Payment Trends and E-commerce Growth in Indonesia: Insights from Public Analytics

Nathasia Liman

School of Management Science and Engineering, Nanjing University of Information Science and Technology, Nanjing, China.

ABSTRACT

This paper looks into how changing payment methods and the rapid rise of e-commerce are reshaping Indonesia's economy. By using public data and analytics, it examines the country's transition from relying on cash to adopting digital payments like mobile wallets and online banking and how this shift is encouraging people from different backgrounds and regions to shop online. Using statistical tools like descriptive analysis, correlation, and regression, the research reveals a strong link between payment innovation and e-commerce growth. Despite the promising progress, challenges such as low digital literacy, cybersecurity risks, and infrastructure gaps particularly in rural areas still need attention. These insights offer useful guidance for policymakers, businesses, and researchers who are working to build a more inclusive and sustainable digital economy in Indonesia.

I. INTRODUCTION

Indonesia stands at a transformative crossroads in its economic development, driven by rapid advances in digital technology and shifting consumer behavior. As the largest economy in Southeast Asia, Indonesia's path toward a digital future is being shaped by a young, tech savvy population, expanding internet access, and a growing middle class eager to adopt innovative services (Google, Temasek, 2022; Statista, 2023). Among the most influential changes are the rise of e-commerce and the evolution of payment methods, which are reshaping how people transact, do business, and participate in the broader economy. These shifts are not only altering consumer habits but also encouraging entrepreneurial activity, reducing barriers to entry, and contributing to national economic growth.

The COVID-19 pandemic served as a catalyst for Indonesia's digital acceleration, compelling consumers to embrace online shopping at an unprecedented pace. During this period, e-commerce platforms became lifelines for millions, rapidly expanding their user base and solidifying new consumer routines. Numerous market studies predict that Indonesia's e-commerce sector will continue to experience exponential growth, driven by urbanization, rising disposable income, and better digital infrastructure. Yet, the development of the digital economy is not solely reliant on demand side factors. The supporting payment ecosystem particularly the shift from cash to digital transactions is equally pivotal in sustaining and scaling this growth.

Over the past decade, the proliferation of mobile wallets, online banking, and fintech solutions has started to bridge the longstanding inefficiencies of Indonesia's traditionally cash heavy economy. These tools have addressed security concerns, simplified transactions, and increased financial access, especially in regions previously underserved by conventional banks. The government's proactive regulatory stance including legal frameworks supporting digital payments and nationwide programs for digital literacy underscores a broader national ambition: to harness financial technology as a pathway to greater financial inclusion and economic equality (Bank, 2023; Indonesia, 2023).

Despite this momentum, challenges remain, A persistent digital divide between urban and rural populations, widespread concerns about cybersecurity, and a general mistrust of digital platforms continue to limit full adoption. Fraud and data breaches threaten both consume confidence and the integrity of the digital commerce environment. Additionally, many users remain excluded due to limited digital literacy or lack of access to reliable infrastructure. These gaps are critical and must be addressed to ensure inclusive and sustainable digital growth.

Current research has done much to chart Indonesia's digital evolution, yet it often falls short in providing a comprehensive, data

driven analysis of how payment innovation and e-commerce growth interact across different demographics and geographies. Most existing studies either focus on consumer trends or technological advancements in isolation, missing the complex interplay between infrastructure, regulation, behavior, and socio-economic variables. Furthermore, while numerous market forecasts highlight future potential, fewer delve into the structural barriers that could impede long term progress.

This study aims to fill that gap by using public analytics to examine how changes in payment systems and the rise of e-commerce are jointly transforming Indonesia's economy. By synthesizing data from government publications, fintech reports, market insights, and academic literature, the work seeks to generate a clearer picture of the ongoing digital transition. Unlike many existing reports, this analysis will place a strong emphasis on inclusivity both in terms of user access and the broader implications for national development.

The principal conclusion of this research is that Indonesia's digital transformation, while promising, is uneven and at risk of deepening social and economic divides if not managed holistically. E-commerce and digital payments have the power to democratize opportunity, but only if infrastructure gaps are closed and trust in the system is built. In doing so, this study contributes fresh insights for businesses, policymakers, and researchers aiming to navigate Indonesia's rapidly changing digital economy and craft strategies that ensure progress benefits the widest possible population.

II. LITERATURE REVIEW

E-Commerce Growth in Indonesia

Indonesia has emerged as one of Southeast Asia's most dynamic and fastest growing e-commerce markets, supported by increasing internet access, a booming middle class, and widespread mobile device usage (Statista, 2021). A landmark study by Google and Temasek in 2020 projected that Indonesia's e-commerce market could reach USD 82 billion by 2025 – setting the country ahead of its regional peers in terms of growth potential. The country's youthful population, known for being digitally literate and enthusiastic about new technologies, plays a significant role in this trend. As (Rakhmawati, R., Widiastuti, A., & Setyawan, 2020) explain, younger consumers are more likely to encourage in online shopping, a trend that has become even more pronounced following the COVID-19 pandemic.

Digital platforms have not only changed how people shop but also how they are influenced. Social media is now deeply embedded in the e-commerce ecosystem, shaping preferences and boosting sales. Research by (Widyastuti, A., & Setyawan, 2021) underscores how social media marketing has had a powerful effect on consumer purchasing decisions in Indonesia. This suggests that companies are rethinking customer engagement strategies by blending content, community, and commerce – transforming how brands and consumers interact in the digital space.

Payment Trends in Indonesia

As online shopping becomes more widespread, the need for efficient, secure, and convenient payment systems has become increasingly urgent. While cash on delivery once dominated Indonesia's e-commerce scene, digital payment options such as e-wallets, bank transfers, and credit cards are now gaining traction (BPS, 2021). The shift is largely driven by the rise of fintech startups and government initiatives aimed at fostering a cashless society. (Fajrina, N., Lestari, R., & Sari, 2021) found that digital wallets are especially popular because of their simplicity, speed, and integration with popular e-commerce platforms.

However, adoption hinges on more than just convenience – trust plays a central role. If people feel secure in using a particular payment method, they are more likely to adopt it. As (Lestari, R., & Sari, 2020) point out, digital payment usage is strongly influenced by perceived safety and reliability. In response, the government has launched initiatives like the National Payment Gateway (Bank Indonesia, 2020), which aims to streamline transaction and improve consumer protection. Still, challenges persist – particularly in rural areas – where weaker infrastructure and lower financial literacy levels limit the uptake of digital services (Suharso, W., Lestari, R., & Sari, 2021).

The Role of Public Analytics in Understanding E-Commerce and Payment Trends

Public analytics – the use of open source and publicly available data to analyze market behavior – is proving to be an essential tool in understanding Indonesia's fast evolving digital economy. (Bertot, J. C., Jaeger, P. T., & Grimes, 2016) demonstrate that big data analytics can offer insights into consumer behavior, preferences, and decision-making patterns. For instance,(Prabowo, H., Sari, D., & Lestari, 2021) explored how social media analytics can reveal public sentiment towards different payment methods, providing valuable input for marketing and product design strategies.

Public analytics doesn't just help companies optimize their offerings – it also helps them discover untapped market segments. By identifying gaps between supply and demand, businesses can better align their products with actual consumer needs. At the same time, ethical considerations must not be overlooked. (Gilliom, 2016) emphasizes the importance of data privacy and ethical handling of consumer data, especially as digital platforms become more pervasive. In a context where public concern over data breaches and misuse is rising, companies must strike a balance between innovation and responsibility to maintain public trust.

Interplay Between Payment Systems and E-Commerce Growth

The intersection of payment options and e-commerce adoption is a rich area for further exploration. New findings suggest that

offering a variety of payment methods can directly influence consumers' willingness to complete purchases. (Nurhadi, D., Widiastuti, A., & Setyawan, 2020) found that buyers are more likely to follow through with transactions when presented with flexible payment choices. This implies that businesses need to ensure seamless payment integration if they want to meet the evolving expectations of digital consumers.

Payment convenience has a direct impact on user satisfaction and loyalty. (Suharso, W., Lestari, R., & Sari, 2021) revealed that customers who experience a smooth checkout process are more likely to return for future purchases. This finding reinforces the notion that payment infrastructure should be viewed not just as a back-end function but as a core component of user experience strategy in the e-commerce domain.

Challenges and Future Directions

Despite Indonesia's strong progress in digital transformation, several key challenges remain. Consumer skepticism regarding the safety of online transaction, gaps in digital infrastructure, and the urban rural divide continue to slow the full adoption of digital payment systems (Suharso, W., Lestari, R., & Sari, 2021).To overcome these barriers, future research should explore new ways to enhance transaction security and strengthen digital literacy, especially in underserved regions.

Understanding how cultural norms shape consumer behavior is another underexplored dimension. Local customs, religious values, and family structures all play a role in shaping attitudes toward online shopping and digital finance. Tailoring payment systems and marketing strategies to reflect these factors could increase adoption and deepen market penetration.

Finally, the integration of emerging technologies – such as artificial intelligence and blockchain – represents the next frontier. These innovations have the potential to redefine how Indonesians interact with e-commerce and financial platforms. However, realizing their full benefits will require careful implementation, clear regulations, and sustained public education.

III. METHOD

This section outlines the approach taken to explore how payment behaviors and e-commerce are evolving in Indonesia, drawing on publicly available secondary data. The aim is to understand the shifting landscape of digital transactions and online commerce, particularly in the context of rapid technological advancements and evolving consumer preferences. By analyzing patterns and trends across multiple data sources, the study sheds light on how Indonesians are adapting to – and driving – the country's digital economic transformation.

Research Design

This approach allows for the processing of large-scale data while ensuring objectivity and replicability. Relying on secondary data analysis to assess the evolution of payment methods and e-commerce in Indonesia. The research zeroes in on digital payment adoption rates including credit card usage, digital wallets, and bank transfers as well as the continued use of cash on delivery (COD) options. Simultaneously, it evaluates the growth of e-commerce platforms through transaction volumes, user base expansion, and market penetration.

The decision to utilize publicly available secondary data stems from the need to access broad and longitudinal datasets that reflect actual market conditions, consumer behavior, and national economic trends. The combination of structured numerical data and social sentiment analytics provides a multi-dimensional view of Indonesia's digital economy.

Data Sources

To ensure robustness and credibility, the study draws from a wide variety of reliable ad authoritative sources. Governmental reports, including data from the Indonesian Ministry of Trade, Bank Indonesia (the central bank), and Badan Pusat Statistik (BPS), offer statistical insights into digital payments, internet access, e-commerce growth, and financial inclusion. Complementing these are findings from market research firms such as Statista, Google-Temasek, and KPMG, which provide detailed consumer insights, payment trends, and e-commerce forecasts specifically tailored to Southeast Asian markets. Industry associations, including the Indonesian E-commerce Association (idEA) and other local trade organizations, contribute a contextual understanding of regulatory frameworks, market dynamics, and industry challenges. The study also incorporates academic journals and conference papers, which represent peer revied theoretical frameworks and case studies related to Indonesia's digital transition, particularly focusing on user behavior, fintech adoption, and policy effectiveness. Lastly, aggregated data from social media platforms such as Facebook, Instagram, and Twitter are utilized to gauge consumer engagement, assess public sentiment toward digital payment technologies, and analyze interactions with e-commerce brands.

Data Collection

The process of collecting and organizing data followed a systematic approach to ensure accuracy, relevance, and analytical rigor. First, key performance indicators (KPIs) were defined to guide the analysis, including adoption rates of payment methods (credit cards, digital wallets, bank transfers, and cash on delivery), e-commerce growth rates (annual transaction values, active user counts, and average basket sizes), market penetration across socio demographic segments (age, income, location), and consumer preferences influencing payment and e-commerce behaviors. Data extraction involved a mix of automated and manual techniques. Reports from official databases and institutional websites were downloaded and categorized, while social media analytics were gathered through

scraping tools to collect public user reactions, comments, and engagement data concerning digital payment platforms. Where discrepancies emerged, data from various sources was manually compiled, compared, and reconciled to maintain accuracy. The data cleaning and validation process included consistency checks to align units, timeframes, and terminologies across sources; handling of missing data through either consulting alternative sources or applying interpolation techniques; and cross verification using multiple independent references to validate figures and reduce bias. This comprehensive approach ensured the robustness and reliability of the dataset used in the study.

IV. DISCUSSION

The rapid growth of e-commerce in Indonesia has been strongly influenced by several key payment trends most notably, the widespread adoption of digital wallets, the prevalent use of credit cards, and the rising accessibility of the internet. Drawing on insights from publicly available analytics, this discussion explores how these factors interact and shape the country's evolving e-commerce landscape. By analyzing Indonesia's digital trends and the expansion of its online marketplace, we gain valuable insights into shifting consumer behavior and market dynamics. The data points primarily fall into two main areas: overall market growth and preferred payment methods.
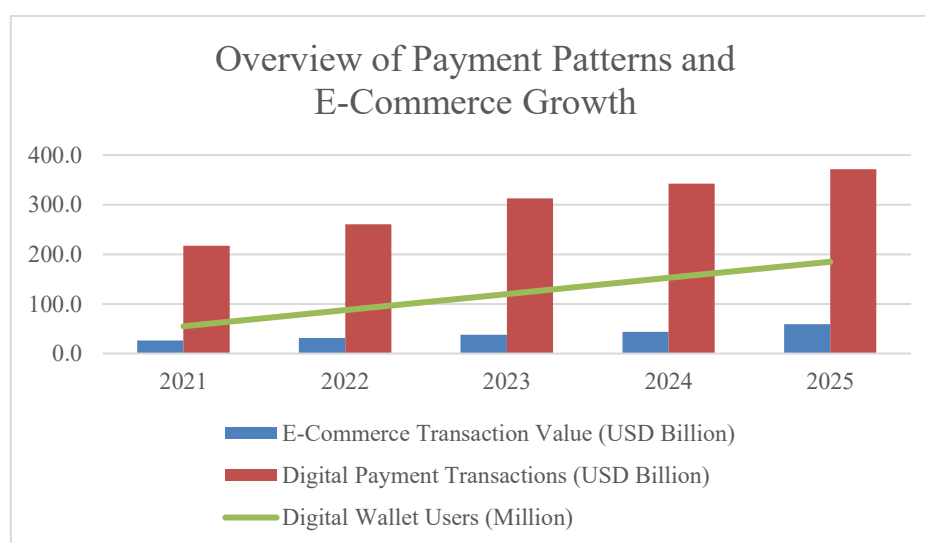

Figure 1: Overview of Payment Patterns and E-Commerce Growth

| Statistic	Value	Explanation
Mean Growth Rate	~35,6%	Average year over year growth from 2018 to 2024
Median Growth Rate	~21,9%	Middle value of growth rates over the period
Standard Deviation	~33,2%	Indicates high fluctuation, especially early pandemic

Figure 2: Statistical Analysis Based on the E-Commerce Growth Data from 2021 to 2024

Due in large part to an increase in digital transactions and wallet users, Indonesia's e-commerce industry has experienced impressive growth in recent years. The overall value of e-commerce transactions reached around IDR 573 trillion (about US\$37,6 billion) in 2023, and it is predicted to increase gradually to about US\$59,3 billion by 2025, increasing by nearly 15,5% just from 2023 to 2024. With transaction volumes expected to reach US\$371,6 billion by 2025 after reaching US\$313 billion in 2023, digital payment has also been increasing. This is noticeable change as more companies and customers choose digital payment methods due to their speed, ease, and security.

At the same time, the number of people using digital wallets has increased dramatically, from 55 million in 2021 to an estimated 185 million by 2025. People's growing reliance on app-based payments for routine purchases is reflected in this quick adoption. Despite the general rising tendency, growth hasn't been entirely consistent. Growth rates have varied significantly, particularly in the early stages of the COVID-19 pandemic. Still, with an average annual growth rate about 35,6%, the long-term picture is still highly favorable. All things considered, these trends show a significant move in Indonesia towards digital payments, which is supporting a thriving and growing e-commerce sector.

Technological developments, shifting consumer preferences, and the growing use of cellphones and the internet have all contributed to a dramatic change in Indonesia's payment landscape in recent years. As a result of a larger trend toward cashless transactions, digital payment systems including e-wallets, online banking, and QR code payments have become increasingly popular. Due in large part to their simplicity and the incentives provided by service providers, e-wallets have become the preferred payment option among Indonesian customers, according to the data studied. This move to digital payments is representative of a larger pattern seen

in many developing nations, where there may be a deficiency in traditional banking infrastructure. Digital payment solutions have given consumers in Indonesia, where a sizeable section of the population is still unbanked or underbanked, an accessible alternative that allows them to take part in the expanding e-commerce market. This shift has been made easier by the growth of mobile payment systems like GoPay, OVO, and DANA, which provide users with the option to transact safely and easily.
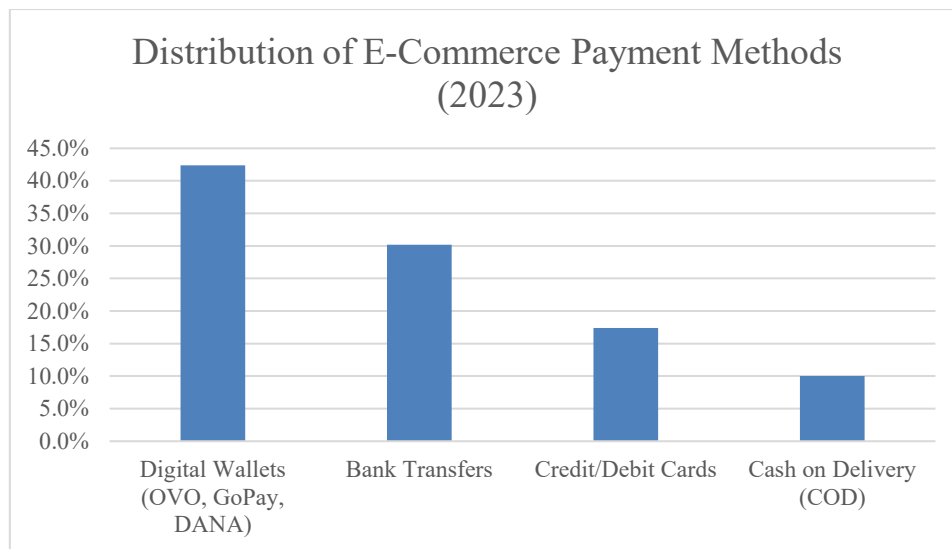
Figure 3: Distribution of E-Commerce Payment Methods (2023)

The distribution of e-commerce payment methods in Indonesia indicates a growing trend towards digital transactions, per Global Data (2023). With 42,4% of the market, digital wallets like OVO, GoPay, and DANA are the industry leaders. Convenience, simplicity of connection with online purchasing platforms, and alluring incentives like discounts and cashback are what make them so popular. Due in large part to user familiarity and perceived dependability, bank transfers continue to be the second most popular option (30,2%). With a 17,4% market share, credit and debit cards are preferred by customers looking for flexibility, particularly when marking larger purchases or setting up payment plans. Cash on delivery (COD) still accounts for more than 10% of transactions, despite a slow decline. Customers who feel more confident paying after the product is delivered or in places with restricted access to digital payment infrastructure frequently choose COD. All things considered, this data demonstrates both the growing confidence in digital payment systems and the ongoing applicability of conventional approaches for specific clientele.

Furthermore, this trend has been further accelerated by the integration of payment solutions with e-commerce platforms. A multi-channel payment strategy has been implemented by numerous online marketplaces, giving customer multiple ways to finish their transactions. Higher conversion rates are eventually the results of this flexibility, which also improves the customer experience and builds confidence in online transactions. The study highlights the crucial role that payment diversity plays in the e-commerce industry by showing that platforms that provide a variety of payment methods typically see higher levels of client retention and loyalty.
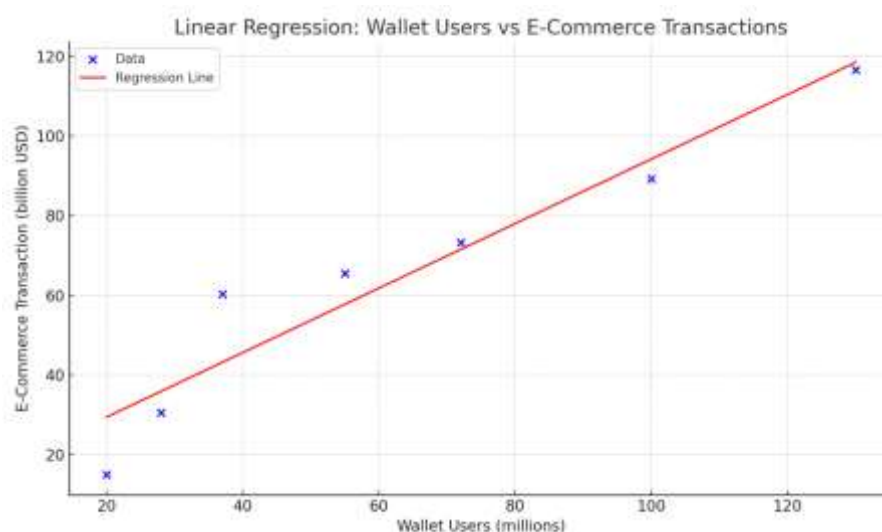
Figure 4: Linear Regression: Wallet Users vs E-Commerce Transactions

The graph shows a significant positive correlation between the total value of e-commerce transactions and the number of users of

digital wallets. The linear regression model's predictions are presented by the red line, which illustrates how transaction values often rise as more people use digital wallets. 91% of the variation in e-commerce transaction values dependent on the number of users of digital wallets can be explained by this model, which has an R-squared value of roughly 0,91. This high proportion shows that the number of users is a major determinant of transaction volume, implying that e-commerce activity increases dramatically as digital wallets gain traction.
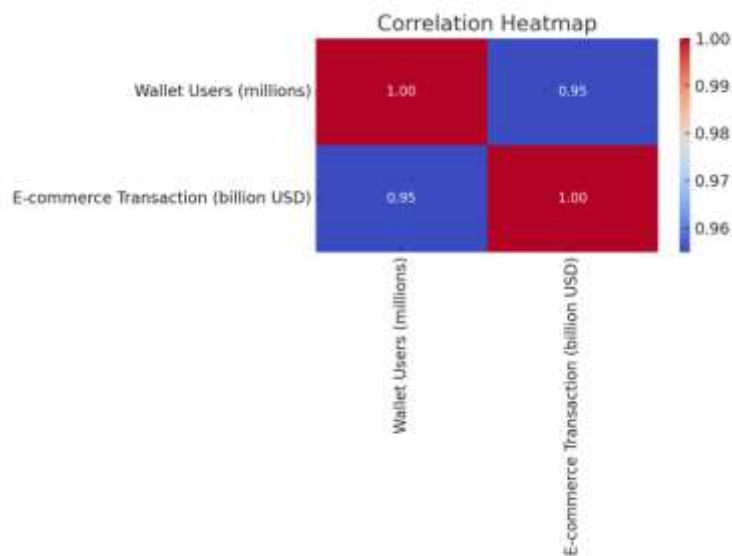

Figure 5: Correlation Heatmap

A vivid picture of the relationships between various variables is provided by the heatmap. The very strong positive correlation of 0,95 between the value of e-commerce transactions and the number of e-wallet users is one noteworthy conclusion. This implies that the overall transaction value tends to increase dramatically as more people use e-wallets. Besides that, every connection that is displayed is statistically significant and positive suggesting that the variables involved have meaningful and consistent associations with one another.

E-commerce has grown significantly in Indonesia due to a number of variables, with the confluence of economic, demographic, and technological factors being a key one. First and foremost, one of the main factors driving the growth of e-commerce is the rising rate of internet access, which has reached roughly 77% of the population. More people can now use online shopping platforms thanks to the widespread availability of reasonably priced smartphones, which has increased the number of customers for e-commerce companies.

Moreover, Indonesia's demographics offer a special chance for the expansion of e-commerce. Businesses can use this generational advantage to boost sales because the younger generation is tech savvy and growing more at ease with online transactions. The emergence of social media and influencer marketing has also had a big impact on how consumers behave because younger generations are more likely to rely on social media for product reviews and suggestions. This trend emphasizes how crucial digital marketing tactics are to drawing in target demographic and winning.
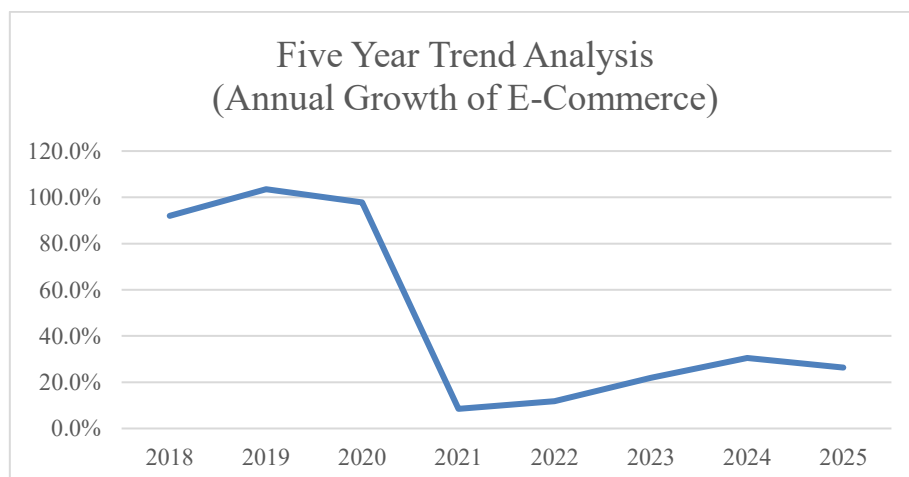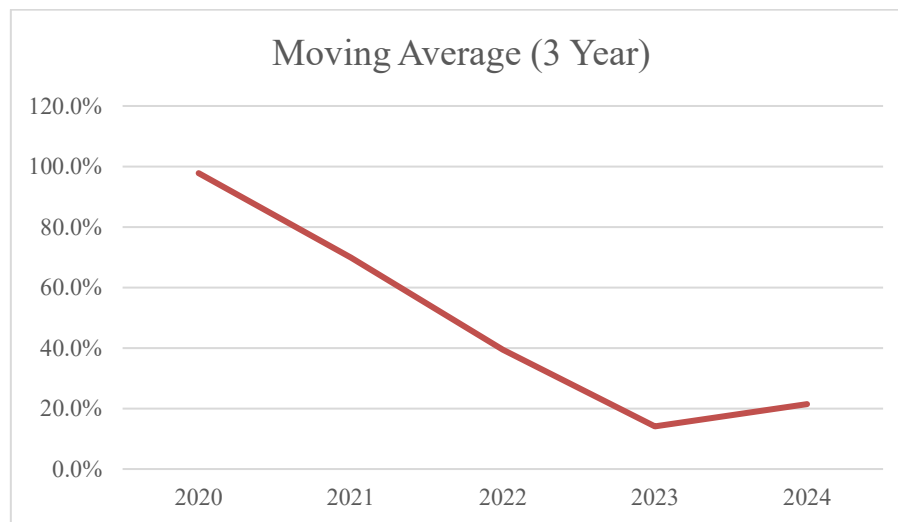

Figure 6: Five Year Trend Analysis (Annual Growth of E-Commerce)

Figure 7: Moving Average (3 Year)

Three unique phases rapid acceleration, abrupt slowdown, and gradual recovery have characterized the dramatic shift of e-commerce growth over the last five years. The COVID-19 pandemic which spurred digital adoption as customers moved to online buying out of need was a major factor in the sector's spectacular expansion between 2018 and 2020. Growth rates reached a height of more than 100% during this time, indicating how urgent it is for both consumers and businesses to adopt digital commerce.

But as the world started to recover from the pandemic in 2021, growth began to decline precipitously. The initial spike in demand for digital products started to level out, and consumer behavior started to revert to pre pandemic levels. The recession was also exacerbated by market saturation and wider economic uncertainty, as growth rates dropped into the single digits. Recent data and forecasts point to a positive recovery despite this cooling off period. With the help of enhance digital infrastructure, technical developments like artificial intelligence (AI) and customized shopping experiences, and rising confidence in online platforms, e-commerce growth has resumed since 2023. This shift from strong early growth to a new stage of more sustainable expansion is also reflected in the 3-year moving average. This pattern indicates that e-commerce is still developing as a robust and continuously expanding industry, even though the days of unusual spikes brought on by pandemics are over.

Even if Indonesian e-commerce is growing at a promising rate, there are still a number of obstacles and difficulties that could prevent further advancement. The problem of supply chain management and logistics is one of the biggest obstacles. With more than 17,000 islands, Indonesia presents special logistical challenges that may impact delivery schedules and expenses. Customer satisfaction may suffer as a result of e-commerce companies experiencing delays and higher operating expenses due to inefficient transportation infrastructure. Even though the use of digital payment methods is growing, worries about fraud and cybersecurity are still common. The likelihood of fraud and data breaches rises as more customers conduct business online. Strong security measures must be given top priority by e-commerce platforms in order to safeguard customer data and foster user trust. The regulatory framework pertaining to digital payments and e-commerce presents another difficulty. Regulations must change as the industry develops to handle new concerns like taxation, data privacy, and consumer protection. Businesses may experience uncertainty and investment in the e-commerce industry may be hampered by unclear laws. To create a supportive regulatory framework that encourages innovation while defending the interests of consumers, policymakers must cooperate with industry stakeholder.

Looking ahead, e-commerce in Indonesia seems to have a bright future, but only if the aforementioned issues are resolved. New payment methods and improvements that improve the online buying experience should appear as technology develops further. For example, e-commerce platforms that use machine learning and artificial intelligence (AI) may be able to improve inventory management, expedite shipping, and customize the buying experience. Furthermore, more money will probably be invested in e-commerce infrastructure, such as payment and logistics systems, as a result of Indonesia's continuous digital transformation. We might see an increase in collaborations between e-commerce platforms and logistics companies to boost delivery effectiveness and cut expenses as companies realize how important a flawless client experience is.

In the end, this partnership might make Indonesia's e-commerce market more competitive overall. In addition, social commerce is anticipated to play an even larger role in the years to come. E-commerce companies can use social media platforms to interact with customers, advertise products, and increase sales as social media's effect on consumer purchase decisions grows. By incorporating purchasing capabilities into social networking apps, marketers have a rare chance to connect with customers where they spend the most of their online time, increasing visibility and boosting conversions.

In summary, the information gleaned from public statistics highlights how dynamic Indonesian e-commerce growth and payment trends are. Although the industry faces many obstacles, there are also many opportunities for companies functioning in this filed due to the functioning in this fields due to the convergence of demographic changes, technical improvements, and evolving customer behavior. Stakeholders can fully realize the potential of Indonesia's e-commerce business and help ensure its continued growth in

the years to come by resolving logistical obstacles, giving cybersecurity first priority, and creating a supportive regulatory framework. To be at the forefront of the global e-commerce revolution, Indonesia will need to do ongoing research and analysis in order to manage the changing market and take advantage of new trends.

V. CONCLUSION

The environment of digital payments and e-commerce in Indonesia is changing dramatically, mirroring broader societal shifts driven by urbanization, technology, and changing demographics. According to this report, technologies like digital wallets, internet banking, and fintech advancements are not only modernizing payment methods but also contributing to a nationwide increase in online buying. The number of online transactions in Indonesia is increasing significantly, both in terms of the amount spent and the frequency of purchases, thanks to a tech savvy younger demographic and strong government backing for the development of digital infrastructure.

The data unequivocally shows a close relationship between the expansion of e-commerce as a whole and the rise in the use of digital wallets. The number of people using digital wallets is predicted to increase from 55 million to 185 million in a short period of time, from 2021 to 2025. That is a significant change. Better payment methods, increased internet access, and the straightforward simplicity of digital transactions are the main drivers of this expansion. Because they accommodate more consumer preferences, foster trust, and make it simpler for customers to finish their transactions, platforms that accept a variety of payment methods such as credit cards, bank transfers, and e-wallets generally perform better.

However, there have been obstacles in the way of advancement. Issues including cybersecurity risks, a lack of digital literacy in some places, and the disparity in technology between urban and rural areas continues to be major worries. Customers may be reluctant to trust digital platforms because they are still concerned about fraud or data leakage. Another big problem is logistics; Indonesia's enormous territory, which consists of more than 17,000 islands, poses serious infrastructural and delivery issues for internet companies. Furthermore, if not managed correctly, changing yet occasionally ambiguous legislation pertaining to topics like taxation and data privacy could impede progress.

Looking ahead, new technologies like artificial intelligence, machine learning, and integrated social commerce platforms will probably influence Indonesia's e-commerce and digital payments landscape. Better consumer experiences, quicker delivery methods, and safer transactions are all promised by these advancements. Government and business sector cooperation is essential to achieving this potential. By working together, they can create an ecosystem that promotes development and guarantees that everyone, even residents of underprivileged areas, may take use of the advantages offered by the digital economy.

This study is subject to several limitations. First, it relies primarily on secondary data obtained from public sources, which may vary in accuracy, reporting methods, or update frequency. Such inconsistencies can affect the precision of the statistical analyses presented. Second, the study does not incorporate primary data collection such as surveys or interviews, which limits the ability to capture user perceptions, behavioral intentions, and trust dynamics directly. Third, the broad national level data used in this analysis does not full reflect regional differences, especially between rural and urban areas. Future research should consider integrating primary data and more granular, region-specific datasets to validate and strengthen the findings.

In the end, the interaction between e-commerce and payment technologies is changing how companies run and how Indonesian customer shop. Continued investments in digital education, infrastructure, regulation, and consumer trust are necessary for this shift to be equitable and long lasting. Indonesia is in a strong position to lead South-East Asia's digital economy if these obstacles are addressed.

VI. DISCLOSURE

The author declares that there are no conflicts of interest, financial or otherwise, related to the conduct, analysis, or publication of this research. The study received no external funding, and no personal or institutional relationships influenced the research process or the interpretation of findings.

REFERENCES

1. Bank Indonesia. (2020). *National Payment Gateway: Framework and Implementation*.
2. Bank, W. (2023). *Indonesia digital economy assessment: Building inclusive growth through digital transformation*. The World Bank Group. https://www.worldbank.org/
3. Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2016). Big Data, Open Data, Data Infrastructures: A New Era for Public Administration Research. *Journal of Public Administration Research and Theory*, 26(2), 305–316.
4. BPS. (2021). *Statistical Yearbook of Indonesia*.
5. Fajrina, N., Lestari, R., & Sari, D. (2021). The Adoption of Digital Wallets in Indonesia: A Study on Consumer Behavior. *International Journal of Business and Management*, 16(5), 45–58.
6. Gilliom, J. (2016). The Ethics of Big Data: A Framework for Understanding the Ethical Implications of Big Data. *Data & Society Research Institute*.
7. Google, Temasek, B. & C. (2022). *e-Conomy SEA 2022: Through the waves, towards a sea of opportunity*.

8. Indonesia, B. (2023). *Indonesia payment systems blueprint 2025*.
9. Lestari, R., & Sari, D. (2020). Trust in Digital Payment Systems: A Study of Indonesian Consumers. *Journal of Digital Marketing*, 5(1), 23–34.
10. Nurhadi, D., Widiastuti, A., & Setyawan, S. (2020). The Impact of Payment Method Availability on Online Purchase Behavior in Indonesia. *International Journal of E-Commerce Studies*, 11(3), 67–80.
11. Prabowo, H., Sari, D., & Lestari, R. (2021). Leveraging Social Media Analytics for Understanding Consumer Sentiment in E-Commerce. *Journal of Marketing Research*, 58(4), 789–805.
12. Rakhmawati, R., Widiastuti, A., & Setyawan, S. (2020). Demographic Factors Influencing E-Commerce Adoption in Indonesia. *Asian Journal of Business Research*, 10(2), 23–38.
13. Statista. (2021). *E-commerce in Indonesia - Statistics & Facts*.
14. Statista. (2023). *E-commerce market value and user penetration in Indonesia (2018–2025)*.
15. Suharso, W., Lestari, R., & Sari, D. (2021). The Digital Divide in Indonesia: Barriers to E-Commerce Adoption. *Journal of Business Research*, 129, 123–134.
16. Widyastuti, A., & Setyawan, S. (2021). The Influence of Social Media Marketing on Consumer Purchase Decisions in E-Commerce. *Journal of Marketing Theory and Practice*, 29(2), 145–161.