

Investigating the Influence of Working Hours, Unemployment, Inflation, and the COVID-19 Pandemic on Self-Harm Trends in Indonesia Through ARIMAX Models

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Abstract

Self-harm is a significant public mental health concern influenced by complex interactions between psychological, social, and environmental factors. Understanding long-term patterns and identifying potential determinants of self-harm are essential for developing effective prevention strategies and counseling interventions in Indonesia. This study analyzed annual self-harm attempt rates in Indonesia from 1991 to 2025 using an autoregressive integrated moving average with exogenous variables (ARIMAX) approach. The explanatory variables included unemployment rate, inflation rate, average working hours, and a COVID-19 pandemic indicator. Several ARIMA specifications were evaluated based on model performance, parameter significance, and information criteria. Residual diagnostic tests were conducted to assess model adequacy, including examinations for autocorrelation and heteroscedasticity. The ARIMAX(1,2,1) model was selected as the preferred specification based on its statistical performance and the complete estimation of its parameters. The findings showed that average working hours ($\beta = 0.1908$, $p = 0.024$) and the COVID-19 pandemic period ($\beta = 0.2275$, $p < 0.001$) were significant predictors of self-harm rates, whereas unemployment and inflation were not statistically significant. Forecasting results indicated a gradual decline in self-harm rates, from 13.06 in 2026 to 12.34 in 2028, with increasing uncertainty over longer forecasting horizons. The findings suggest that self-harm trends in Indonesia are closely associated with psychosocial stressors, particularly occupational burden and major social disruptions. Integrating time-series evidence with counseling and public mental health strategies may support more targeted prevention efforts, early identification, and improved psychological support systems.

Keywords: Self-harm, Mental Health, Working Hours, Labor Market, ARIMAX, guidance counseling



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Introduction

Mental health has become an increasingly important issue in contemporary societies, with socioeconomic conditions playing a crucial role in shaping individual well-being. Among the various indicators of psychological distress, self-harm has received growing attention because of its association with adverse mental health outcomes, reduced quality of life, and increased suicide risk. Self-harm refers to intentional behaviors that result in injury or harm to oneself, regardless of suicidal intent, and is increasingly recognized as a significant public health concern worldwide. Although self-harm may occur for various psychological and social reasons, its prevalence is often influenced by broader environmental and economic circumstances. Recent evidence further suggests that broader psychosocial stressors arising from environmental and societal changes can substantially influence

mental health outcomes, emphasizing that psychological distress should be understood within wider social and contextual environments (Putra & Afiati, 2026). Understanding the factors that contribute to changes in self-harm trends is therefore essential for developing effective prevention strategies and evidence-based public health policies.

In recent years, Indonesia has experienced various socioeconomic challenges, including fluctuations in inflation, changes in labor market conditions, and increasing demands in the workplace. These conditions may affect psychological well-being through multiple pathways. Long working hours can contribute to stress, fatigue, emotional exhaustion, burnout, sleep disturbances, and work-life imbalance. Similar findings have also been reported in occupational mental health research, where persistent workplace demands and inadequate organizational support were associated with elevated psychological distress and poorer mental health outcomes among professionals working in high-pressure environments (Putra, Ardi, & Afiati, 2026). A growing body of evidence suggests that excessive working hours are associated with a wide range of adverse mental health outcomes, including depressive symptoms, psychological distress, suicidal ideation, and suicide mortality (Baek et al., 2023; Choi, 2018; Han et al., 2021; Kim et al., 2024; Lee et al., 2020; Yoon et al., 2015). A systematic review and meta-analysis conducted by Kim et al. (2024) found that individuals working more than 55 hours per week were significantly more likely to experience suicidal ideation compared with those working standard hours. Longitudinal studies have further demonstrated that extended working hours increase the risk of developing depressive symptoms and suicidal thoughts over time (Baek et al., 2023, 2024; Ezekekwa et al., 2025). These findings suggest that excessive working hours may represent an important socioeconomic determinant of self-harm behavior.

Unemployment constitutes another major socioeconomic factor that may influence mental health outcomes. Job loss and prolonged unemployment often result in financial insecurity, reduced social participation, loss of identity, and uncertainty regarding future prospects. Such conditions may generate psychological distress and increase vulnerability to self-harm and suicidal behaviors. A comprehensive meta-analysis by Amiri (2022) reported that unemployed individuals exhibit significantly higher risks of suicide mortality, suicide attempts, and suicidal ideation than employed individuals. Furthermore, insecure employment and unstable working conditions have been linked to increased psychological distress and suicidal thoughts among working-age populations (Park, 2019). These findings highlight the importance of labor market conditions as potential drivers of self-harm trends at the population level.

Inflation represents an additional socioeconomic challenge that may affect mental health through economic stress mechanisms. Rising prices reduce household purchasing power, increase financial pressure, and may intensify concerns regarding income adequacy and future economic stability. Economic hardship resulting from inflation can exacerbate psychological distress, particularly among vulnerable populations with limited financial resources. Although the direct relationship between inflation and self-harm has received less attention than other socioeconomic determinants, previous studies have suggested that periods of economic instability and financial uncertainty are often associated with deteriorating mental health outcomes and increased suicidal behavior. Consequently, inflation may indirectly contribute to self-harm through its effects on economic well-being and psychological stress.

Recent evidence has also emphasized the importance of broader societal and economic disruptions in shaping self-harm behavior. The COVID-19 pandemic, for example, generated unprecedented economic uncertainty, labor market instability, and social isolation. Several studies reported increases in self-harm and suicidal ideation among vulnerable populations during and after the pandemic (Baillet et al., 2024; Kim et al., 2025; Sinyor et al., 2022; Wong et al., 2023). These findings suggest that self-harm is influenced not only by individual psychological characteristics but also by changing socioeconomic environments. This perspective is consistent with emerging evidence from low- and middle-income

countries, which emphasizes that mental health outcomes are strongly shaped by contextual socioeconomic conditions and therefore require context-specific empirical investigations (Putra, Ardi, Ildil, et al., 2026). Therefore, investigating macroeconomic and labor-related factors may provide valuable insights into the temporal dynamics of self-harm at the national level.

The growing availability of longitudinal socioeconomic data has encouraged researchers to employ time series methodologies to investigate complex temporal patterns and improve forecasting accuracy. Time series analysis has been widely applied across various fields to understand the evolution of phenomena over time and to identify influential factors affecting future outcomes. For example, Asri et al. (2026) employed a Seasonal Autoregressive Integrated Moving Average (SARIMA) model to forecast railway freight transportation in Sumatra, demonstrating the capability of time series approaches to capture temporal patterns in transportation systems. Similarly, Yollanda et al. (2025) analyzed school enrollment trends in Indonesia using time-series methods to inform counseling and communication strategies, highlighting the usefulness of temporal analysis in social and educational research.

The incorporation of external variables into time-series frameworks has further enhanced researchers' ability to explain the underlying mechanisms behind observed trends. Devianto et al. (2024) developed a seasonal time series model incorporating exogenous variables and long-memory characteristics to improve the forecasting accuracy of chili prices. In another study, Devianto, Permana, et al. (2024) proposed a hybrid model that integrates fuzzy time series with exogenous variables to capture seasonal patterns in train passenger movements. These findings demonstrate that external socioeconomic and environmental factors can substantially improve model performance while providing greater explanatory power for the dynamics of the phenomena studied.

Beyond conventional forecasting approaches, advanced time series techniques have also been applied to investigate relationships among economic, environmental, and social variables. Devianto et al. (2025) utilized a Bayesian Vector Autoregressive (BVAR) model to analyze the interactions among renewable energy consumption, economic growth, forest area, and carbon dioxide emissions. Earlier, Devianto et al. (2023) employed a BVAR framework to evaluate the impacts of government expenditure shocks during the COVID-19 pandemic on macroeconomic indicators. These studies illustrate the growing importance of multivariate time series models in understanding dynamic relationships among interconnected variables.

Recent developments in artificial intelligence and machine learning have further expanded the application of time series analysis. Arif et al. (2024) combined Long Short-Term Memory (LSTM) neural networks with fractional time series models to improve inflation forecasting performance, while Devianto, Yollanda, Maiyastri, et al. (2023) applied Feed-Forward Neural Networks (FFNN) to address heteroscedasticity in exchange rate modeling. Additionally, Yollanda et al. (2025) employed FFNN models to analyze regional economic dynamics and their implications for career planning. Collectively, these studies demonstrate the flexibility and effectiveness of time series methodologies in addressing diverse real-world problems.

Despite the widespread application of time-series methods in fields such as economics, transportation, environmental science, and education, their use in mental health research remains relatively limited, particularly for investigating self-harm trends. Existing studies on self-harm have predominantly focused on individual-level clinical, psychological, or behavioral risk factors using cross-sectional or cohort designs. While these studies have substantially advanced the understanding of self-harm determinants, they provide limited evidence on how changing macroeconomic conditions influence self-harm at the population level over time. Moreover, previous research has rarely employed time-series models that simultaneously account for temporal dependence and the dynamic effects of socioeconomic indicators, such as working hours, unemployment, and inflation. This limitation is particularly evident in developing countries, including Indonesia, where rapid socioeconomic change has occurred, yet longitudinal evidence linking macroeconomic conditions to self-harm trends remains

scarce. Therefore, important research gaps remain regarding the dynamic relationships between socioeconomic conditions and self-harm, as well as the application of time-series approaches to quantify these effects in developing-country settings.

To address this gap, the present study investigates the effects of working hours, unemployment, and inflation on self-harm trends in Indonesia through Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) models. The ARIMAX framework is particularly suitable because it simultaneously accounts for temporal dependence in self-harm data and the influence of external socioeconomic variables. By integrating forecasting and explanatory analyses, this study aims to identify the socioeconomic determinants of self-harm trends and provide empirical evidence to support the development of mental health interventions and public policies in Indonesia. The findings are expected to contribute not only to the mental health literature but also to the growing body of research that applies time-series approaches to complex social and public health challenges.

Method

Data Collection and Preparation.

This study employed annual time-series data covering 1991 to 2025, yielding 35 observations. The objective of this study was to investigate the effects of labor market conditions and macroeconomic factors on self-harm trends in Indonesia. The dependent variable was the annual self-harm rate, while the explanatory variables consisted of the Open Unemployment Rate (OUR), Inflation Rate (INF), Covid-19 (COV), and Average Weekly Working Hours (WH).

The self-harm variable represents the annual prevalence of self-harm attempts in Indonesia. The unemployment rate reflects the percentage of the labor force that is unemployed but actively seeking employment. Inflation measures the annual percentage change in the consumer price index, while working hours represent the average number of hours worked per week by employed individuals. These variables were selected based on Economic Stress Theory and Job Demand-Resources Theory, which suggest that economic hardship, labor market uncertainty, and excessive work demands may contribute to psychological distress and adverse mental health outcomes.

Table 1. Variables and Data Sources

Variable	Description	Unit	Source
Self-Harm	Annual self-harm attempt rate	%	IHME
OUR	Open unemployment rate	%	World Bank
Inflation	Annual inflation rate	%	World Bank
Working Hours	Average weekly working hours	Hours	ILO
Covid-19	The occurrence of Covid 19	Dummy	WHO

Prior to model estimation, the data were examined for completeness, consistency, and temporal patterns. Descriptive statistics and graphical visualizations were generated to identify trends, fluctuations, and potential structural changes throughout the observation period. The self-harm attempt rate data were obtained from the Institute for Health Metrics and Evaluation (IHME), while socioeconomic indicators, including unemployment and inflation rates, were obtained from the World Bank. Average working hours data were collected from the International Labor Organization (ILO).

Stationarity Testing

Stationarity is a fundamental assumption in time-series analysis because non-stationary data may produce spurious regression results. Therefore, all variables were tested using the Augmented Dickey-Fuller (ADF) test. The ADF model is expressed as (Box et al., 2016):

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t$$

where Y_t denotes the observed time series, Δ is the difference operator, t represents the time trend, p is the lag length, and ε_t is the random error term. The hypotheses of the ADF test are:

$H_0: \gamma = 0$ (Series contains a unit root and is non-stationary)

$H_1: \gamma < 0$ (Series is stationary)

If a variable was found to be non-stationary ($p > 0.05$), then the differencing transformations were applied until stationarity was achieved. The number of differencing operations required determined the order of integration of the series.

ARIMAX Model

To analyze the influence of unemployment, inflation, and working hours on self-harm trends, this study employed the Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) model.

The ARIMAX model extends the conventional ARIMA model by incorporating external explanatory variables into the forecasting process. The general ARIMAX model can be written as:

$$Y_t = c + \sum_{i=1}^p \phi_i Y_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \beta_1 OUR_t + \beta_2 INF_t + \beta_3 WH_t + \beta_4 COV_t + \varepsilon_t$$

where Y_t is self-harm rate at the time t , OUR_t is the open unemployment rate, INF_t is inflation rate, WH_t is average weekly working hours, c is intercept, ϕ_i is autoregressive parameters, θ_j is moving average parameters, β_k is coefficients of exogenous variables, and ε_t is white-noise error term.

The identification stage followed the Box-Jenkins methodology. Candidate autoregressive and moving average orders were identified through examination of the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots. Model parameters were estimated using Maximum Likelihood Estimation (MLE). Several competing ARIMAX models were compared to determine the optimal specification.

Besides, the model selection of ARIMAX can be determined by Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC) that can be formulated as follows:

- a. Akaike Information Criterion (AIC)

$$AIC = -2\ln(L) + 2k$$

- b. Bayesian Information Criterion (BIC)

$$BIC = -2\ln(L) + k\ln(n)$$

where L is the maximum likelihood value, k is the number of estimated parameters, and n is the sample size. The model with the lowest AIC and BIC values, while satisfying all diagnostic assumptions, was selected as the final model.

Diagnostic Checking

After estimation, diagnostic tests were performed to verify the adequacy of the selected ARIMAX model. A valid ARIMAX model should generate residuals that behave as white noise, meaning they are

independently and normally distributed with constant variance. Therefore, three diagnostic procedures were conducted, including autocorrelation, normality, and heteroscedasticity tests.

a. Autocorrelation Test

The autocorrelation of residuals was examined using the Ljung–Box test to determine whether the residuals were independently distributed over time. The Ljung–Box statistic is defined as:

$$Q = n(n+2) \sum_{k=1}^h \frac{\hat{\rho}_k^2}{n-k}$$

where Q denotes the Ljung–Box statistic, n represents the number of observations, h is the number of tested lags, and $\hat{\rho}_k$ represents the residual autocorrelation at lag k . The null hypothesis states that the residuals are independently distributed and exhibit no significant autocorrelation. A p-value greater than 0.05 indicates that the null hypothesis cannot be rejected, suggesting that the residuals are free from serial correlation and satisfy the white noise assumption.

b. Normality Test

The normality of residuals was assessed to evaluate whether the error terms follow a normal distribution. This assumption is important because normally distributed residuals indicate that the model adequately captures the underlying structure of the observed data. The Jarque–Bera statistic was used and is expressed as:

$$JB = n \left(\frac{S^2}{6} + \frac{(K-3)^2}{24} \right)$$

where JB denotes the Jarque–Bera statistic, n is the number of observations, S represents the skewness coefficient of the residuals, and K represents the kurtosis coefficient of the residuals. The null hypothesis states that the residuals are normally distributed. A p-value greater than 0.05 indicates that the null hypothesis cannot be rejected, implying that the residuals follow a normal distribution.

c. Heteroscedasticity Test

The presence of changing residual variance was examined using the ARCH-LM test to determine whether the residuals exhibit heteroscedasticity. A well-specified ARIMAX model should produce residuals with constant variance over time. The ARCH-LM test is based on the following auxiliary regression:

$$e_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + \cdots + \alpha_m e_{t-m}^2 + u_t$$

where e_t^2 denotes the squared residual at time t , α_0 represents the constant parameter, α_i represents the ARCH coefficients, and u_t denotes the error term. The test statistic is calculated as:

$$LM = nR^2$$

where R^2 is obtained from the auxiliary regression. The null hypothesis states that there is no ARCH effect, indicating that the residual variance is constant over time. A p-value greater than 0.05 indicates that the null hypothesis cannot be rejected, suggesting that the residuals do not exhibit heteroscedasticity and satisfy the constant variance assumption.

Forecast Accuracy Evaluation

The forecasting performance of the selected ARIMAX model was evaluated using two commonly used accuracy measures: Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE). Overall, the ARIMAX model, with lower MAPE and RMSE, is considered to have superior forecasting

ability because it produces predictions that deviate less from actual observations. These metrics were used to assess the difference between observed and forecast values, with smaller error values indicating better predictive performance.

a. Mean Absolute Percentage Error (MAPE).

The Mean Absolute Percentage Error (MAPE) measures the average magnitude of forecasting errors in percentage terms. The MAPE is expressed as:

$$MAPE = \frac{100}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right|$$

where $MAPE$ represents the mean absolute percentage error, n denotes the number of observations, A_t represents the actual value at time t , and F_t represents the forecasted value at time t . The MAPE value indicates the average percentage deviation between the actual and predicted values. A lower MAPE indicates that the forecasting model produces predictions closer to the observed data.

b. Root Mean Squared Error (RMSE)

The Root Mean Squared Error (RMSE) quantifies the magnitude of forecasting errors by taking the square root of the mean squared difference between actual and predicted values. The RMSE is calculated as:

$$RMSE = \sqrt{\frac{1}{n} \sum_{t=1}^n (A_t - F_t)^2}$$

where $RMSE$ represents the root mean squared error, n is the number of observations, A_t denotes the actual value at time t , and F_t denotes the forecasted value at time t . Since RMSE gives greater weight to larger errors due to squaring, it is useful for identifying models with relatively small forecasting deviations. Lower RMSE values indicate higher forecasting accuracy and better overall model performance.

Results and Discussion

1. Data Collection and Preparation.

The dataset used in this study consists of annual observations from 1991 to 2025. The dependent variable is the self-harm attempt rate in Indonesia, while the explanatory variables include the unemployment rate, inflation rate, and average working hours. Before conducting the ARIMAX modeling procedure, an exploratory data analysis was performed to examine the temporal patterns and preliminary characteristics of each variable. Figure 1 presents trends in the self-harm attempt rate and selected socioeconomic indicators over the observation period.

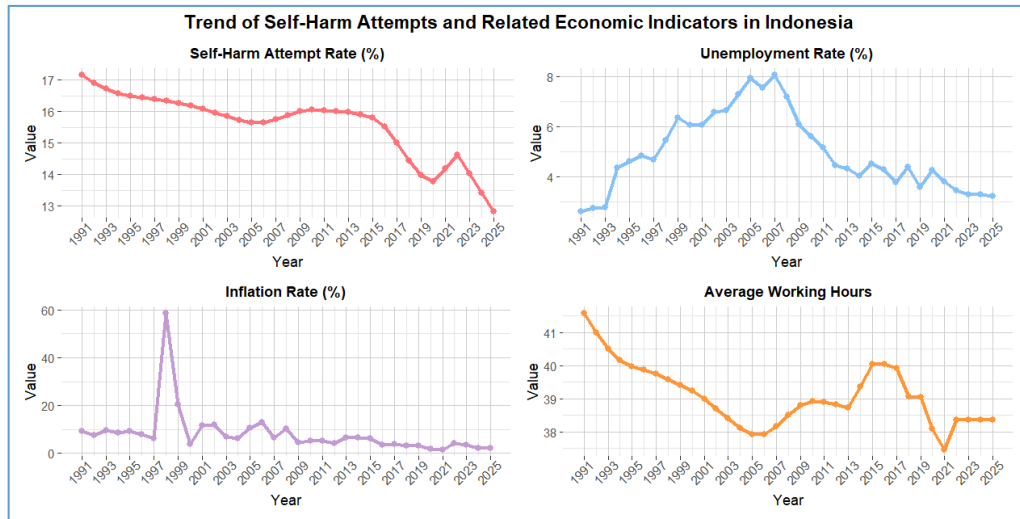


Figure 1. Trend on Self-Harm Attempt Rate, Unemployment Rate, Inflation Rate, and Average Working Hours

Figure 1 illustrates the dynamic patterns of the dependent variable and its potential explanatory factors over time. The self-harm attempt rate shows a gradual declining trend from the early 1990s until the mid-2000s, followed by a relatively stable period and a noticeable decrease after 2015. However, fluctuations can be observed in the later years, indicating possible changes in social and economic conditions that may influence self-harm behavior.

The unemployment rate shows an upward trend in the late 1990s and early 2000s, coinciding with periods of economic instability, before gradually declining in subsequent years. Meanwhile, the inflation rate exhibits substantial volatility, with a sharp increase during the late 1990s reflecting a major economic shock, followed by a more stable pattern in later periods. The average working hours show a long-term decline from the early 1990s to the mid-2000s, followed by a moderate recovery and stabilization in recent years.

These observed variations suggest that socioeconomic conditions have experienced considerable changes over time and may contribute to fluctuations in self-harm attempt rates. Therefore, incorporating unemployment, inflation, and working hours as external predictors in the ARIMAX framework provides a relevant approach to investigate their potential influence while accounting for the temporal dependency structure of the self-harm time series.

2. Time Series Model of Self-Harm

Prior to estimating the ARIMAX model, the stationarity of the dependent variable was examined using the Augmented Dickey-Fuller (ADF) test. Stationarity assessment is an essential step in time series modeling because ARIMAX requires the underlying series to have a stable statistical structure over time. If the series contains a unit root, differencing is required to remove non-stationarity and obtain a stationary process. Table 2 presents the ADF test results for the self-harm attempt rate series at different levels of differencing.

Table 2. Augmented Dickey-Fuller Test Results

Series	ADF Statistic	p-value	Conclusion
Original Series	-0.191	0.9896	Non-Stationary
First Difference	-3.007	0.1827	Non-Stationary
Second Difference	-9.915	0.01	Stationary

The ADF test results indicate that the original self-harm attempt rate series was non-stationary, as evidenced by the high p-value (0.9896), suggesting the presence of a unit root. After first-order

differencing, the series remained non-stationary (p -value = 0.1827), indicating that a single differencing procedure was insufficient to achieve stationarity. However, after applying second-order differencing, the ADF statistic decreased substantially to -9.915 with a p -value of 0.0100, allowing rejection of the null hypothesis of a unit root. Therefore, the self-harm attempt rate series was considered stationary after second-order differencing and was subsequently used as the response variable in the ARIMAX modeling framework.

After achieving stationarity through second-order differencing, the identification of the autoregressive (AR) and moving average (MA) components was conducted using the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots. The ACF and PACF analyses provide preliminary information regarding the appropriate orders of the ARIMA model by examining the correlation structure of the stationary series. Figure 2 presents the ACF and PACF plots of the second-differenced self-harm attempt rate series.

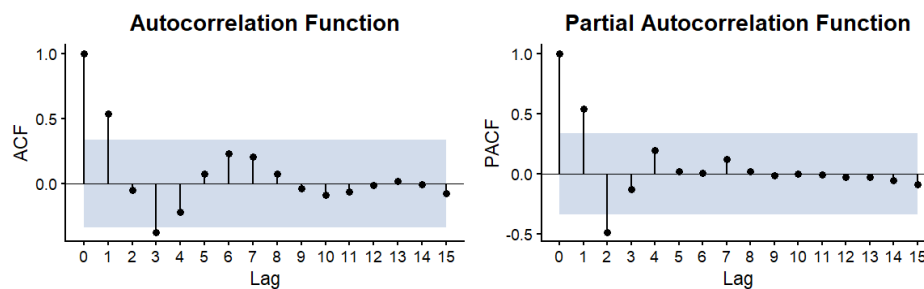


Figure 2. The ACF and PACF plots

Following second-order differencing, the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots were examined to identify the appropriate orders of the autoregressive (AR) and moving average (MA) components for the self-harm attempt rate series. These plots provide information regarding the temporal dependency structure of the stationary series and guide the selection of the ARIMA specification within the ARIMAX framework. Figure 2 presents the ACF and PACF plots of the second-differenced self-harm attempt rate series. Figure 2 indicates that the ACF plot exhibits a significant autocorrelation at lag 1, while the subsequent lags fall within the confidence interval, suggesting a possible moving-average component of order 1. Meanwhile, the PACF plot shows a significant partial autocorrelation at lag 2, indicating an autoregressive component of order 2. Based on these identification results, several candidate models were considered, including ARIMA(1,2,0), ARIMA(2,2,0), ARIMA(0,2,1), and ARIMA(2,2,1). Several ARIMAX specifications were estimated by incorporating unemployment rate (OUR), inflation rate, average working hours, and the COVID-19 dummy variable as external regressors.

As shown in Table 3, ARIMAX(2,2,1) yielded the lowest AIC value; however, the model produced undefined standard errors (NA) for the inflation and working hours coefficients, preventing statistical inference for these variables. Therefore, ARIMAX(1,2,1) was selected as the preferred model because it achieved the lowest AIC among the fully estimable models and contained no undefined parameter estimates. Furthermore, the model identified average working hours and the COVID-19 dummy as significant predictors of self-harm attempts, while maintaining an adequate representation of the underlying time-series dynamics. The parameter estimation and significance results for all candidate ARIMAX models are presented in Table 3.

Table 3. ARIMAX Model Parameters and Significance

Model	Parameter	Estimate	Std. Error	p-value	AIC	Description
ARIMAX(2,2,1)	AR(1)	-0.3329	0.1498	0.0262	-21.34	Significant
	AR(2)	-0.5152	0.151	0.0006		Significant
	MA(1)	0.9999	0.0817	<0.0001		Significant

	OUR	0.0005	0.0163	0.9756		Not Significant
	Inflation	-0.0001	NA	NA		NA
	Working Hours	0.1862	NA	NA		NA
	Covid19	0.2027	0.0251	6.16E-16		Significant
ARIMAX(2,2,0)	AR(1)	0.0953	0.1574	0.5449	-9.87	Not Significant
	AR(2)	-0.4481	0.1497	0.0028		Significant
	OUR	-0.0201	0.0388	0.6048		Not Significant
	Inflation	0	0.0013	0.9947		Not Significant
	Working Hours	0.1895	0.0684	0.0056		Significant
	Covid19	0.2348	0.0788	0.0029		Significant
ARIMAX(1,2,1)	AR(1)	-0.2744	0.1783	0.1237	-14.02	Not Significant
	MA(1)	0.9999	0.0783	<0.0001		Significant
	OUR	0.007	0.0267	0.7940		Not Significant
	Inflation	-0.0001	0.0009	0.9155		Not Significant
	Working Hours	0.1908	0.0845	0.0240		Significant
	Covid19	0.2275	0.0385	3.53E-09		Significant
ARIMAX(1,2,0)	AR(1)	0.0501	0.1786	0.7792	-4.29	Not Significant
	OUR	-0.0291	0.0456	0.5245		Not Significant
	Inflation	0	0.0016	0.9799		Not Significant
	Working Hours	0.1873	0.078	0.0163		Significant
	Covid19	0.2872	0.0983	0.0035		Significant
ARIMAX(0,2,1)	MA(1)	1	0.0812	<0.0001	-13.65	Significant
	OUR	-0.0034	0.0188	0.8574		Not Significant
	Inflation	-0.0001	NA	NA		NA
	Working Hours	0.1863	NA	NA		NA
	Covid19	0.2169	0.0292	1.02E-13		Significant

Parameter Estimated ARIMAX models (own computation, 2026).

Based on the estimation results presented in Table 3, the ARIMAX(1,2,1) model was selected as the final specification because it had the lowest AIC among models with complete parameter estimates and statistically interpretable coefficients. The results indicate that average working hours ($\beta = 0.1908$, $p = 0.0240$) and the COVID-19 dummy variable ($\beta = 0.2275$, $p < 0.001$) were statistically significant determinants of self-harm attempts in Indonesia.

The positive coefficient for average working hours suggests that longer working hours are associated with higher self-harm rates. This finding is consistent with previous empirical evidence demonstrating that excessive working hours contribute to adverse mental health outcomes, including depressive symptoms, psychological distress, and suicidal ideation (Choi, 2018; Han et al., 2021). Longitudinal studies have further shown that prolonged exposure to excessive working hours increases the risk of developing depressive symptoms and suicidal ideation over time (Baek et al., 2023). Moreover, a recent systematic review and meta-analysis concluded that employees working more than 55 hours per week face significantly higher risks of suicidal ideation compared with those working standard working hours (Kim et al., 2024). These findings support occupational stress theories suggesting that excessive working hours may increase fatigue, burnout, sleep disturbances, and work-life imbalance, thereby elevating psychological distress and vulnerability to self-harming behaviors.

The COVID-19 dummy variable also exhibited a positive and highly significant effect, indicating that self-harm attempts were more prevalent during the pandemic period than in non-pandemic years. This result is consistent with previous studies documenting the psychological consequences of the COVID-19 pandemic. Pandemic-related disruptions, including social isolation, uncertainty, fear of infection, employment instability, and reduced access to support systems, have been associated with increased risks of self-harm and suicidal ideation across various populations (Sinyor et al., 2022). Elevated rates

of self-harm during the pandemic have also been observed among children and adolescents in several countries (Wong et al., 2023). At the population level, COVID-19-related societal disruptions have been shown to significantly increase self-harm incidence (Baillet et al., 2024). The positive effect observed in the present study may therefore reflect the combined psychological and socioeconomic pressures experienced during the pandemic period. Furthermore, the significant MA(1) parameter ($p < 0.001$) indicates that current self-harm rates were strongly influenced by shocks occurring in the previous period, highlighting the importance of short-term temporal dynamics in explaining fluctuations in self-harm behavior over time.

In contrast, the unemployment rate (OUR) and inflation rate were not statistically significant ($p > 0.05$), suggesting that their direct effects on self-harm rates were not sufficiently strong after accounting for temporal dependence and other explanatory variables. The insignificant effect of unemployment differs from previous evidence showing that unemployment is associated with elevated risks of suicide mortality, suicide attempts, and suicidal ideation (Amiri, 2022). One possible explanation for this discrepancy is that the present study analyzes aggregate national time-series data rather than individual-level outcomes. While unemployment may substantially affect vulnerable individuals, its impact may be less visible at the population level, particularly in countries where family and community support systems remain relatively strong. Similarly, inflation did not exhibit a statistically significant effect on self-harm attempts. Although previous studies have suggested that economic instability and financial hardship can adversely affect mental health, the effect of inflation may be indirect and mediated through other socioeconomic factors such as household income, employment stability, debt burden, and social support. In Indonesia, individuals experiencing economic difficulties often receive financial and emotional assistance from family networks and local communities, potentially mitigating the immediate psychological consequences of rising prices. Consequently, fluctuations in inflation may not directly translate into measurable changes in self-harm rates at the national level.

Thus, the findings suggest that psychosocial stressors associated with working conditions and the COVID-19 pandemic played a more prominent role in explaining self-harm attempts in Indonesia than broader macroeconomic indicators during the study period. These results emphasize the importance of workplace well-being initiatives, mental health support services, and preparedness strategies during large-scale societal disruptions. From a policy perspective, interventions aimed at reducing excessive working hours and strengthening mental health services during public health crises may contribute more effectively to reducing self-harm risk than policies focusing solely on macroeconomic stabilization.

3. Residual Diagnostic of ARIMAX(1,2,1)

To evaluate the adequacy of the selected ARIMAX(1,2,1) model, several residual diagnostic tests were conducted, including the ARCH-LM test for heteroscedasticity, the Ljung–Box test for autocorrelation, and the Shapiro–Wilk test for normality. The results are presented in Table 4.

Table 4. Residual Diagnostics of the ARIMAX(1,2,1) Model

Diagnostic Test	Null Hypothesis	Test Statistic	p-value	Decision	Conclusion
ARCH-LM Test	No ARCH effects (homoscedastic residuals)	$\chi^2 = 11.00$	0.989	Accept H_0	No evidence of heteroscedasticity
Ljung–Box Test	No residual autocorrelation	$\chi^2 = 13.72$	0.1862	Accept H_0	Residuals are independently distributed
Shapiro–Wilk Test	Residuals are normally distributed	$W = 0.7988$	0.000019	Reject H_0	Residuals are not normally distributed

The ARCH-LM test yielded a p-value of 0.989, indicating no evidence of autoregressive conditional heteroscedasticity in the residuals. Likewise, the Ljung–Box test yielded a p-value of 0.1862, indicating that the residuals are free of significant autocorrelation. These results indicate that the model has successfully captured the underlying temporal patterns of the series and that the residuals behave as random disturbances.

The Shapiro–Wilk test indicated that the residuals were not normally distributed ($p < 0.001$). However, this does not necessarily invalidate the model. In time-series analysis, the absence of autocorrelation and heteroscedasticity is generally considered more important than strict residual normality, particularly when the primary objective is forecasting and explaining temporal dynamics. Moreover, self-harm behavior is influenced by complex psychological, social, and environmental factors that may generate extreme observations and irregular fluctuations, making departures from normality relatively common. Therefore, despite the violation of the normality assumption, the ARIMAX(1,2,1) model can still be regarded as statistically adequate because the residuals satisfy the independence and homoscedasticity assumptions required for reliable model estimation and forecasting.

4. Forecasting Self-Harm Trends in Indonesia (2026–2028)

Following model estimation and diagnostic evaluation, the selected ARIMAX(1,2,1) model was used to forecast self-harm trends in Indonesia for the period 2026–2028. Prior to generating forecasts, the model's predictive performance was assessed using several measures of forecast accuracy. These metrics indicate how well the model reproduces observed self-harm rates and whether it is suitable for forecasting future values. The accuracy results are presented in Table 5. As shown in Table 5, the ARIMAX(1,2,1) model achieved relatively low forecasting errors, with an RMSE of 0.1469 and an MAE of 0.0805. The MAPE value of 0.5517% indicates a very small average percentage forecasting error, suggesting excellent predictive accuracy. In addition, the MASE value of 0.4403 is substantially below one, indicating that the model performs better than a naïve forecasting benchmark. These results confirm that the selected model adequately captures the underlying dynamics of the self-harm series and is suitable for forecasting future trends. Consequently, the ARIMAX(1,2,1) model was used to project self-harm rates in Indonesia for the period 2026–2028.

Table 5. Forecast Accuracy Measures of the Selected ARIMAX(1,2,1) Model

Model	RMSE	MAE	MAPE (%)
ARIMAX(1,2,1)	0.1469	0.0805	0.5517

Source: Author's computation (2026).

The forecasting results are presented in Table 6. Point forecasts and prediction intervals were generated to account for uncertainty in future estimates. The 80% and 95% prediction intervals provide a range of plausible future values, with wider intervals indicating greater uncertainty as the forecasting horizon increases.

Table 6. Forecasted Self-Harm Rates in Indonesia, 2026–2028

Year	Point Forecast	Lower 80%	Upper 80%	Lower 95%	Upper 95%
2026	13.0603	12.8429	13.2777	12.7278	13.3928
2027	12.7029	12.0775	13.3283	11.7465	13.6594
2028	12.3387	11.2314	13.4461	10.6452	14.0323

Source: Author's computation using the ARIMAX(1,2,1) model (2026).

The forecast results indicate a gradual decline in self-harm rates over the projection period. The predicted rate is expected to decrease from 13.06 in 2026 to 12.70 in 2027, then to 12.34 in 2028. Although the decline is relatively modest, the forecasts suggest a continuing downward trend in self-harm

attempts in Indonesia. The overall trajectory of observed and projected self-harm rates is illustrated in Figure 3.



Figure 3. Actual and ARIMAX(1,2,1) Fitted-Forecasted Self-Harm Trends in Indonesia (1991–2028)

The prediction intervals become wider as the forecast horizon increases, reflecting greater uncertainty in longer-term projections. For example, the 95% prediction interval ranges from 12.73–13.39 in 2026 but expands to 10.65–14.03 in 2028. Such widening intervals are common in time-series forecasting because uncertainty accumulates over time. Therefore, while the forecasts suggest a declining trend in self-harm rates, the projected values should be interpreted as likely future trajectories rather than exact predictions. Overall, the findings indicate that self-harm rates in Indonesia are expected to remain relatively stable with a slight downward trend during the 2026–2028 period.

5. Counseling Implications and Mental Health Intervention Perspectives

The forecasting results presented in Table 6 and illustrated in Figure 3 provide valuable insights that extend beyond statistical prediction, particularly for stakeholders involved in counseling practice and public mental health communication. The projected decline in self-harm rates during 2026–2028 suggests a favorable trend; however, the persistence of self-harm behaviors highlights the need for continuous prevention and early intervention strategies. Forecast-based evidence can support counselors, mental health professionals, and policymakers in identifying periods of increased vulnerability and developing proactive approaches rather than relying solely on reactive responses. By integrating empirical forecasting with human-centered interventions, mental health services in Indonesia can become more adaptive, preventive, and responsive to population needs.

Counseling services play an important role in addressing the psychosocial factors associated with self-harm behaviors. The significant influence of average working hours identified in the ARIMAX(1,2,1) model emphasizes the importance of recognizing occupational stress, emotional exhaustion, and work–life imbalance as potential risk factors. This finding is consistent with previous studies showing that excessive working hours increase the likelihood of depressive symptoms, psychological distress, and suicidal ideation (Baek et al., 2023; Choi, 2018; Han et al., 2021; Kim et al., 2024). The meta-analysis further demonstrated that individuals working more than 55 hours per week face significantly greater risks of suicidal ideation than those working standard hours. Consequently, counselors in workplace, educational, and community settings should consider incorporating stress management programs, emotional regulation strategies, resilience training, and routine psychological screening to identify individuals experiencing excessive psychological burden. Such interventions may help reduce the accumulation of chronic stress that can contribute to self-harming behaviors. Furthermore, counseling approaches should not only focus on individual coping mechanisms but also

consider social environments, including family relationships and support networks, which represent important protective factors within the Indonesian context.

The significant impact of the COVID-19 period also underscores the need to strengthen mental health communication and crisis-responsive counseling strategies. Previous studies have documented substantial increases in self-harm risk, suicidal ideation, and psychological distress during the pandemic period due to social isolation, uncertainty, fear of illness, economic disruption, and reduced access to support systems (Baillet et al., 2024; Kim et al., 2025; Sinyor et al., 2022; Wong et al., 2023). The positive and significant COVID-19 coefficient identified in the present study suggests that large-scale societal disruptions can have lasting implications for mental health outcomes. Therefore, public communication efforts should promote mental health awareness, reduce stigma surrounding self-harm and psychological difficulties, and encourage individuals to seek professional support when needed. Messages delivered through schools, workplaces, digital platforms, and community organizations should emphasize that psychological distress is a manageable condition and that accessible support systems are available. Expanding tele-counseling services and digital mental health interventions may also improve access to services during future crises or emergencies.

Although unemployment and inflation were not statistically significant predictors in the final model, counseling interventions should continue to consider broader socioeconomic and personal circumstances during assessment. Previous evidence suggests that unemployment is associated with elevated risks of suicide mortality, suicide attempts, and suicidal ideation (Amiri, 2022), even though such effects were not directly observed in the present aggregate time-series analysis. This discrepancy may indicate that socioeconomic hardship operates indirectly through family stress, perceived insecurity, social pressure, and individual coping capacity rather than exerting a direct population-level effect. Similarly, inflation may affect mental health through financial strain and uncertainty, particularly among economically vulnerable households. Therefore, comprehensive counseling practices should integrate psychological assessment with evaluations of social support, occupational conditions, family dynamics, financial stressors, and coping resources. Such a holistic approach enables counselors to identify underlying vulnerabilities that may not be immediately visible through economic indicators alone.

The findings also have important implications for preventive mental health policy. Since working hours and pandemic-related disruptions emerged as significant determinants of self-harm, policymakers should prioritize workplace mental health promotion, employee well-being programs, flexible work arrangements, and psychosocial support services during periods of societal crisis. Collaboration among mental health professionals, educational institutions, employers, public health agencies, and community organizations may enhance the effectiveness of early intervention efforts. By aligning statistical evidence, counseling practice, and public mental health communication, Indonesia can strengthen self-harm prevention strategies and promote a more supportive environment for individuals experiencing psychological challenges.

Conclusion

This study provides important insights into the dynamics and future trajectory of self-harm trends in Indonesia by examining the influence of socioeconomic and temporal factors over the period 1991–2025. The findings indicate that average working hours and the COVID-19 pandemic period were significant factors associated with self-harm attempts, highlighting the important role of psychosocial stressors, occupational burden, and major social disruptions in shaping mental health outcomes. The forecasting results suggest a gradual decline in self-harm rates during 2026–2028; however, the continued presence of self-harm behaviors indicates that sustained prevention efforts and early intervention strategies remain necessary. These findings emphasize that self-harm should be understood as a complex phenomenon influenced not only by individual psychological conditions but also by broader social and environmental contexts.

Beyond the empirical findings, this study offers practical implications for counseling practice, mental health services, and public communication strategies. The significant relationship between working hours and self-harm rates highlights the importance of addressing occupational stress, emotional exhaustion, and work-life imbalance through preventive counseling programs. Furthermore, the impact of the COVID-19 period underscores the need to strengthen accessible psychological support systems, crisis-responsive interventions, and community-based mental health initiatives. Although unemployment and inflation were not significant direct predictors, their potential indirect effects through family conditions, social support, and individual coping mechanisms remain relevant considerations in counseling assessment and intervention.

By integrating quantitative forecasting with a human-centered mental health perspective, this study contributes to a deeper understanding of self-harm dynamics in Indonesia. The findings provide evidence-based support for developing more targeted prevention strategies and emphasize the importance of collaboration among counselors, policymakers, healthcare providers, and communities. Such collaborative efforts are essential to strengthen early identification, improve access to psychological support, and promote long-term mental well-being.

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