

EFFECT OF CIGARETTE PRICES ON CIGARETTE CONSUMPTION IN INDONESIA: MYOPIC AND RATIONAL ADDICTION STUDIES

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ABSTRACT

This study analyzes the effect of cigarette prices on cigarette consumption in Indonesia. By using aggregate macro data on cigarette consumption (administrative data) for 2015-2020, estimated using OLS, 2SLS, GMM, and System-GMM, we found that cigarette prices have a negative and significant effect on cigarette consumption based on myopic and rational addiction models. The estimation results also confirm that cigarettes are inelastic products where price changes do not significantly impact cigarette consumption. It implies that the Government needs to significantly increase excise rates and minimum selling prices regularly to control cigarette consumption more effectively.

Keywords: Cigarettes Excise Taxes, Price Elasticity, Rational Addiction.

JEL: D12; H25; I12

To cite this document: Lesmana, I. & Khoirunurrofik. (2022). Effect of Cigarette Prices on Cigarette Consumption in Indonesia: Myopic and Rational Addiction Studies. *JDE (Journal of Developing Economies)*, 7(2), 294-308.

Introduction

Various countries have adopted policies to control the consumption of tobacco products to prevent harm to health. Likewise, government controls over tobacco products in Indonesia pose challenges given that Indonesia has the highest smoking prevalence in the world. According to [WHO \(2020\)](#), adult male smokers in Indonesia are in the range of 60.8 million people, and adult female smokers are around 3.7 million. Riset Kesehatan Dasar 2018 informs that tobacco use amounts to 62.9 % of men and 4.8 % of women aged 15 years and over. This phenomenon is part of the Government's concern, considering that smoking harms health. Tobacco uses in Indonesia is estimated to be the most significant cause of death for smokers, with around 225,700 deaths yearly.

In addition, tobacco use also increasingly burdens the Indonesian Jaminan Kesehatan Nasional (JKN), where smokers are more susceptible to falling ill. According to estimates from the Indonesian Ministry of Health in 2017, Indonesia lost nearly 374 trillion human productivities yearly related to tobacco use ([WHO, 2020](#)). One of the policies implemented to control cigarette consumption is increasing excise rates and increasing the minimum selling price of cigarettes. According to [Chaloupka et al. \(2012\)](#), it is quite effective in suppressing cigarette consumption.

Empirical studies on cigarette price's effect on cigarette consumption in Indonesia have

ARTICLE INFO

Received: July 7th, 2022

Revised: November 18th, 2022

Accepted: November 26th, 2022

Online: December 6th, 2022

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been conducted. [Djutaharta et al. \(2005\)](#), using aggregate data for the period 1970-2001 and monthly data for the period 1996-2001, estimated using OLS, found the elasticity of demand from the real price of cigarettes is -0.345. [Adioetomo et al. \(2005\)](#), using household data from a 1999 social and economic survey (Susenas), estimated using a two-part demand model and found that price is not a significant factor influencing smoking decisions or not but has a considerable effect on the number of cigarettes consumed. In addition, any 10% increase in prices will reduce cigarette consumption by 6%. The latest research by [Tirtana & Ariutama \(2022\)](#), with data from 33 provinces in Indonesia for the 2013-2018 period and estimated using fixed effects and random effects, shows that the elasticity of cigarette prices to demand is -0.317, supporting the fact that cigarette consumption is an inelastic product.

Unlike the previous study, which used household panel data, this study used administrative data as aggregate macro data on cigarette consumption for the 2015-2020 period sourced from the Government. This data has the advantage of survey data at the individual level because it does not have measurement errors due to self-reports ([DeCicca et al. 2020](#)). In addition, unlike the previous study, this study uses the theory of rational addiction pioneered by [Becker & Murphy \(1988\)](#), which was refined by [Chaloupka \(1991\)](#), as a reference in creating a dynamic specification model that considers the characteristics of cigarettes as addictive goods. The myopic addiction model and the rational addiction model are both types of dynamic specification models. In myopic addiction, past consumption influence in consumption of addictive goods today. The rational addiction model translates the current consumption of addictive goods influenced by past and future factors. Based on this, this study hypothesizes that cigarette prices are suspected to be negatively correlated with cigarette consumption, and cigarettes are alleged to be inelastic goods.

Using the OLS, 2SLS, GMM, and System-GMM estimation models conducted by [Hidayat & Thabrany \(2010\)](#), we choose System-GMM estimation as the best model to describe the dynamic specification model of cigarette consumption. We found that cigarette prices negatively and significantly affected cigarette consumption. Based on the myopic addiction model, every 1% increase in the real price of cigarettes leads to a decrease in cigarette consumption by 0.128 %, *ceteris paribus*. Meanwhile, using a rational addiction model, any increase in cigarette prices currently by 1% leads to a decrease in cigarette consumption by 0.367 %, *ceteris paribus*. The magnitude of the coefficient is less than one, so cigarettes are inelastic.

This paper consists of several parts: introduction, literature review, data and research methods, findings and discussion, and conclusion.

Literature Review

We will discuss five points in the literature review: externalities, the effect of excise on the balance of demand and supply, the theory of the consumption of addictive goods, the definition and classification of excise duty on tobacco products in Indonesia, and literature studies.

Externalities are an uncompensated result of a person's actions that affect another's well-being ([Mankiw, 2007](#)). Externalities are a form of market failure. Externalities appear when a person engages in activities that affect well-being but do not pay or receive part of the effect. A negative externality arises if the outcome is damaging, and oppositely, a positive externality appears if the result benefits society. Externalities can occur if buyers and sellers ignore their actions' external impact when deciding how much demand or supply is and make the market balance inefficient when there are externalities. In general, the Government responds through command-and-control policies that regulate behaviour directly and mar-

ket-based policies by providing incentives so that they will solve their problems.

To control the effects of negative externalities by internalizing externalities, Government can impose an indirect tax, such as Pigouvian taxes (Sandmo, 1975). Pigouvian tax is levied on each unit of the output set on an amount balanced with the marginal cost of the damage caused. The imposition of taxes will shift the curve of marginal private costs that increase along with the number of externalities. Suppose the tax is imposed on the number of externalities (marginal social costs) resulting from the negative influence of the product. In that case, the producer will reduce the production output to the new output at a socially optimal level. The desire of a consumer to buy goods at a price level during a specific period is demand, while the quantity of goods demanded by consumers is several goods that consumers want to buy at a certain price level. For an item subject to excise, the producer will calculate the excise tax as a component of costs that will eventually increase the price. In economic principle, known as the law of demand, that is, price and demand are inversely proportional, meaning that if the price of an item rises (other factors remain constant), then the demand for the goods will fall, and vice versa (Baye & Prince, 2013).

The theory of consumption of addictive goods is known as myopic and rational addiction models. Myopic addiction in the decision to consume addictive goods today is influenced by consumption in the past. However, this model does not consider future implications. If it is depicted in the utility function, the myopic addiction model is as follows:

$$U_t = f[C_t, C_{t-1}, X_t] \quad (1)$$

where Y_t is the consumption of addictive goods of the previous period, C_t is the consumption of composite goods. The utility function of this myopic addiction model is constrained by income so that the current demand function (C_t) is:

$$C_t = g[P_t, C_{t-1}, Y_t, Z_t] \quad (2)$$

where Y_t is income and Z_t is a vector of variables that indicate preferences or other variables. Based on the myopic addiction model, the consumption of addictive goods considers current and past factors. If the increase in past consumption will increase consumption in the present, the goods are considered addictive.

In contrast to the myopic addiction model, the rational addiction model translates the current consumption of addictive goods influenced by past and future consumption factors. Becker & Murphy (1988) describe irrationally behaved individuals who consume addictive goods and are consistently fully informed by maximizing their utility. The current form of the request function (C_t) for the rational addiction model is:

$$C_t = g[P_t, C_{t-1}, C_{t+1}, Y_t, Z_t] \quad (3)$$

where C_{t+1} is the future consumption. The rational addiction model considers that current consumption is influenced by current, past, and future factors, so an item is referred to as an addictive item if the increase in past consumption increases current consumption. The response to current prices considers future prices. Following Chaloupka (1991), we added variables of cigarette prices in the past, and the future to the rational addiction model becomes:

$$C_t = g[P_t, P_{t-1}, P_{t+1}, C_{t-1}, C_{t+1}, Y_t, Z_t] \quad (4)$$

Based on the Excise Law, the definition of excise is a state levy imposed on certain goods with the properties and characteristics stipulated in the law, namely goods that, in their use, need to be limited and supervised. Tobacco products are excisable goods that include

cigarettes, cigars, leaf cigarettes, sliced tobacco, e-cigarettes, and other processing products with no regard to the substitutes or auxiliary materials used. The excise tariff policy for tobacco products in Indonesia considers the nature or characteristics of excisable goods that harm health. They want to be strictly limited in circulation and use. The Government can carry out the policy by establishing excise rates and determining retail or minimum selling prices.

The studies about price elasticity of cigarettes are quite a lot, with a wide variety of periods and estimation models. [Chaloupka & Warner \(2000\)](#) found that smoking is price-responsive but relatively inelastic, with a price elasticity of -0.3 to -0.5 for adult smokers. In addition, the price elasticity of cigarettes in developed countries ranges about -0.8 in developing countries, according to [Jha & Chaloupka \(2000\)](#). In Indonesia, [Djutaharta \(2005\)](#), using aggregate data for the period 1970-2001 and monthly data for the period 1996-2001 estimated using OLS, found the elasticity of demand from the real price of cigarettes of -0.345. [Adioetomo et al. \(2005\)](#), using household data from a 1999 social and economic survey (Susenas), estimated using a two-part demand model and found that price is not a significant factor influencing smoking decisions or not but has a substantial effect on the number of cigarettes consumed. In addition, any 10% increase in prices will reduce cigarette consumption by 6%.

The latest research by [Tirtana & Ariutama \(2022\)](#), with data from 33 provinces in Indonesia for the 2013-2018 period and estimated using fixed effects and random effects, shows that the elasticity of cigarette prices to demand is -0.317, so it is concluded that cigarette consumption is inelastic. Studies on cigarette consumption using the theoretical model of myopic addiction and rational addiction in Indonesia have been conducted by [Hidayat and Thabrany \(2010\)](#) with the result that cigarettes are addictive. The demand for cigarettes is more sensitive to price changes in the long term (-0.39) than in the short time (-0.35).

Data and Research Methods

Data and Variable Description

In general, the data used in empirical studies of cigarette consumption are divided into aggregate data on cigarette consumption (sales-based) and data on the level of individuals or households obtained from surveys ([DeCicca et al., 2020](#)). According to [IARC \(2011\)](#), each data source has its strengths, but some weaknesses pose challenges for researchers to accurately estimate the demand for tobacco, especially cigarettes.

Using aggregated data from official statistics on cigarette sales or aggregated excise data from the Government as a proxy for consumption is very useful in measuring the overall impact of cigarette excise and prices on cigarette consumption. The aggregate excise data accurately records all sales of tobacco products that pay excise duty; therefore, this data has no measurement errors due to self-reports ([DeCicca et al., 2020](#)). The use of aggregated data may result in measurement errors in dependent variables if opportunities for tax avoidance exist. In addition, there are time trends and seasonality issues to deal with the behaviour of companies that place large-scale excise tape orders at the end of the year in anticipation of an increase in excise duty next year.

In contrast to aggregated data, survey data at the individual or household level can explain how tobacco or cigarette use is affected by changes in excise and prices. Using these data, researchers can assess how variations in sub-populations such as age, gender, social status, race/ethnicity, and other characteristics respond to changes in excise and prices of tobacco products. In addition, we can use data at the individual level to study the impact of prices

on various behavioural changes, including the initiation of tobacco use, discontinuation, and product switching. The advantages of using survey data in empirical studies of cigarette consumption make it easier for researchers to obtain a more precise estimate of the independent effects of factors affecting tobacco or cigarette consumption. But the use of survey data also has its weaknesses. The main drawback is the number of measurement errors because the nature of the survey is self-reports, data quantity, and a limited period, especially in surveys conducted in developing countries.

Based on the point of view of the data sources above and paying attention to the advantages and disadvantages, this study uses aggregated excise data sourced from the Directorate General of Customs and Excise, Ministry of Finance of the Republic of Indonesia. This secondary data is macro-level data per brand per type of cigarette produced by companies licensed by the Government, so this data does not represent illegal cigarette consumption. For information, the level of illicit cigarette circulation so far continues to decline in line with the Government's efforts to suppress the circulation of illegal cigarettes. According to a survey conducted by [Kartika et al. \(2019\)](#), among 1201 packs of cigarettes, only 20 packages were found that were identified as illegal, so it can be concluded that the level of tax avoidance is shallow, and the impact on the possibility of underestimating independent variables is meagre.

Cigarette consumption used in this study is macro data in the form of aggregate data on transactional cigarette consumption aggregated into annual data. According to [Czart & Chaloupka \(2013\)](#), cigarette sales information, particularly excise data, can be used as a proxy for cigarette consumption in the aggregate cigarette demand model. Cigarette consumption can be seen from the number of cigarette packs attached to excise tape, so it can assume that the product is intended for consumption. Considering that the cigarettes to be exported are non-taxable, and imported cigarettes must pay taxes, the assumption of cigarette consumption in the form of production and imports reduced by exports has been fulfilled. ([Surjono, 2013](#)). Therefore, this cigarette consumption data can be used as a proxy for the consumption of the aggregate cigarette demand model. To measure cigarette consumption, we use units of cigarettes.

Cigarette consumption data is transactional data. The data is aggregated into annual data to anticipate the issue of time trend and seasonality due to the behaviour of companies that tend to make large-scale excise tape purchases at the end of the year. For transactional cigarette consumption data, summary data is carried out into annual data. In contrast, cigarette price data is aggregated into annual data using the weighted average method by weighing the amount of cigarette consumption in that year to produce nominal price data. Once averaged, the data is converted into real prices and tariffs using the consumer price index of cigarettes and tobacco. The variable per capita income is obtained from the Central Bureau of Statistics in annual data.

After aggregation, there were 14,794 observations in the study period consisting of 4842 cross-section units with five-time series periods from 2015 to 2020. The data is unbalanced panel data because not all cross-section units have a complete time series. It is because, in that period, there were companies that no longer operated or new companies appeared in the research period. In addition, they no longer used cigarette brands during the research period, or new brands appeared. Excise provisions also distinguish cigarette brands based on the number of cigarettes per pack, even though the cigarette brands are the same. It is related to the excise tape used because if the contents per package are different, then it is also another.

The variable price of cigarettes is obtained from the retail selling price and is regularly updated according to market prices. The retail selling price is the nominal price, converted into an actual price using the consumer price index of cigarettes and tobacco published by the Central Bureau of Statistics. Before being converted into a real price, the price of cigarettes is calculated based on the weighted average, weighing the amount of cigarette consumption in that year. Per capita, national income is a proxy of income (Djutaharta et al., 2005). National income is Gross National Product (GNP) minus indirect taxes and depreciation. GNP is Gross Domestic Product (GDP) plus the net factor of income from abroad. Data on annual national income and population is obtained from BPS. Per capita income is calculated from national income divided by the number of people.

Dummy variables of cigarette type are used to identify differences in cigarette types. This variable is dichotomous. The determination of the dummy variable type of cigarette follows the provisions on excise duty, namely dum_SKM for cigarette brands with a kind of Machine-Rolled Cigarette (SKM) worth one and other types of cigarettes worth 0; dum_SPM for cigarette brands with a sort of Machine White Cigarette (SPM) worth 1, while different types of cigarettes are worth 0; dum_SKT for cigarette brands with a kind of Hand-Rolled Clove Cigarette (SKT) is worth 1, while other types of cigarettes are worth 0.

Empirical models

The equation models in this study are grouped into two dynamic model specifications, namely the myopic addiction model and the rational addiction model, using references from Becker & Murphy (1988), Chaloupka (1991), Luo et al. (2003), and Hidayat & Thabrany (2010). The dependent variables used are cigarette consumption ($Dcig_{it}$), while the independent variables are cigarette prices ($Pcig_{it}$), and other variables (X_{it}) that have the potential to affect cigarette consumption, such as per capita income level ($Ycap_{it}$) and cigarette type ($dum_SKT, dum_SKM, dum_SPM$). In addition, variables of past consumption ($Dcig_{it-1}$), future consumption ($Dcig_{it+1}$), or future price ($Pcig_{it+1}$) of cigarettes are also added as independent variables representing the theory of rational addiction. The instrument variables used include dummy cigarette type ($dum_SKT, dum_SKM, dum_SPM$), past cigarette price ($Pcig_{it-1}$), future cigarette prices ($Pcig_{it+1}$), past per capita income ($Ycap_{it-1}$), or future per capita income ($Ycap_{it+1}$) with references from the research of Chaloupka (1991) and Luo et al. (2003).

Based on this, the myopic addiction specification model is described as follows:

$$\ln Dcig_{it} = \beta_0 + \beta_1 \ln Dcig_{it-1} + \beta_2 \ln Pcig_{it} + \beta_3 \ln X_{it} + \epsilon_{it} \tag{5}$$

where i is the brand of cigarettes per type per company that is the object of the study, t is the period of research, and ϵ_{it} is the error term. For the rational addiction model, in addition to adding the variables of past consumption ($Dcig_{it-1}$), also added variables of future consumption ($Dcig_{it+1}$) and future price ($Pcig_{it+1}$) of cigarettes in the model so that it becomes:

$$\ln Dcig_{it} = \beta_0 + \beta_1 \ln Dcig_{it-1} + \beta_2 \ln Dcig_{it+1} + \beta_3 \ln Pcig_{it} + \beta_4 \ln Pcig_{it+1} + \beta_5 \ln X_{it} + \epsilon_{it} \tag{6}$$

This study uses an econometric approach conducted by Hidayat & Thabrany (2010) using the OLS estimation method, two-stage least squares (2SLS), the generalized method of moment (GMM), and system-GMM to estimate the model. The use of OLS in this study is an initial model for finding the best estimation model. According to Hidayat & Thabrany (2010), the assumption of OLS is the expected value of the error term with the condition that several independent variables will be equal to zero. However, suppose OLS is used to estimate the

model equations (5) and (6). In that case, there is a potential for error terms related serially (serial correlation) with other variables because this study uses panel data. In addition, because the theory (myopic and rational addiction) requires the addition of independent variables in the form of past consumption or future consumption, which are determinants of dependent variables, it is likely to cause selection bias due to endogeneity. If there is a selection bias, the coefficient of the estimated result will be underestimated or overestimated, so we cannot use the calculated result. This study uses an instrumental variable approach using the 2SLS, GMM, and System-GMM estimation methods to correct that.

The use of an instrumental variable approach has the potential to have implications for changing directions and coefficients. For this reason, in choosing the best estimate among these estimation methods, the author uses classical assumption tests, such as endogeneity tests, to observe the probability of serial correlation in the error term (ε_{it}) with other variables. Statistical tests are also used to evaluate the model in choosing the best estimation method. The statistical tests were exogeneity tests using Durbin and Wu-Hausman for 2SLS and GMM C statistics for GMM. In addition, over-identification restriction tests were carried out using Sargan and Basman tests for 2SLS and Hansen's J tests for GMM and System-GMM estimation models. The consistency of the estimation parameters generated by the 2SLS and GMM estimates depends on the availability of the instrument variable. Therefore, the instrument variable must meet the corresponding condition of the endogenous, validity, and orthogonal variable with the error term (ε_{it}). If one of these conditions is not met, the estimation results of 2SLS and GMM are not correct (Hidayat & Thabrany, 2010).

Results and Discussions

Cigarette consumption in the 2015-2020 period, as in Table 1, ranged from 1200 (SKT cigarette brands in 2019), and the highest consumption up to 43.78 billion cigarettes from one of the SKM cigarette brands in 2015. Table 1 shows that cigarette brands and types of cigarettes are one of the considerations for smokers in consuming cigarettes; if smokers like more brands and types of cigarettes, their consumption will also increase. The nominal excise rate on cigarettes is in the range of Rp. 80 for the type of SKT III in 2015-2017, up to Rp. 790 per stick for the type of SPM I in 2020, while the real excise rate after being adjusted to the Consumer Price Index (CPI) of cigarettes and tobacco products, the tariff range is between Rp. 53.18 to Rp. 434.26. The lowest nominal price of cigarettes is Rp. 2860, and the most expensive is Rp. 85,000. While the lowest real price of cigarettes is Rp. 2156.72, and the costliest is Rp. 59,106.31.

Table 1: Cigarette Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Cigarette consumption	14794	137.700.000	1.026.000.000	1200	43.780.000.000
Nominal price	14794	9746,664	6532,288	2860	85.000
Real price	14794	6141,568	3917,687	2156,722	59.106,313
Nominal rates	14794	241,888	162,21	80	790
Real rates	14794	152,658	97,747	53,184	434,257
Per capita income	14794	9.861.576,8	824.435,19	8.235.507,2	10.670.351

Source: own calculation

Based on the data obtained, the number of cigarette brands grew from 2015-2020 with an average growth rate of 8.76%. The highest growth occurred in 2019, with a growth rate of 10.65%. The SKT cigarette-type brand was the most widely circulated brand during the

research period. Cigarette consumption per type of cigarette has decreased yearly, especially SKM and SPM. This is due to the increase in cigarette excise that occurs every year. Considering that the consumption of SKM cigarettes is the highest among other types, the Government takes a policy of increasing excise duty on these products to control their consumption in the community.

In Figure 1, the highest average excise rate is imposed on the SPM cigarette type, after which the SKM cigarette type is also subject to a higher excise rate than the SKT cigarette type. The excise rate on SPM cigarettes is an anomaly considering that the consumption of SPM

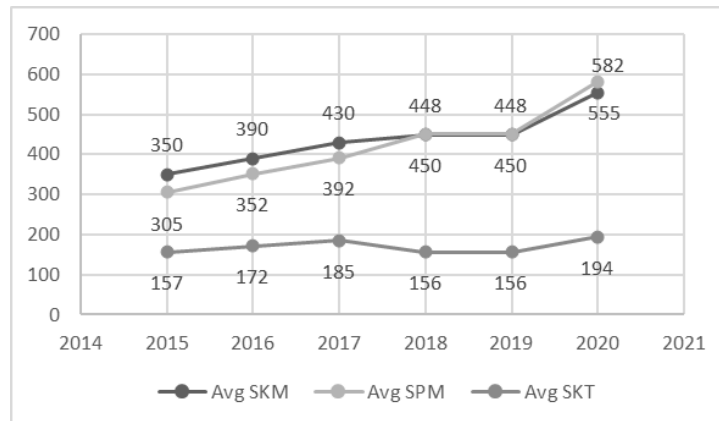


Figure 1: Cigarette Excise Rate Trend

Source: own calculation

cigarettes are the lowest among other types. However, Badan Kebijakan Fiskal (BKF) said that the difference in the imposition of excise rates was one of the considerations on local content. SPM cigarettes have a large amount of tobacco in both size and weight using imported tobacco products, so it is considered that the local scope is low and is subject to higher excise duty than other types.

In addition, the trend of increasing excise rates for SKT cigarettes tends to be gentler than other types. According to the Press Release of the Ministry of Finance, there are considerations of labor aspects in the form of government efforts to protect the existence of labor-intensive industries in the Hand-Rolled Clove Cigarette industry; therefore, the imposition of excise taxes is not as high as other types of cigarettes. The imposition of cigarette excise impacts the increase in cigarette prices. Moreover, with the Government setting the minimum selling price for cigarette sales where the price includes the cigarette excise component, then when the Government sets an increase in cigarette excise, at the same time, the minimum selling price of cigarettes also increases.

Based on the results of descriptive analysis, it is necessary to conduct empirical analysis using panel data regression analysis. As previously stated, in conducting empirical testing regarding the study of the effect of cigarette prices on cigarette consumption using two model specifications, namely the myopic addiction dynamic specification model using equation (5) and the rational addiction dynamic specification model using equation (6). Both models were estimated using STATA software using OLS, 2SLS, GMM, and System-GMM estimates.

Myopic Addiction Model Results

In the myopic addiction dynamic specification model, the decision to consume addic-

tive goods is currently influenced by past consumption only, so the past consumption variable of the cigarette ($Dcig_{t-1}$) is added as an independent variable in the model. In addition, in estimating instrument variables, past cigarette prices ($Pcig_{t-1}$), past per capita income ($Ycap_{it-1}$), and dummy types of SKT, SKM, and SPM cigarettes ($dum_SKT, dum_SKM, dum_SPM$) were added.

Table 2. Estimation Results of the Myopic Addiction Model

Variable	Estimation Model			
	OLS	2SLS	GMM	SysGMM
Past consumption ($Dcig_{t-1}$)	0,952*** [0,000]	1,128*** [0,000]	1,139*** [0,000]	1,105*** [0,000]
Cigarette price ($Pcig_{it}$)	0,081* [0,043]	-0,123*** [0,008]	-0,130*** [0,000]	-0,128*** [0,000]
Per capita income ($Ycap_{it-1}$)	-0,386 [0,079]	0,072 [0,788]	0,079 [0,770]	-1,304*** [0,000]
Constant	6,073 [0,088]	-2,062 [0,662]	-2,290 [0,631]	20,513*** [0,000]
Number of Observations	9891	9891	9891	9891
R ²	0,8333	0,8051	0,8012	
Number of Instruments		5	5	9
Own Elasticity	0,081	-0,123	-0,130	-0,128
Elasticity	Inelastic	Inelastic	Inelastic	Inelastic

Legend: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Source: own calculation

Table 3. Summary of Statistical Tests

	Statistical Value	P-value
Exogeneity test:		
Past consumption ($Dcig_{t-1}$)		
Durbin (2SLS)	Chi ² (1) = 12.3244	0,0004
Wu-Hausman (2SLS)	F (1,9886) = 12,3335	0,0004
GMM C statistic (GMM)	Chi ² (1) = 14.0773	0,0002
Over-identification restriction test:		
Sargan (2SLS)	Chi ² (2) = 45,5643	0,0000
Basman (2SLS)	Chi ² (2) = 45.7474	0,0000
Hansen's J (GMM)	Chi ² (2) = 45.9511	0,0000
Hansen's J (SysGMM)	Chi ² (5) = 10,17	0,071

Source: own calculation

Based on the estimation results of the myopic addiction dynamic specification model

in Table 2, the results of the cigarette price variable estimation ($Pcig_{it}$) have a consistent and significant direction on all estimation models except OLS. Based on the results of statistical tests in Table 3, the best model is system-GMM. The results of the coefficient of the past consumption variable ($Dcig_{it-1}$) in the OLS estimation model are underestimated; in addition, the coefficient and direction of the cigarette price variable ($Pcig_{it}$) are also overestimated due to an unobserved variable existence, so the estimated result becomes biased. The 2SLS and GMM methods are used to correct this. In the 2SLS estimation model, the variables of past cigarette consumption ($Dcig_{it-1}$) were shown to be endogenous based on the results of the Durbin and Wu-Hausman tests, and there was an over-identification restriction based on the Sargan and Basman tests, so the 2SLS estimation results were not used.

The GMM and system-GMM estimation models are chosen by considering all-instrumental variable test results (Hidayat & Thabrany, 2010). Hansen's J test on the GMM estimation model states that over-identification restrictions exist. The GMM C statistical test rejects the null hypothesis so that the instrument variable orthogonality requirements are not met, so the GMM estimation results are not used. The System-GMM estimation model receives a null hypothesis stating there is no over-identification restriction so that the instrument variables are valid and the model is correctly specified; based on this, the best estimation results for the myopic addiction model using the System-GMM estimation model.

The system-GMM estimation model uses more instrument variables than the 2SLS estimation model and GMM of 9 instruments. The F test (simultaneously) resulted in a value of Prob F = 0.0000 < 0.05, which showed that the variables of cigarette consumption in the past, cigarette prices, and per capita income had a significant effect on cigarette consumption in Indonesia. The t-test (partial) showed that the estimation coefficient obtained using system-GMM was entirely significant at a significance level of 5% with a p-value of < (0.05).

The results of the System-GMM estimate in Table 2. show that the price of cigarettes ($Pcig_{it}$) has been shown to have a negative and significant effect on cigarette consumption with a beta coefficient value of -0.128. Based on this, if the price of cigarettes increases by 1%, then cigarette consumption will decrease by 0.128%, ceteris paribus.

Rational Addiction Model Results

In the rational addiction model, the decision to consume addictive goods today is influenced by past and future consumption factors and is also influenced by future cigarette price factors. So, in the model, in addition to adding variables of past cigarette consumption ($Dcig_{it-1}$) are also added variables of future cigarette consumption ($Dcig_{it+1}$) and future cigarette prices ($Pcig_{it+1}$) as independent variables. The instrument variables used are the same as those in myopic addiction models.

The results of the estimates as per Table 4. state if the cigarette price ($Pcig_{it}$) has a consistent and significant direction in all estimation models. Based on the results of statistical tests in Table 5, the best model is System-GMM. The result of the cigarette price variable coefficient ($Pcig_{it}$) in the OLS estimated model is overestimated; this is due to the existence of an unobserved variable, so the estimation result becomes biased. We use 2SLS and GMM methods to correct this. In the 2SLS and GMM estimation models, the future cigarette consumption variable ($Dcig_{it+1}$) proved to be exogenous based on the results of the Durbin test, the Wu-Hausman test, and the GMM C statistic test; in addition to the over-identification restriction test, there was also no over-identification restriction in the 2SLS and GMM estimation models. However, because there is heteroskedasticity in the 2SLS and GMM estimation

models, the System-GMM estimation model was chosen as the best model.

The System-GMM estimation model produces more instrument variables than the 2SLS and GMM estimation models of 12 instruments. The F test (simultaneously) resulted in a Value of Prob F = 0.0000 < 0.05, which shows the variables of past cigarette consumption ($Dcig_{it-1}$), future cigarette consumption ($Dcig_{it+1}$), cigarette price ($Pcig_{it}$), future cigarette prices ($Pcig_{it+1}$), and per capita income ($Ycap_{it}$), have a significant effect on cigarette consumption in Indonesia. The t-test (partial) showed that the estimation coefficient obtained using system-GMM was entirely significant at the level of 5% with a p-value smaller than α (0.05) except for an insignificant variable of per capita income.

Table 4. Estimation Results of Rational Addiction Models

Variable	Estimation Model			
	OLS	2SLS	GMM	SysGMM
Past consumption ($Dcig_{it-1}$)	0,476*** [0,000]	0,411*** [0,000]	0,413*** [0,000]	0,396*** [0,000]
Future consumption ($Dcig_{it+1}$)	0,510*** [0,000]	0,579*** [0,000]	0,577*** [0,000]	0,597*** [0,000]
Cigarette price ($Pcig_{it}$)	-0,451*** [0,000]	-0,399** [0,001]	-0,402** [0,001]	-0,367** [0,009]
The price of future cigarettes ($Pcig_{it+1}$)	0,478*** [0,000]	0,413*** [0,000]	0,415*** [0,000]	0,386** [0,004]
Per capita income ($Ycap_{it}$)	-0,957*** [0,000]	-0,960*** [0,000]	-0,958*** [0,000]	-0,887*** [0,000]
Constant	15,493*** [0,000]	15,639*** [0,000]	15,605*** [0,000]	14,361*** [0,000]
Number of Observations	6464	6464	6464	3446
R ²	0,9286	0,9274	0,9275	
Number of Instruments		6	6	12
Own Elasticity	-0,451	-0,399	-0,402	-0,367
Elasticity	Inelastic	Inelastic	Inelastic	Inelastic

Legend: * p<0.05; ** p<0.01; p<0.001

Source: own calculation

Table 5. Summary of Statistical Tests

	Statistical Value	P-h
Exogeneity test:		
Future consumption ()		
Durbin (2SLS)	Chi ² (1) = 1.5684	0,2104
Wu-Hausman (2SLS)	F (1,6457) = 1,5671	0,2107
GMM C statistic (GMM)	Chi ² (1) = 1.4617	0,2267

	Statistical Value	P-h
Over-identification restriction test:		
Sargan (2SLS)	Chi ² (1) = 0.1300	0,7184
Basman (2SLS)	Chi ² (1) = 0.1299	0,7185
Hansen's J (GMM)	Chi ² (1) = 0.1161	0,7333
Hansen's J (SysGMM)	Chi ² (6) = 6,26	0,394

Source: own calculation

The results of the estimation of the dynamic-rational specification model in Table 4. show that the price of cigarettes ($Pcig_{it}$) has been shown to have a negative and significant effect on conventional cigarette consumption, with a beta coefficient of -0.367. This elasticity value is not much different from the results of previous studies. Based on this, if the price of cigarettes increases by 1%, then cigarette consumption will decrease by 0.367%, ceteris paribus. The future price of cigarettes ($Pcig_{it+1}$) has proven to have a positive and significant effect on cigarette consumption, with a beta coefficient of 0.386. Based on this, if the future price of cigarettes increases by 1%, then the current cigarette consumption will increase by 0.386%, ceteris paribus. The per capita income variable ($Ycap_{it}$) also has the same direction in all estimation models. If per capita income rises by 1%, then cigarette consumption will fall by 0.887%, ceteris paribus.

Summary

The hypothesis test in this study is based on the results of estimation using the myopic addiction dynamic model and rational addiction dynamic model. Because the variable coefficients of past cigarette consumption ($Dcig_{it-1}$) and future cigarette consumption ($Dcig_{it+1}$) are both positive on the rational addiction dynamic specification model, showing that cigarettes are addictive. The results of the model's estimates were selected to prove the research hypothesis. The summary is presented in Table 6.

Table 6. Summary of Research Hypothesis Testing Results

No	Hypothesis	Estimation Results		Conclusion
		Dynamic-Myopic	Dynamic-Rational	
1	Cigarette prices are thought to be negatively correlated with cigarette consumption	-0,128 [0,000]	-0,367 [0,009]	does not reject the Hypothesis
2	Cigarette consumption is suspected to be inelastic	-0,128 (Less than 1)	-0,367 (Less than 1)	does not reject the hypothesis

Source: own calculation

This study aims to analyze how cigarette prices influence cigarette consumption in Indonesia and test the elasticity of demand for cigarettes. This research proves that the price of cigarettes negatively affects cigarette consumption in the dynamic model. The results of this study are in line with the research results of Djutaharta et al. (2005), Adioetomo et al. (2005), and Tirtana & Ariutama et al. (2022). However, the results of this study are not following the results of the study by Jha & Chaloupka (2000), which states that the elasticity of cigarettes in developing countries ranges from about -0.8, and people with low income are more respon-

sive to price changes. The result of this study indicates if Indonesian people are less responsive to price changes because cigarettes in Indonesia are cheap and affordable (Zheng et al., 2018). The Government must raise the price of cigarettes by significantly increasing tax rates so that cigarettes become unaffordable.

The results of this study prove that cigarettes are inelastic goods, meaning that changes in cigarette prices do not significantly impact cigarette consumption. WHO (2020) said cigarette prices in Indonesia are the lowest among Asia Pacific countries, indicating high cigarette consumption. With cheap types of cigarettes and the sale of cigarettes in a repellent manner, cigarettes have become easy for all people to access. For this reason, the most effective and impactful way to reduce cigarette consumption is to implement a policy of increasing excise rates and minimum selling prices, which will cause cigarette prices to rise and reduce the affordability of cigarettes.

Conclusion

Based on previous estimates and discussions, the study concludes that cigarette prices are empirically proven to have a negative and significant effect on cigarette consumption. The increase in cigarette prices has caused cigarette consumption to decrease. According to the dynamic model of myopic addiction, a 1% increase in cigarette prices will reduce cigarette consumption by 0.128%, ceteris paribus. Meanwhile, if using a dynamic model of rational addiction, increasing cigarette prices by 1% cause cigarette consumption to decrease by 0.386%, ceteris paribus. The value of the elasticity of demand that is less than one also indicates that cigarettes are goods whose elasticity of demand is inelastic.

The elasticity of demand for cigarettes has proven to be inelastic in Indonesia; this is very beneficial for the Government in designing a more effective excise policy. If cigarettes are an inelastic item, then the increase in cigarette excise and the change in the minimum selling price of cigarettes do not significantly impact cigarette consumption. The most effective and impactful way to reduce cigarette consumption is to implement a policy of significantly increasing excise rates and minimum selling prices (percentage increases above 10% every year) so that it will cause cigarette prices to rise and reduce the affordability of cigarettes.

This study has some limitations. The aggregate excise data we used in this study cannot present information on who consumes cigarettes, the gender of the smoker, where the seller/store is located, health impact, and variations geographically. So, it is less able to present a more accurate estimate of the independent effects of factors affecting cigarette consumption at the individual level, including smoking behaviour.

For further study, the analysis of the effect of cigarette prices on cigarette consumption of aggregated data could be complementary by survey data at the individual or household level. It will capture the independent impact of factors affecting cigarette consumption. In addition, further research needs to use sales-based data from online and retail sellers to reflect the actual real price. The timeline of the following research period is suggested to be longer, including the research period during the Covid-19 pandemic, so that the study can capture more variation in events.

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