transparency and active participation in the public expenditure process.

Corruption

The secrecy and illegality of corruption create severe market distortions and uncertainties in the business environment (Mendoza et al., 2015). As a result, an unfavourable business environment undermines the operational efficiency of firms and, at the same time, increase the cost of doing business (Igwe et al., 2018). In public policy, corruption refers to the abuse of public power for private gain (Mendoza & Bancolita, 2013). As a result, corrupt officials may target businesses that are willing to pay bribes and try to extort them (Mendoza et al., 2015). According to Ullah (2019), corruption is one of the obstacles that hinders small business growth. Moreover, deprived small businesses appear to be negatively affected by corruption (Mendoza & Bancolita, 2013). According to Ogembo (2018), small businesses employ multiple strategies to evade presumptive

tax compliance in the form of bribes to government agencies. The implications of bribery are much more affordable than the legal consequences of penalties and other legal forms of tax evasion (Mendoza & Bancolita, 2013). Based on the above literature review, the present study brings forward the following conceptual model.

The conceptual model and hypotheses development

Following the factors discussed in the previous section, a conceptual model and hypotheses are formulated. The conceptual model proposes that tax morale, taxpayer/tax office relationships, and corruption affect the presumptive tax compliance of small business owners and managers.

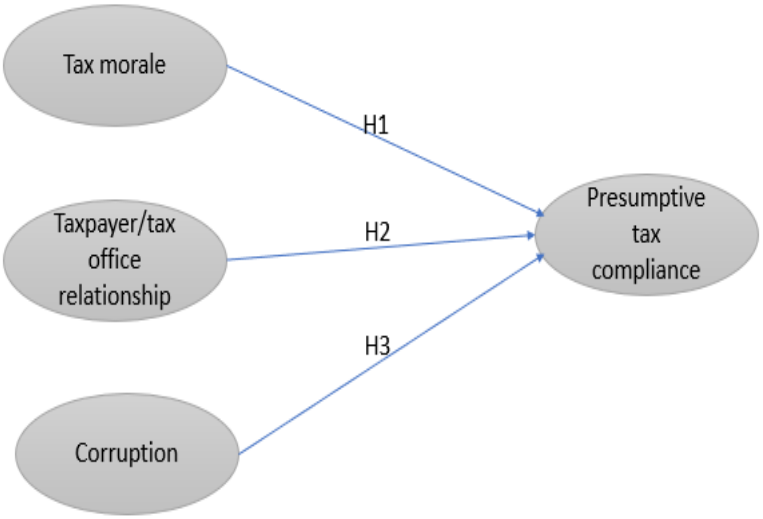

Figure 1. The conceptual model
Source: Author's own research

Hypotheses development

Tax morale and tax compliance

Tax morale is a key determinant of tax compliance behaviour (Nichita & Batrancea, 2012). In the context of SMEs, Nakku & Nabaweesi (2013) argue that the small business sector is given little democratic leeway to express its

preferences and monitor and control politicians. Most small businesses prefer to operate in the informal sector at a time when corruption in government appears to be on the rise (Alm & Martinez-Vazquez, 2008). A lack of democracy reduces the information asymmetry between small businesses and the government (Nakku & Nabaweesi, 2013). In Zimbabwe, small businesses face poor economic conditions, a lack of transparency in government spending, and high levels of government corruption leading to low tax morale (Sebele-Mpofu, 2020). Nyamapfeni & Robinson (2021) found that taxpayers who believe that the country's governance is reasonably democratic have high tax morale. In addition, small business tax morale is also hampered by a lack of trust in the tax system, accountability by the tax authorities, perceptions of corruption, political interventions and a lack of consultation with small business stakeholders on tax policy matters (Sebele-Mpofu, 2020).

Rantelangi & Majid (2017) concluded that taxpayers with high tax morale are more likely to comply voluntarily. Similarly, Jusoh et al. (2021) concluded that tax morale serves to increase intrinsic motivation to pay taxes. The positive perception of justice and trust in the tax system could improve tax compliance attitudes. This is also in line with Hardika et al. (2020), who found that taxpayers with good morale (honesty) tend to be obedient to paying taxes. On the basis of the preceding discussion, the following hypothesis is formulated:

> H1: There is a significant positive relationship between tax morale and presumptive tax compliance.

Taxpayer/tax office relationship and tax compliance

Voluntary compliance increases if governments wisely spend state revenues on basic amenities such as education, health, and safety, as well as public transportation (Palilet al., 2013). In this case, positive perceptions indicate that tax compliance is likely to improve when taxpayers share information with governments (Nkundabanyanga et al., 2016). Kaplanoglou et al. (2016) argue that, if tax authorities are powerful, but governments are unreliable, tax compliance will suffer. This indicates that small businesses are more likely to comply when they trust the tax authorities (Kaplanoglou et al., 2016). Furthermore, Ayuba & Saad (2016) reflected that high levels of corruption could reduce the level of presumptive tax payments due to a lack of trust in the tax authority. Small businesses are more likely to trust tax authorities if they perceive them to be more considerate, competent, ethical and fair in the decision-making process (Tan & Eva, 2016). Taxpayers would therefore entrust their money to an uncorrupted government backed by an effective tax authority (Kaplanoglou et al.,

2016). In further support of this view, Inasius (2019) found that if governments use tax revenues wisely, voluntary presumptive tax compliance is likely to increase. Considering the above discussion, the following hypothesis is formulated:

> H2: The relationship between small business taxpayers and the tax authority is positively correlated with presumptive tax compliance.

Corruption and tax compliance

The presence of corruption defeats the goals of any tax system. Authorities in most African countries have not taken sufficient steps to root out corruption, thus seriously hindering tax compliance (Ogembo, 2018). Corrupt politicians often endorse treaties that allow inappropriate exceptions, thereby influencing the taxation of profits (Schlenther, 2017). According to Bertinelli et al. (2020), corruption can adversely affect tax payments through two channels. First, some individuals or businesses may pay bribes to reduce or avoid paying taxes (Bertinelli et al., 2020). Second, through the fiscal theory contracts, tax revenue depends on agents' willingness to accept. Corruption in the procurement of public services generally reduces the willingness to incur tax payments (Bertinelli et al., 2020).

Furthermore, Bertinelli et al. (2020) conclude that corruption negatively impacts tax compliance. The incentive to pay the estimated tax becomes negative if small business tax contributions do not benefit society. Based on the above discussion, the present study proposes the following hypothesis:

> H3: There is a significant negative relationship between corruption and presumptive tax compliance.

Research Methodology

Research approach and design

This study used a deductive approach to test the formulated hypotheses. The choice of this approach was justified by the need to analyse the data in a quantitative manner. Quantitative research is usually associated with deductive approaches that focus on using data to test theories (Saunders et al., 2016). This includes standard data collection, numerical data measurements, and analysis using various statistical and graphical techniques to explore relationships between variables (Saunders et al., 2016). The study used a survey design focused on small business operators in Zimbabwe.

Population and sampling

The study population consisted of owners and managers of small businesses operating in 10 provinces of Zimbabwe. This study used a random sampling technique to select participants from small businesses operating in different economic sectors in Zimbabwe's ten provinces. The sampling frame was limited to operators who were members of small business associations and were liable for presumptive taxation. The study sample size was 219. In a similar study, Pope & Abdul-Jabbar (2008) surveyed the tax behaviour and compliance of SMEs in Malaysia using a sample of 175 SMEs from various economic sectors. Another similar study by Oladipupo & Obazee (2016) on tax knowledge, penalties and tax compliance of SMEs in Nigeria used a sample size of 277 SMEs.

Measurement instrument

The data was collected using an online questionnaire, which presents items relating to each study variable. Tax morale was measured by seven items, taxpayers/tax office relationships had eight items, corruption was measured by five items and presumptive tax compliance was measured by four items. A five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used to measure all the items. Data collected from small business owners and managers was used to test the relationship of variables in the conceptual model (Figure 1). This was performed through a structural equation model (SEM).

Reliability of the research instrument

The reliability of the research instrument was analysed using Cronbach's Alpha. The results in Table 1 showed that all the variables were above the acceptable threshold of 0.7 and, therefore, considered to be suitable for the current study.

Table 1. Reliability analysis

Variables	**Cronbach's Alpha**
Tax morale	0.798
Taxpayer/tax office relationship	0.729
Corruption	0.714
Presumptive tax compliance	0.857

Source: Authors' calculations

Profile of respondents

Table 2 demonstrates the demographic profile of the respondents.

Table 2. Demographic profile

Variables	Frequency	Cronbach's Alpha
Age		
Below 20	5	2.3
20 – 30	37	16.9
31 – 40	93	42.5
41 – 50	61	29.7
Above 50	23	10.5
Business sector		
Transport	30	13.7
Hairdressing and saloon	20	9.1
Informal trader	66	30.1
Small-scale miner	17	7.8
Cross border trader	10	4.6
Restaurant/bottle store	20	9.1
Cottage industry	7	3.2
Accommodation	15	6.8
Agriculture	34	15.5
Annual turnover (USD)		
Less than $50 000	143	65.3
$50 000 - $100 000	49	22.4
$100 001 - $150 000	18	8.2
$150 001 - $200 000	2	0.9
Above $200 000	7	3.2
Number of employees		
Less than 5	140	63.9
5 – 20	47	21.5
21 – 40	13	5.9
41 – 60	10	4.6
More than 60	9	4.1
Level of education		
Primary	19	8.7
Secondary	20	9.1
National certificate	22	10.0
National diploma	26	11.9
Higher National diploma	21	9.6
Bachelor's degree	82	37.4
Post-Graduate degree	29	13.2

Variables	Frequency	Cronbach's Alpha
Business Location		
City/town	181	82.6
Growth point	16	7.3
Rural shopping centre	22	10.0
Years of business operation		
Less than 5	101	46.1
5 – 10	74	33.8
Above 10	44	20.1

Source: Authors' calculations

Most respondents were in the 31 to 40 age group (42.5%), followed by the age group 41 to 50 (29.7%). Most respondents operate as informal traders (30.1%), followed by agriculture, which constituted 15.5% of the study sample. It was also observed that most businesses have an annual turnover of less than US$50,000 (65.3%). In terms of staff establishment, most small businesses have less than five employees (63.9%), while the dominant level of education among small business operators is an undergraduate degree (37.4%). It was also observed that most small businesses are operating in urban centres (82.6%), and the majority of them have been in business for less than five years (46.1%).

Results and Discussion

This study employed a two-step process to analyse the output of the SEM path results. The two-step process employed in this study includes (1) the measurement model assessment and (2) the structural model assessment. The measurement model assessed the reliability and validity of the study variables and items. Then, the structural model was used to evaluate the hypothesised relationships (Figure 1) in terms of their significance.

Measurement model

The measurement model was evaluated in terms of its convergent and discriminant validity. Convergent validity is the assessment employed to measure the level of correlation of multiple indicators of the same variable that are in agreement (Hamid et al., 2017). Convergent validity was assessed using the average variance extracted (AVE) and the composite reliability (CR). To establish convergent validity, the value of AVE should be greater than or equal to 0.50, whilst the composite reliability for all latent variables should be above

0.70 (Hamid et al., 2017). Table 3 presents the outcome of the item's loadings Cronbach's Alpha values, and composite reliability values. All the observations exceed the threshold values of 0.5 (AVE) and 0.70 (CR). These results were used to confirm convergent validity.

Table 3. Convergent validity assessment

Latent variable	Measure-ment item	Cronbach alpha	C.R. value	AVE value	Factor loading
Tax morale (TM)	-				-
	TM2				0.480
	TM3				0.565
	TM4	0.823	0.829	0.568	0.938
	TM5				0.917
	-				-
	-				-
	-				-
Taxpayer/tax office relationship (TTR)	-				-
	TTR2				0.562
	TTR3				0.842
	TTR4				0.695
	-	0.755	0.759	0.522	-
	TTR6.1				0.517
	TTR6.2				0.576
	TTR6.3				0.639
	TTR6.4				0.786
	TTR6.5				0.722
Corruption (C)	C1				0.509
	C2				0.759
	C3	0.719	0.817	0.558	0.664
	-				-
	C5				0.596
Presumptive tax compliance (PTC)	PTC1				0.686
	PTC2	0.857	0.872	0.636	0.899
	PTC3				0.919
	PTC4				0.649

Source: Authors' calculations

After assessing the convergent validity of the measurement model, the discriminant validity of the study components was also evaluated using the Fornell and Larcker (1981) criterion. The discriminant validity is measured using the AVE square roots and the variables' correlations co-efficient. It measures the degree of differences between overlapping variables (Hamid et al., 2017). According to Fornell and Larker (1981), discriminant validity is achieved when the diagonal values in bold (square root of AVE) are higher than the values in its row and column. Table 4 shows that the square root of AVE exceeds the diagonal values for each row and column, indicating discriminant validity between the variables. Therefore, it is evident that the measurement model meets the validity and reliability requirements.

Table 4. Discriminant validity assessment

	CR	AVE	TM	C	TTR	PTC
TM	0.829	0.568	**0.754**			
TTR	0.759	0.522	0.021	**0.722**		
C	0.817	0.558	-0.24	0.237	**0.747**	
PTC	0.872	0.636	0.348	-0.36	0.082	**0.797**

Source: Authors' calculations

Model goodness of fit assessment

One of the key steps in applying structural equation modelling is evaluating the model's goodness-of-fit index with data (Munyanyi & Pooe, 2020). The model fit can be assessed by considering the chi-square (CMIN), root mean square error of approximation (RMSEA), goodness-of-fit (GFI), adjusted goodness-of-fit (AGFI), root mean square residual (RMR), standard root mean residual (SRMR), normed fit index (NFI), Tucker Lewis Index (TLI), comparative fit index (CFI), parsimony goodness-of-fit index (PGFI) and Akaike Information Criterion (Hooper et al., 2008; Sun, 2005). The RMSEA cut-off range of 0 to 0.08 is considered an indication of a good fit (Feng & Chen, 2020; Hooper et al., 2008; Sun, 2005). Regarding CFI, GFI and TLI, the values should be greater than or equal to 0.90 to attain an acceptable fit (Feng & Chen, 2020; Hooper et al., 2008; Sun, 2005). Another important fit index is chi-square, which must be greater than 0.05 for the model to fit (Walker, 2010). Furthermore, Feng and Chen (2020) report that chi-square degrees of freedom (CMIN/df) values of less than 3 are acceptable to achieve a well-fitted model. In this study, CMIN, CMIN/df, RMSEA, TLI, CFI, and

GFI were considered when assessing the model fit. All indices met the acceptable range for a good model fit (Table 5). Therefore, analysing the path relationships between study variables was possible using a structural model.

Table 5. Goodness-of-fit assessment

Name of category	Name of index	Level of acceptance	Value
Absolute fit	Chi-square	P-value>0.05	1021.75
	RMSEA	RMSEA<0.08	0.061
	GFI	GFI>0.90	0.916
Incremental fit	CFI	CFI>0.90	0.920
	TLI	TLI>0.90	0.906
Parsimonious	Chisq/df	Chisq/df<3.0	1.890

Source: Authors' calculations

Structural model analysis

The assessment of the structural model incorporated 219 cases, and the results are demonstrated in Table 6. Using the t-values, the hypothesised relationships were analysed. The path coefficient's significance was also examined to explain the degree of association between the independent and dependent variables.

Table 6. Results of hypotheses testing

Hypothesis number	Path	Path Coefficient (β)	T-value	P-value	Decision
H1	TM – PTC	0.438	3.183	***	Supported
H2	TTR – PTC	-0.007	-0.042	0.866	Rejected
H3	C – PTC	-0.514	-4.283	***	Supported

Source: Authors' calculations

H1 proposed that there is a significant positive relationship between tax morale (TM) and presumptive tax compliance (PTC). The results in Table 6 revealed a significant relationship between TM and PTC ($\beta = 0.438$; $t = 3.183$; $p < 0.001$). Thus, this hypothesis was supported. This result supports Nichita & Batrancea (2012), who found that high tax morale leads to high tax compliance levels.

Regarding the impact of taxpayer/tax office relationships (TTR) on PTC, the result of the H2 which predicted a significant positive relationship between TTR and PTC indicated that TTR had no significant influence on PTC (β = -0.007; t = -0.042; p > 0.001). Therefore, H2 is not supported. These results contrast with the views of Inasius (2019), who concluded that the taxpayer/tax office relationship improves if the government spends the tax revenue wisely, for example, on basic facilities such as public transportation and education, and this leads to an increase in voluntary presumptive tax compliance.

In this study, H3 proposed that there is a significant negative relationship between corruption (C) and PTC. The results show that H3 is supported (β = -0.514; t = -4.283; p < 0.001). This is consistent with Bertinelli et al. (2020), who argue that corruption negatively influences tax payments as individuals or firms pay bribes to reduce or avoid tax payments.

Moreover, this study validated the conceptual model that was evaluated using the SEM. From the three hypotheses proposed, the results provide support for two hypotheses. From the empirical results of the study, tax morale has a positive influence on the level of compliance with presumptive taxation. However, the existence of corruption has a negative impact on decisions to comply with presumptive taxation. The validated model for presumptive tax compliance used in this study is shown in Figure 2.

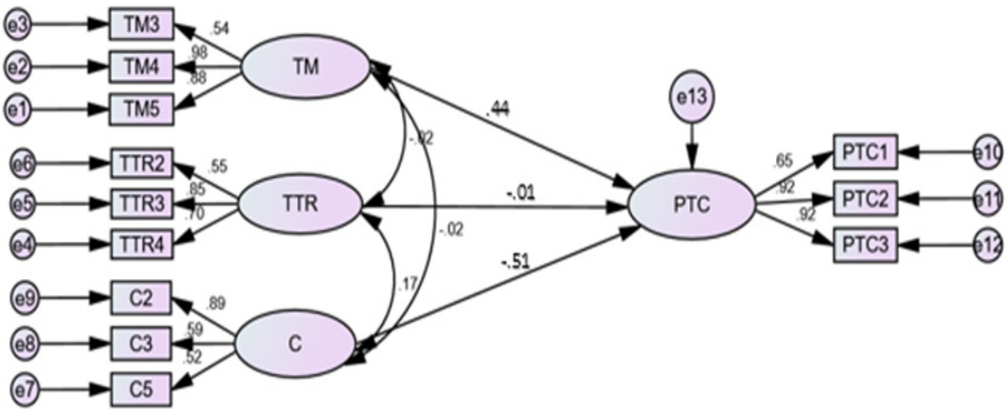

Figure 2. Validated presumptive tax model

Source: Authors' research

The results of this study highlight the complex dynamics of tax compliance among small firms in Northern India, particularly under presumptive taxation. Tax morale (TM) and presumptive tax compliance (PTC) have a positive and statistically significant link, which aligns with existing theories that highlight the significance of taxpayers' attitudes. In line with the results of the present study, Nichita & Batrancea (2012) contend that greater compliance levels are positively correlated with high tax morale. This relationship highlights the potential impact of promoting a positive view of taxes and government policies. It implies that programmes that aim to improve openness, accountability, and democratic procedures may increase small businesses' willingness to comply with presumptive tax obligations voluntarily.

The non-significant correlation between the taxpayer/tax office relationship (TTR) and presumptive tax compliance contradicts widely held beliefs. According to Inasius (2019), effective government spending in conjunction with a positive taxpayer-tax authority relationship could improve voluntary compliance. Nonetheless, the lack of a noteworthy association in this investigation demands a more intricate examination of the particular dynamics of this association inside the framework of Northern India. In order to fully comprehend the intricacy of taxpayer/tax office relations, more research is required. Cultural or institutional intricacies may significantly influence how people perceive tax authorities.

Presumptive tax compliance (PTC) and corruption (C) have a negative and statistically significant association that is consistent with other research showing the detrimental impact of corruption on tax payments. According to Bertinelli et al. (2020), bribery and decreased willingness to comply with tax duties are two ways that corruption creates opportunities for tax evasion. This result underscores how urgently the tax system needs to implement anti-corruption measures. According to the report, presumptive taxation systems must address corruption concerns to succeed, especially in areas where corruption impedes compliance. To improve tax compliance, governments and tax authorities must place a high priority on fighting corruption and promoting an atmosphere of openness and confidence.

Numerous goodness-of-fit indices demonstrate that the structural equation model is well-fitted, which gives the study methodological robustness. This confirms the validity of the current research and emphasises how well the conceptual model captures the complex interactions between the variables. The findings have significant ramifications for Northern Indian tax officials and policymakers. Initiatives focusing on increasing tax morale and combatting corruption appear as essential components of measures aimed at improving presumptive tax compliance among small enterprises.

Positive tax cultures may be fostered by educational initiatives and public awareness campaigns that emphasise the observable advantages of paying taxes. Furthermore, the lack of significance in the relationship between presumptive tax compliance and the taxpayer/tax office interaction points to the necessity for a customised understanding of these dynamics in various industry- or region-specific settings. It is imperative for policymakers to devise policies that are congruent with the complex dynamics at work in cultivating a favourable rapport between tax authorities and small firms.

To sum up, this study adds to our understanding of tax compliance from an academic perspective and offers policymakers useful information to support presumed taxation systems in the distinct socioeconomic context of Northern India. The results highlight the complexity of factors influencing tax compliance and the necessity for focused, situation-specific interventions to increase small firms' voluntary compliance.

Conclusion

The study evaluated the impact of tax morale, corruption and taxpayer/tax office relationships on presumptive tax compliance in the Zimbabwean context. On the basis of the research findings, high tax morale among taxpayers leads to an increase in compliance levels with the presumptive tax system. Regarding the perceptions of corruption, a significant negative impact was discovered on presumptive tax compliance. Accordingly, the government could provide a range of motivations that justify the rationale of paying presumptive taxes. Furthermore, it is also essential for the Zimbabwe Revenue Authority (ZIMRA) to increase awareness and educational programs targeting small businesses regarding the benefits of paying taxes. Moreso, because of the negative attitude towards tax officials by small businesses, the government needs to enhance the autonomy and capacity of tax officials and reduce taxpayers' interaction with tax officials. Less interaction between tax officials and taxpayers could be achieved through the digitalisation of the tax system. The digital transformation should aim at bringing small businesses into e-filing, e-payment, and e-documentation. The benefit could be realised by reducing corruption practices and improving trust that promotes the willingness to comply with the presumptive tax system. By so doing, both the tax authority and small business operators would create more time to focus on other higher-value activities.

In the context of taxpayer/tax office relationships, the study found that the relationships between the tax office and taxpayers are not a significant determinant of presumptive tax compliance. Therefore, it is paramount for

ZIMRA to dedicate time to research small business operators' social norms, morality, and peer pressure to initiate steps that could create positive relationships and increase tax compliance.

The current study contributes to the literature on presumptive taxation. First and foremost, the online survey covers small businesses operating in different economic sectors in Zimbabwe's ten provinces. Thus, the results represented the views of a large population of small businesses in Zimbabwe. Secondly, this study provides new insights into tax morale, perceptions of corruption and taxpayer/tax office relationships. The findings of this study extend the dimensions of tax morale, corruption and taxpayer/tax office relationships, thus providing an update to the existing literature.

Practical implications and limitations

Regarding the implications to practice, this study provides tax authorities and governments with relevant presumptive tax compliance information. Firstly, the government and ZIMRA must acknowledge the existence of tax morale. The government and ZIMRA need to ensure that the provision of public services is a priority, considering the changing needs of the small business sector. Secondly, the government, ZIMRA and small businesses should exchange information to curb corruption and improve working relationships between small business operators and the tax authority. Both tax officials and taxpayers should know the consequences of tax bribes. The findings would be helpful to tax authorities in reforming existing presumptive tax systems.

The study's conclusions have significant practical implications. Tax authorities and policymakers can utilise the study's findings, which emphasise the promotion of tax compliance and the decrease in dishonest activity, to enhance presumptive tax systems. The realisation that contacts between the tax office and taxpayers are ineffective compels a reevaluation of resource allocation, emphasising thorough educational initiatives and programming catering to small businesses. The case for digitising tax systems is stated as a deliberate move to boost confidence, reduce corruption, and increase efficiency.

Similar to other studies, the present one had some limitations. First and foremost, the study focused on presumptive tax compliance in Zimbabwe. While the study considered the views of small businesses operating in Zimbabwe, caution should be taken to the study findings owing to other tax types applicable to small businesses. In this regard, future researchers can consider the determinants of small businesses' tax compliance using different tax types such as value-added tax, pay-as-you-earn and the newly introduced intermediary money transfer tax (IMTT). Secondly, the study used an online questionnaire to collect data

from small business operators. The study was limited to the use of a quantitative approach. Therefore, further studies can use both quantitative and qualitative approaches (questionnaires and in-depth interviews) to gain deep insights into issues surrounding presumptive tax compliance.

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ECONOMIC TREMORS FROM A PERFECT STORM: THE UKRAINIAN CRISIS AND ITS IMPACT ON REGIONAL STOCK MARKET VOLATILITY

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ABSTRACT. This study investigates the impact of the Russia-Ukraine war on stock market volatility in neighboring countries, analyzing five stock market indices (BET, BUX, WIG, SAX, and MOEX) over a three-year period encompassing one year before and two years after the conflict's outbreak. Employing four volatility estimators (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell), this research examines the evolution of market volatility and inter-market correlations. Findings reveal a general increase in volatility across most indices following the war's commencement, with the MOEX index experiencing the highest turbulence. The concept of a "proximity penalty" is partially supported, as geographical closeness to the conflict zone does not uniformly correspond to increased volatility. Also, findings show an initial strengthening of correlations between markets in the first year of the war, suggesting a "contagion effect." However, this is followed by a weakening of correlations in the second year, indicating a potential "decoupling effect" as markets begin to respond more to local economic conditions. These results have significant implications for investors, policymakers, and risk managers, highlighting the

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need for dynamic portfolio management strategies, tailored policy responses, and flexible risk models that can adapt to changing market conditions during prolonged geopolitical crises. This study contributes to the existing literature by extending the temporal scope of analysis beyond the immediate aftermath of the war's outbreak and providing insights into the "proximity effect" in the context of a major European conflict. The observed patterns of initial volatility spikes followed by varying degrees of persistence and changing correlation structures offer a nuanced picture of how geopolitical events impact financial markets over time, emphasizing the complex interplay between political events and financial market dynamics.

Keywords: Stock market volatility; geopolitical risk; Russia-Ukraine war; range-based volatility estimators; proximity effect.

JEL classification: **G15, F51**

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Introduction and brief review of the relevant literature

The outbreak of war between Russia and Ukraine on February 24, 2022 sent shockwaves through global financial markets, particularly impacting neighboring countries in Eastern Europe. This major geopolitical event has heightened uncertainty and risk perceptions among investors, leading to increased volatility in stock markets across the region. The conflict's far-reaching economic and political implications have made it a critical case study for examining how geopolitical crises affect financial market dynamics, especially in proximate nations.

Geopolitical events like wars, terrorist attacks, and political tensions have long been recognized as significant drivers of stock market volatility (Caldara & Iacoviello, 2022). These events introduce uncertainty into the economic landscape, affecting investor sentiment and decision-making processes. The unpredictable nature of geopolitical crises often leads to rapid shifts in market behavior as investors reassess risks and adjust their portfolios accordingly (Antonakakis et al., 2017). In the case of armed conflicts, the potential for economic disruption, sanctions, and shifts in international relations can have profound effects on market stability and investor confidence.

The relationship between geopolitical events and stock market volatility has been well-documented in financial literature. Studies have shown that heightened geopolitical risks can lead to increased market volatility, decreased returns, and changes in correlation patterns between different markets (Boubaker et al., 2022). For instance, research on the impacts of terrorist attacks has demonstrated significant short-term increases in volatility following such events (Corbet et al., 2018). Similarly, studies on the effects of political tensions and military conflicts have revealed their substantial influence on stock market dynamics (Omar et al., 2017; Hudson & Urquhart, 2015).

The Russia-Ukraine conflict presents a unique opportunity to examine these dynamics in the context of a major European war – the first of its kind since World War II. The conflict's geographic location and the economic significance of both countries have amplified its impact on neighboring nations and global markets. Russia's role as a major energy supplier to Europe and both countries' importance in global commodity markets have created complex economic ripple effects that extend far beyond their borders (Liadze et al., 2022).

Recent studies have begun to explore the specific impacts of the Russia-Ukraine war on financial markets. Yousaf et al. (2022) found significant negative abnormal returns in G20 stock markets following the outbreak of the conflict. Similarly, Boubaker et al. (2022) documented negative abnormal returns for MSCI indices in response to the invasion. These findings underscore the war's broad impact on global markets, but they also highlight the need for more focused research on its effects in neighboring countries.

The concept of proximity plays a crucial role in understanding the differential impacts of geopolitical events on various markets. Federle et al. (2022) introduced the idea of a "proximity penalty," suggesting that markets closer to conflict zones may experience more severe effects. This concept was further supported by Martins et al. (2023a,b), who found evidence of heightened market reactions in countries geographically closer to the Russia-Ukraine conflict. These findings suggest that neighboring countries may be particularly vulnerable to increased volatility and market disruptions due to their physical proximity to the war zone and potential economic ties to the conflicting nations.

Furthermore, the Russia-Ukraine conflict has had significant implications for energy and commodity markets, which in turn affect stock market dynamics. Adekoya et al. (2022) and Wang et al. (2022) have explored the complex relationships between energy markets and other financial markets in the context of this conflict. Their findings suggest that countries with strong ties to Russian energy markets or those competing with Russia in energy production may experience unique patterns of stock market volatility in response to the war.

Given the ongoing nature of the conflict and its continued impact on global markets, there is a pressing need for comprehensive research that examines its long-term effects on stock market volatility, particularly in neighboring countries. While existing studies have provided valuable insights into the immediate market reactions to the war's outbreak, there is a gap in the understanding of how these effects evolve over time and how they specifically impact the markets of countries in close proximity to the conflict zone.

Considering this context, the main objective of this research is to analyze the impact of the Russia-Ukraine war on stock market index volatility in neighboring countries over an extended period, comparing pre-war and post-war market behavior. By examining a sample of index quotations from neighboring countries for one year before the war and two years after its commencement, this study aims to provide a comprehensive assessment of how proximity to the conflict zone influences stock market volatility patterns.

This research contributes to the existing literature in several important ways. First, it extends the temporal scope of analysis beyond the immediate aftermath of the war's outbreak, allowing for a more nuanced understanding of how market volatility evolves over time in response to ongoing geopolitical tensions. Second, by focusing specifically on neighboring countries, the study provides insights into the "proximity effect" in the context of a major European conflict, building on the work of Federle et al. (2022) and Martins et al. (2023a,b). Finally, the research offers practical implications for investors, policymakers, and financial institutions operating in or connected to markets in close proximity to geopolitical hotspots.

Understanding the long-term impacts of the Russia-Ukraine war on stock market volatility in neighboring countries is crucial for developing effective risk management strategies, informing policy decisions, and guiding investment practices in an increasingly uncertain global environment. As geopolitical tensions continue to shape the international landscape, this research provides valuable insights into the complex interplay between political events and financial market dynamics.

Research methodology

This study employs a comprehensive approach to assess the impact of the Russia-Ukraine war on stock market volatility in neighboring countries, using four well-established range-based volatility estimators: Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell. These methods are chosen for their ability to capture intraday price fluctuations and provide more efficient estimates of volatility compared to traditional close-to-close estimators (Floros, 2009).

The collected dataset comprises daily stock index quotations for five markets in close proximity to the conflict zone: BET (Romania), BUX (Hungary), WIG (Poland), SAX (Slovakia), and MOEX (Russia). These markets represent countries that share direct borders with Ukraine, making them particularly relevant for studying the proximity effect of the conflict. The selected countries form a geographical corridor along the frontier of the conflict zone, providing a comprehensive view of the war's financial impact on neighboring markets.

Also, the selected markets share similar characteristics as emerging European economies, with comparable market structures and development levels. This homogeneity allows for more meaningful comparisons and reduces the potential bias from differing market maturity levels. The collected data from the selected markets is rendered consistent, reliable, and complete daily trading data throughout the study period, ensuring robust analysis.

The study excludes the Ukrainian stock market (PFTS) from the dataset due to: a direct effect of the conflict on their grounds (as opposed to Russia, where the conflict is outside their border), trading suspensions following the war's outbreak (rendering incomplete price data series), a lack of reliability for high and low prices needed for range-based volatility estimation, as well as significant market disruptions.

The sample period spans from February 24, 2021, to February 23, 2024, encompassing one year before the outbreak of the Russia-Ukraine war and two years following its commencement. This timeframe allows us to analyze the pre-war volatility patterns and compare them to the post-war dynamics, providing insights into the conflict's immediate and prolonged effects on market volatility.

Daily opening, closing, high, and low prices for each index were collected from reliable financial data providers. The use of these four price points enables the application of range-based volatility estimators, which have been shown to be more efficient than traditional methods that rely solely on closing prices (Garman & Klass, 1980; Rogers & Satchell, 1991).

In the full extent of the computations spectrum, the methodology is grounded on four well-established estimators of volatility assessment:

A. Close-to-Close (CC)

The Close-to-Close historical volatility estimator is a standard method of calculation of historical volatility. The estimator calculated by the through of logarithmic returns over a given period of observation. CC volatility reflects the historical price movements of the underlying stock, measuring the assets' actual volatility.

$$\sigma_{CC}^2 = \frac{1}{T-1}\sum_{t=1}^{T}(r_t - \acute{r})^2 \quad (1)$$

Where:

- σ_{CC}^2 is the Close-to-Close variance estimate;
- T is the number of trading days;
- $r_t = \ln(C_t/C_{t-1})$ represents the logarithmic return between consecutive closing prices;
- $\acute{r}$ is the mean of the logarithmic returns;
- C_t and C_{t-1} are the closing prices on days t and t-1, respectively.

This estimator uses only closing prices and assumes that returns are normally distributed. While it is the most traditional approach, it has limitations as it ignores intraday price movements and can be more sensitive to market microstructure effects than range-based estimators. The CC estimator is particularly useful for long-term volatility analyses and serves as a benchmark for comparing other volatility estimation methods.

B. Parkinson estimator

The Parkinson estimator, introduced by Parkinson (1980), utilizes the daily high and low prices to estimate volatility. It is defined as:

$$\sigma_P^2 = \frac{1}{4ln(2)T}\sum_{t=1}^{T}\left(ln\frac{H_t}{L_t}\right)^2 \quad (2)$$

Where:

- σ_P^2 is the Parkinson variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively.

The Parkinson estimator is considered more efficient than the close-to-close estimator, as it captures intraday price movements and is less affected by microstructure noise (Alizadeh et al., 2002).

C. Garman-Klass estimator

Garman and Klass (1980) proposed an improved estimator that incorporates opening and closing prices in addition to high and low prices. The Garman-Klass estimator is defined as:

$$\sigma_{GK}^2 = \frac{1}{T}\sum_{t=1}^{T}\left[0.5\left(ln\frac{H_t}{L_t}\right)^2 - (2ln2 - 1)\left(ln\frac{C_t}{O_t}\right)^2\right] \quad (3)$$

Where:

- σ_{GK}^2 is the Garman-Klass variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively;
- O_t and C_t are the opening and closing prices on day t, respectively.

This estimator is theoretically more efficient than the Parkinson estimator, as it utilizes more price information (Chan and Lien, 2003).

D. Rogers-Satchell estimator

Rogers & Satchell (1991) developed an estimator that is unbiased in the presence of a non-zero drift, making it particularly suitable for longer estimation periods or markets with strong trends. The Rogers-Satchell estimator is defined as:

$$\sigma_{RS}^2 = \frac{1}{T}\sum_{t=1}^{T}\left[ln\frac{H_t}{O_t}ln\frac{H_t}{C_t} + ln\frac{L_t}{O_t}ln\frac{L_t}{C_t}\right] \quad (4)$$

Where:

- σ_{RS}^2 is the Rogers-Satchell variance estimate;
- T is the number of trading days;
- H_t and L_t are the high and low prices on day t, respectively;
- O_t and C_t are the opening and closing prices on day t, respectively.

This estimator has the advantage of being drift-independent, which is particularly relevant for the current study given the potential for significant market trends during the conflict period (Rogers et al., 1994).

For each of the five indices (BET, BUX, WIG, SAX, and MOEX), computations include daily volatility estimates using the Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell methods. The process involved the following steps:

- In the preprocessing phase, data quality is ensured by checking for and addressing any missing values or outliers in the price series.
- For each trading day, computations include daily volatility estimates using the four previously described methods.
- To facilitate comparison and interpretation, data annualizes the daily volatility estimates by multiplying by the square root of the number of trading days in a year (typically 252).

- The study inclused time series of annualized volatility estimates for each index and each estimation method.

To assess the interconnectedness of market volatilities and potential spillover effects, the study proceeds with correlation analyses between the volatility estimates of the five indices. More specifically, computations include Pearson correlation coefficients for three distinct periods:

- Pre-war period: February 24, 2021 - February 23, 2022;
- First year of war: February 24, 2022 - February 23, 2023;
- Second year of war: February 24, 2023 - February 23, 2024.

This segmentation allows us to examine how the relationships between market volatilities evolved from the pre-war period through the first and second years of the conflict.

In the subsequent sections of this study, interpretations include a detailed analysis of these results, discussing their implications for investors, policymakers, and risk managers operating in or connected to these markets. The study also explores potential explanations for the observed patterns, drawing on existing literature on geopolitical risks and financial market behavior.

Results and discussion

The volatility estimates obtained using the four methods (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) show varying levels of market turbulence across the five indices over the study period. Generally, as findings show in *Table 1*, an increase in volatility is noted, following the outbreak of the Russia-Ukraine war, with the magnitude and persistence of this increase varying across markets.

A notable finding from the volatility estimates presented in *Table 1* is the consistency across all four estimation methods (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) for each market index. For instance, in the pre-war period (2021-2022), the BET index shows minimal variation between estimators, ranging from 0.74% (Garman-Klass) to 0.83% (Close-to-Close). Similarly, the MOEX index demonstrates consistent values across all estimators, ranging from 2.27% to 2.56%.

This consistency in volatility estimates across different methodologies strengthens the robustness of the findings and suggests that the observed market dynamics are not artifacts of the estimation method chosen. Similar values obtained through different approaches, each with its theoretical advantages, provide strong validation of the measured volatility levels and their changes

across the three distinct periods. This convergence is particularly important given that each estimator captures different aspects of price movements - from simple close-to-close returns to more sophisticated measures incorporating intraday price ranges.

Table 1. Volatility estimators of analyzed stock market indices before and after the start of the conflict in Ukraine

Timeframe	Estimator	BET	BUX	WIG	SAX	MOEX
2021-2022	Close to close	0.8300%	1.2200%	1.2300%	0.7200%	2.5600%
	Parkinson	0.7700%	1.1500%	0.8800%	0.2400%	2.2800%
	Garman and Klauss	0.7400%	1.1100%	0.8300%	0.1600%	2.2700%
	Roger Satchell	0.7800%	1.1400%	0.8100%	0.1300%	2.3600%
2022-2023	Close to close	1.1700%	1.8700%	1.6700%	0.8500%	3.1700%
	Parkinson	1.0000%	1.6500%	1.1900%	0.2700%	2.6600%
	Garman and Klauss	0.9300%	1.5600%	1.1100%	0.1900%	2.6400%
	Roger Satchell	0.9500%	1.5600%	1.0800%	0.1600%	2.7400%
2023-2024	Close to close	0.6900%	0.9000%	1.0800%	0.7600%	0.8100%
	Parkinson	0.6200%	0.9200%	0.8700%	0.1100%	0.8100%
	Garman and Klauss	0.5900%	0.9200%	0.8400%	0.0900%	0.8200%
	Roger Satchell	0.6000%	0.9400%	0.8300%	0.0800%	0.8400%

Source: authors' computation based on data collected from investing.com (with validation from stock markets' official websites) between February 24, 2021 and February 23, 2024

For the MOEX index, findings show the highest volatility levels, particularly in the immediate aftermath of the war's outbreak. Specifically, the Parkinson estimator showed a volatility of 2.66%, the Garman-Klass estimator 2.64%, and the Rogers-Satchell estimator 2.74% for MOEX in the year following the war's start. In contrast, the SAX index exhibited relatively low volatility, with estimates typically below 1% throughout the study period. For instance, in the year following the war's outbreak, the SAX index showed volatility estimates of 0.27% (Parkinson), 0.19% (Garman-Klass), and 0.16% (Rogers-Satchell).

The BET, BUX, and WIG indices showed intermediate levels of volatility. In the year following the war's start, the BET index exhibited volatility estimates of 1.00% (Parkinson), 0.93% (Garman-Klass), and 0.95% (Rogers-Satchell). The BUX index showed slightly higher volatility with 1.65% (Parkinson), 1.56%

(Garman-Klass), and 1.56% (Rogers-Satchell). The WIG index demonstrated volatility levels of 1.19% (Parkinson), 1.11% (Garman-Klass), and 1.08% (Rogers-Satchell).

Comparing the pre-war period to the first year of the war, findings show significant increases in volatility across all indices except SAX. For instance, the BET index saw its Parkinson volatility rise from 0.77% to 1.00%, while the BUX index experienced an increase from 1.15% to 1.65%.

For the correlation analysis between market indices, the study employed the close-to-close volatility estimator, which is calculated using logarithmic returns over the observation period. While the volatility data was computed using multiple estimators (Parkinson, Garman-Klass, and Rogers-Satchell), the close-to-close method was selected for correlation calculations due to its widespread use in financial literature and its established reliability in capturing market co-movements.

The choice of the close-to-close estimator for correlation analysis is further supported by preliminary tests showing that all estimators (Close-to-Close, Parkinson, Garman-Klass, and Rogers-Satchell) yielded similar correlation patterns. The consistency across different estimation methods suggests that the findings regarding market interconnectedness are robust and not dependent on the specific volatility estimation technique employed

The close-to-close estimator's simplicity and direct interpretation render it particularly suitable for the correlation analysis, as it captures the overall daily price movements that are most relevant for understanding market relationships. This approach allows for a clear and straightforward assessment of how different markets respond to shared external shocks, such as the geopolitical crisis under study.

The correlation analysis reveals interesting patterns in the co-movement of volatilities across markets over the three distinct periods. For instance, in the pre-war period (see *Table 2*), results reveal moderate positive correlations between most pairs of indices. The strongest correlation (0.233) is found between BET and WIG, significant at the 0.01 level. This suggests a moderate level of market integration between Romania and Poland prior to the conflict. The MOEX index shows weak to moderate positive correlations with other indices during this period, with significant correlations with BET (0.129) and WIG (0.146) at the 0.05 level.

An interesting finding is that the BUX index shows a significant negative correlation (-0.140) with MOEX, indicating a potential divergence in market behavior between Hungary and Russia before the war.

Table 2. Volatility correlation matrix between indices – timeframe: February 24, 2021 – February 23, 2022

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.036	0.233**	0.015	0.129*
	Sig. (2-tailed)		0.571	0.000	0.810	0.041
BUX	Pearson Correlation		1	0.200**	-0.010	-0.140*
	Sig. (2-tailed)			0.001	0.874	0.026
WIG	Pearson Correlation			1	0.111	0.146*
	Sig. (2-tailed)				0.081	0.020
SAX	Pearson Correlation				1	0.005
	Sig. (2-tailed)					0.938
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					
****. Correlation is significant at the 0.01 level (2-tailed).**						
***. Correlation is significant at the 0.05 level (2-tailed).**						

Source: authors' computation based on quotation data collected from investing.com

In the first year of the war (see *Table 3*), findings show a general strengthening of correlations between indices. The correlation between BET and WIG increased to 0.336, significant at the 0.01 level. New significant correlations emerged, such as between BUX and MOEX (0.331), and between BET and BUX (0.265), all significant at the 0.01 level.

Table 3. Volatility correlation matrix between indices – timeframe: February 24, 2022 – February 23, 2023

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.265**	0.336**	-0.055	0.206**
	Sig. (2-tailed)		0.000	0.000	0.386	0.002
BUX	Pearson Correlation		1	0.281**	-0.061	0.331**
	Sig. (2-tailed)			0.000	0.338	0.000
WIG	Pearson Correlation			1	-0.152*	0.415**
	Sig. (2-tailed)				0.016	0.000
SAX	Pearson Correlation				1	0.021
	Sig. (2-tailed)					0.750
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					
****. Correlation is significant at the 0.01 level (2-tailed).**						
***. Correlation is significant at the 0.05 level (2-tailed).**						

Source: authors' computation based on quotation data collected from investing.com

This strengthening of correlations suggests increased market interconnectedness during the initial phase of the conflict. The strongest correlation in this period is observed between WIG and MOEX (0.415), indicating a particularly strong co-movement between Polish and Russian market volatilities.

Another peculiar finding is that in the second year of the war (2023-2024), as shown in *Table 4*, the analysis exhibits a weakening of correlations across most index pairs. Only the correlation between BUX and WIG remains statistically significant at 0.151, while other correlations become insignificant or approach zero. This decoupling of market volatilities could indicate a normalization of market behavior or a divergence in economic responses to the prolonged conflict across different countries.

Table 4. Volatility correlation matrix between indices – timeframe: February 24, 2023 – February 23, 2024

		BET	BUX	WIG	SAX	MOEX
BET	Pearson Correlation	1	0.041	0.102	-0.002	0.051
	Sig. (2-tailed)		0.516	0.111	0.970	0.420
BUX	Pearson Correlation		1	0.151*	0.043	-0.049
	Sig. (2-tailed)			0.017	0.504	0.444
WIG	Pearson Correlation			1	-0.024	-0.008
	Sig. (2-tailed)				0.706	0.905
SAX	Pearson Correlation				1	-0.055
	Sig. (2-tailed)					0.389
MOEX	Pearson Correlation					1
	Sig. (2-tailed)					

***. Correlation is significant at the 0.05 level (2-tailed).**

Source: authors' computation based on quotation data collected from investing.com

These findings provide valuable insights into the evolving dynamics of stock market volatilities in countries neighboring the conflict zone. The observed patterns of initial volatility spikes followed by varying degrees of persistence and changing correlation structures offer a nuanced picture of how geopolitical events impact financial markets over time.

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The immediate increase in volatility across most indices following the war's outbreak aligns with findings from previous studies on the impact of geopolitical events on financial markets. For instance, Yousaf et al. (2022) found

significant negative abnormal returns in G20 stock markets following the outbreak of the conflict, which is consistent with the observations of increased volatility.

The concept of a "proximity penalty" introduced by Federle et al. (2022) is partially supported by the study's findings. While the MOEX index, representing the Russian market, indeed showed the highest volatility, the SAX index, representing Slovakia, which is also geographically close to the conflict, showed the lowest volatility. This suggests that factors beyond mere geographical proximity, such as economic ties and policy responses, play crucial roles in determining market reactions.

The evolution of correlations over the three periods provides insights into the changing dynamics of market integration in response to the conflict. The initial strengthening of correlations in the first year of the war suggests a "contagion effect," where the shock of the conflict led to more synchronized market movements. This is consistent with findings from Martins et al. (2023a,b), who observed heightened market reactions in countries geographically closer to the Russia-Ukraine conflict.

However, the subsequent weakening of correlations in the second year of the war presents an interesting phenomenon. This could indicate a "decoupling effect," where markets begin to respond more to local economic conditions and policy measures rather than the ongoing conflict. This finding contributes new insights to the existing literature on long-term impacts of geopolitical events on market integration.

These results have several implications for investors, policymakers, and risk managers. For instance, the changing correlation structures highlight the importance of dynamic portfolio management for investors in times of geopolitical crisis. The initial increase in correlations suggests reduced diversification benefits in the short term, while the subsequent decrease may present new opportunities for portfolio diversification.

Policymakers should be aware of the potential for prolonged market volatility, particularly in countries closely tied to the conflict economically. The varying responses of different markets (e.g., MOEX vs. SAX) underscore the need for tailored policy responses that consider each country's unique economic situation and ties to the conflicting nations.

Risk managers need to adapt their models to account for the changing nature of market correlations during extended geopolitical crises. The observed pattern of initial correlation increase followed by a decrease suggests that risk models should be flexible and regularly updated to reflect these dynamic market conditions.

Conclusions, limitations and research perspectives

In essence, this study provides valuable insights into the impact of the Russia-Ukraine war on stock market volatility in neighboring countries. The analysis of five stock market indices (BET, BUX, WIG, SAX, and MOEX) over a three-year period reveals significant changes in volatility patterns and market correlations following the outbreak of the conflict.

The results from the current study demonstrate a general increase in volatility across most indices after the war's commencement, with the MOEX index experiencing the highest levels of turbulence. This aligns with the concept of a "proximity penalty" but also highlights the complexity of market reactions, as evidenced by the SAX index's relatively low volatility despite its geographical proximity to the conflict. The evolution of market correlations over time provides further insights into the changing dynamics of market integration. Findings show an initial strengthening of correlations in the first year of the war, suggesting a "contagion effect," followed by a weakening of correlations in the second year, indicating a potential "decoupling effect."

These findings have important implications for investors, policymakers, and risk managers. They underscore the need for dynamic portfolio management strategies, tailored policy responses considering each country's unique economic situation, and flexible risk models that can adapt to changing market conditions during prolonged geopolitical crises.

The study's limitations include its focus on a specific set of neighboring countries, which may not fully represent the broader impact of the conflict on global markets. Additionally, the use of daily data may not capture intraday volatility spikes, potentially underestimating the full extent of market reactions to specific war-related events.

Future research endeavors will aim to expand on this study by incorporating a wider range of countries, including those indirectly affected by the conflict. Investigating the specific economic and policy factors contributing to the observed volatility patterns and correlation changes will provide deeper insights into market behavior during geopolitical crises. Furthermore, exploring the long-term implications of these market dynamics on economic growth and financial stability in the region could offer valuable perspectives for policymakers and investors alike.

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UNLOCKING THE SHOPPER'S MIND: HOW EMERGING TECHNOLOGIES LIKE ARTIFICIAL INTELLIGENCE IS SHAPING THE FUTURE OF RETAIL

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ABSTRACT. The fast-changing landscape of consumer behavior, driven by digitalization in retail, fosters big changes in industry. Two other major trends are omnichannel strategies, integrating physical experience with online shopping, and the rise of experiential shopping technologies such as AR (augmented reality) in shaping how retailers connect with consumers. The increasing function of artificial intelligence and machine learning to optimize supply chains also raises crucial questions regarding the ethics of these developments in retail marketing.

This paper also discusses neuromarketing, an innovative approach whereby neuroscience is combined with marketing, as a tool to help optimize sales techniques and improve customer service. Techniques such as EEG (electroencephalogram), eye-tracking, and fMRI (functional magnetic resonance imaging) offer retailers insight into customers' unconscious responses to stimuli, from advertising to product placement. While these approaches have been increasingly adopted by retailers, the current study investigates whether the drift toward digital platforms impacts the efficiency of neuromarketing strategies and how AI takes further priority in this direction (Goncalves et al., 2024).

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The backbone of this research is to establish the level at which businesses have integrated neuromarketing into their greater marketing strategies and to find any new consumer behavior that could be proposed within a retail context. This paper will attempt to contribute, by exploratory research and secondary data analysis, to a better understanding of how these new trends adapts to the digitization of retail due to technological development and ethical concerns raised by its increased use.

Keywords: Retail, E-commerce, Omnichannel, Personalization, Artificial Intelligence, Neuromarketing, Ethical implications.

JEL classification: **M310, M160**

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Introduction

Over the past two decades, the retail industry has undergone a profound transformation, driven by increasingly rapid technological advances and changes in consumer behavior. Beyond monitoring stocks and decisions based on data, the influence of digitalization is extensive and transformative, as is the management strategy of facilitating customer interactions. Digitization has become necessary for companies in this sector that aspire to remain competitive in a dynamic and globalized market (Nodirovna & Sharif o'g'li, 2024). Moreover, according to the authors from McKinsey's Consumer & Retail Practice, they explained in their article how countless retailers, witnessing the evolution of e-commerce and artificial intelligence as well as Big Data and advanced analysis, have begun to explore new ways to improve this consumer experience, the supply chain and in terms of increasing operational efficiency (Bick et al., 2022). Today's customers have considerable expectations regarding both the online and the offline experience, that's why according to the specialists in the field, the winners in a better position in terms of consumer loyalty are those retailers who can offer a combination of personalized interactions, efficiency and better compatibility between channels (PwC, 2023). All these authors mention how this series of factors that led to the remodeling of the industry has accelerated since the pandemic. These factors are the growth of e-commerce but also omnichannel, changing customer behavior and hyper-personalization as well as the increasing complexity of the supply chain (Bick et al., 2022).

Literature Review

Omnichannel retail: a modern approach

Omnichannel commerce is one of the essential strategies in contemporary retail because it emphasizes an exceptional integration of online and offline channels (Nodirovna & Sharif o'g'li, 2024). In specialized publications, a popular definition is "the synergistic management of numerous channels and contact points, so that the customer experience and channel performance are optimized" according to the authors Verhoef et al. (2015). Through this synergistic management of all contact points, the final goal becomes to offer customers a unique, coherent, and amorphous experience, compared to multichannel retail, which aims to optimize each channel in an independent way (Cai & Lo, 2020; Mishra et al., 2021).

Extension to social commerce

Social commerce is an essential step in the omnichannel strategy because it facilitates shopping directly on social media platforms such as Facebook, Tok-Tok, or Instagram. In the article written by Nodirovna & Sharif o'g'li, (2024) there appears a blurring of the boundaries between the process of socialization and that of commerce, thus allowing consumers to discover, analyze and eventually buy the product without having to leave the social media application. They also explain how merchants use shopping posts, these in-app purchases, and influencer marketing manage to stimulate sales, turning social interaction into a shopping experience.

This pattern is supported by additional research. Hutter et al. (2013), for example, point out how social media platforms have developed into powerful venues for branding and marketing, improving customer experiences by enabling direct communication between customers and brands. Authors describe how, by leveraging the social element of purchasing, which many customers find more alluring, this type of interactive shopping increases customer loyalty. In a similar vein, Shankar et al. (2003) explain that social commerce is about developing relationships, forming communities, and cultivating brand champions rather than just transactions. Customers feel more involved in the process thanks to this experience, which turns the passive activity of shopping into an active, community-driven event.

Personalization – A KEY FACTOR

Personalization is truly a game changer in the omnichannel strategy because it reaches parameters such as a more engaging and relevant experience for consumers. Moreover, advanced technologies help retailers, both large and small, to analyze consumer behaviors and preferences with greater ease. Thus, by using data analysis or artificial intelligence (AI), they manage to deliver personalized recommendations, promotions, and offers of products or services much more easily according to the needs of their consumers (Nguyen et al., 2021). At the same time, marketing campaigns have also experienced considerable progress due to the involvement and advancements in big data and machine learning (ML), together with natural language processing (NLP) and computer vision, thus having greater predictability in the offer and the more advanced outlining in personalized recommendation allowing a different implementation of personalized marketing campaigns and a dynamic pricing strategy (Balakrishnan et al., 2018, Artun & Levin, 2015).

Consumer experience

Customers' "cognitive, emotional, behavioral, sensory, and social responses to a firm's offerings" are part of customer experiences, which are typically multidimensional (Verhoef et al., 2009). The pandemic has changed how satisfactory customer experience works and has allowed retailers to provide superior customer experiences (Murugan & Kumar, 2024).

According to Kotler (2017), a consumer's decision to buy consists of five distinct phases: determining needs, gathering information, weighing options, making a purchase decision, and post-purchase behavior experiences (Murugan & Kumar, 2024). It was pointed out how AI helps marketers analyze customer preferences and turn vast amounts of data into useful insights. Hence, by optimizing product cataloging and providing personalized recommendations, AI improves marketing tactics leading to a more relevant and efficient shopping experience. As mentioned in the article written by Sagar (2024), digitization has revolutionized the interaction of consumers with brands, contributing to an accelerated migration to online and omnichannel commerce. Thus, following the thread of ideas provided above, e-commerce platforms have radically transformed the way consumers shop, offering a certain convenience due to easy navigation, the opportunity to compare prices, access to reviews, and various product options (Sagar, 2024). These changes have led consumers to prefer personalized online experiences, emphasizing intuitive interfaces and secure transactions with fast delivery.

Moreover, the impact that influential people have on consumer preferences has contributed to the success of marketing that influences (Abidin, 2016). To promote their goods, brands work with influencers, leveraging the trust and genuine relationship they have with their audience. Users produce content such as photos, videos, and reviews to build brand credibility. Because customers believe that this type of content is more dependable and realistic than traditional advertising, brands that promote this type of content gain authenticity (Kaplan & Haenlein, 2010). This shift in marketing demonstrates a shift from traditional promotion to more direct interactions tailored to customer needs.

Key technologies and innovations in omnichannel

This advancement in omnichannel also provides for the integration of modern technologies such as Augmented Reality (AR) and Virtual Reality (VR), which brings real success to this type of strategy (Grewal et al., 2020; Nodirovna & Sharif o'g'li, 2024). One of the examples offered by specialty items is the Sephora Virtual Artist platform that allows you to try on cosmetics before purchasing them virtually, thus leading to higher loyalty and a better shopping experience (Quach et al., 2022; Thaichon et al., 2024). At the same time, based on AI, predictive analysis helps retailers more easily identify emerging trends and adjust their strategies to increase their competitiveness in the market. (Huang & Rust, 2021). Thus, AI also helps to optimize the inventory, creating a forecast of growth patterns, but also reducing at the same time the risk of running out of stocks or overstock by adjusting their levels according to seasonal fluctuations and market trends, as is also mentioned by the authors indicated above in the text.

In the same vein, according to the author Sagar (2024), Logistics Chain Management has seen a reinvention and evolution in terms of visibility, efficiency, and adaptability. Thanks to technologies such as RFID (Radio-Frequency Identification) and the Internet of Things (IoT), real-time tracking of the movement of goods is facilitated, thus increasing the degree of control over the logistics chain by retailers. Through this monitoring, the delivery time is reduced, a much more qualitative and faster communication between producers and consumers is created, as well as ensuring a constant supply. In addition, IoT has also brought a change regarding physical stores, bringing them to the level of intelligent spaces. (Varakantham et al., 2018). Customer satisfaction and loyalty increase due to the optimization of the store layout and the efficient placement of products on the shelf.

Neuromarketing

In an age where the retail industry is being profoundly transformed by modern technologies, the concept of neuromarketing is essential to understanding and influencing consumer behavior. Neuromarketing uses neurological and biometric research to study consumers' subconscious reactions to marketing stimuli (Goncalves et al., 2024). This gives us a better understanding of consumer buying actions.

Based on the same article written by Goncalves et al. (2024), the evolution of omnichannel strategies, which aim to offer customers a unique and personalized experience on each sales channel, has expanded this field. Retailers can improve customer shopping experiences in real time by using AI and ML to collect and analyze customer behavioral data from multiple sources, from physical stores to online platforms (Goncalves et al., 2024). Therefore, neuromarketing thus offers greater personalization and a closer connection between emotional reactions and purchase decisions.

On the other hand, neuromarketing research has made progress, but more extensive studies are still needed to integrate it into the marketing mix, say the specialists Goncalves et al. (2024). The same authors say that researchers have primarily focused on neuroimaging and physiological tools such as EEG, eye tracking, and skin response to study consumer behavior, emotions, attention, and decision-making processes have focused primarily on neuroimaging and physiological tools such as EEG, eye tracking, and skin response to study consumer behavior, emotions, attention, and decision-making processes, demonstrating how different areas of consumers' brains are connected to their reactions, providing useful data for marketing (Goncalves et al., 2024). Also, what is important is the final help given by this technology, more precisely objectivity in measurement by preventing biases in self-reported data about customers, such as cognitive biases or emotional influences. Neuromarketing also includes AI and ML. These technologies improve productivity by reducing the time required for analysis processes and providing better customer data (Goncalves et al., 2024).

The combination of neuromarketing and AI technologies improves marketing efficiency by analyzing consumer behavior and targeting campaigns. However, because AI is used discreetly in many marketing applications, ethical concerns about its impact on consumer privacy are often ignored.

Ethical implications

Increasing transparency in the decision-making processes of these systems is necessary as artificial intelligence grows. As authors Thaichon et al., (2024) highlighted, explainable AI (XAI) techniques improve understanding of how AI models make decisions. This builds trust in AI systems and encourages informed decision-making in organizations (Thaichon et al., 2024). The same authors say that to maintain accountability, AI transparency helps identify problems and validate predictions. Additionally, there is growing concern about the morality of using AI. Companies face issues of bias, accountability, and fairness, and implementing ethical practices and auditing frameworks that guarantee the impartiality of AI models is essential to address them (Thaichon et al., 2024). These measures are necessary to maintain high ethical standards in AI applications and to reduce associated risks (Hamadaqa et al., 2024). Companies need customer data for omnichannel retail strategies to enhance the customer experience across all points of contact (Ameen et al., 2021; Tyrväinen et al., 2020). For instance, AI can use customer tracking data to personalize multiple components of the offer, such as the cost, advertisement, goods, duration, and delivery location (Weber & Schütte, 2019). However, access to customers' personal information can have a negative impact on merchants and customer privacy (Cui et al., 2021). In this case, omnichannel research demonstrates that technology has both positive and detrimental consequences. For instance, research conducted by Quach et al., (2022) shows that while canal integration enhances customer satisfaction in omnichannel retail, it also increases customer privacy risk, which results in a decrease in customer trust. In addition, the findings of Shi et al. (2020) findings support the idea that elements like confidentiality, adaptability, personalization, and compatibility are perceived as improving customers' perceptions of risk.

Methodology

This paper uses an exploratory research approach, focusing on a literature-based analysis to examine emerging technologies and strategies in the retail industry. The methodology primarily used referral-based approach and citation chain analysis. This began with general searches on Google Scholar, which led to relevant sources on sites such as ResearchGate and other academic and specialist sites. A dynamic and iterative process was used to find relevant materials, tracking the bibliographies of key articles and examining relevant works that appeared in the search results. The adoption of transformative omnichannel

strategies and the integration of AI and neuromarketing in retail are some of the main trends that were identified through this process. Secondary data was collected over a period of one month, and information was gathered from authoritative industry sources and academic databases. Table 1 presents a summary of the data collection process. Comparative analysis of these findings helped to trace general trends in the industry and assess success factors for businesses that implemented these innovations.

Table 1. Data Collection Summary

Step	Source/ Platform	Purpose
Initial Search	Google Scholar	Conduct a thorough search for pertinent articles about retail tactics and technologies.
Citation Chaining	Bibliographies of articles	Locating important cited publications for additional research.
Further Exploration	ResearchGate, related links	Browsing publications that are linked to or quoted by preliminary findings
Industry Reports	McKinsey & Company, PwC, Gartner	Incorporating insights from industry leaders on practical applications.
Iterative Refinement	Revisited Google Scholar searches	Adjusting search parameters in response to emerging themes to locate more sources.

Source: Authors' compilation

Results and Discussions

The retail sector has seen significant transformation in the last ten years. The COVID-19 epidemic has accelerated several of these tendencies, and retailers are finding it difficult to keep up with their development, according to McKinsey & Company's 2023 research technological capabilities, while consumers have moved from offline to online. They also point out that in order to become more responsive to these changes, retailers can leverage technology as a crucial component in a number of high-end retail industries. End-to-end customer choice journeys are made simpler by technology, which makes it possible to seamlessly integrate online and offline channels with intelligent digital services (McKinsey & Company, 2023). Reliable and customized offers are backed by eye-catching digital content and can be updated almost instantly.

A general idea found after the study is the need for changes in IT operations by traders. More precisely, this change can be found in 6 interconnected steps, which could be helpful to many businesses in this new digitalization context. In the following paragraphs these steps will be presented as well as the explanation of their implementation. Companies that have succeeded in thriving in today's digital age are those that have adopted an omnichannel strategy, harnessed the power of data, and updated their technology infrastructure to provide customers with efficient and personalized shopping experiences, from integrating sales channels to improving operational models.

Omnichannel integration: creating a unified consumer experience

As suggested by the authors of the study carried out by the specialists from McKinsey & Company, retailers were also a big exception because they are used to traditionally manage their online and offline operations separately, thus creating a break between customer experiences. However, there are leading companies today that have adopted "headless commerce" architectures that unify all touchpoints, such as appointments, wish-lists, and payments, to provide a single experience across all channels (Bick et al., 2022). The same authors talk about a remarkable retail company that has implemented a strong omnichannel strategy Home Depot. The company has created options such as click and collect, which allow customers to order products online and pick them up in-store, ensuring a seamless interaction between the digital and physical environments. In addition, Nike has integrated its mobile app into its physical store network, giving consumers the ability to reserve items online and try them in-store. This method improves both consumer experience and the conversion rate (Bick et al., 2022).

Datafication: the potential of data to make informed choices

Traditional retail architecture stores data in disparate systems, which prevents scalability and the use of advanced analytics. Cloud platforms that facilitate automation and data reuse help market-leading retailers make fast and efficient decisions. Delivery Hero uses customer data to determine their lifetime value. The company can decide which marketing campaigns to prioritize for specific customer groups and which markets to expand into with the help of this information. Similarly, Sephora enhances the shopping experience by using a sophisticated analytics platform to understand consumer behavior and provide personalized recommendations (Bick et al., 2022).

Technology modernization: micro-services that provide scalability and flexibility

Retailers have traditionally used monolithic applications, but these do not allow rapid adaptation to market changes and an increase in operational costs. Moving to micro-services-based architecture, which offers more scalability and flexibility, was the solution. Walmart has invested heavily in technological advancement, establishing Walmart Global Tech, which has a team of more than 15,000 engineers and data scientists. Through this change, the company was able to quickly create new digital functionalities and compete effectively with the online giants. By adopting micro-services, Luiza stores in Brazil managed to transform from a traditional company to a digital leader. In just four years, the stock has increased in value by more than 18,000% (Bick et al., 2022).

The product-based operating model: efficiency and agility

Retailers use a product-oriented operating model that combines business resources and technology in cross-functional groups to help drive digital transformation. This allows processes to be optimized and quickly adapted to changing market demands. To improve efficiency and speed of delivery, the organization must transform IT functions into a product-focused organization. Inventory management, demand forecasting, and checkout process optimization are important skills that dedicated teams work on. Amazon and Alibaba have enabled the rapid release of new products and features by automating the software development cycle (Bick et al., 2022).

Talent-based transformation: investing in the internal team

Many retail companies have historically relied on external partners to develop and maintain their applications. However, technology has become a differentiator today and retailers are investing in in-house teams of professionals to preserve their intellectual property and speed time to market. For example, in India, Decathlon has employed more than 2,000 engineers in a technology center of excellence. The company was able to create innovative digital products that could quickly adapt to changes in customer preferences thanks to this initiative (Bick et al., 2022).

Retailers must invest in technological innovation, implement omnichannel architectures and use scalable data platforms to remain competitive. Companies that can combine technology with customer-centric strategies will become market leaders as digitization redefines the industry. Investment in talent and operational modernization improves not only productivity, but also the ability to provide customers with personalized experiences that retain them for the long term.

The incorporation of AI is growing as a crucial component of digital transformation strategies for businesses across all industries. Companies are required to provide personalized services and increase operational efficiency in the digital world. Below in Table 2, it can be observed a structuring of how Starbucks, Zara, Microsoft, and Waymo use AI to enhance customer experiences, optimize operations, and create innovative solutions.

Table 2. Implementation of Artificial Intelligence by companies from different fields

Company Name	*Concerns discovered*	*Implemented Solution*	*Result*
Starbucks	They needed to reduce waiting time and make the in-store experience more personalized.	Launched Deep Brew, its proprietary AI platform that anticipates orders and shortens wait times by analyzing customer data. Companies can optimize store operations and adapt the way they interact with customers using AI.	Improved customer experience and reduced wait times, increasing loyalty to the Starbucks Rewards program
Zara	Experienced difficulty in anticipating demand, resulting in excess inventory or product shortages.	Uses AI to analyze sales data, social media trends and external variables in real time. This helps to adjust inventories, reducing overstock and improving demand response.	Optimized the supply chain by reducing excess inventory and quickly adapting to changing customer preferences
Microsoft	Faced high customer response times, which affected user satisfaction.	Virtual agents implemented artificial intelligence to automate technical support interactions. This reduced response times and resolution of customer issues.	Reduced the number of repetitive tasks associated with support processes, resulting in improved user satisfaction and the efficiency of support teams.
Waymo	It was necessary to improve the safety and navigation skills of autonomous vehicles in complicated areas.	A subsidiary of Alphabet Inc. uses sensor fusion and deep learning for AI to improve road safety and navigation for autonomous vehicles. AI reduces traffic risks by assisting vehicles in real-time decision-making.	Has advanced autonomous vehicle technology, improving safety and the ability to navigate independently

Source: Authors' work based on the information provided by Ajiga et al. (2024) and Sagar (2024)

These case studies show that the use of AI can optimize processes and improve customer experience in many industries. AI adoption improves efficiency and user satisfaction across a wide range of industries, not limited to a specific domain. These examples show how digital technologies are changing the internal operations of companies and the way they interact with their customers, thus redefining the shopping experience.

Conclusion

Retailers must quickly adapt to customers' growing expectations for personalized, convenient, and integrated shopping experiences across all channels to remain competitive in today's dynamic marketplace. Investments in infrastructure and technology are required to optimize omnichannel operations, integrate digital with physical and upgrade e-commerce platforms, as well as adopt cloud solutions for scalability.

By using AI solutions and data analytics to provide personalized recommendations and offers, personalizing the customer experience becomes even more important. Additionally, retailers should examine social commerce opportunities to increase direct conversions on social platforms, such as shoppable posts and influencer promotion. The use of emerging technologies such as voice commerce, AR, and AI have the potential to provide customers with experiences that are interactive and engaging, allowing goods to differentiate themselves from the competition. In addition, flexibility and speed are crucial; retailers must follow market trends and consumer preferences to quickly adapt their strategies and maintain a competitive edge in the digital age.

The future of predictive analytics promises to provide increasingly detailed insights into market trends and consumer behavior, supported by rapid advances in AI. Real-time data processing will be improved with accuracy and timeliness by combining AI with emerging technologies such as edge computing and quantum computing. However, companies must have strong data governance and invest in security and ongoing training to address data quality issues, privacy, and the need for advanced skills. Continued research and development will be essential to improve methodologies and discover new opportunities for the use of predictive analytics in various industries, giving companies a strategic advantage in today's competitive landscape. Consequently, AI-based predictive analytics has become a useful tool for innovation and informed decision-making. However, there are still obstacles that need to be addressed to maximize the use of this technology.

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