MJIFM | MAJAPAHIT JOURNAL OF ISLAMIC FINANCE AND MANAGEMENT

Vol. 5 No. 4, 2025, 3719–3731 e-ISSN 2798-0170

ANALYSIS OF THE EFFECT OF EXCISE RATES INCREASES, TOTAL TOBACCO PRODUCTION, AND EDUCATION LEVEL ON THE PREVALENCE OF YOUTH SMOKERS IN INDONESIA

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Abstract

The high prevalence of smoking among individuals aged 15–24 in Indonesia represents a serious issue requiring greater attention, particularly in relation to the effectiveness of fiscal and social policies. This study aims to analyze the impact of excise rate increases, total tobacco production, and education level on youth smoking prevalence in Indonesia. Panel data from 34 provinces for the years 2017, 2019, 2021, and 2023 were utilized. The analytical method employed was panel data regression with a fixed-effect approach, selected based on the results of the Chow and Hausman tests. The findings reveal that, partially, excise rate increases have a negative and significant effect on youth smoking prevalence, while total tobacco production shows no significant effect. Education level exerts a negative and significant influence on youth smoking prevalence. Simultaneously, the three independent variables significantly affect youth smoking prevalence in Indonesia. These results suggest that fiscal policies, such as excise rate increases, alongside improvements in access to education, can serve as effective instruments in reducing smoking prevalence among young people. The study recommends that the government further optimize excise policies and educational programs as strategic measures to control tobacco consumption in Indonesia.

Keywords: Excise Rate, Tobacco Production, Education Level, Youth Smoking Prevalence

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INTRODUCTION

Tax revenues play a crucial role in financing Indonesia's development, with the excise rate representing one of the most significant domestic sources. Beyond its fiscal function, the excise rate serves a regulatory role by influencing economic equilibrium and shaping public behavior. According to Law No. 39 of 2007, excise is levied on specific goods with characteristics that require government control due to their potential negative impacts, including tobacco products. Among these, tobacco excise has attracted particular attention because of its dual nature: contributing substantially to state revenue while simultaneously serving as a policy instrument to curb cigarette consumption (Hassan et al, 2025).

Tobacco consumption remains a major public health challenge in Indonesia. The World Health Organization (WHO) defines smoking prevalence as the proportion of individuals who actively consume tobacco products within a given period, highlighting its significance in monitoring global health burdens. In Indonesia, according to the Central Bureau of Statistics (2022), cigarette consumption ranks as one of the largest household expenditures after food, surpassing basic needs such as grains and vegetables. The Institute for Health Metrics and Evaluation (IHME) identifies smoking as the second-largest risk factor for mortality in Indonesia, disproportionately affecting vulnerable groups such as youth and low-income households.

Youth smoking prevalence is particularly concerning. Data from the Indonesian Health Survey (2023) indicate that 23.55% of smokers are aged 15–24, a critical demographic representing the nation's future human capital. The accessibility of cheap tobacco products, sustained production levels exceeding 300 billion cigarettes annually (DG Customs and Excise, 2023), and pervasive social influences all contribute to persistent smoking habits among young people. This is consistent with earlier findings Chaloupka & Warner (2000) that emphasize the importance of both fiscal and non-fiscal interventions in controlling tobacco consumption.

Education emerges as another determinant in shaping smoking behavior. Higher educational attainment is associated with increased health awareness and reduced smoking propensity (Perry et al., 1990; Priambudi & Purwanti, 2024). Nevertheless, national surveys Riskesdas (2018) reveal that smoking prevalence remains high among individuals with only secondary education, underscoring the limitations of schooling in isolation, particularly when not reinforced by supportive environments.

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In recent years, the Indonesian government has consistently raised tobacco excise rates as part of its fiscal and health policy agenda. For instance, Minister of Finance Regulation No. 191/2022 mandated an average 10% increase in tobacco excise for 2023–2024. While this policy aligns with the National Medium-Term Development Plan (RPJMN) target to reduce youth smoking prevalence, its effectiveness remains contested. Some studies report that despite multiple excise hikes, smoking rates have continued to rise in certain regions (Prasetia & Woyanti, 2024), suggesting the need for further empirical evaluation.

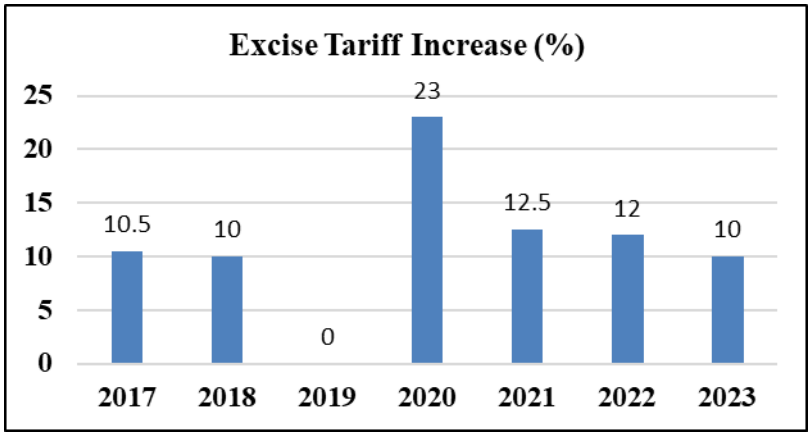

Figure 1.
Excise Tariff Increase in Indonesia

Given the persistent high prevalence of youth smoking, the resilience of the tobacco industry, and the mixed evidence on the impact of excise hikes, this study aims to analyze the influence of excise rate increases, total tobacco production, and education levels on youth smoking prevalence in Indonesia. By examining these factors both individually and simultaneously, this research seeks to contribute to the evidence base for more effective fiscal and social policies in reducing tobacco consumption among young people and safeguarding the demographic dividend toward Indonesia's Vision 2045.

LITERATURE REVIEW

Excise

Excise is generally defined as a discriminatory tax imposed on goods or services that generate externalities or are considered luxury items. In Indonesia, the imposition of excise is regulated under Law No. 39 of 2007, which specifies that excise applies to goods whose consumption must be controlled, circulation supervised, or whose use has negative impacts on society and the environment. Excise functions not only as a fiscal instrument that provides significant state

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revenue but also as a regulatory tool to reduce the consumption of harmful goods. The three primary excisable goods in Indonesia are tobacco products, alcoholic beverages, and ethyl alcohol, all of which are associated with adverse health and social outcomes. Thus, excise plays a dual role in revenue generation and public health protection.

Excise Tariff

Excise tariffs serve as a central mechanism in controlling tobacco consumption by directly influencing the final price of products. Higher tariffs are expected to reduce affordability, particularly among youth and low-income groups, who tend to be more price-sensitive. Empirical studies demonstrate that tobacco excise increases are effective in reducing smoking prevalence, with every 10% price increase reducing consumption by 4–5% depending on market elasticity (F. J. Chaloupka et al., 2012). In Indonesia, excise tariffs are structured under a multi-tiered specific tax system, determined by production capacity and retail price categories. This makes excise tariffs not only a fiscal driver but also a key public health policy instrument.

Tobacco Production

In economic theory, production is the process of transforming inputs such as labor, capital, and raw materials into outputs to meet consumer demand (Mankiw, 2012). Within the tobacco industry, production levels are closely linked to consumer demand and the pursuit of profit maximization by producers. High levels of cigarette production in Indonesia reflect the industry's efficiency and ability to operate at economies of scale, reducing per-unit costs (Varian, 2010). Such efficiency, however, also contributes to maintaining the affordability and availability of cigarettes, particularly for youth consumers. Therefore, production dynamics play a critical role in shaping tobacco consumption patterns in the country.

Education Level

Education level is a key indicator of formal learning achievement and an important determinant of health-related behavior. According to Human Capital Theory (Grossman, 1972; Schultz, 1961), education enhances cognitive skills, health literacy, and awareness of the risks of unhealthy behavior such as smoking. Empirical findings show that higher education levels are associated with lower smoking prevalence, as educated individuals tend to adopt healthier lifestyles. However, studies in Indonesia reveal that even high school graduates remain vulnerable to smoking due to peer influence and insufficient health education (Kuntari, 2019). Thus, education plays both a protective and moderating role in youth smoking behavior.

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Youth Smoking Prevalence

Youth smoking prevalence has become a critical public health concern, as early initiation substantially increases the risk of nicotine addiction and chronic diseases (WHO, 2020). The Social Learning Theory (Bandura, 1977) explains that adolescents often adopt smoking behavior through imitation of peers, parents, or public figures. Meanwhile, the Theory of Planned Behavior (Ajzen, 1991) highlights how attitudes, social norms, and perceived behavioral control influence smoking intentions. Studies have shown that permissive social norms and easy access to cigarettes contribute to rising smoking rates among Indonesian youth (Maryani et al., 2019; Smet et al., 1999). These findings underscore the urgency of integrating fiscal measures, education, and stronger regulatory enforcement to address the issue

RESEARCH METHOD

Research Design

This study employs a quantitative approach using panel data regression to examine the effects of excise rate increases, tobacco production, and education level on youth smoking prevalence in Indonesia. Panel data were constructed from 34 provinces covering four observation years (2017, 2019, 2021, and 2023). The use of panel data allows for capturing both cross-sectional and time-series variations, thereby improving the efficiency and robustness of estimation.

Variables and Data Sources

The dependent variable is youth smoking prevalence (PP), defined as the proportion of individuals aged 15–24 years who smoke daily or occasionally, sourced from the Central Statistics Agency (BPS). The independent variables consist of:

1. Excise rate increase (TC), measured as the annual percentage increase in tobacco excise rates (Directorate General of Customs and Excise).
2. Tobacco production (HT), total provincial tobacco product output, measured in sticks (Directorate General of Customs and Excise).
3. Education level (TP), proxied by the percentage of population completing senior secondary school (BPS).

All variables are structured as panel data combining provincial cross-sections with multi-year observations.

Empirical Model

The relationship between the dependent and independent variables is estimated using the following panel data regression specification:

$$PP_{it} = \alpha + \beta_1 TC_{it} + \beta_2 HT_{it} + \beta_3 TP_{it} + \varepsilon_{it}$$

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i = province
t = year
α = constant
β = coefficients
ε_{it} = error term.

Model selection between Common Effect, Fixed Effect, and Random Effect was based on the Chow and Hausman tests, with the fixed-effect model ultimately chosen as the most appropriate specification.

Data Analysis

The analysis was conducted in two stages. First, descriptive statistics were used to summarize the distribution of variables. Second, inferential analysis employed panel data regression with diagnostic tests to ensure the validity of results. Classical assumption tests were performed, including tests for normality, heteroskedasticity, autocorrelation, and multicollinearity.

Hypothesis Testing Consisted of:

1. t-tests, to assess the partial significance of each independent variable;
2. F-tests, to evaluate the joint significance of all predictors;
3. Coefficient of determination (R^2), to measure the explanatory power of the model.

All statistical procedures were conducted using standard econometric software, ensuring reproducibility of the analysis.

RESULTS AND DISCUSSION

Descriptive Statistical Analysis

Descriptive statistical analysis was conducted using Stata 19 to provide an overview of the characteristics and distribution of the variables used in this study. The panel dataset covers 34 provinces in Indonesia over the period 2017–2023, resulting in 136 observations for each variable. Table 1 summarizes the descriptive statistics of the dependent variable (youth smoking prevalence) and the independent variables (excise rate increase, tobacco production, and education level). These descriptive results serve as the foundation for further econometric analysis using the panel regression model.

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Table 1.
Descriptive Statistics of Research Variables (2017–2023)

Variable	N	Unit	Mean	Std. Dev.	Min	Max
Youth Smoking Prevalence (15–24 years)	136	Percentage	17.54	3.06	10.37	23.78
Excise Rate Increase	136	Percentage	8.26	4.88	0.00	12.50
Tobacco Production	136	Sticks	9,800,000,000	31,600,000,000	0	202,000,000,000
Education Level	136	Percentage	62.80	11.11	27.44	90.12

Source: Authors' calculation based on BPS, PMK, and DJBC data

The descriptive results show that the average youth smoking prevalence (ages 15–24) is 17.54%, with a standard deviation of 3.06%. This indicates that the distribution of smoking prevalence across provinces is relatively homogeneous, ranging from 10.37% (Bali, 2023) to 23.78% (West Nusa Tenggara, 2019). The relatively low variation suggests that smoking among youth remains a widespread and persistent issue across Indonesia. Furthermore, the fluctuation pattern over time tends to be moderate rather than extreme, implying a stable but concerning prevalence level.

The excise rate increases variable records an average of 8.26% with a standard deviation of 4.88%, showing moderate variation between periods. The minimum value of 0% in 2019 indicates that no tax increase was imposed in that year, while the maximum of 12.5% occurred in 2021, reflecting the government's fiscal intervention through the Ministry of Finance Regulation (PMK). The descriptive findings confirm that excise policy is not applied uniformly each year, but rather follows fiscal and political considerations. This variation is important in assessing the extent to which excise hikes influence youth smoking prevalence.

The tobacco production variable demonstrates the widest variation, with a mean of 9.8 billion sticks and a very high standard deviation of 31.6 billion sticks. The minimum value of zero indicates that several provinces do not produce tobacco at all, while the maximum of over 202 billion sticks highlights the concentration of production in certain regions. These disparities underline the

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structural dominance of major tobacco-producing provinces, which may offset the effect of fiscal policies by ensuring stable supply availability. Such heterogeneity in production capacity could weaken the intended impact of excise increases on reducing consumption.

The education level variable shows an average of 62.80%, with a standard deviation of 11.11%. The lowest figure was recorded in Papua (27.44% in 2019), while the highest was found in Yogyakarta (90.12% in 2021). This indicates substantial regional disparities in educational attainment across Indonesia, which may influence awareness and decision-making related to health behaviors, including smoking. Higher education levels are generally associated with stronger health literacy, suggesting that variations in education across provinces could be an important determinant in shaping smoking prevalence among youth.

Model Selection

Panel data regression model selection was conducted through a series of specification tests, including the Chow Test, the Lagrange Multiplier Breusch–Pagan (LMBP) Test, and the Hausman Test. The Chow Test resulted in a p-value of 0.0000 (< 0.05), indicating that the Fixed Effect Model (FEM) is preferable to the Common Effect Model (CEM). Meanwhile, the LMBP Test also produced a chi-square value of 0.0000 (< 0.05), suggesting that the Random Effect Model (REM) is superior to the CEM. To refine the choice between FEM and REM, the Hausman Test was applied, yielding a chi-square probability of 0.6795 (> 0.05). Thus, the null hypothesis could not be rejected, confirming that REM is the most appropriate specification for this study. Overall, these results consistently support the use of the Random Effect Model as the optimal estimation technique.

Table 2.
Model Specification Tests

Test	Statistic	Probability	Decision	Selected Model
Chow Test	–	0.0000	Reject H_0	FEM
LMBP Test	Chi^2	0.0000	Reject H_0	REM
Hausman Test	Chi^2	0.6795	Fail to Reject H_0	REM

Source: Authors' calculation using Stata 19.

Classical Assumption Tests

The classical diagnostic tests indicate that most econometric assumptions were satisfied, with the exception of autocorrelation. The normality test shows a

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probability value of 0.6121 (> 0.05), suggesting that residuals are normally distributed. Similarly, the heteroskedasticity test reports a probability of 0.9907 (> 0.05), confirming homoskedasticity. Multicollinearity was not detected, as the Variance Inflation Factor (VIF) values for all independent variables were below 10, indicating that no serious correlation exists among them. However, the autocorrelation test revealed a probability value of 0.0000 (< 0.05), implying serial correlation in the residuals. To address this issue, the VCE (Variance–Covariance Estimation) cluster method was employed, as recommended by (Hoechle, 2007).

Table 3.
Results of Classical Assumption Tests

Test	Statistic	Probability	Decision	Selected Model
Chow Test	–	0.0000	Reject H_0	FEM
LMBP Test	Chi^2	0.0000	Reject H_0	REM
Hausman Test	Chi^2	0.6795	Fail to Reject H_0	REM

Source: Authors' calculation using Stata 19.

Hypothesis Testing

The regression analysis using the Random Effect Model (REM) is presented in Table 4. The results demonstrate that excise rate increases (TC) and education level (TP) have a statistically significant negative effect on youth smoking prevalence, while tobacco production (HT) is not statistically significant.

Table 4.
Regression Results (REM)

Variable	Coefficient	Probability	Interpretation
Constant	24.1115	0.000	Baseline prevalence without predictors
TC	-0.0503	0.015	Significant, negative effect
HT	3.29E-12	0.549	Not significant
TP	-0.0985	0.001	Significant, negative effect
R^2 Overall	0.0981	–	Model explanatory power = 9.81%
Prob (F-stat)	–	0.0000	Jointly significant

Source: Authors' calculation using Stata 19.

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The estimated regression equation is:

$$PP = 24.11 - 0.05TC + 3.29 \times 10^{-12}HT - 0.098TP$$

This implies that, holding other factors constant, a 1% increase in excise rate reduces youth smoking prevalence by 0.05 percentage points, while a 1% increase in education level reduces it by 0.098 percentage points. Conversely, the effect of tobacco production on prevalence is negligible and statistically insignificant.

Coefficient of Determination

The R-squared overall value of 0.0981 indicates that the three independent variables jointly explain 9.81% of the variation in youth smoking prevalence. This relatively modest explanatory power suggests that other unobserved factors, such as cultural influences, peer effects, advertising, and enforcement of regulations, may account for the remaining 90.19%. Nevertheless, the model is statistically valid as confirmed by the F-test.

Simultaneous and Partial Significance Tests

The F-test result (Prob = 0.0000) confirms that the independent variables collectively exert a significant influence on youth smoking prevalence. However, the t-test results reveal that the effects differ across variables (see Table 5). Excise rate increases and education level both show significant negative impacts, while tobacco production remains statistically insignificant.

Table 5.
t-test Results

Variable	Probability	Decision	Significance
TC	0.015	Reject H_0	Significant
HT	0.549	Fail to reject H_0	Not significant
TP	0.001	Reject H_0	Significant

Source: Authors' calculation using Stata 19.

These findings imply that fiscal policy in the form of excise rate hikes and structural improvements in education play more critical roles in shaping youth smoking behavior than supply-side factors such as aggregate tobacco production.

Discussion

The findings indicate that increases in excise rate rates have a negative and significant impact on youth smoking prevalence in Indonesia. This result aligns with demand theory, which posits that higher prices reduce consumption, particularly among younger individuals who are more sensitive to price changes due to limited purchasing power. Consistent with prior studies, this underscores

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the effectiveness of fiscal policy in controlling tobacco consumption through price instruments. Thus, excise rate increases can be considered a strategic policy tool to reduce youth smoking while reinforcing broader public health objectives.

In contrast, total tobacco production was found to have no significant effect on youth smoking prevalence. The high level of supply in the market, including the availability of low-cost cigarettes, ensures continuous accessibility despite fiscal interventions. This suggests that production factors are more closely associated with industry performance rather than directly influencing youth consumption behavior. Consequently, although higher excise ratees may discourage demand, the absence of production or distribution restrictions may offset their potential impact on reducing youth smoking prevalence.

Education level was shown to have a negative and significant effect on youth smoking prevalence. Youth with higher levels of education are generally more aware of the health risks associated with smoking and are more capable of making rational decisions to maintain healthy lifestyles. This finding highlights the preventive role of education in shaping health awareness and behavior among younger generations. Expanding access to quality education, particularly health education, could therefore serve as an effective complementary strategy to fiscal policies in reducing smoking prevalence among youth.

Taken together, excise rate, tobacco production, and education level were found to significantly influence youth smoking prevalence, although they explained only a modest portion of the variation in the model. This indicates that additional factors, such as social norms, tobacco advertising, peer influence, and local accessibility, may also play a critical role in shaping smoking behavior among young people. Accordingly, tobacco control policies should not rely solely on fiscal instruments but instead adopt a more comprehensive approach that incorporates social and regulatory measures.

CONCLUSION

This study analyzed the effects of excise rate increases, tobacco production, and education levels on youth smoking prevalence in Indonesia using provincial panel data from 2017–2023. The findings reveal that excise rate increases significantly reduce youth smoking prevalence, indicating that fiscal measures remain an effective instrument to curb cigarette consumption among price-sensitive adolescents. Meanwhile, tobacco production was not found to significantly affect youth smoking prevalence, reflecting that availability of supply alone does not directly drive smoking behavior when demand-side factors are more decisive. Education level, on the other hand, demonstrated a significant

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negative relationship with youth smoking, emphasizing the role of education in shaping health awareness and fostering more rational decision-making among young people. Collectively, the independent variables explained only 9.81% of the variation in smoking prevalence, suggesting that social, cultural, and regulatory factors beyond taxation, production, and education are also highly influential.

From a policy perspective, several recommendations emerge. First, the Ministry of Finance is encouraged to simplify the excise rate structure by reducing the number of tiers, ensuring that cigarette prices remain a deterrent for underage consumers. Strengthening enforcement against illegal tobacco excise practices is also essential, both to protect state revenue and to reduce the accessibility of low-cost cigarettes to adolescents. Furthermore, tobacco production oversight should be improved, with clearer regulatory limits to prevent excessive supply that may undermine the effectiveness of fiscal measures. Second, inter-ministerial collaboration is necessary—particularly among the Ministry of Health, Ministry of Education, and Ministry of Communication and Information, in designing targeted anti-smoking campaigns for the 15–24 age group. At the local government level, stricter enforcement of age restrictions in cigarette sales is critical, supported by local regulations and sanctions against retailers selling tobacco products to individuals under 18 years old.

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