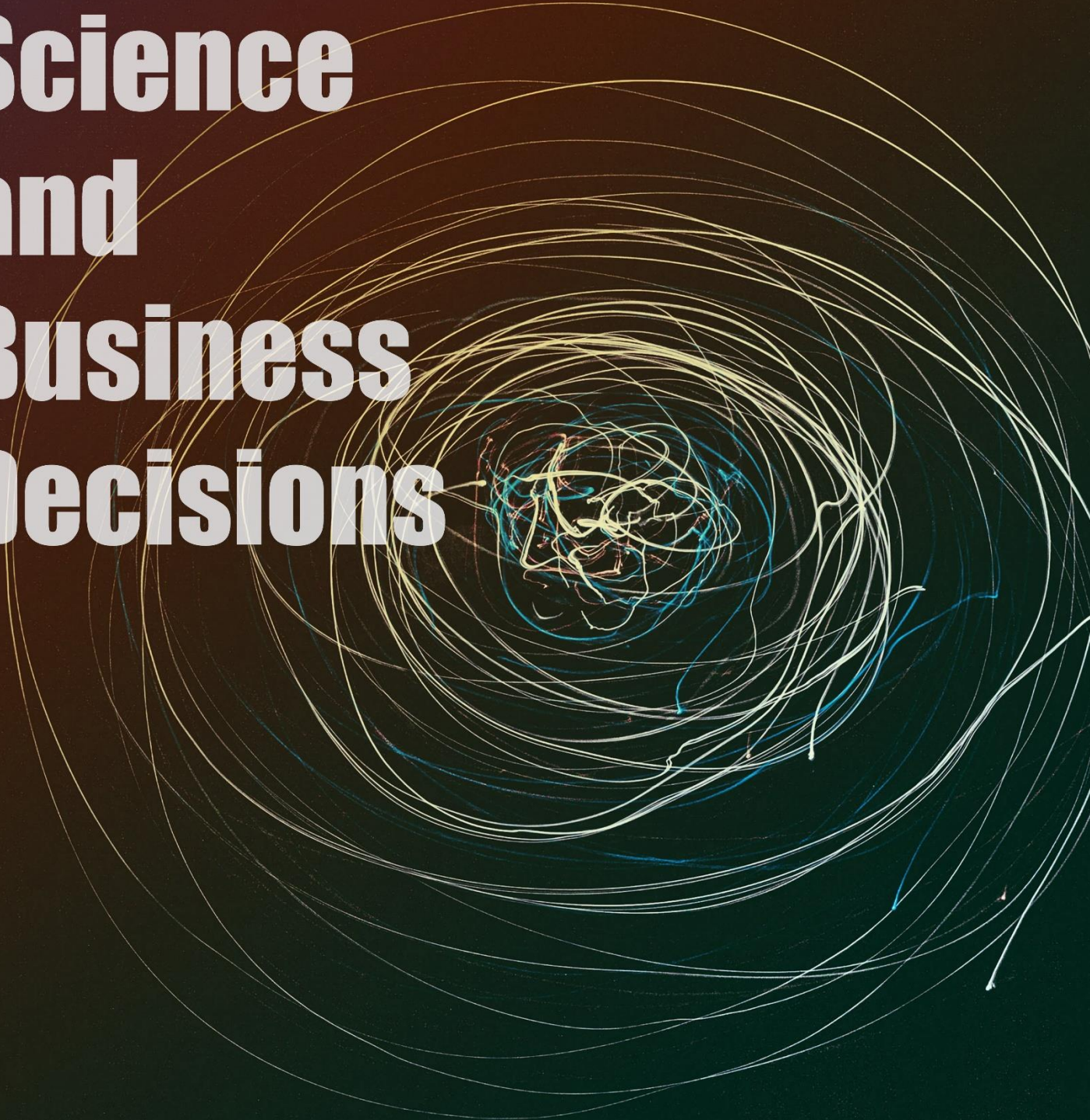


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# Management Science and Business Decisions



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**Editor-in-chief**  
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|   |    |
|---|----|
| <b>Editorial Advisory Board</b>   | 3  |
| <b>Evolution of Generative AI for Business Decision-Making: A Case of ChatGPT</b> | 5  |
| <i>Euclides Lourenco Chuma, Angela Maria Alves and Gabriel Gomes de Oliveira</i>  |    |
| <b>Effects of Fuel Subsidy Removal on Small-Scale Industries in Nigeria</b>       | 15 |
| <i>Obidah Godwin Titus, Umar Ali Umar and Ayodeji Nathaniel Oyedeji</i>           |    |

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# Evolution of Generative AI for Business Decision-Making: A Case of ChatGPT

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**Abstract:** This work presents a comparative analysis between the responses generated by ChatGPT 3.5 (January 2023 version) and ChatGPT 4 (January 2024 version) in response to a set of questions about business. It serves as an update to the previously published work titled "Generative AI for Business Decision-Making: A Case Study with ChatGPT" by the authors, which utilized ChatGPT 3.5 in January 2023. The same methodology and questions from the previous work were applied, but this time using ChatGPT 4 in its January 2024 version. This approach allows us to offer insights into the evolution of the ChatGPT tool for business decision-making. Therefore, this work can be seen as a continuation of the previous work by the authors and will also serve as a basis for future comparative studies. The responses generated by ChatGPT 4 proved to be more detailed and organized compared to those generated by ChatGPT 3.5. However, in some questions, ChatGPT 3.5 provided answers regarding certain possibilities that were not emphasized in ChatGPT 4. Furthermore, ChatGPT 4's responses contained more up-to-date content. In all the cases analyzed, ChatGPT 4 remained an asset in the decision-making process, providing a comprehensive overview of the topics. However, it's essential to emphasize that ChatGPT 4 does not substitute for a business decision-making expert.

**Keywords:** Artificial Intelligence; Generative AI; ChatGPT; Decision-Making; Chatbot

## 1. Introduction

ChatGPT 3.5 (OpenAI, 2024) was introduced as a prototype in November 2022 by the OpenAI company. It swiftly attracted attention due to its comprehensive answers across various knowledge domains and its human-like text generation capabilities. ChatGPT was fine-tuned for human interaction using reinforcement learning with human feedback, a method that utilizes human demonstrations (likes or dislikes) to guide the model towards desired behavior. It is based on GPT-3.5, a language model trained to generate text.

A year ago, a few months after the release of ChatGPT 3.5, we authored an article titled "Generative AI for Business Decision-Making: A Case of ChatGPT" (Chuma & de Oliveira, 2023), where we tested the newly introduced ChatGPT 3.5 for business decision-making. In that study, we posed three questions to ChatGPT 3.5 (OpenAI, 2024) and analyzed its responses. In summary, our findings indicated that while ChatGPT 3.5 generated straightforward and valuable answers for decision-making, it could not fully replace the insights provided by a business decision-making expert.

The primary objective of the current study is to compare the responses provided by ChatGPT 3.5 one year ago with the responses offered by ChatGPT 4 (version 4) in its current state. By doing so, we aim to document the progress of generative artificial intelligence (AI) tools, such as the one utilized in ChatGPT, in the context of business decision-making. Concurrently, we intend to observe the potential impact of such tools on decision-making processes within the business domain.

At that time, there were limited studies available on the utilization of generative artificial intelligence, like the one employed by OpenAI's ChatGPT. Since then, numerous advancements, research efforts, and discussions have emerged. For instance, Abrokwah-Larbi (2023) examined the role of generative artificial intelligence, such as ChatGPT, in advancing customer personalization within business organizations. Ayinde *et al.* (2023) conducted an extensive literature review to investigate various viewpoints regarding the integration of ChatGPT into organizational management. Additionally, Raj *et al.* (2023) conducted a study focusing on elucidating the potential advantages for companies that adopt ChatGPT.

Over the past year, numerous competitors to OpenAI's ChatGPT have emerged, including Google Bard (Google, 2024), Meta Llama (Meta, 2024), Claude by Anthropic (Anthropic, 2024), and various other tools harnessing Generative AI. Nonetheless, OpenAI's ChatGPT continues to maintain its position as the most widely adopted choice (Humphries *et al.*, 2023).

Despite the considerable success of ChatGPT 3.5, OpenAI continued to enhance the tool, and in March 2023, they released ChatGPT 4. Several changes were made from ChatGPT 3.5 to ChatGPT 4, some of which include:

- Updated: ChatGPT 4 was last updated in April 2023, while ChatGPT 3.5 has a knowledge cutoff date for training data up until September 2021.
- Model Size and Complexity: ChatGPT 4 is more advanced, featuring a larger model size and greater complexity. Consequently, it has been trained on more data and possesses a better understanding of nuanced language, context, and complex queries compared to ChatGPT 3.5.
- Accuracy and Knowledge Base: ChatGPT 4 generally provides more accurate and relevant responses as it has been trained on a more extensive dataset, including more recent information. This equips it better to understand and respond to a broader range of topics with updated knowledge.
- Contextual Understanding: ChatGPT 4 demonstrates a refined ability to understand and maintain context over longer conversations, resulting in more coherent and contextually relevant responses, even in prolonged interactions.
- Language and Tone Adaptability: ChatGPT 4 exhibits improved adaptability in language style and tone, enabling it to match the user's style of communication more accurately, whether formal, casual, or technical.
- Handling Complex Instructions: With its advanced algorithms, ChatGPT 4 excels at following complex sets of instructions or queries, breaking them down into more manageable components and addressing each part more effectively.
- Error Reduction: While both versions are prone to mistakes, ChatGPT 4 is designed to reduce errors in understanding and responding to queries, resulting in fewer misunderstandings and overall, more accurate responses.
- Multitasking Abilities: ChatGPT 4 demonstrates improved multitasking abilities, effectively managing different threads of conversation or types of tasks within a single interaction.
- Creativity and Generation Capabilities: In tasks requiring creativity, such as writing, storytelling, or generating ideas, ChatGPT 4 displays a more nuanced and sophisticated approach, producing more diverse and creative outputs.
- Customization and Application: ChatGPT 4 offers enhanced customization options for specific applications, rendering it more suitable for a variety of professional, educational, and recreational uses.



- **Ethical and Safe Responses:** While both versions are designed to provide safe and ethical responses, ChatGPT 4 has an improved understanding of nuanced ethical considerations and is better equipped to navigate complex or sensitive topics.

In summary, ChatGPT 4 represents a significant advancement over ChatGPT 3.5, showcasing improvements in accuracy, context handling, multitasking, creativity, and overall interaction quality. These enhancements make it a more powerful tool for a wide range of applications.

In this study, we offer an analysis of the utilization of ChatGPT 4 as a decision-making tool in the business context, utilizing the same set of questions as in our previous study (Chuma, E. 2023), which employed ChatGPT 3.5..

## 2. Methodology

For the sake of sound comparative analysis, we maintained the same methodology used in our previous work (Chuma & de Oliveira, 2023): Logging into the platform (<https://chat.openai.com/chat>) automatically redirects users to a chat screen. The tests were conducted in ChatGPT 4 on January 22, 23, and 24, 2024, using a laptop computer located at CTI Renato Archer, Brazil. OpenAI did not release the technical details of GPT-4. Three questions were chosen to ask ChatGPT:

Question 1 pertained to the merger of large companies in Europe, a topic that consistently raises societal concerns regarding monopolies and job retention (Chiriac, 2021). Mergers of large companies have garnered interest from academics and professionals alike. While mergers and acquisitions continue to be scrutinized, numerous questions remain regarding the merger process (Cho & Chung, 2022).

Question 2 addressed the risk associated with investing in the stock market of a large oil company in a country with an emerging economy. Individuals engage in stock market investments for various purposes, as indicated by Nadeem *et al.* (2020). One primary motivation is securing financial future for retirement, as discussed by Clark-Murphy and Soutar (2004). Additionally, people also utilize stock market investments to facilitate asset accumulation, enhance overall well-being, and ensure more stable consumption patterns, as highlighted by Cole and Shastry (2009).

Question 3 delved into the factors impacting online shopping behavior, a topic previously examined by various scholars, including Mesatania (2022) who focused on the Shopee company.

## 3. Results and discussion

Question 1, posed to ChatGPT 4 on January 22, 2024, concerned the merger of two Swedish supermarket chains, ICA and COOP.

### Question 1:

What is the impact of a merger between ICA and COOP Swedish supermarkets?

### Reply by ChatGPT 4 (text is exactly as presented, without changes):

The merger between ICA and COOP, two major Swedish supermarket chains, appears to have significant impacts on the Swedish retail market. On one side, ICA, as the leading grocery retailer in Sweden, has announced an investment of approximately one billion Swedish kronor in 2024 to reduce regular prices in its stores. This investment primarily targets price reductions on essential products frequently purchased by consumers. This reflects a joint effort by ICA retailers to better meet customer needs and improve the pricing scenario in the long term, especially following a challenging year in 2023.

On the other hand, COOP, one of Sweden's main consumer cooperative organizations, has undergone several reorganizations and rebranding over the years. Currently, the COOP brand is used for small to medium-sized grocery stores, while the Stora COOP brand is for larger stores and

hypermarkets. Additionally, COOP introduced the X-tra brand for discount supermarkets, incorporating some former Netto stores.

These changes reflect the competitive dynamics in the Swedish retail sector, where major supermarket chains like ICA and COOP are continually adapting and innovating to meet market demands and consumer expectations. The merger between ICA and COOP can thus be seen as part of this ongoing dynamic, likely aimed at strengthening their market positions, improving operational efficiency, and offering more competitive pricing to attract and retain customers.

**Reply by ChatGPT 3.5 (text is exactly as presented, without changes):**

A merger between ICA and Coop, two of the largest supermarket chains in Sweden, would likely have a significant impact on the Swedish retail market. The combined company would likely become one of the largest retailers in Sweden, with a significant market share in the grocery and consumer goods market.

This would likely lead to increased competition for other retailers and suppliers, as the combined company would have more negotiating power when it comes to pricing and product offerings. Customers could also potentially see changes in product availability and prices.

Additionally, the merger could also lead to job losses as the company may look to cut costs by reducing redundancies in the company.

However, it should be noted that the merger would also have to go through regulatory scrutiny and be approved by the competition authorities, to ensure that the merger would not harm competition in the market.

Both versions of ChatGPT could identify the sizes and locations of companies, as well as their operating segments; therefore, there was nothing new in this regard.

The first observation pertains to the fact that ChatGPT 4 provided us with specific dates: "... one billion Swedish kronor in 2024 to reduce ... a challenging year in 2023". Data play a crucial role as an input and variable for business decision-makers. Therefore, in this aspect, ChatGPT offers advantages as a tool for decision-making.

The second observation is that while ChatGPT 3.5 warned about potential job losses associated with the merger, ChatGPT 4 simply disregarded this possibility. Additionally, ChatGPT 3.5 expressed concerns about the merger negatively affecting market competition, while ChatGPT 4 also ignored this concern.

The third observation is that ChatGPT 4 provided an explanation about the importance of the merger process: "These changes reflect the competitive dynamics in the Swedish retail sector, where major supermarket chains like ICA and COOP are continually adapting and innovating to meet market demands and consumer expectations..." In contrast, ChatGPT 3.5 did not offer an explanation regarding the importance of the merging process.

Therefore, upon comparing the results of ChatGPT 3.5 and ChatGPT 4, it is evident that ChatGPT serves as a better tool for business decision-makers due to its ability to provide temporal data and offer contextualization by explaining the reasons behind the merger process.

Question 2, which was posed to ChatGPT again on January 22, 2024, focused on the risks associated with investing in shares of Petrobras. Petrobras is a large Brazilian company in the oil sector, known for experiencing significant fluctuations in the price of its shares due to the Brazilian political and economic scenario.

**Question 2:**

What are the risks of investing in Petrobras company shares?

**Reply by ChatGPT 4 (text is exactly as presented, without changes):**

Investing in shares of Petrobras, like any investment in stocks, carries a variety of risks. Petrobras, being a Brazilian multinational corporation in the oil, natural gas, and energy industry, has specific risks related to its industry, market, and operational environment. Here are some key risks to consider:

1. **Market Volatility:** The oil and gas sector is highly sensitive to global supply and demand dynamics, geopolitical events, and environmental policies. Changes in these factors can lead to significant price volatility.

2. **Political and Regulatory Risks:** As a state-controlled entity, Petrobras is subject to political influence and changes in government policies. This can impact its operations, profitability, and strategic direction.

3. **Economic Risks:** Being based in Brazil, Petrobras is exposed to the economic conditions of the country. Fluctuations in the Brazilian economy, including currency exchange rates, inflation, and interest rates, can affect the company's financial performance.

4. **Environmental and Social Governance (ESG) Risks:** The oil and gas industry is under increasing scrutiny for its environmental impact. Companies like Petrobras need to navigate evolving environmental regulations and societal expectations regarding climate change and sustainability.

5. **Operational Risks:** These include risks associated with exploration and production activities, accidents, and technological challenges. Oil spills, accidents, and operational failures can lead to significant financial and reputational damage.

6. **Legal and Compliance Risks:** Petrobras has faced legal challenges and scandals in the past, such as corruption investigations. Such events can impact investor confidence and lead to financial penalties and reputational harm.

7. **Competition and Market Changes:** The energy sector is undergoing significant transformation with the shift towards renewable energy. Petrobras needs to adapt to these changes to remain competitive, which may involve substantial investment and strategic shifts.

8. **Debt Levels:** The level of debt and financial leverage of the company can be a risk, particularly if there are fluctuations in its revenue streams.

9. **Currency Exchange Risk:** As an international company, Petrobras deals in multiple currencies. Fluctuations in exchange rates can impact its financial results.

10. **Dependency on Commodity Prices:** The company's profitability is closely tied to the prices of oil and gas, which are subject to global market conditions.

It's important for investors to conduct thorough due diligence and consider these risks in the context of their overall investment strategy and risk tolerance. Additionally, staying informed about the latest developments in the industry and the company itself is crucial for managing investment risks effectively.

**Reply by ChatGPT 3.5 (text is exactly as presented, without changes):**

Petrobras is a state-controlled oil and gas company in Brazil, and investing in its shares may carry certain risks. Some of the key risks to consider when investing in Petrobras include:

**Political risk:** As a state-controlled company, Petrobras is subject to significant political influence and changes in government policies could impact the company's operations and financial performance.

**Operational risk:** The company's operations are primarily focused in Brazil, which poses a range of operational risks such as environmental, social and safety risks, along with the challenges of operating in deep-water and other technically demanding areas.

**Corruption risk:** In the past, Petrobras has been involved in significant corruption scandals. These have led to significant fines, legal proceedings and reputational risks, which may negatively impact the company's financial performance and share price.

**Financial risk:** Petrobras is heavily leveraged, and its credit rating is lower than investment grade, so the company's high debt levels and cash flow volatility could make it more vulnerable to economic downturns or unexpected changes in commodity prices.

**Currency risk:** A significant portion of Petrobras' revenue is generated in U.S. dollars, while its debt is primarily denominated in Brazilian reals. Changes in the exchange rate between these two currencies could impact the company's financial performance and share price.

It's important to note that past performance of the company or sector is not a guarantee of future performance and that the risks mentioned above are not exhaustive and should be considered along with other factors such as the overall market conditions and your personal investment profile.

It is evident that ChatGPT 4 provided a considerably more comprehensive response, highlighting several aspects that warrant consideration when evaluating an investment in Petrobras shares. However, it is noteworthy that in ChatGPT 3.5, the term "corruption" was explicitly emphasized, whereas in ChatGPT 4, one must attentively review the section titled "6. Legal and Compliance Risks" for pertinent information. Consequently, there has been a refinement in the wording of the text, rendering it less straightforward and adopting a more formal tone.

Furthermore, ChatGPT 4 also does not furnish a direct answer regarding whether one should endorse the actions of Petrobras as a company. Consequently, it does not serve as a substitute for a business decision-maker.

For historical documentation, on the same date that the question was posed to ChatGPT 4, the value of Petrobras shares on the New York Stock Exchange was approximately 15.70 USD (see Figure A.1 in *Appendix*). According to the CNN Business website (CNN Business, 2023), accessed on January 20, 2023 (one year ago), the "Stock Price Forecast" was as follows: "The 14 analysts offering 12-month price forecasts for Petroleo Brasileiro SA Petrobras have a median target of 13.75, with a high estimate of 16.50 and a low estimate of 8.45. The median estimate represents a +21.09% increase from the last price of 11.36." Therefore, the CNN Business website stock price forecast showed good performance.

Finally, when comparing the information provided by CNN Business and ChatGPT 4, it becomes evident that CNN Business offers significantly more data for making informed decisions than ChatGPT. Therefore, when it comes to practical business decisions regarding stock investments, ChatGPT 4 is primarily useful for educational or didactic purposes.

Question 3, posed to ChatGPT on January 22, 2024, inquired about the factors influencing online buying behavior.

### Question 3:

What are the factors influencing online buying behavior?

**Reply by ChatGPT 4 (text is exactly as presented, without changes):**

Online buying behavior is influenced by a multitude of factors that can broadly be categorized into individual, product, website/technological, social, and environmental factors. Understanding these factors can help businesses tailor their online presence and marketing strategies to better meet the needs and preferences of their customers. Here are some key factors:

1. Individual Factors:

**Personal Preferences and Taste:** Individual likes, dislikes, and specific needs greatly influence online purchasing decisions.

**Income and Spending Power:** The financial status of an individual determines what they can afford and influences their buying choices.

**Age and Life Stage:** Different age groups and life stages have different needs, which influence their online shopping behavior.

**Psychological Factors:** These include attitudes, perceptions, personality, and lifestyle. For example, a tech-savvy person might be more inclined to shop online than someone who is not as comfortable with technology.

2. Product Factors:

**Product Type:** Certain products, like electronics and books, have historically been more successful in online markets compared to others like perishable goods.

**Price:** Competitive pricing can be a major draw for online shoppers.

**Quality and Brand Reputation:** High-quality products and well-known brands are more likely to be trusted and purchased online.

**Availability and Variety:** Online stores offering a wide range of products and exclusive items can attract more customers.

3. Website/Technological Factors:

**Ease of Use and Navigation:** A user-friendly website encourages more online purchases.

**Website Design and Aesthetics:** An attractive and professional-looking website can positively influence buying decisions.

**Security and Privacy:** Assurance of secure transactions and privacy protection is critical.

**Mobile Compatibility:** With the increasing use of smartphones, mobile-friendly websites and apps are essential.

4. Social Factors:

**Social Media Influence:** Recommendations and reviews on social media platforms can significantly impact buying decisions.

**Peer Influence and Word of Mouth:** Opinions and experiences shared by friends and family often sway purchasing decisions.

**Influencer Marketing:** Endorsements by influencers can attract their followers to certain products or brands.

5. Environmental Factors:

**Economic Conditions:** General economic environment, like a recession or boom, can influence consumer spending habits.

**Cultural Trends:** Cultural shifts, like the growing focus on sustainability, can affect buying behavior.

**Legal and Regulatory Environment:** Laws and regulations governing online transactions, data privacy, etc., can impact consumer trust and willingness to purchase online.

#### 6. Marketing and Promotional Factors:

**Advertising:** Effective online advertising can increase product awareness and interest.

**Sales Promotions:** Discounts, coupons, and sales are powerful incentives for online purchases.

**Customer Reviews and Ratings:** Positive reviews and high ratings can significantly boost the attractiveness of a product or service.

Understanding these factors can help businesses develop more effective strategies to attract and retain customers in the online marketplace. For consumers, being aware of these influences can lead to more informed and satisfactory purchasing decisions.

#### **Reply by ChatGPT 4 (text is exactly as presented, without changes):**

There are several factors that can influence online buying behavior, including:

1. **Convenience:** The ease and convenience of shopping online can be a major factor in influencing buying behavior.

2. **Price:** Online shoppers can easily compare prices and find deals, which can influence their buying behavior.

3. **Product reviews and ratings:** The ability to read reviews and ratings from other shoppers can influence a person's decision to buy a product.

4. **Product selection:** Online retailers often have a wider selection of products than brick-and-mortar stores, which can influence buying behavior.

5. **Social influence:** Social media and online communities can influence buying behavior by highlighting popular products and trends.

6. **Personalization:** Many e-commerce sites now offer personalized recommendations based on a shopper's browsing and buying history, which can influence buying behavior.

7. **Trust and security:** Trust in the online retailer and security of the website can also play a role in influencing online buying behavior.

8. **Marketing and advertising:** Online marketing and advertising can also influence buying behavior by showcasing products, offering discounts and promotions

ChatGPT 4 provided a more extensive response, albeit with a reduced number of main items (6 items in ChatGPT 4 compared to 8 items in ChatGPT 3.5). Notably, ChatGPT 4 incorporated subitems within its response, whereas ChatGPT 3.5 did not. Consequently, it appears that ChatGPT 4 can present results in a more structured format, enhancing the user's educational experience.

The response provided by ChatGPT 4 listed 6 factors with 21 subitems, which, while comprehensive, may still lack depth. Compared to other studies, such as the article by Mesatania (2022), which identified 23 factors for analysis, we have quantitatively determined that ChatGPT 4 is not currently a suitable tool to serve as the sole source of advice for making business decisions.

#### 4. Conclusion

This study presents a comparative analysis between ChatGPT 3.5, the January 2023 version, and ChatGPT 4, the January 2024 version, as tools for decision-making in business.

In the test, three questions were posed to ChatGPT 3.5 in January 2023 and ChatGPT 4 in January 2024, and their results were analyzed. ChatGPT 4, in January 2024, demonstrated improvements compared to ChatGPT 3.5 in January 2023. The responses generated by ChatGPT 4 were more detailed and organized than those of ChatGPT 3.5. Additionally, ChatGPT 4's replies featured more up-to-date content. In all cases analyzed, ChatGPT 4 remained an asset in the decision-making process by providing an overview of the topic.

It's important to note that, in its current version, ChatGPT 4 does not replace a business decision-making expert. However, ChatGPT is evolving and can serve as a useful tool for business decision-making experts to enhance productivity and free up time for other activities.

The utility of tools like ChatGPT has raised doubts regarding their actual usefulness in various office professional tasks. However, we are now confident that tools like ChatGPT are here to enhance productivity and, in some instances, potentially replace professionals, which in turn raises ethical questions about their usage. There is also a significant debate surrounding the copyright of content used for training AI tools such as ChatGPT.

#### Appendix

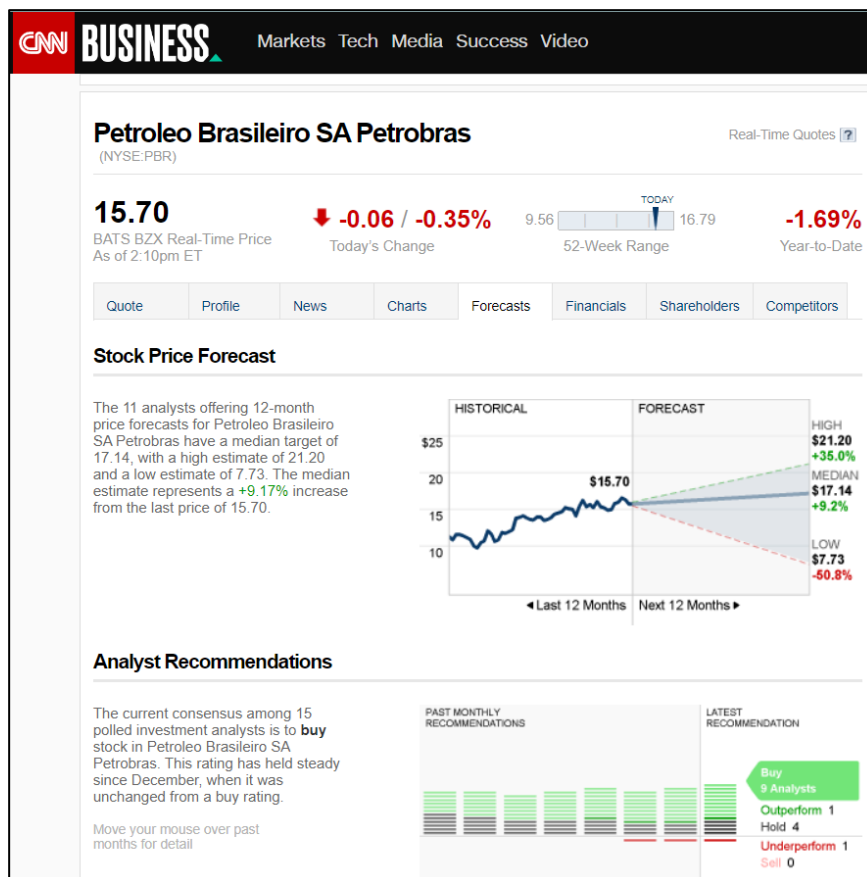


Fig A.1. Screenshot of CNN Business website about Petrobras (CNN Business, 2024)

## Originality statement

The authors declare that the work reported in the current study is original, and no content (concept, text, tables, illustrations, data, etc.) supposed to be produced/generated/estimated/written/collected by the authors in the current study is partially or completely generated through Artificial Intelligence (AI) or any AI-based software.

This work is a continuation of the previous study "Generative AI for Business Decision-Making: A Case of ChatGPT" (Chuma & de Oliveira, 2023), and therefore, some texts were copied to enhance the reader's understanding. As this is a work where the central subject is textual content generated by a generative AI, some texts were reproduced exactly as provided by the AI. However, the analyses, comments, and conclusions are not produced by any type of AI.

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# Effects of Fuel Subsidy Removal on Small-Scale Industries in Nigeria

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**Abstract:** The work explores the effects of fuel subsidy removal on small-scale businesses in Nigeria, a critical sector in the nation's economic landscape. The study contributes to existing knowledge by focusing on the relationship between subsidy removal and its impact on small-scale industries. A comprehensive literature review considers climate change impacts, socio-economic and environmental externalities, and the historical context of fuel subsidies. While previous studies have investigated macro and micro consequences, this research examines the repercussions on small-scale businesses. Utilising a descriptive research design and a Likert-structured questionnaire, the study investigates the ramifications of recent fuel subsidy removal in a typical community in the country. Key factors, including changes in sales, operational costs, and profit margins, are analysed using descriptive statistical methods and the Chi-square test. The findings highlight the interconnectedness between government policies and the health of small-scale businesses, emphasising the need for evidence-based decision-making to support resilience in adapting to policy changes.

**Keywords:** Fuel Subsidy Removal; Small-Scale Business; Economic Impact; Operational Costs; Profit Margins

## 1. Introduction

The term “subsidy” denotes the government’s financial support mechanism sectors, institutions, or individuals use to achieve economic and social objectives (Wenqi *et al.*, 2022). In the context of fuel subsidies, governments intervene by setting prices below the international market rates, thus alleviating the financial burden on consumers (Xiang *et al.*, 2021). The rationale behind subsidies is often rooted in the desire to support critical sectors, foster economic development, and improve citizens’ living standards (Bao *et al.*, 2020). Fuel subsidies have been a longstanding and contentious policy tool governments employ to ensure energy affordability, stimulate economic growth, and shield citizens from fluctuations in global oil prices (Skovgaard & van Asselt, 2019). These subsidies, which artificially lower the cost of fuels like gasoline and diesel, have played a crucial role in shaping economic landscapes, particularly in developing nations (Solarin, 2020). However, the consequences of such subsidies are complex, with significant implications for various sectors, including the backbone of many economies—small-scale industries.

Previous studies have focused more on the climate change impacts of fuel subsidies. For instance, Skovgaard and van Asselt (2019) opined that despite the potential climate change mitigation benefits of reforming fossil fuel subsidies, the complex international and domestic political context

complicates this process, posing challenges that may not align with traditional climate politics. Similarly, according to Monasterolo and Raberto (2019), there is an increasing consensus that fossil fuel subsidies provided by high-income country governments contradict the global climate agenda's emission reduction goals, prompting discussions on their negative socio-economic and environmental externalities. Aside from other studies that evaluated the impact of fuel subsidies on developed nations (Chepeliev & van der Mensbrugghe, 2020; Erickson *et al.*, 2020; Heger *et al.*, 2019; Bassi *et al.*, 2023). Solarin (2020) investigated the driving factors behind environmental deterioration, focusing on fossil fuels subsidies, in 35 emerging and developing countries. The study revealed that a 10% increase in fossil fuel subsidies leads to a rise in the ecological footprint by 0.3% to 1.5%, highlighting the role of various factors, such as population size, real Gross Domestic Price (GDP) per capita, urbanisation, and the non-dependent population, in contributing to environmental degradation.

In the case of Nigeria's developing economy, heavily reliant on its oil and gas sector, fuel subsidies have been extremely ingrained in economic policies since the establishment of the Nigerian National Petroleum Corporation (NNPC) in 1977 (Agbonifo, 2023; McCulloch *et al.*, 2021). The subsidy regime, initiated in the 1970s to mitigate the impact of rising global oil prices, has become a significant component of the nation's economic structure (Solarin, 2020). Over the years, however, fuel subsidisation has incurred substantial costs, with estimates suggesting that billions of dollars have been expended on fuel subsidy payments in recent decades (Houeland, 2020). Despite the intended benefits of fuel subsidies, their removal has become a topic of discussion and policy action. In May 2023, President Bola Ahmed Tinubu announced the complete removal of fuel subsidies, marking a significant shift in the economic landscape. This decision has triggered a series of events, most notably an increase in fuel prices, subsequently affecting the operational dynamics of businesses, particularly small-scale industries—the engine of economic growth in Nigeria.

Previous studies have considered the effects of fuel subsidy removal at various times in Nigeria on different socio-economic areas. For example, Houeland (2020) investigated the interplay between popular protests and institutional politics of fuel subsidy removal. The study posits four interconnected claims about the protests' influence on institutional politics, emphasising historical labour-led subsidy protests, the contextual factors amplifying the 2012 protests, the impact of new actors on movement fragmentation, and the enduring civic agency's influence on state-citizen relations, particularly evident in party politics and elections. Agbonifo (2023) further employed Gaventa's 'power cube' as an analytical framework to delve into the dynamics between the government and protesters, viewing power relations as a complex interplay of both domination and resistance, thereby offering a fresh perspective on the debate over the connection between protests and empowerment, often mired in essentialist arguments. On the other hand, Ozili and Obiora (2023) examined the ramifications of the 2023 fuel subsidy removal in Nigeria. The study shed light on macroeconomic and microeconomic consequences using discourse analysis methodology. The removal is anticipated to yield positive effects, such as freeing up financial resources for other sectors, boosting domestic refinery production, diminishing dependence on imported fuel, enhancing employment, directing funds toward critical infrastructure development, reducing the budget deficit, generating a budget surplus, curbing corruption linked to fuel subsidies, fostering competition, revitalising domestic refineries, and alleviating pressure on the exchange rate.

The removal of fuel subsidies in 2023 is particularly crucial for small-scale businesses, as it not only influences their operational costs and profit margins but also shapes the overall economic landscape in which they operate. However, these reviewed studies and many others (Baba Mohammed *et al.*, 2020; Ikenga & Oluka, 2023; Yunusa *et al.*, 2023) did not consider the potential ripple effects on sectors like small-scale industries to highlight the interconnectedness between government policies, such as subsidy removal, and the health of businesses at the grassroots. Hence, the focal point of this research is an in-depth examination of the repercussions of fuel subsidy removal on small-scale industries, which constitute a significant portion of the Nigerian business landscape, of about 44.4% (Gumel, 2017). Small-scale businesses, often characterised by their

sensitivity to production costs and reliance on affordable energy, play a critical role in job creation, innovation, and income generation (Ogunsanya, 2021). Understanding how removing fuel subsidies impacts these industries is paramount for policymakers, business owners, and the broader society. This research aims to unravel the relationship between fuel subsidy policies and the dynamics of small-scale industries. By delving into case studies, analysing data, and drawing upon existing literature, we seek to provide comprehensive insights that inform evidence-based decision-making. The study addresses critical questions related to customer demands, operational costs, and profit margins within a typical community in Nigeria, offering a clear perspective on the effects of fuel subsidy removal on businesses that form the region's economic backbone.

## 2. Methodology

### 2.1 Data collection

This study employs a comprehensive research methodology to explore the impact of the recent removal of fuel subsidies on small-scale businesses within the Sabon-Gari Local Government Area of Kaduna State, Nigeria. Using a descriptive design to systematically describe and quantify the effects of this policy change on small-scale enterprises, this study focused on variations in sales, operational costs, and profit margins.

*2.1.1 Research Design.* The descriptive research design was selected based on its suitability for this type of study as highlighted in recent literature (Bello *et al.*, 2022; Kuburi *et al.*, 2023; Terab *et al.*, 2023; Umar *et al.*, 2023). This approach allows for a structured and statistical inquiry into the predefined aspects of small-scale businesses impacted by fuel subsidy removal. The study variables were operationalised based on data collected from the revenue department, which provided a comprehensive breakdown of small-scale businesses operating within the study area.

*2.1.2 Data Collection Instruments and Procedure.* The primary instrument for data collection was a stratified questionnaire designed to capture detailed information across several dimensions:

- **Demographic Information:** Each respondent was asked to provide basic demographic information to facilitate the analysis of data across different population segments.
- **Impact on Business Operations:** Questions specifically tailored to understand changes in sales, expenses, and profit margins post-policy implementation.

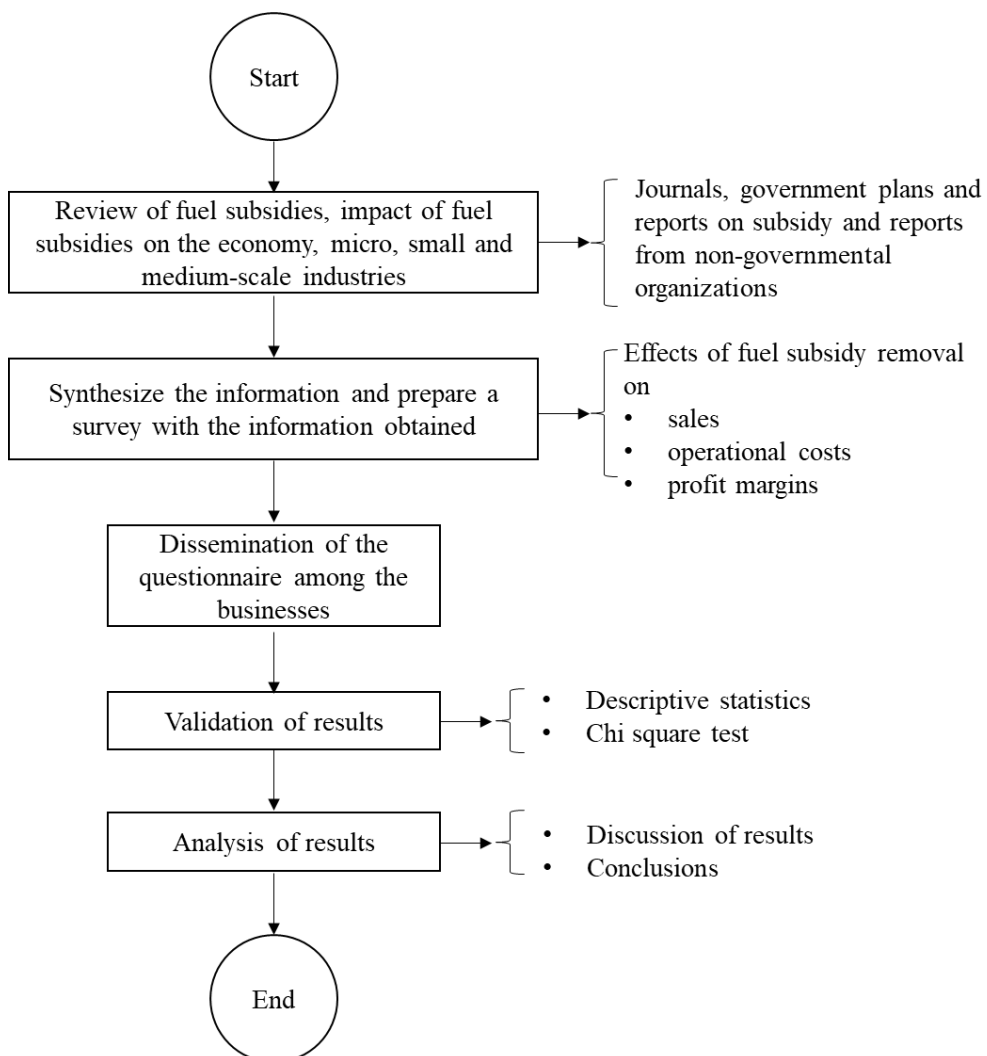
The questionnaire was administered face-to-face by trained research assistants to ensure high response rates and reliable data. Sampling was stratified by the type of business to ensure representative data across various sectors such as Fabrication and Welding, Furniture Making, Production of Goods, Agriculture, and others. The distribution of the sample size is illustrated in Table 1. Data collection spanned from June to October 2023, beginning one month after the fuel subsidy was removed, to capture the immediate and short-term effects of the policy change. Figure 1 gives the flowchart of the study's methodology spanning from the research process, from data collection through to analysis.

### 2.2 Data analysis

Data was obtained from the designed Likert-structured questionnaire and was then subjected to descriptive statistical methods for analysis and presentation. The Chi-square test was employed to assess the significant association between two categorical variables (sales and customer demand/operational costs/profit margins and fuel subsidy removal for small-scale businesses). The significance level ( $\alpha$ ), set at 0.05 or 5%, is chosen to determine the threshold for statistical significance. The chi-square distribution table with the calculated degrees of freedom and significance level was used to critical Chi-square value, and comparing the critical chi-square value with the calculated chi-square value from the IBM SPSS (version 26), decisions on the acceptance or rejection of the null hypotheses are made. For data visualization, Origin Pro Software (2021) was used.

**Table 1.** Registered small-scale businesses in the study area

| <i>Small-scale businesses</i> | <i>Number of businesses</i> |
|-------------------------------|-----------------------------|
| Production of Goods           | 13                          |
| Fabrication and Welding       | 15                          |
| Agriculture                   | 15                          |
| Hospitals/Clinics             | 19                          |
| Wholesale                     | 20                          |
| Transportation                | 22                          |
| Hotels                        | 23                          |
| Furniture Making              | 26                          |
| Restaurants                   | 41                          |
| Mechanic Services             | 43                          |
| Education                     | 76                          |
| Pharmacy                      | 82                          |



**Fig 1.** Flowchart of the study's methodology

### 3. Results and discussion

#### 3.1 Demographic distribution of the respondents

The analysis of the survey conducted in the study area provided comprehensive insights into the demographic and socio-economic characteristics of the small-scale businesses in the region. The predominance of male-owned businesses (62.6%) shown in Figure 2 aligns with broader trends observed in various economies, such as in Canada (Rosa & Sylla, 2018) and among black and Mexican-American entrepreneurs (Peterson & Altounian, 2019), reflecting historical patterns of entrepreneurial ownership. However, the notable presence of female-owned businesses (37.4%) suggests a growing diversity in the entrepreneurial landscape, potentially influenced by changing societal norms and support structures for women in business (Taiwo, 2023). The distribution across age brackets shown in Figure 2 indicates a relatively balanced representation, with 36.9% falling within the 29-39 years bracket and 34.9% within the 40-50 years bracket. This suggests a distribution that spans different career stages, potentially indicating a dynamic and evolving business community, as reported also by Ogunrinola (2011). The emphasis on tertiary education qualifications (56.9%) among small-scale business owners, as shown in Figure 2, reflects an increasingly educated entrepreneurial class. This trend aligns with the global shift toward knowledge-based economies, where higher education often correlates with innovation and business success (Halberstadt *et al.*, 2019; Solomon *et al.*, 2008).

The prevalence of sole proprietorship businesses (56.4%), as shown in Figure 2, indicates a significant reliance on individual entrepreneurship. However, diverse ownership structures, including partnerships (28.7%) and cooperatives (5.6%), suggest a varied business ecosystem that leverages different organisational models. The concentration of businesses with 10-16 employees

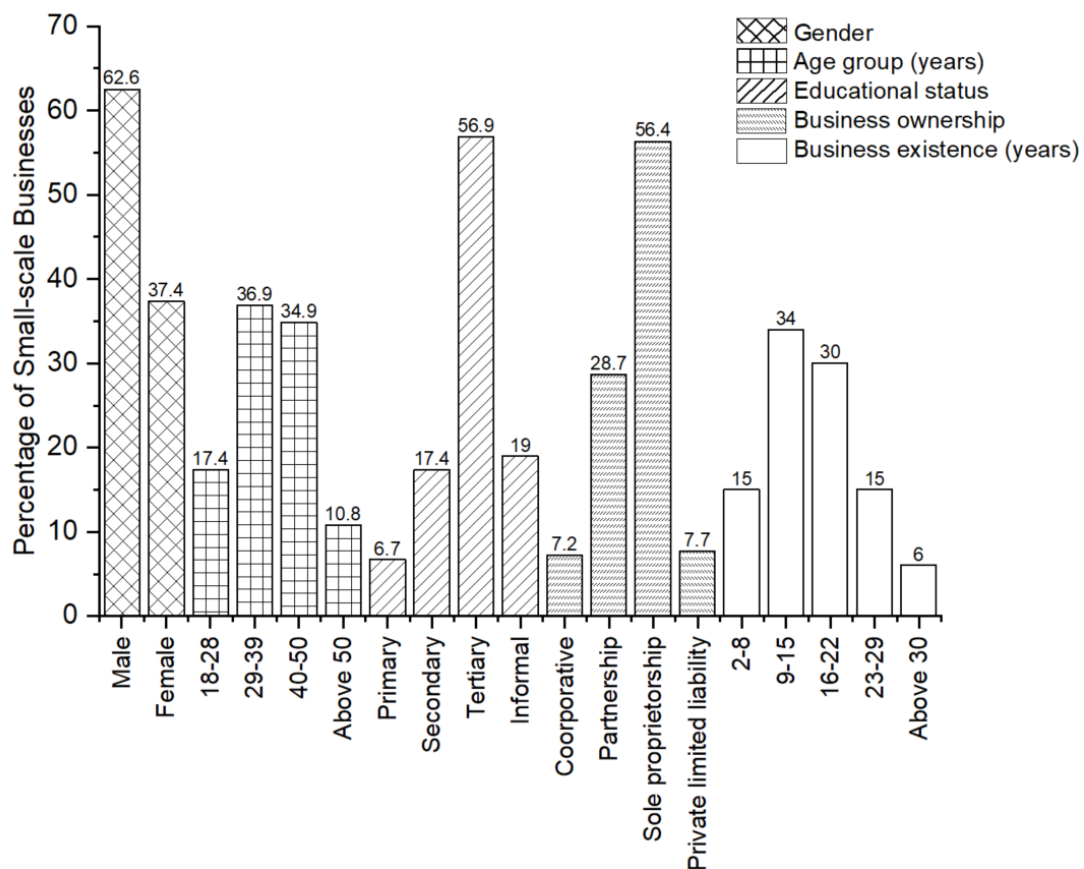


Fig 2. Demographic characteristics of the small-scale business owners

(64.6%) indicates a moderate scale of operations. This distribution aligns with the typical characteristics of small-scale enterprises, often characterised by limited but impactful employment generation (Ogunsanya, 2021). The distribution of businesses across different age brackets suggests a mix of established and relatively new ventures. The concentration of businesses in the 9-15 years bracket (34.8%), as shown in Figure 2, may indicate a period of stability and maturity for a significant portion of the local business community.

### 3.2 Impact of fuel subsidy removal on sales/customer demand

In the half-decade preceding the 2023 fuel subsidy removal, distinct shifts in sales and customer demand were observed among surveyed small-scale businesses. The dynamics of the sales/customer demand preceding fuel subsidy removal and post-fuel subsidy removal are illustrated in Figure 3. Notably, 37.4% reported no discernible change, 22.6% experienced a moderate decline, 19.5% faced a significant downturn, 15.9% noted a moderate upswing, and 4.6% enjoyed a notable increase in sales and customer demand. The observed diversity in business responses to sales and customer demand changes before the fuel subsidy removal suggests a complex interplay of factors influencing market dynamics. Previous studies have indicated that economic uncertainties (caused by pandemics), consumer behaviour shifts, and industry-specific conditions can contribute to such variations (Das *et al.*, 2021; Munro, 2021). In the aftermath of the fuel subsidy removal, a subsequent wave of changes emerged. Of the surveyed small-scale businesses, 37.9% faced a moderate decrease in sales and customer demand, 23.6% experienced a moderate increase, and 22.1% reported no significant change. Notably, 6.7% encountered a significant decrease, and 3.6% enjoyed a significant increase in sales and customer demand.

The post-removal scenario reflects a shifting landscape, possibly influenced by altered consumer spending patterns and business operational costs (Ozili & Obiora, 2023). The moderate fluctuations may stem from the initial adjustments businesses make in response to changing economic conditions. Comparative studies (Bao *et al.*, 2020; Xiang *et al.*, 2021) on subsidy removals in diverse settings can provide valuable insights into these observed trends. The findings emphasise the need for policymakers and business stakeholders to consider the complicated nature of market responses to fuel subsidy removals. To further scrutinise the interplay between sales/customer demand and the shift introduced by fuel subsidy removal in 2023, a null hypothesis was formulated, which states that no significant association exists between sales/customer demand and fuel subsidy removal. The Chi-square test was employed, generating a calculated chi-square of 259.929 with a p-value of  $<0.001$ . The results, as summarised in Table 2, prompt the rejection of the null hypothesis, signifying a noteworthy association between sales/customer demands and fuel subsidy removal. This statistical significance suggests that the observed changes in sales/customer demand are not mere coincidences but are linked to removing fuel subsidies.

### 3.3 Impact of fuel subsidy removal on business operating costs

Aside from the impact of fuel subsidy removal on sales/customer demand, a substantial portion of small-scale businesses experienced various shifts in operating costs. In the pre-fuel subsidy removal era, 41.0% of these businesses had no notable change in operating costs, while 27.2% reported a moderate increase. Conversely, 17.4% saw a significant decrease, and 11.8% encountered a moderate decline. A smaller percentage, 2.6%, faced a significant increase in operating costs during this period. Following the fuel subsidy removal in May 2023, the landscape of small-scale business operating costs underwent a substantial transformation. A significant majority, 70.1%, reported a significant increase in operation costs. Another 24.7% indicated a moderate cost rise, while 2.1% reported no change. A minimal percentage, 1.0%, experienced a moderate decrease, and an equal proportion reported a significant decrease in operating costs (see Figure 4).

As seen in the result, the substantial increase in operating costs post-fuel subsidy removal significantly impacts small-scale businesses. The overwhelming majority attributing this surge

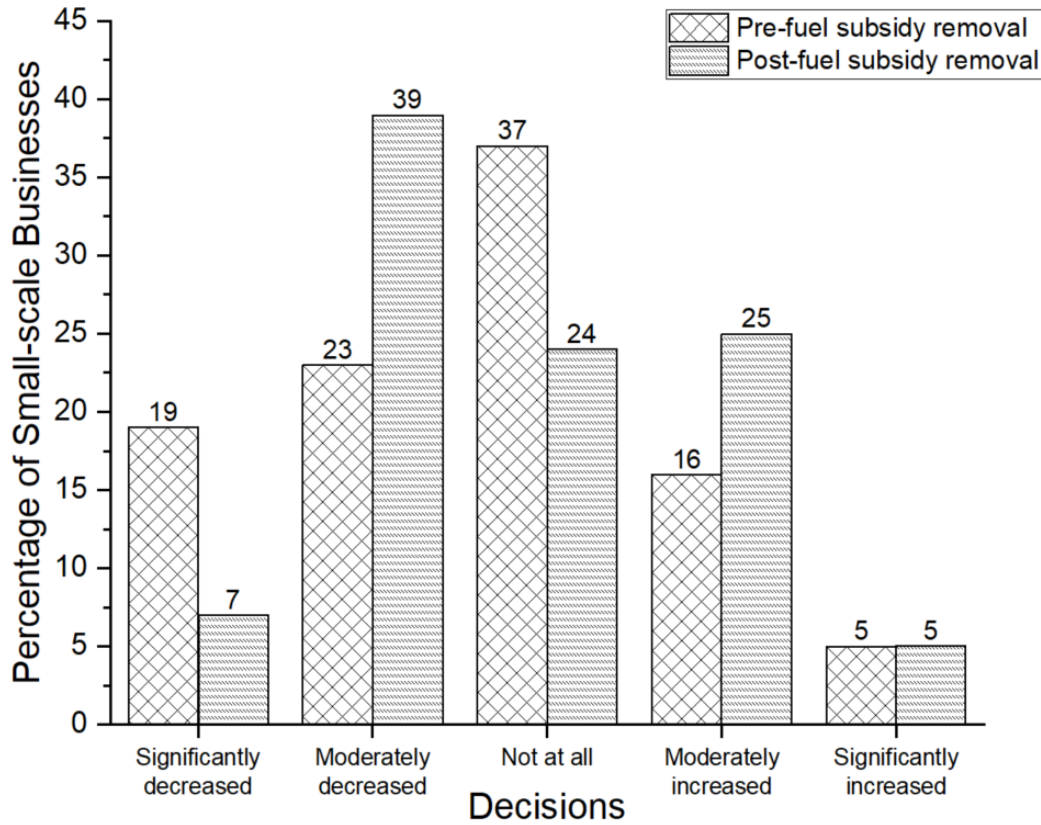


Fig 3. Dynamics of the sales/customer demand pre-fuel subsidy and post-fuel subsidy removals

Table 2. Chi-Square test for sales/customer demands and fuel subsidy removal

| Variables          | Value   | Df | Asymptotic significance (2-sided) |
|--------------------|---------|----|-----------------------------------|
| Pearson Chi-Square | 259.929 | 36 | <.001                             |
| Likelihood Ratio   | 56.075  | 36 | .018                              |
| N of Valid Cases   | 197     |    |                                   |

directly to the removal aligns with established economic literature on the repercussions of subsidy alterations, affirming the substantial influence on operational expenses (Baba Mohammed *et al.*, 2020; McCulloch *et al.*, 2021). This outcome resonates with the anticipated economic shifts associated with subsidy removal and highlights small-scale enterprises’ challenges in adapting to these changes. The study also investigated the association between operational costs and fuel subsidy removal. The null hypothesis posited no significant association between these variables. Table 3 presents the chi-square test results, revealing a calculated chi-square value of 593.66 and a p-value <0.001. The null hypothesis is rejected because the p-value is smaller than the standard alpha value of 5% ( $\alpha=0.05$ ). This signifies a significant association between operating costs and fuel subsidy removal. The statistically significant association between operational costs and fuel subsidy removal emphasizes subsidy alterations’ profound impact on small-scale businesses’ financial dynamics. This aligns with studies such as Wenqi *et al.* (2022) emphasising how policy changes, especially subsidies, can have far-reaching implications for operational expenditures.

### 3.4 Impact of fuel subsidy removal on profits/profit margin

Leading up to eliminating fuel subsidies in May 2023, around 34.4% of the small-scale businesses surveyed reported no discernible changes in their profits or profit margins over the previous five

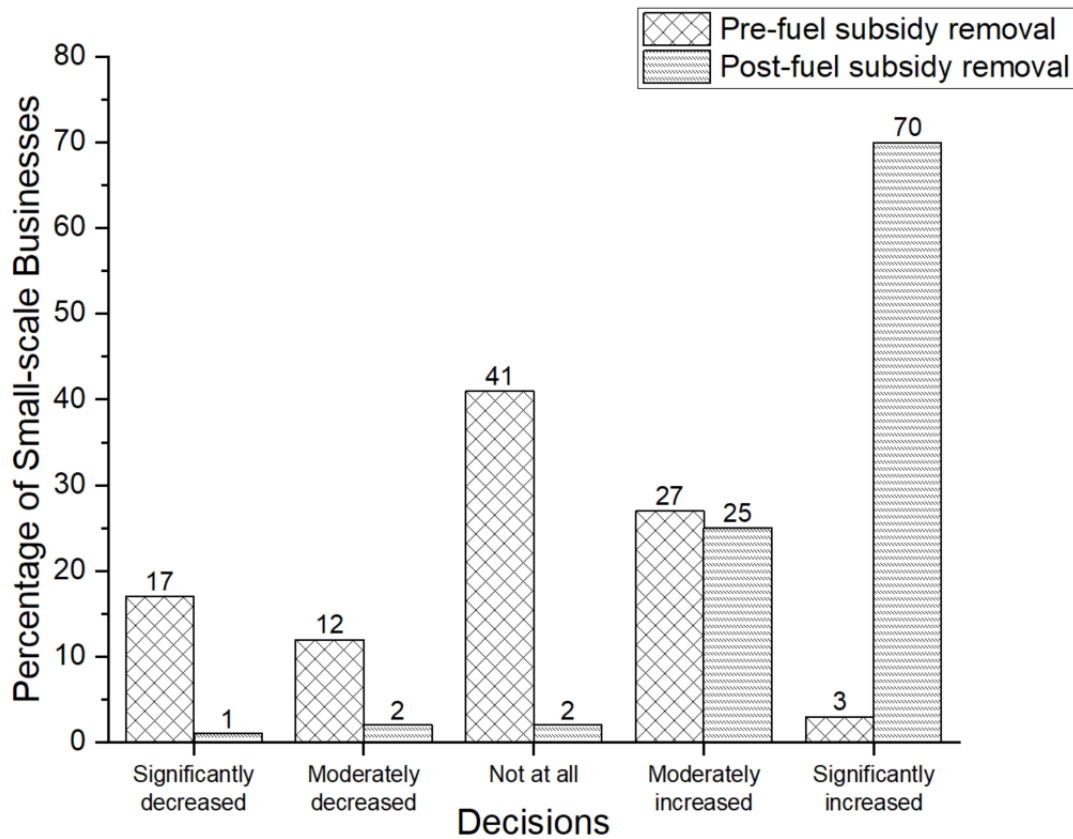


Fig 4. Dynamics of the business operating costs pre-fuel subsidy removal and post-fuel subsidy removal

Table 3. Chi-Square test for operational costs and fuel subsidy removal

| Variables          | Value   | Df | Asymptotic significance (2-sided) |
|--------------------|---------|----|-----------------------------------|
| Pearson Chi-Square | 593.677 | 36 | <.001                             |
| Likelihood Ratio   | 159.666 | 36 | <.001                             |
| N of Valid Cases   | 197     |    |                                   |

years. Conversely, 10.3% noted a moderate increase, and 0.5% reported a significant increase in profits and margins. However, following the fuel subsidy removal, a notable shift occurred, with 45.1% of businesses reporting a moderate increase and 35.9% noting a significant increase in profits and margins. Meanwhile, 15.4% reported a moderate decrease, 3.1% noted a significant decrease, and 0.5% observed no change (see Figure 5). Examining the association between profits and profit margin and fuel subsidy removal yielded compelling results based on the chi-square analysis. The alternate hypothesis challenged the null hypothesis, positing no significant association between these variables, suggesting a notable connection. The Chi-square test statistics (see Table 4), with a calculated chi-square value of 438.46 and a p-value of <0.001, highlighted the significance of this association. Rejecting the null hypothesis implies that there is a substantial and statistically significant relationship between the changes in profit and profit margin and the removal of fuel subsidies.

The contrasting trends before and after subsidy removal highlight the distinct effects of this policy change on the financial landscape of small-scale businesses. The drivers behind these changes include shifts in consumer behaviour, market dynamics and operational costs. Moreover, a comparative analysis with a similar study (Baba Mohammed *et al.*, 2020) validates the observed trends. The study argues that for the sustainability of the subsidy removal, the hardship of the people, the business owners inclusive, who have experienced reduced profits needs to be alleviated.



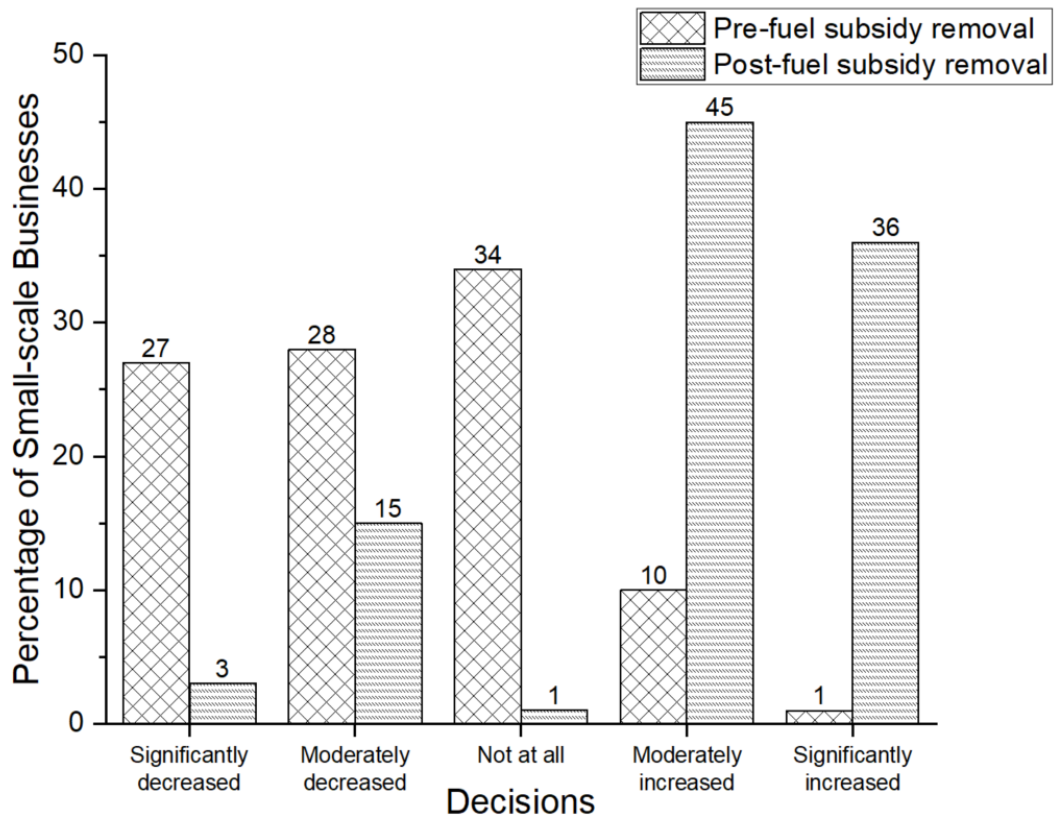


Fig 5. Dynamics of the business profits and profit margin pre-fuel subsidy and post-fuel subsidy removals

Table 4. Chi-Square test for business profits and profit margin and fuel subsidy removal

| Variables          | Value   | Df | Asymptotic significance (2-sided) |
|--------------------|---------|----|-----------------------------------|
| Pearson Chi-Square | 438.463 | 36 | .000                              |
| Likelihood Ratio   | 144.879 | 36 | .000                              |
| N of Valid Cases   | 197     |    |                                   |

#### 4. Conclusion

The findings of this study shed light on the implications of fuel subsidy removal on small-scale businesses in the study area. The demographic analysis uncovered a diverse entrepreneurial landscape, with a significant prevalence of male-owned businesses and a noteworthy presence of female-owned enterprises, indicating a shift towards greater gender inclusivity in entrepreneurship. The impact of fuel subsidy removal on sales and customer demand exhibited distinct shifts in the half-decade leading up to the policy change. The varied responses suggest a complex interplay of factors influencing market dynamics. Post-subsidy removal, the landscape continued to evolve, with a significant proportion of businesses experiencing changes in sales and customer demand. The Chi-square test point out a statistically significant association between these variables, emphasising a direct link between the observed market dynamics and fuel subsidy removal. Operational costs faced a substantial transformation post-subsidy removal, with most businesses reporting a significant increase. Examining profits and profit margins revealed a notable shift following fuel subsidy removal. Many businesses reported a significant increase, while others experienced moderate or significant decreases. The chi-square analysis further affirmed a significant association between sales/customer demand, operational costs, profit margins and fuel subsidy removal, highlighting the profound impact of policy changes on the financial dynamics of small-scale businesses.

The limitations of this study include its focus on a single community, which may not be representative of other regions, and the reliance on self-reported data that could introduce biases in reporting business impacts, limiting the generalizability of the findings. However, the study underlines the need for policymakers and stakeholders to consider the interconnected nature of the variables examined. The findings provide valuable insights into the challenges and opportunities small-scale businesses face in adapting to policy changes, emphasising the importance of targeted support measures to mitigate potential hardships. The study recommends ongoing monitoring and assessment to inform evidence-based policies that promote the sustainability of subsidy removal while safeguarding the interests of businesses and fostering economic resilience.

## Originality statement

The authors declare that the work reported in the current study is original, and no content (concept, text, tables, illustrations, data, etc.) supposed to be produced/generated/estimated/written/collected by the authors in the current study is partially or completely generated through Artificial Intelligence (AI) or any AI-based software.

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