

Analysis and Forecasting of Electronic Money Transaction Usage in Indonesia: An ARIMA Approach (2024–2025)

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Abstract. The development of financial technology is driving the transformation of the payment system in Indonesia, making electronic money (e-money) a vital instrument in the digital economy ecosystem, supported by policies such as the implementation of QRIS. Data shows that the e-money transaction trend is fluctuating yet indicates a positive growth direction. Therefore, accurate analysis and forecasting are crucial for infrastructure and regulatory preparedness. The objective of this study is to model and project the movement of monthly electronic money transaction values in Indonesia (January 2024–February 2025). The method used is time series analysis with the Autoregressive Integrated Moving Average (ARIMA) model. Data was processed using the SPSS Expert Modeler software to identify the best model and test its performance and residual diagnostics. The results indicate that the best-fit model is ARIMA (0,1,1), which proved to be reliable and highly accurate with a MAPE value of 5.982% and explained 75.5% of the data variation ($R^2=0.755$). Analysis of the observation data shows a significant transaction surge (peaking at around Rp65.5 trillion in January 2025). This surge was driven by strong seasonal factors, particularly the e-commerce shopping peak season and the year-end holiday period (November–January). The conclusion is that electronic money transactions are on a strong growth trend, and the ARIMA (0,1,1) model is an effective tool for monitoring short-term movements, providing essential guidance for industry players and monetary authorities in managing the dynamics of payment digitalization.

Keywords: Electronic Money, Forecasting, ARIMA, Time Series, Payment Digitalization.

1 Introduction

Electronic money (e-money) is a digital, non-cash payment instrument that allows for the electronic storage of value and the reduction of the balance according to the transaction nominal (Hukum & Airlangga, 2017). Its usage continues to increase because it supports mass, fast, and small-value transactions, such as in public transportation, toll roads, and retail. Financial technology innovation is the main driver of the payment system transformation in Indonesia, where practical, secure, and efficient e-money plays a crucial role in the digital economy ecosystem (Hidayat, 2006).

The acceleration of payment system digitalization has gained significant momentum since the implementation of QRIS in 2019. Bank Indonesia data shows that QRIS transactions grew by 162 % year-on-year in July 2025, signaling a shift in public behavior toward digital payments. This growth further confirms that digital transactions have become an essential element in daily economic activities.

The increasing dominance of digital payments necessitates analysis and forecasting of electronic money usage. According to *watevec.com*, although cash is still used, its role continues to decline with the development of digital payment instruments. Without proper analysis and projection, business actors, regulators, and the financial industry may face infrastructure unpreparedness, increased operational risks, and an imbalance between innovation and regulation.

This urgency aligns with Bank Indonesia's vision for developing the digital economic and financial ecosystem, which includes national integration, banking digitalization, interlinkage between banking and fintech, consumer protection, and national interests in cross-border digital economy (Sistem et al., n.d.). Given the fluctuating but increasing pattern of electronic money transactions, an analytical approach capable of accurately capturing these dynamics is required.

2 Literature Review

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2.1 Definition, Characteristics, and Types of Electronic Money

The definition of electronic money (e-money) varies based on regulatory and technological perspectives. (REPORT ON, 1998) defines electronic money as monetary value stored electronically on a device and used for payments without requiring a bank account for each transaction. From a technical standpoint, Pratama refers to electronic money as value stored using chips or RFID technology connected to a computer system, with the fund transfer mechanism based on Electronic Funds Transfer (Bank Indo).

In Indonesia, Bank Indonesia Regulation No. 16/8/PBI/2014 explains electronic money as a payment instrument where the value is deposited in advance, stored electronically on a chip or server medium, used for payment to parties other than the issuer, and is not classified as a deposit, thus not guaranteed by the Deposit Insurance Agency (LPS). This characteristic makes electronic money a fast, efficient, and bank account-independent prepaid instrument (Hukum & Airlangga, 2017).

Its primary characteristics include the storage of value in a digital medium, either a chip card or a server, and the automatic reduction of the balance when used. Electronic money plays a role in modernizing the payment system by supporting fast and low-cost transactions (Sistem et al., n.d.).

PBI No. 20/6/PBI/2018 classifies electronic money into two types based on the scope of use: closed loop, which can only be used at the issuer's merchants, and open loop, which can be used across various service providers. Based on the value storage medium, e-money is distinguished as chip-based (which can transact offline) and server-based (which requires an online connection). In terms of user identity, there are registered and unregistered types, which determine the balance limit, transaction limit, and level of security.

Table 1. Summary of Electronic Money Types Based on Regulation and Technology.

Category	Type	Key Characteristic
Scope of Use	Closed Loop	Only used at the issuer's merchant.
	Open Loop	Can be used at merchants outside the issuer.
Value Storage Medium	Chip-based	Balance stored on a chip; transactions can be done offline.
	Sever-based	Balance stored on the issuer's database; requires a connected device.
User Identity	Registered	User identification exists; higher balance and transaction limits.
	Unregistered	Without identity verification; lower balance and transaction limits.

Source: Bank Indonesia Regulation Number 20/6/PBI/2018 concerning Electronic Money.

The classification of electronic money is based on differences in regulation and technology. The division between closed loop and open loop relates to usage flexibility. The distinction between chip and server indicates variations in transaction mechanisms according to the technical structure of the device (Rivani & Rio, 2021).

Meanwhile, the classification into registered and unregistered relates to security and user identity. This aligns with the view of (Sistem et al., n.d.) regarding the importance of maintaining a balance between digital innovation and consumer protection.

2.2 Development of Electronic Money Usage in Indonesia

The advancement of digital technology contributes significantly to the increasing use of electronic money. Information technology accelerates transaction processes, enhances the efficiency of money circulation, and reduces transaction costs (Rindiani et al., 2024). This digitalization also influences the transmission of monetary policy. (Indrawati et al., 2020) found that the development of electronic transactions is related to the effectiveness of interest rate policy transmission.

The increased velocity of money circulation through digital instruments potentially triggers inflationary pressure. (Hermawan et al., 2024) explain that the intensity of digital transactions accelerates the movement of money in the economy, while research by (R. Kurniawan et al., 2025) indicates that e-money usage impacts the dynamics of money velocity. Various other studies reinforce that digital transactions are an important indicator for monetary authorities in managing price stability (Dialnet).

Empirical patterns show a significant increase in the value of electronic money transactions from 2015 to 2024. Although a decrease occurred in 2023, transactions rebounded in 2024. This trend reflects a shift in public payment preferences and the macroeconomic implications that must be considered by regulators.

Table 2. Development of Electronic Money Transaction Value in Indonesia, 2015–2024 (Trillion Rupiah)

Year	Value (IDR Trillion)
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2015	0.505
2016	0.786
2017	1.178
2018	1.86
2019	2.504
2020	2.5
2021	2.8
2022	1177.797
2023	835.84
2024	2500.0

Source: Official Bank Indonesia; Estimation based on Bank Indonesia; and Media (GoodStats)

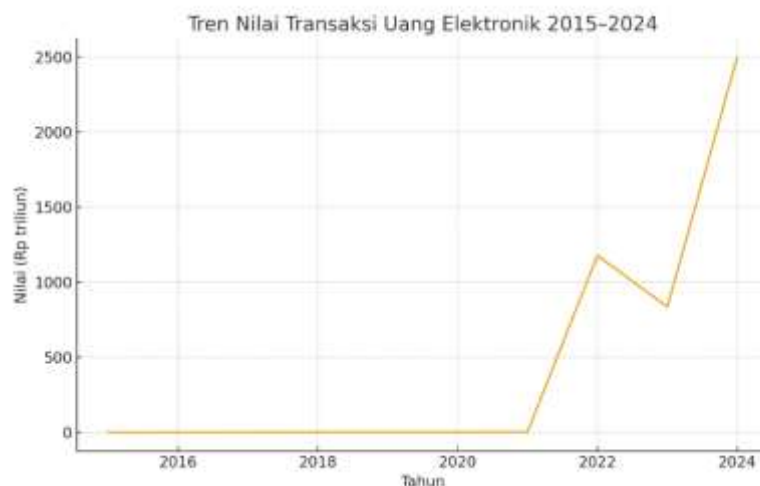


Figure 1. Electronic Money Transaction Value Trend, 2015–2024

Source: Bank Indonesia and GoodStats (data processed)

2.3 Factors Affecting Electronic Money Usage

Technological advancements drive the rapid growth of fintech services in Indonesia, especially electronic payments which offer faster, safer, and more practical processes (Abidin, 2019). Users are attracted to using electronic money due to time efficiency, security, and ease of transaction.

Trust is a significant factor in technology adoption. (Kotler, P., & Keller, 2016) explain that trust is an individual's readiness to rely on others. In the context of electronic money, trust encompasses the user's belief in the provider's ability to maintain system and data security.

In addition to trust, perceived risk also has an influence. Perceived risk relates to the possibility of balance misuse if the device is lost or stolen, as some instruments can still be accessed without authentication (Kemanfaatan & Terhadap, 2020).

Ease of use and service benefits are other factors that increase adoption interest. The easier and more beneficial a system is, the greater the likelihood users will integrate it into their daily activities (Ernawati, N., & Noersanti, 2020). Usage intention then drives the actual behavior of using the service (Atriani, A., Permadi, L. A., & Rinuastuti, 2020).

2.4 Previous Research Related to Electronic Money and Forecasting

Various studies discuss the forecasting of electronic money transactions and the digital economy. (Susila et al., 2023) found that the hybrid ARIMA-Neural Network model provides better accuracy compared to classic ARIMA. [Another study] shows that ARIMAX-GARCH improves prediction accuracy by considering external variables such as the COVID-19 pandemic.

Other research in digital finance also demonstrates the relevance of ARIMA. (Ruhana, 2023) used ARIMA to predict fintech lending risk indicators and found stable results. (Susanti & Wiyono, 2025) applied ARIMA to project the ROA of fintech lending.

(Inflow et al., 2021) compared ARIMA, ARIMAX, TSR, and Neural Network in forecasting currency cash flows and found that ARIMAX and Neural Network were superior when involving exogenous variables. (Sam et al., n.d.) also indicated that LSTM performs better in predicting stock prices compared to ARIMA or ARIMA-GARCH.

Overall, previous research shows that forecasting models are continually evolving toward hybrid and machine learning approaches due to the increasing complexity of digital financial data.

2.5 Basic concepts of Forecasting and the ARIMA Model

Forecasting is an analytical process used to predict future values based on historical data patterns. The essential steps include data pattern identification, model selection, parameter estimation, and accuracy evaluation (Hermanto, F. Wibowo, 2020).

The ARIMA model is one of the main approaches in time series analysis. ARIMA consists of autoregressive, integrated, and moving average components. The autoregressive component describes the influence of past values; the integrated component converts the data into stationary form through differencing; while the moving average component uses past errors as the basis for prediction (M. R. Kurniawan, 2018).

Stationarity is a crucial prerequisite before applying ARIMA. Non-stationary data can lead to biased estimates, requiring testing using the ADF test. Once the data is declared stationary, the determination of orders p and q uses patterns in the ACF and PACF plots (M. R. Kurniawan, 2018). The final stage is diagnostic testing, such as the Ljung-Box test, to ensure the residuals are random.

With these procedures, ARIMA becomes a robust method for modeling trends and fluctuations, including those in electronic money transactions which exhibit dynamic movement patterns.

3 Research Method

3.1 Data Source and Research Variables

The data source for this research is the official GoodStats website. The data is in the form of monthly time series regarding the volume of electronic money transactions in Indonesia for the period January 2024 to February 2025, totaling 14 observations. This data is used entirely in the analysis process without separation between training data and testing data, as the research objective focuses on modeling and short-term forecasting of the latest trend. The variables used in this research consist of:

- Main variable (Y): Monthly electronic money transaction volume (in billion rupiah).
- Time variable (t): Month and year of observation (2024–2025).

Table 3. Monthly Electronic Money Transaction Data in Indonesia (2024–2025)

Date	Uang Elektronik
2024-01	42.409,40
2024-02	41.393,52
2024-03	45.785,56
2024-04	43.726,15
2024-05	45.860,31
2024-06	47.195,58
2024-07	50.803,69
2024-08	55.740,08
2024-09	53.358
2024-10	53.729
2024-11	49.115,88
2024-11	68.081,84
2025-01	65.534,58
2025-02	63.735

Source: Data processed from GoodStats, 2025.

3.2 Research Approach

This study uses a quantitative approach with the Autoregressive Integrated Moving Average (ARIMA) method, also known as the Box–Jenkins method. This method is chosen because it is effective for performing short-term forecasting based on historical patterns in time series data (Salwa et al., 2018). ARIMA utilizes the relationship between past values, differences over time, and the error component to predict the value in the subsequent period. The ARIMA model consists of three main components, namely:

- Autoregressive (AR),
- Integrated (I), and
- Moving Average (MA).

These components are estimated based on the patterns of autocorrelation and partial autocorrelation in the data.

3.3 Research Data

The data used is electronic money transaction data in Indonesia in the form of a monthly time series. The data was processed using SPSS software, which yielded the best model through an automated identification process. The visualization and numerical output from SPSS were used to support the analysis.

3.4 Approach and Analysis Technique

This research uses the Autoregressive Integrated Moving Average (ARIMA) method to analyze the pattern and forecast the value of electronic money transactions. The ARIMA method was chosen because it is capable of handling trend patterns in time series data and is frequently used for short-term forecasting with a high degree of accuracy.

The stages of time series analysis include:

Model Identification

- Observing the initial data pattern
- Stationarity test
- Performing differencing if necessary
- Observing the ACF and PACF plots

Model Estimation

- Parameter estimation using an automated procedure (SPSS Expert Modeler)
- Selection of the best model based on the smallest BIC value Residual Diagnostic Test
- Ljung-Box test to check whether the residuals are white noise
- Examination of the residual pattern

Model Performance Evaluation

- Using MAPE, MAE, RMSE, and R-square values

Data Identification and Transformation

- The initial graph indicates that the data has an increasing trend pattern, particularly in the period late 2024 to early 2025. Since the data is non-stationary at the initial level, a first-order differencing process ($d = 1$) was performed to achieve stationarity.

ARIMA Model Selection

- The automated identification process through the SPSS Expert Modeler resulted in the best model: ARIMA (0,1,1)

This model was selected because:

- It has the smallest BIC value compared to other candidate models.
- It has a lower forecasting error.
- The residuals do not show a specific pattern (white noise).

The ARIMA (0,1,1) model means:

- $p = 0$ (no autoregressive component)
- $d = 1$ (one-time differencing)
- $q = 1$ (has one moving average component)

Model Description

Model Type			
Model ID	Uang Elektronik	Model_1	ARIMA(0,1,1)

Figure4. Model Description (SPSS Output)

4 Results and Discussion

4.1 Model Performance Evaluation

SPSS yielded the following summary of the model performance.

Model Fit											
Fit Statistic	Mean	SE	Minimum	Maximum	5	10	25	Percentile			
Stationary R-squared	.493	.	.493	.493	.493	.493	.493	.493	.493	.493	.493
R-squared	.755	.	.755	.755	.755	.755	.755	.755	.755	.755	.755
RMSE	4435.466	.	4435.466	4435.466	4435.466	4435.466	4435.466	4435.466	4435.466	4435.466	4435.466
MAPE	5.982	.	5.982	5.982	5.982	5.982	5.982	5.982	5.982	5.982	5.982
MaxAPE	19.657	.	19.657	19.657	19.657	19.657	19.657	19.657	19.657	19.657	19.657
MAE	3160.507	.	3160.507	3160.507	3160.507	3160.507	3160.507	3160.507	3160.507	3160.507	3160.507
MaxAE	9654.713	.	9654.713	9654.713	9654.713	9654.713	9654.713	9654.713	9654.713	9654.713	9654.713
Normalized BIC	17.189	.	17.189	17.189	17.189	17.189	17.189	17.189	17.189	17.189	17.189

Figure 4.1. Model Summary (Output SPSS)

The calculation results show:

- MAPE = 5.982% (very good accuracy level (MAPE category < 10%))
- MAE = 3160.507 (relatively low Mean Absolute Error)
- R-squared = 0.755 (the model explains 75.5% of the data variation)
- RMSE is low (the model is stable in predicting actual values)

These values indicate that the model is reliable and accurate for use in forecasting e-money transactions.

4.2 Model Diagnostic Test

The diagnostic results show:

- Residuals do not have an autocorrelation pattern, as seen from the non-significant Ljung-Box Q value
- No outliers are present
- Residuals are randomly scattered, thus the model satisfies the white noise assumption

Model Statistics						
Model	Number of Predictors	Model Fit statistics		Ljung-Box Q(16)		Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
Uang Elektronik-Model_1	0	.493	.	0	.	0

Figure 4.2. Model Statistics (SPSS Output)

Thus, the ARIMA(0,1,1) model is declared feasible for use.

4.3 Model Diagnostic Test

Data Visualization and Model Fit

The observation graph shows a sharp increase, especially in the months of:

- November 2024 – January 2025, which peaked at around 65.5 trillion
- A small decrease in February 2025 (63.7 trillion)

This pattern is consistent with the increasing use of electronic money in:

- E-commerce platforms
- Digital transportation
- Bill payments
- End-of-year holiday season (seasonal bias)

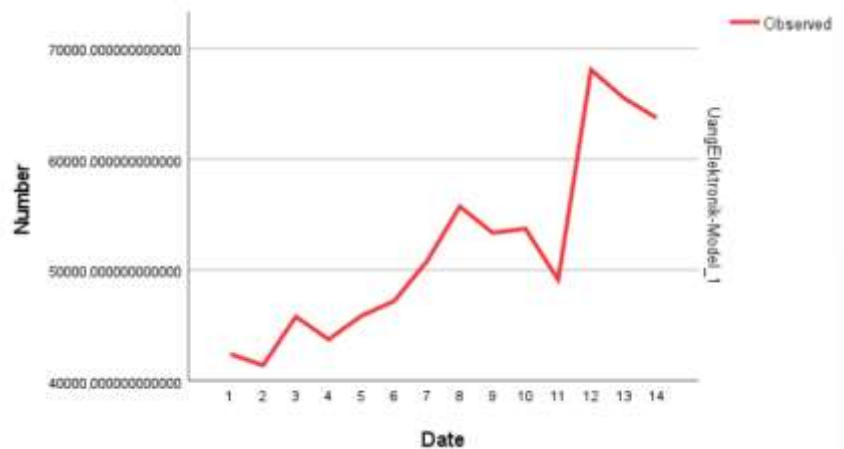


Figure 4.3. Observed Data Graph

This increasing data movement is in line with the national trend of using digital payment instruments.

4.4 Discussion

Based on the analysis results, the ARIMA (0,1,1) model proved to deliver excellent performance evaluation and successfully meets all residual diagnostic tests. The high accuracy value (MAPE = 5.982%), which falls below the 10% category, confirms that this model is reliable and suitable for modeling the short-term trend in electronic money transactions.

Analysis of Transaction Spike and Seasonal Factors

The observation chart shows a sharp increase in electronic money transactions, particularly in the period from November 2024 to January 2025. This significant surge, which peaked at around Rp65.5 trillion, indicates that electronic money transactions are on an uptrend.

This drastic increase was driven by specific seasonal and economic factors:

- **E-commerce Promos and Peak Season:** The spike in November and December 2024 is strongly correlated with the national online shopping peak season, including the National Online Shopping Day (Harbolnas) 11.11 and 12.12. These major promotional activities directly encourage increased use of electronic money as the primary payment method.
- **Year-End Holiday Season:** Increased economic activity during the Christmas and New Year period (December–January), which includes travel, digital transportation, and seasonal consumption, also accelerated the volume of electronic money transactions.
- **Post-Peak Regression:** The minor dip that occurred in February 2025 (Rp63.7 trillion) is a reasonable pattern (post-holiday slump) following high expenditures during the year-end peak season.

Fundamental Factors and Model Implications

This increasing trend is also a reflection of:

- **Accelerated Digital Adoption:** The accelerated adoption of digital payments within the community.
- **Service Integration:** The strengthening integration of e-money transactions with various public and private service applications (such as bill payments).
- **Regulatory Support:** Although not tested in the model, this trend aligns with the acceleration of payment system digitalization supported by Bank Indonesia's policies, such as the implementation of QRIS, which has expanded the user base for non-cash instruments.

The ARIMA (0,1,1) model, which has proven to be valid and accurate, can be used by policymakers, industry players, and researchers to monitor and forecast the movement of digital transactions in subsequent periods, while taking into account the strong seasonal factor at the year-end.

5 Conclusion

- This study aimed to analyze the pattern and forecast the value of electronic money transactions in Indonesia using the ARIMA method. Based on monthly data from January 2024 to February 2025, the results show that electronic money transactions continue to increase, especially from late 2024 to early 2025. This increase aligns with the acceleration of payment system digitalization, the integration of financial services with various digital applications, and increased economic activity during the year-end period.
- The analysis results using SPSS indicate that the best model obtained is ARIMA (0,1,1). This model was chosen because it has the smallest BIC value and satisfies classic assumptions through residual diagnostic tests. Its performance is assessed as very good, demonstrated by a MAPE value of 5.982%, a relatively low MAE, and an R-squared of 0.755, which suggests that the model is able to explain most of the data variation. The white noise residuals confirm that the model is valid and feasible for prediction.
- The research findings indicate that electronic money transactions in Indonesia are on an increasing trend and have the potential for continued short-term growth. This reflects the strengthening adoption of digital payments in the community. These results are relevant for financial industry players, regulators, and technology developers to estimate infrastructure needs, mitigate risks, and set policy directions in support of the evolving digital economic ecosystem.
- Overall, the use of the ARIMA model is proven effective in capturing the movement pattern of electronic money transactions during the latest period, and provides accurate projections to support data-driven decision-making.

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Indonesia secara yang menempel pada uang , kartu kredit , atau pembayaran dari sistem pembayaran tunai ke penyedia sistem pembayaran dengan mengikuti perkembangan saat ini dengan memunculkan sistem pembayaran digital . Masyarakat pun telah (cashless society) atau dikenal dengan Gerakan uang elektronik tersebut ; dan sebagaimana dimaksud dalam undang- Nilai Uang Elektronik adalah nilai uang yang disimpan secara elektronik pada suatu media server atau chip yang dapat dipindahkan untuk Laila Ramadhani dalam jurnalnya yang berjudul “ Pengaruh Penggunaan Uang Elektronik terhadap Pengeluaran Konsumsi Mahasiswa ” mendefinisikan uang elektronik sebagai alat pembayaran yang dapat digunakan untuk berbagai macam jenis pembayaran (multi purposed), tidak bahwa uang elektronik merupakan salah satu inovasi instrumen pembayaran yang muncul akibat dari dampak perkembangan teknologi media elektronik tertentu yang dimana dimiliki konsumen dan telah mendapat izin serta diatur dalam Peraturan Bank Indonesia . 75–90.

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