HNP DISCUSSION PAPER

Economics of Tobacco Control Paper No. 26

Cigarette Consumption, Taxation, and Household Income:

Indonesia Case Study

Sri Moertiningsih Adioetomo, Triasih Djutaharta and Hendratno

February 2005

Tobacco Free Initiative
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ECONOMICS OF TOBACCO CONTROL PAPER NO. 26

CIGARETTE CONSUMPTION, TAXATION AND HOUSEHOLD INCOME: Indonesia Case Study

Sri Moertiningsih Adioetomo[1], Triasih Djutaharta[1] and Hendratno[1]

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Paper prepared for the World Bank, with funding from the US Centers for Disease Control and Prevention, Office on Smoking and Health. Analysis completed in 2003.

Abstract: Cigarette consumption has been increasing in Indonesia, as in many other developing countries, causing a rising burden of disease and premature death. Higher excise taxes have proved effective in many countries in reducing cigarette consumption and raising government revenues. This study examines the effect of higher prices/taxes on the decision to smoke, the quantity of cigarettes consumed by smokers in different income groups in Indonesia, and government revenues. It uses 1999 Social and Economic Survey (SUSENAS) household data, with households as the unit of analysis. There was at least one smoker in 57% of all households. Most households smoked kretek cigarettes with filters (64%), or without filters (31%). Average household monthly cigarette consumption was 18 packs of 16 cigarettes. Per capita cigarette consumption was higher for higher income households: 7.83 packs per month, compared to 4 packs for low-income households. On average, households spent 6.22 percent of their total income on cigarettes and kreteks, lower-income households spent the highest percentage.

The study suggests that price is not a significant factor in household decisions to smoke or not, but has a significant effect on the quantity of cigarettes smoked: each 10% increase in price would reduce total cigarette consumption by 6%. The reduction would be higher–nearly 7%–among low-income households, and lower–3%–among high-income households. Cigarette consumption increases as income rises: a 10% increase in household income would increase consumption by 6.5%, with a particularly strong effect among low-income households–a 9% increase–but little change among high income households–an increase of less than 1%.

Simulations show that a 10 percent tax increase that raised cigarette prices by 4.9% would reduce consumption by 3%, and increase tax revenues by 6.7%, ceteris paribus, including assuming no significant switching among cigarette products with different prices and tax levels. Despite the decrease in total consumption, the share of total household expenditures on cigarettes would increase slightly from 4.55% to 4.63%. Tax revenue would rise 6.7%. A 50 percent tax increase would raise tobacco tax revenues by 27.5 percent. (To the extent that there is substitution from cigarettes and kreteks with higher to lower taxes, the increase in total taxes would be lower.)

Keywords: tobacco, Indonesia, tobacco tax, cigarette, cigarette tax, kreteks, smoking, economics of tobacco, tobacco control, tobacco policy, price elasticity, income elasticity, tax elasticity, cigarette tax, two part demand model, regression analysis, tax revenues

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PREFACE

In 1999, the World Bank published "Curbing the Epidemic: governments and the economics of tobacco control", which summarizes trends in global tobacco use and the resulting immense and growing burden of disease and premature death. In 2000, there were nearly 5 million deaths from tobacco each year, and this huge number is projected to grow to 10 million per year by 2030, given present consumption trends. Already about half of these deaths are in high-income countries, but recent and continued increases in tobacco use in the developing world is causing the tobacco-related burden to shift increasingly to low- and middle-income countries. By 2030, seven of every ten tobacco-attributable deaths will be in developing countries.

"Curbing the Epidemic" also summarizes the evidence on the set of policies and interventions that have proved to be effective and cost-effective in reducing tobacco use, in countries around the world. Tax increases that raise the price of tobacco products are the most powerful policy tool to reduce tobacco use, and the single most cost-effective intervention. They are also the most effective intervention to persuade young people to quit or not to start smoking. This is because young people, like others with low incomes, tend to be highly sensitive to price increases.

Why are these proven cost effective tobacco control measures –especially tax increases– not adopted or implemented more strongly by governments? Many governments hesitate to act decisively to reduce tobacco use, because they fear that tax increases and other tobacco control measures might harm the economy, by reducing the economic benefits their country gains from growing, processing, manufacturing, exporting and taxing tobacco. The argument that "tobacco contributes revenues, jobs and incomes" is a formidable barrier to tobacco control in many countries. Are these fears supported by the facts?

In fact, these fears turn out to be largely unfounded, when the data and evidence on the economics of tobacco and tobacco control are examined. The team of about 30 internationally recognized experts in economics, epidemiology and other relevant disciplines who contributed to the analysis presented in "Curbing the Epidemic" reviewed a large body of existing evidence, and concluded strongly that in most countries, tobacco control would not lead to a net loss of jobs and could, in many circumstances actually generate new jobs. Tax increases would increase (not decrease) total tax revenues, even if cigarette smuggling increased to some extent. Furthermore, the evidence shows that cigarette smuggling is caused at least as much by general corruption as by high tobacco product tax and price differentials, and the team recommended strongly that governments not forego the benefits of tobacco tax increases because they feared the possible impact on smuggling, but rather act to deter, detect and punish smuggling.

Much of the evidence presented and summarized in "Curbing the Epidemic" was from high-income countries. But the main battleground against tobacco use is now in low- and middle-incomes countries. If needless disease and millions of premature deaths are to be

prevented, then it is crucial that developing counties raise tobacco taxes, introduce comprehensive bans on all advertising and promotion of tobacco products, ban smoking in public places, inform their citizens well about the harm that tobacco causes and the benefits of quitting, and provide advice and support to help people who smoke and chew tobacco, to quit.

In talking to policy-makers in developing countries, it became clear that there was a great need for country-specific analytic work, to provide a basis for policy making, within a sound economic framework. So the World Bank and the Tobacco Free Initiative of the World Health Organization (as well as some of the WHO regional offices and several other organizations, acting in partnership or independently) began to commission and support analysis of the economics of tobacco and tobacco control in many countries around the world.

The report presented in this Economics of Tobacco Discussion Paper makes a valuable contribution to our understanding of the issues and likely economic impact of tobacco control in a specific country setting. Our hope is that the information, analysis and recommendations will prove helpful to policy makers, help result in stronger policies to reduce the unnecessary harm caused by tobacco use.

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1. INTRODUCTION AND METHODOLOGY

Introduction

Smoking causes fatal and disabling diseases and greatly increases the risk of premature death, and yet, approximately 61 million Indonesians smoke. In many developed countries, smoking prevalence has declined rapidly, but in Indonesia, as in many other developing countries, smoking prevalence has been increasing substantially. Estimates based on the National Household Health Survey indicate that in 1980 there were about 25 million smokers in Indonesia. This number increased to 32 million in 1986 and to 41 million in 1995. Smoking prevalence for men increased from 46 percent in 1980 to 51 percent in 1995.

Consumption per capita is also increasing: from 500 cigarettes[1] in the 1970s to 950 cigarettes in the 1980s to 1,180 cigarettes in the 1990s (WHO 1997). Kreteks (clove cigarettes) are the most popular type of cigarettes in Indonesia. In 1995, 60 percent of urban male smokers smoked filtered kreteks; 25 percent smoked unfiltered kreteks; and only 15 percent smoked white cigarettes (conventional tobacco cigarettes). Unfiltered kreteks are more popular among rural smokers: 50 percent of rural smokers chose unfiltered kreteks compared with 34 percent who chose filtered kreteks, and 14 percent who chose white cigarettes (Suhardi 1997). The white cigarette is the least popular type of cigarette because of the difference in taste and aroma compared with the kretek, which Indonesians have smoked for centuries. According to Hanuz (2000), kreteks have a specific aroma and heavier taste because of the cloves and other ingredients. However, they contain higher tar and nicotine levels than white cigarettes. In 1983, the average tar content of kreteks was 58.0 mg (a range of 41 mg to 71 mg), and the nicotine content was 2.4 mg (a range of 1.2 mg to 3.2 mg). These levels are substantially higher than those permitted for cigarettes in industrialized countries (WHO 1997).

Indonesians are starting to smoke at younger ages than before, and some evidence suggests that many start smoking before the age of 15. The National Household Health Survey for 1995 shows that the average age of starting smoking is 15.2 years. However, the Indonesia Family Life Survey 1997 reported that 29 percent of youth aged 15–19 years and 16 percent of those aged 20–24 said that they started smoking before they were 15 years old. The most recent adolescent survey found that 46 percent of respondents aged 15–24 smoked regularly (Demographic Institute 1999). Although this adolescent survey is not a nationally representative sample, the findings clearly indicate that the age of starting to smoke is becoming younger, and smoking prevalence among youth is increasing rapidly.

The increased prevalence of smoking in Indonesia has raised public concern. It is expected that health costs related to smoking will be very high in years to come. If the

[1] Formula to estimate cigarette consumption per adult = $\frac{\text{Production + Imports − Exports}}{\text{Population aged 15+}}$

prevalence of smoking is decreasing in developed countries, why is Indonesia experiencing a rapid increase in the prevalence and intensity of smoking? What factors have contributed to the increase in cigarette consumption? This study addresses the economic aspects of cigarette consumption, so that appropriate and effective tobacco control policy can be implemented.

Tobacco Control in Indonesia

Smoking causes 90 percent of all cancers of the mouth, throat, trachea, bronchia, and lungs, 75 percent of all chronic obstructive pulmonary disease, and 40 percent of cerebrovascular disease in Indonesia. The Ministry of Health estimated that smoking made 6.4 million Indonesians seriously ill in 1995. As de Beyer and Yurekli (2000) noted, "Smoking is stealing millions of years of healthy life from Indonesians."

The increasing prevalence and intensity of smoking in Indonesia have raised concern among public health experts and government policy makers. Anti-smoking campaigns began in Indonesia many years ago; however, the effort is still minimal and ineffective. One reason is that the health effects of smoking typically develop after many years of smoking, so the problem is often underestimated. Another reason is the addictiveness of nicotine, which makes it difficult to quit smoking. Longitudinal data taken from the Indonesia Family Life Survey in 1993 and 1997 show that, out of 12 percent of "ever-smokers" who had stopped smoking in 1993, 10 percent were smoking again in 1997.

In Indonesia, anti-tobacco campaigns have been conducted mainly by non-government organizations (WHO 1997). It was not until May 1991 that the Ministry of Health instructed all cigarette producers to put the following message on every pack of cigarettes: "Government warning: Smoking damages health." At first, this warning was written on a sticker placed on only one side of a cigarette package. In October 1991, the Director General for Food and Drug Control instructed that the message be printed on every pack of cigarettes. Sanctions from both the Ministry of Health and the Department of Industry and Trade were applied to those who violated the regulation (Angkatan Bersenjata, 19 April 1991). Health warnings are also placed on cigarette advertisements. However, there is no regulation about the size of the warnings on cigarette packs and advertisements.

Recently the Government of Indonesia has become a little more active in anti-smoking campaigns. In 1998 and 1999, the Ministry of Health worked in collaboration with the World Health Organization (WHO) and the Healthy Heart Foundation to increase youth awareness of the health risks of smoking.

Government regulation number 81/1999 banned cigarette advertising on TV, and permitted it only in printed media and outdoor advertising. But the cigarette industry strongly protested, and the regulation was revised (PP 38/2000), to permit advertising on television after 21:30 each evening. However, compliance with the restriction is very low.

Regulation No. 38 of the year 2000 was enacted to bring Indonesia into line with WHO standards, and stated that the tar content of cigarettes should not exceed 20 mg and nicotine should not exceed 1.5 mg per cigarette. This raised protests from *kretek* cigarette producers and farmers. To meet these standards, *kretek* producers argued that they would need to replace locally produced high tar and nicotine tobacco with more expensive imported tobacco, which caused protests by tobacco farmers. The alternative was to invest billions of rupiah to produce sophisticated filters for cigarettes (Tempo 14 November 1999). A new regulation, No 19 in the year 2003, repealed the maximum tar and nicotine content limits. However, there is increasing awareness and demand for lower tar and nicotine cigarettes among Indonesian smokers, so most companies are beginning to reduce tar and nicotine levels in order to satisfy consumer demand.

The Effect of Taxes and Prices on Tobacco Use

The low level of kretek and cigarette prices in Indonesia contributes to the high and rising prevalence of smoking. Cigarettes are much cheaper in Indonesia than in many other low- and middle-income countries. For example, Indonesia has lower cigarette prices than Albania, Bolivia, Bulgaria, Colombia, El Salvador, Jamaica, Philippines, Thailand, Turkey and Venezuela (Jha and Chaloupka 2000). In the East Asia and Pacific Region, between 1980 and 2000, real cigarette prices in Indonesia were amongst the lowest in the region. In 2003, the average price of the most expensive brands of white cigarettes in Indonesia was US$0.8, lower than in Bangladesh (US$0.95), India (US$1.24), Maldives (US$1.42), Nepal (US$0.95), Sri Lanka (US$1.75) and Thailand (US$1.29) (Guindon et al 2003). Higher cigarettes prices would reduce consumption. Taxation policy should be used much more as an instrument for tobacco control, to raise prices. Higher cigarette excise taxes would increase cigarette prices, which in turn would reduce consumption, especially of low-income households.

Indonesia has a complex tobacco tax system in which the government determines the minimum price as the basis for an ad valorem excise tax. Machine-made cigarettes produced in high capacity enterprises are subject to higher tax rates and minimum prices than hand-made cigarettes produced in lower capacity enterprises. Ad valorem rates varied between 36% and 2% in 2000. Changes in the tax regime (changes in minimum prices, tax rates and the enterprise capacity thresholds for different tax rates) caused changes in the overall level of tax, and as a percent of the final retail price. The average tax share of the retail price of cigarettes was 29% in 1999, increased to 37% in 2000, and fell to 33% in 2001.

In Indonesia, the question arises whether there is a potential conflict between the desired health impacts of anti-smoking efforts and collection of excise tax revenue. In recent years, tobacco tax revenue has been increasing dramatically. Some government officials worry that if tobacco control is too effective in reducing consumption, an important source of government revenue will be threatened. However, studies in many countries show clearly that increasing cigarette excise tax rates will increase government revenues (not reduce them) for many years, because the fall in consumption is proportionately smaller than the tax rate increase that causes it (Jha and Chaloupka 2000).

Objectives of the Study

The general objective of this study is to analyze the social, economic and demographic determinants of smoking, and explore the effects of taxation and price on demand, as a basis for policy decisions to reduce tobacco use, within a sound economic framework.

The study explores a set of key economic policy issues to provide information for use by Indonesian economists and the ministries of finance and health. These are:

- How do changes in cigarette taxes and prices affect the overall demand for cigarettes?
- What effect do changes in cigarette price have on the decision to smoke and the intensity of smoking (number of cigarettes smoked) of different income groups?
- What social and demographic factors affect the decision to smoke and the quantity of cigarettes smoked?
- What impact would cigarette tax increases have on government tax revenues?

Methodology

Three parameters were estimated to indicate the responsiveness of smokers to changes in cigarette price: 1) price elasticity of smoking participation, 2) conditional price elasticity of demand, and 3) total price elasticity. Price elasticity of smoking participation measures the impact of changes in cigarette price on the probability that members of households smoke. Participation is measured as the ratio of the number of households that consume cigarettes to those that do not consume cigarettes in logarithm value (log-odds ratio). The conditional price elasticity of demand is the percentage change in the quantity of cigarettes consumed (by households whose member/s smoke), divided by the percentage change in cigarette price. The total price elasticity shows the impact of price changes on the total quantity of cigarettes consumed across all households, taking account of both "participation" decisions as to whether or not to smoke, and decisions on how many cigarettes to smoke. The tax elasticity of price is also estimated to measure how cigarette prices change in response to tax rate changes.

The data used in this study are taken from the 1999 National Socio-Economic Survey (Susenas), collected by the Central Bureau of Statistics. Susenas data contain variables derived from the core and module questionnaires. The core questionnaire was used to survey 205,747 households. The module questionnaire was used for 61,484 households. Most module households also answered the core questions; 882 "module" households were not in the core survey, and were not used in the analysis. This leaves 60,602 cases available for analysis.

The following information from the core questionnaire is used in this analysis: demographic characteristics, education, household income, and labor force participation of the household members. Information on the quantity of cigarettes consumed and expenditures by type of cigarette comes from the module questionnaires. The survey

showed that the average household size is 4.15 members; this information is used to convert "per household" data to "per person" data. (Definitions of the variables used in the analysis are shown in Appendix 1. The mean values and standard errors of the variables are shown in Appendices 2-4: Appendix 2 shows unweighted data for all households, Appendix 3 has the unweighted data for households with at least one smoker, and Appendix 4 shows the weighted values for all households).

Two-Part Demand Model

The price elasticity of smoking participation, conditional price elasticity of demand, and total price elasticity were estimated using a two-part model as described by Cragg (1971). This Cragg-type model was employed by Manning et al. (1981) to study the demand for medical care. Hu et al. (1995) and Mao et al. (2000) applied it to the demand for cigarettes in California and China, respectively. The two-part model assumes that households (or more accurately, their members) first decide whether or not they will smoke; and then if they decide to smoke, they choose how much to smoke.

The literature suggests several reasons for using the two-part model:

- The decision to smoke may be influenced by different factors than those that determine the numbers of cigarettes smoked (Manning et al. 1981, Duan et al. 1983). Jones (1986, 1989) found that this was the case in the United States.
- The quantity of cigarettes smoked does not follow a normal distribution, and the decision to smoke or not is a binary (yes/no) variable. This makes the two-part model econometrically more appropriate (Manning et al. 1981 and Duan et al. 1983); using ordinary least square estimation could result in inconsistent estimates.

We used the logarithmic value of the dependent variable, the number of cigarettes smoked, because this variable has a skewed distribution (Mao et al. 2000). After the transformation into a logarithmic value, the distribution of cigarette consumption among smokers is close to normal, resulting in more precise estimates (Hu et al. 1995). The logarithmic value for cigarette prices was also calculated in both the logit participation equation and the estimation of conditional demand. The coefficients thus calculated can be interpreted automatically as the price elasticity of smoking participation and the conditional price elasticity (Mao et al. 2000).

The elasticity coefficients can be calculated from the two-part model. Logit estimation is applied to determine the coefficients for the independent variables affecting the probability of a household smoking. The price coefficient in equation 3 (shown later) is the price elasticity of smoking participation.

Calculating Price

Information on cigarette price is not available from the 1999 Susenas, but there is information on household expenditures on cigarettes and the quantity of cigarettes consumed, by type of cigarettes, for households that include at least one smoker, which we will refer to as "smoker households". The prices paid by smoker households are

estimated by dividing household expenditure on cigarettes by the quantity of cigarettes consumed. This is calculated for each type of cigarette: filtered kreteks, unfiltered kreteks, and white cigarettes (Deaton 1997, p.288 calls this a unit value).

Nonsmoker households have no expenditures on cigarettes, so it is not possible to estimate unit values to use as the price variable that applies to these households. But even though their members choose not to smoke, there is also a relevant range of cigarette prices that are very likely to be one factor in their decision not to smoke. Therefore, we estimated the price they face by assuming that smokers and nonsmokers with similar income, age, sex, education level, and living in the same province face similar actual cigarette prices. The unit values estimated for smoker households are used to construct cigarette prices that apply to nonsmoker households as well (equation 1 below).

(1) *Price (in log)* $= \propto_0 + \propto_1 \textit{income} + \propto_2 \textit{tax} + \propto_3 \textit{urban} + \propto_4 \textit{elementary} + \propto_5 \textit{junior high plus} + \propto_6 \textit{white collar} + \propto_7 \textit{blue collar} + \propto_8 \textit{Sumatra} + \propto_9 \textit{Java-Bali} + \propto_{10} \textit{Kalimantan} + \propto_{11} \textit{Sulawesi} + U_1$

where

price	=	cigarette price in rupiah per pack of 16 cigarettes (pieces) (in log)
tax	=	cigarette excise tax in rupiah per pack of 16 cigarettes
income	=	per capita household income per day in rupiah
urban	=	dummy variable = 1 if urban; otherwise = 0
elementary	=	proportion of household members who have completed elementary school
junior high plus	=	proportion of household members who have completed junior high school or above
white-collar	=	dummy variable for white-collar workers, where *white-collar* = 1 if the head of household works in a white-collar occupation; otherwise, *white-collar* = 0
blue-collar	=	dummy variable for blue collar workers where *blue-collar* = 1 if the head of household works in a blue-collar occupation; otherwise, *blue collar* = 0
Sumatra	=	dummy variable for Sumatra island where *Sumatra* = 1 if the household lives in Sumatra; otherwise, *Sumatra* = 0
Java-Bali	=	dummy variable for Java and Bali islands where *Java-Bali* = 1 if the household lives in Java or Bali; otherwise, *Java-Bali* = 0
Kalimantan	=	dummy variable for Kalimantan island where *Kalimantan* = 1 if the household lives in Kalimantan; otherwise, *Kalimantan* = 0
Sulawesi	=	dummy variable for Sulawesi island where *Sulawesi* = 1 if the household lives in Sulawesi; otherwise, *Sulawesi* = 0
U_1	=	disturbance term

Calculating the Excise Tax for Equation 1

For this analysis, the excise tax had to be calculated before the price function could be estimated. In Indonesia, the cigarette excise tax varies according to the scale of the manufacturer (number of cigarettes produced), whether the cigarettes are made by

machines or are hand-rolled,[2] and the government's tax target in a particular year. Tax values for cigarettes in Indonesia are defined differently from those in most countries. The Indonesian tax administration sets a percentage tax rate and also a minimum price, based on various criteria, as the basis for assessing the tax.

In this study, we apply a tax estimate based on two government decisions: decision number 118/KMK.05/1998 by the Minister of Finance on tax classification and the excise tax rate on tobacco products, dated February 1998, and decision number Kep-27/bc/1998 by the Director General of Customs and Excise on the minimum retail unit price excise tax for cigarettes, dated March 30, 1998 (Table 1). These two rules came into effect on 1 April 1998 and still applied when the Susenas 1999 data were collected in February 1999.

Table 1: Minimum Price and Tax Rate by Type of Cigarette, 1998

Price (rupiah per cigarette)	Tax rate (%)
a. Machine-made/filtered kreteks	
≥ 175	36
130 ≤ price < 175	28
120 ≤ price < 130	24
85 ≤ price < 120	20
price < 85	0
b. Hand-made/unfiltered kreteks	
≥ 120	16
80 ≤ price < 120	8
60 ≤ price < 80	4
45 ≤ price < 60	2
price < 45	0
c. White cigarettes	
> 125	38
95 ≤ price < 125	34
50 ≤price < 95	26
35 ≤price < 50	20
price < 35	0

Source: Government of Indonesia.

From the above rules, we can observe that if the price of machine-made kreteks is greater than Rp175 per piece, the tax applied is 36 percent. This tax is included in the price paid by the household. In order to assign a tax value for nonsmoker households, we assumed that high-income households would tend to choose similar types of cigarettes. Using tax per pack paid by smoker households, we estimated the relationship between tax and income of households (equation 2). Then using these coefficients, we predicted tax values for nonsmokers based on their income levels. This tax variable was included as one of the dependent variables in equation (1) above, to estimates cigarette prices facing all households.

[2] In Indonesia, "hand-made" kreteks are made in factories, using a labor-intensive production method. This should not be confused with "roll your own" cigarettes, where the user buys loose tobacco and cigarette papers separately.

(2) $Tax\ value = \partial_0 + \partial_1\ income + U_2$

where U_2 is the disturbance term

Independent Variables Used in Equation 1

For the cigarette price regression, we assumed that several independent variables, such as per capita household income, excise tax, area (urban or rural), big island residence, education, and head of household's type of occupation, affect the cigarette price that the household is able or willing to pay. The results of the price estimation for smoker households from equation 1 were used to generate cigarette prices that nonsmoker households were assumed to face in deciding whether or not to smoke.

The first independent variable, per capita household income, reflects household economic status and purchasing power, and thus affects the price the household pays for cigarettes. Household income is defined as annual household income including salary or other goods/services, income from farm and non-farm businesses, and income from other sources. Total income is divided by household size to calculate per capita household income, in rupiah per day. The second independent variable, the cigarette excise tax, affects the price of cigarettes, so needs to be included in the price equation. The third variable, area, takes into account rural-urban differences in consumption behavior. The education variable is the proportion of household members who attained each level of education. Education affects the way an individual uses information on the health consequences of cigarette consumption. This variable is a dummy variable with three categories of education: no schooling or incomplete elementary school, elementary school, and junior high school or above. The first category is used as the base variable.

The fifth variable, household head's occupation, may be treated as a proxy for the social status of the household. Differences in social status may influence cigarette consumption. We distinguished three types of occupations: white collar, blue collar, and others not classified as blue collar or white collar. There are five white collar occupations (0 to 4):

- categories 0 and 1 are professional workers and other workers,
- category 2 is legislative and government institution officials or management workers,
- category 3 is administrative supervisors, implementing government officials, stenographers, typists, puncher and telex operators, and administrative workers,
- category 4 is trading company managers and owners, sales supervisors and purchase workers, technical article salespeople and technical services advisors, insurance marketing workers, building and land rental workers, valuable papers and establishment services workers, auctioneers, and small traders and workers.

Blue collar occupations are described in five categories (5 to 9):

- category 5 covers labor services establishments such as catering and lodging managers, owners of catering and lodging services, housekeeping and services workers, cooks, restaurant/bar servers and workers,
- category 6 is agricultural workers including those working in fields, animal husbandry, forestry, and hunting.

- categories 7, 8, and 9 are production workers and labor, transportation workers, and operators.

The base group is the "other" occupation, comprising members of the armed forces, job seekers, and other workers who cannot be classified in white or blue collar occupations.

The sixth variable in equation 1 is region. The rationale for including this variable is the significant regional economic and infrastructure disparities among the major islands in Indonesia. Differences in distance affect the cost of transportation, which influences cigarette prices. For example, Java is densely populated and has a much better road network than other islands. It is not only the center of tobacco production, but also the location of cigarette manufacturers. Regional differences appear in the form of dummy variables representing the islands of Sumatra, Java and Bali, Kalimantan, and Sulawesi. Irian Jaya and other islands serve as the reference group.

Since rich and poor households may have different responses to cigarette taxes, prices, smoking participation, and consumption, we have done separate analyses by income group in addition to the estimates for the full sample. Households are classified by income level (monthly average income in US dollars, US$1 = Rp8655.8 in 1999): low (≤US $1), middle (>US $1 and ≤US $2), and high income (>US $2).

Calculating Conditional Price Elasticity of Demand

Estimating the probability of smoking is the first step in obtaining the price elasticity of smoking participation in the two-part model. We performed a logistic regression that included all the above variables, plus the proportion of males in the household and the household age composition. There is a strong gender bias in smoking participation, and it is reasonable to expect the age composition of the household also to affect smoking participation. Age is specified by the following categories (the last category serves as the base category):

Age 0–9 = the proportion of household members 9 years of age or less
Age10–14 = the proportion of household members 10–14 years of age
Age15–24 = the proportion of household members 15–24 years of age
Age 25–59 = the proportion of household members 25–59 years of age
Age 60+ = the proportion of household members 60 years of age and above

The logistic equation is as follows:

$$(3)\ Prob.\ (C=1) = \frac{1}{1+e^{-(\beta 0+\beta 1\ price\ (log)\ +\beta 2\ income(log)\ +\ \beta 3\ urban\ +\ \beta 4 male\ +\ \beta 5 white\text{-}collar\ +\ \beta 6 blue\text{-}collar\ +\ \beta 7 elementary\ +\ \beta 8 junior\ high\ plus\ +\beta 9 age0\text{-}9\ +\ \beta 10\ age10\text{-}14\ +\ \beta 11\ age15\text{-}24\ +\ \beta 12\ age25\text{-}59\ +\ U3)}}$$

where U_3 is the disturbance term.

Before calculating equation 3, we applied a Durbin-Wu endogeneity test on the cigarette price variable in equation 1. For all households, we first estimated price equation 1. We

calculated the *price residual* (in log) from equation 1, and then we performed the Durbin-Wu Hausman test on the residuals. We added the *price residual* (in log) to equation 3[3]. Equation 4 (below) is the equation we used to test endogeneity in the logit model.

$$(4)\ Prob.\ (C=1) = \frac{1}{1+e^{-(\beta 0+\beta 1\ price\ in\ log\ +\ \beta 11\ price\ resid.(log)\ +\ \beta 2\ income\ (log)\ +\ \beta 3\ urban\ +\ \beta 4 male\ +\ \beta 5 white\text{-}collar\ +\ \beta 6 blue\text{-}collar + \beta 7 elementary + \beta 8 junior\ high\ plus + \beta 9 age0\text{-}9 + \beta 10\ age10\text{-}14\ +\ \beta 11\ age15\text{-}24\ +\ \beta 12\ age25\text{-}59\ +U3)}}$$

where U_3 is the disturbance term.

A significant *price residual* (β_{11}) indicates that the price variable is endogenous. If price is endogenous, then smoking participation needs to be estimated using equation 3 with the *price variable* replaced by the *predicted price*. If the endogeneity test indicates that price is not endogenous, then smoking participation can be estimated using equation 3 as written and using the original price variable. (The results of the test for endogeneity are reported below, and also in Appendices 5, 6, 7 and 8.)

The second equation in this two-part model is the conditional demand function of cigarette consumption, measured by packs (each containing 16 cigarettes or "pieces") per capita per household per month. The quantity per capita per household was obtained by dividing the monthly consumption by the number of household members (4.15) (see Appendix 1). The cigarette consumption equation is as follows:

$$(5)\ Consumption\ (in\ log) = \varphi_0 + \varphi_1\ price\ (log) + \varphi_2\ income\ (log) + \varphi_3\ urban + \varphi_3\ male + \varphi_4\ white\text{-}collar + \varphi_5\ blue\text{-}collar + \varphi_6\ age0\text{-}9 + \varphi_7\ age10\text{-}14 + \varphi_8\ age15\text{-}24 + \varphi_9\ age25\text{-}29 + \varphi_{10}\ elementary + \varphi_{11}\ junior\ high\ plus + U_4$$

where U_4 is the disturbance term.

We estimated this equation only for smoker households. As in equation 3, we performed the same endogeneity test on the cigarette price variable. Equation 6 (below) was used to test for endogenity in the conditional demand function.

$$(6)\ Consumption\ (in\ log) = \varphi_0 + \varphi_1\ price\ (log) + \varphi_{11}\ price\ residual\ (log) + \varphi_2\ income\ (log) + \varphi_3\ urban + \varphi_3\ male + \varphi_4\ white\text{-}collar + \varphi_5\ blue\text{-}collar + \varphi_6\ age0\text{-}9 + \varphi_7\ age10\text{-}14 + \varphi_8\ age15\text{-}24 + \varphi_9\ age25\text{-}29 + \varphi_{10}\ elementary + \varphi_{11}\ junior\ high\ plus + U_4$$

where U_4 is the disturbance term.

If the test indicates that price is endogenous, then equation 5 should be calculated using two-stage least squares (2SLS). At the first stage, price is estimated as a function of tax and other independent variables (equation 1), and at the second stage, the demand for cigarettes is estimated using predicted price as the exogenous variable on the right hand

[3] Please note that in testing the endogeneity of price using the Hausman test, some studies use predicted price, others use the predicted residual in the second stage. Both produce the same result.

side of the equation (equation 5). As seen in Appendix 8, the price was endogenous for the full data set and for the low-income and middle-income households, but exogenous for the sub-set of high-income households.

Calculating Total Price Elasticity

After estimating the coefficients for equations 3 through 6, using the same method of calculation as Hu et al. (1995), we obtained the total price elasticity using equation 7.

(7) Total price elasticity $= (1-p(c=1))\ \propto 1 + \varphi 1$

where
$P(c=1)$ = the proportion of smoker households to all households in the sample
$\propto 1$ = price elasticity of smoking participation
$\varphi 1$ = conditional price elasticity for smokers

The tax parameter estimated from equation 1 was used to calculate the impact of a tax increase on cigarette price. From the impact of the price increase ($\propto 1$), we estimated the proportion of households that would stop smoking.

2. ANALYSIS, RESULTS AND SIMULATIONS

Descriptive Analysis

This study used data from the 1999 Susenas for 60,602 households collected from all 26 Indonesian provinces.

Table 2: Smoking Prevalence, Number of Smoker Households and Sample Sizes, by Type of Cigarette and Income Group, 1999

Type of Cigarette	Overall	Low Income	Middle Income	High Income
	Smoking prevalence (%)			
All cigarette types	57.20	57.87	55.55	50.83
Filtered kretek	36.71	35.74	41.10	39.03
Unfiltered kretek	17.83	19.34	11.98	10.97
White cigarettes	5.42	5.54	5.19	4.06
	Number of smoker households			
All cigarette types	34,663	28,121	5,138	1,404
Filtered kretek	22,247	17,368	3,801	1,078
Unfiltered kretek	10,807	9,396	1,108	303
White cigarettes	3,282	2,690	480	112
	Number of households in sample			
Total	60,602	48,591	9,249	2,762

Source: Computed from the National Socio-Economic Survey, Indonesia, 1999

Smoking Prevalence

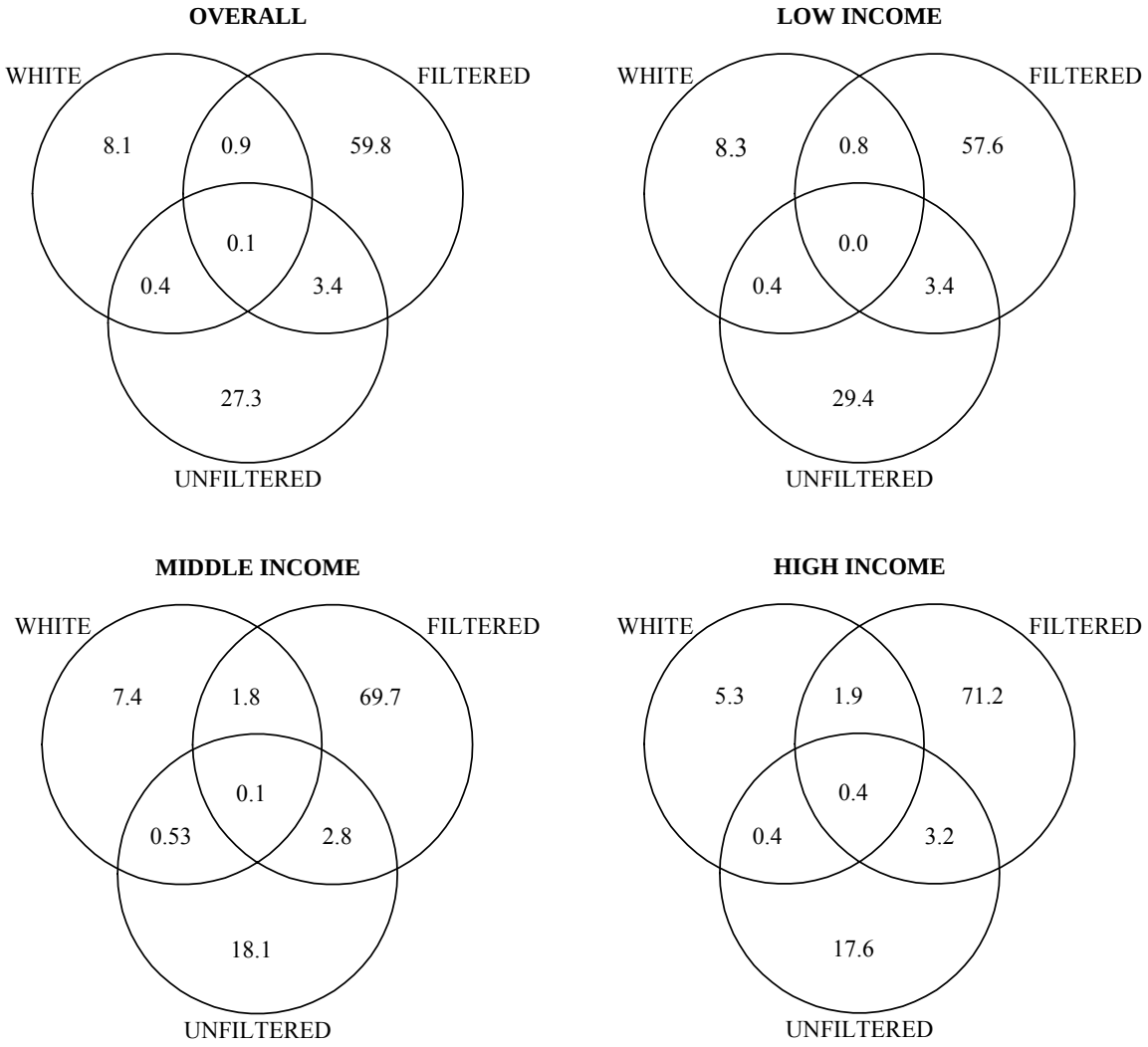
Table 2 shows the percentage of households that have at least one member who smokes (the household prevalence rate). In Indonesia in 1999, 57 percent of households included at least one member who smoked. The percentage was highest in low-income households (almost 58 percent), followed by middle-income households (55.6 percent) and lowest in high-income households 51 percent). The 1995 Household Health Survey also reported that smoking prevalence was higher in low-income households (Suhardi 1997).

This finding—that smoking prevalence is higher in low-income households—is consistent with findings from other studies (World Bank 1999). Bobak et al. (2000, p. 48) reports similar patterns in India, China, Brazil, Mexico, Vietnam, Guatemala, Poland, Hungary, South Africa, and Costa Rica. This pattern is also found in developed countries such as Norway and the United Kingdom, in which prevalence rates among low-income male smokers in 1990 were 48 and 40 percent, respectively, compared with 28 and 12 percent for high-income males (World Bank 1999). Bobak et al. (2000, p. 57) suggested several reasons for this, including the possibility that the extent of nicotine dependence in poor smokers may be greater.

Cigarette Preferences

Table 3 and Figure 1 show household preferences for each type of cigarette. Of the 34,663 smoker households, 64 percent chose filtered kreteks; 31 percent consumed unfiltered kreteks, and only 9 percent of households smoked white cigarettes. This pattern is reflected in each income group. The National Household Health Survey in 1995 reported that the prevalence rate for filtered kreteks was 42 percent; for unfiltered kreteks 23 percent; for self-rolled cigarettes 19 percent; and for white cigarettes only 15 percent (Suhardi 1997). Thus the pattern of prevalence rates for each type of cigarette is fairly consistent over time.

Figure 1: Household Cigarette Preferences, Percentages by Income Group



Source: Computed from the National Socio-Economic Survey, Indonesia, 1999

Table 3: Household Preference by Income Group

	Overall	Income group Low	Middle	High
	%	%	%	%
Filtered kreteks	64.18	61.76	73.98	76.78
Unfiltered kreteks	31.18	33.41	21.56	21.58
White cigarettes	9.47	9.57	9.34	7.98
Number of households consuming at least 1 type of cigarette	34,663	28,121	5,138	1,404

Source: Computed from the National Socio-Economic Survey, Indonesia, 1999

Among the 60,602 households in the sample, about 5 percent have members who smoke more than one type of cigarette (Figure 1). The percentage is slightly larger at higher incomes. About 4.7 percent of low-income households, about 4.8 percent of middle-income households, and about 5.9 percent of high-income households smoke more than one type of cigarette. As Figure 1 shows, in households consuming two types of cigarette, the preferred combination is filtered and unfiltered kreteks, followed by filtered kreteks and white cigarettes. The least likely combination is unfiltered kreteks and white cigarettes. Relatively few households in each income group consume all three types of cigarettes. In estimating the regressions, households that consumed two (or three) types of cigarettes were treated as two (three) observations in the analysis. This increased the number of observations in the analysis.

The Price of Cigarettes

Table 4 shows that the average price of cigarettes paid by smoker households in Indonesia in 1999 was Rp2725 (US$0.31) per pack of 16 pieces. The higher the income group, the higher the price paid. The low-income group paid Rp2609 per pack of 16 pieces; the middle-income group paid Rp3173; and the high-income group paid Rp3410.

As stated earlier, the price variable used in this analysis is actually the unit value as described by Deaton (1997). Deaton explains that the unit value usually indicates the quality of the commodity purchased; and therefore, it might be thought that higher cigarette prices indicate higher quality cigarettes. However, although consumers may be willing to pay more for some brands of cigarettes than others, regardless of the unit value or "quality" of cigarettes, smoking is hazardous to health.

For each type of cigarettes, the higher the income group, the more the price paid. Comparing the various types of cigarettes, the price paid for filtered kreteks is the highest at Rp2944, followed by white cigarettes at Rp2490. The price paid for unfiltered kreteks is the lowest overall at Rp2379. Within income groups, this pattern holds only for the low-income group. For the middle-income group, filtered kreteks have the highest price, followed by unfiltered kreteks, and white cigarettes. The high-income group pays most for unfiltered kreteks, followed by filtered kreteks, and white cigarettes.

What kind of unfiltered kretek does the high-income group smoke? Informal communication with a CEO from the second biggest kretek manufacturer provided

information about a popular brand of unfiltered kretek. It is handmade and considered to be very "tasty." Advertising for these kreteks targets executives and others members of the elite. It is the highest priced of all types of cigarettes. According to the manufacturer, smoking this brand gives smokers the feeling of being among the elite. The high-income group in this study may be consuming this type of unfiltered kretek.

Table 4: Average Consumption per Capita per Household, Price and Tax Paid by Smoker Households by Type of Cigarette and Income Group, 1999

		Income Group		
	Overall	Low	Middle	High
Consumption per month per capita in packs (16 pieces per pack)				
Filtered kreteks	4.26	3.82	5.97	7.33
Unfiltered kreteks	3.62	3.38	5.24	6.76
White cigarettes	4.40	4.03	6.31	7.35
All types of cigarettes	4.32	3.91	6.22	7.83
Price per pack, Rp				
Filtered kreteks	2,944	2,844	3,272	3,410
Unfiltered kreteks	2,376	2,257	3,078	3,503
White cigarettes	2,490	2,426	2,699	3,124
All types of cigarettes	2,725	2,609	3,173	3,410
Tax value per pack, Rp				
Filtered kreteks	962	912	1,122	1,188
Unfiltered kreteks	330	307	467	547
White cigarettes	911	884	998	1,170
All types of cigarettes	770	717	979	1,064
Tax as a percentage of price				
Filtered kreteks	32.66	32.08	34.30	34.83
Unfiltered kreteks	13.90	13.61	15.17	15.62
White cigarettes	36.58	36.45	36.98	37.45
All types of cigarettes	28.24	27.46	30.86	31.20
Household income (rupiah per month)	815,859	621,850	1,303,384	2,917,578
Cigarette Expenditure as % of income	6.22	7.24	5.53	3.02

Source: Computed from the National Socio-Economic Survey, Indonesia, 1999

The generally cheaper price of unfiltered kreteks is related to the lower tax rate for this type of cigarette, as discussed earlier and shown in Table 1. Unfortunately, the 1999 Susenas did not provide information about self-rolled cigarette consumption, although the 1995 National Household Health Survey reported that 25.4 percent of smokers rolled their own cigarettes, and the economic crisis might have increased use of these cheaper cigarettes. Some households in the Susenas report such low prices paid for their cigarettes that it is highly likely that they roll their own. Smokers who roll their own cigarettes may in fact contribute zero tax payments, and pay only the price of the tobacco used.

Cigarette Consumption

The pattern of smoking prevalence by income group differs from the pattern of cigarette consumption (quantity consumed). Table 4 shows that the average cigarette consumption per month is 4.32 packs (16 pieces per pack) per capita per household or 17.9 packs per

household. The intensity of smoking is highest for the high-income group. The low-income group consumes 3.91 packs per person per month; the middle-income group consumes 6.2 packs; and the high-income group consumes 7.83 packs per person. This pattern is consistent with the cross-country comparisons reported in Gajalakshmi et al. (2000, p. 17), which show highest daily consumption per smoker in high-income countries.

The high-income group consumes more cigarettes than the low-income group, despite the fact that the high-income group has more education. In developed countries, better educated people tend to have more information and thus a greater understanding of the health hazards of smoking (Jha and Chlaoupka (eds) 2000). In developing countries like Indonesia, information about the health hazards of smoking has not been disseminated effectively. High income reflects high purchasing power, and is associated with greater consumption of cigarettes.

The Cigarette Excise Tax

In Indonesia, the cigarette excise tax applied differs according to the manufacturers' scale and method of production and the type of cigarette, as well as the government's tax target for a particular year. The percentage of tax can be estimated according to the price of the type of cigarette using the tax percentages in Table 1. Table 4 also shows the estimated amount of tax paid by smoker households in each income group for each type of cigarette.

The average tax paid by smoker households is Rp770 per pack or 28.2 percent of the price paid. Low-income smoker households paid 27.5 percent tax, while middle-income and high-income smoker households paid 30.9 percent and 31.2 percent tax respectively. For each type of cigarette, the estimated tax percentage rises with income group.

By type of cigarette, the highest percentage tax paid by smoker households is for white cigarettes (36.6 percent), followed by filtered kreteks (32.7 percent), with taxes on unfiltered kreteks far lower (13.9 percent). This pattern is seen in each income group.

On the basis of a cigarette price of Rp2,725 per pack, the average expenditure by a smoker household for cigarettes is Rp11,387 per month. As shown in Table 4, the average monthly income is Rp815,859, and average household expenditure on cigarettes is about 6.2 percent of total expenditures. For the low-income group, cigarette expenditure as a percentage of household expenditure is 7.2 percent; for the middle-income group, it is 5.6 percent; and for the high-income group, it is 3.0 percent. The 7.2 percent of total expenditure that the low-income group spends on tobacco has a high opportunity cost; this money could be used instead to buy food or other necessities.

Results

Tax and Price Equation Estimation

Earlier, we described the steps taken in estimating the price elasticity of cigarette demand. First, we estimated the tax function (equation 2) to predict tax incidence for nonsmoker households. Second, we included the tax value predicted for nonsmokers in estimating the cigarette price function (equation 1), which depends on per capita household income, tax, area, education, household head's type of occupation, and region. Third, we estimated the probability-of-smoking function (equation 3) in a two-part model using logit regression. Fourth, we estimated the cigarette demand function (equation 4) to arrive at the conditional price elasticity of demand for cigarettes. We performed the estimation for all households and for low-, medium-, and high-income groups separately.

Estimating the Tax Function

In calculating equation 2 to obtain a predicted tax for nonsmokers, we first applied the ordinary least square method on 34,663 smoker households from 36,336 observations (including the multiple observations for households that consume more than one type of cigarette). The results of the estimation from equation 2 are shown in Table 5. It is clear that per capita household income is significantly positively related to the tax paid per pack by households in the low- and middle-income groups.

Table 5: **Estimated Coefficients of Tax Equation (Ordinary Least Squares Model for Smoker Households) 1999**

Explanatory variables	Full sample			Low Income		
	Coefficients	t value	Sig. level	Coefficients	t value	Sig. level
Constant	−1376.127	−35.68	***	−1733.526	−27.03	***
Per capita income (log)	247.628	55.04	***	290.512	37.82	***
Number of observations	36,336			29,454		
R-squared	0.084			0.0501		
Mean tax per pack	769.5			716.5		
[δtax/tax]/[δIncome/Income][1]	0.32			0.41		
	Middle Income			**High Income**		
	Coefficients	t value	Sig. level	Coefficients	t value	Sig. level
Constant	−790.453	−2.34	**	679.016	1.92	*
Per capita income (log)	187.100	5.16	***	35.879	1.04	
Number of observations	5,389			1,493		
R-squared	0.0057			0.0009		
Mean tax per pack	979.2			1064.0		
[δtax/tax]/[δIncome/Income]	0.19			0.03		

Notes: Dependent variable is excise tax/pack in Rupiah.
1/ Change in tax as income changes (income elasticity with respect to tax) was evaluated at the tax mean value.
*** significant at $p < 0.01$; **significant at $p < 0.05$; *significant at $p < 0.10$

The results of the parameter estimation shown in Table 5 were then used to predict the tax value for nonsmoker households. We assumed that the ability to pay tax is similar for both smoker and nonsmoker households, and used the coefficients estimated for 25,939 observations on smoker households (42% of the total sample of 61,346 households) to predict values for nonsmoker household with similar income and other characteristics.

Estimating the Cigarette Price Function

Nonsmoker households have no price information since they spend nothing on cigarettes, but face similar prices as smoking households. Price equation (1) is used to generate the prices facing nonsmoker households, separately for each income group. Table 6 shows the results of price estimation (equation 1) for smoker households (36,336 observations). For the full sample and the low-income group, most variables are significantly associated with price. For the middle- and high-income groups, the occupation of the household head is not significantly associated with price, nor is education significant for middle-income households, or region significant for the high-income group.

Table 6: Estimated Coefficients of Price Equation in Log (Ordinary Least Squares Model for Smokers) 1999

Explanatory variables	**All households**		**Low Income**		**Middle Income**		**High Income**	
	β	T	β	t	B	t	β	T
Constant	7.076	397.2*	7.10	274.4*	6.94	47.6*	7.45	46.9*
Tax/pack	0.001	221.7*	0.001	201.2*	0.001	72.1*	0.001	39.7*
Ln Income/capita	0.029	14.1*	0.03	7.9*	0.05	3.2*	0.01	0.5
Urban	0.017	7.2*	0.02	6.2*	0.02	3.6*	0.03	2.5**
Household head's type of occupation (dummy variable)								
Blue collar	−0.006	−1.5	−0.01	−1.9**	0.002	0.2	0.01	0.6
White collar	0.012	2.7*	0.01	2.1**	0.01	1.2	0.03	1.6
Proportion of household members by education								
Elementary sch.	0.015	3.6*	0.02	4.3*	−0.01	−1.2	−0.04	−1.8***
Junior high & more	0.004	0.7	0.002	0.36	0.02	1.4	−0.06	−2.7*
Islands (dummy variable)								
Sumatra	−0.023	−4.9*	−0.03	−4.9*	−0.003	−0.3	−0.02	−0.6
Java and Bali	0.033	8.1*	0.04	8.6*	0.02	1.8 ***	−0.01	−0.3
Kalimantan	0.000	−0.1*	0.003	0.6	−0.002	−0.1	−0.02	−0.6
Sulawesi	−0.009	−1.8***	−0.006	−1.3	−0.007	−0.6	−0.03	−1.2
Number of observations.	36,336		29,454		5,389		1,493	
Population size	30,673,169		25,292,715		4,240,189		1,140,265	
R-squared	0.772		0.778		0.683		0.586	
Mean of tax/ pack	769.5		716.5		979.2		1064.0	
(δprice/price)	0.49		0.47		0.58		0.55	
(δtax/tax)								

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

These coefficients are used to predict prices for nonsmoker households. The results of equation (1) are also used in the first part of the estimation of the 2SLS demand model.

Per capita household income and tax values are positively related to household spending on cigarettes for the full sample and for low- and middle-income groups. For all households, a 10 percent increase in income is associated with a 3 percent increase in spending on cigarettes.

The Effect of Tax on Cigarette Price

An increase in tax increases the price of cigarettes. Table 6 shows that a 10 percent increase in tax increases the price of cigarettes by 4.9 percent. For the low-income group, a 10 percent tax increase increases the price of cigarettes by 4.7 percent; for the middle-income group, by 5.8 percent; and for the high-income group, by 5.5 percent. (These differences are because of different types of cigarettes/kreteks smoked, with different tax rates.) If taxes accounted for a larger share of final price, tax increases would have a bigger impact on price (leaving aside manufacturers' decisions on the extent to adjust retail prices in response to a tax increase). In developed countries, the cigarette tax can account for up to 84 percent of the final price (Chaloupka et al. 2000, p. 241). In Indonesia, tax as a percentage of price is 28 percent for all households (see Table 4).

Government policy on cigarette taxes in Indonesia is different from most other countries, in that the government sets tax rates, as well as determining minimum prices for cigarettes to which the tax rates apply. For example, the tax rate for machine-made kreteks produced by medium-scale factories increased from 28 percent in 1998 to 36 percent in 2000. The minimum price also increased from Rp130 in 1998 to Rp165 per stick in 2000 (see Appendices 2.8 and 2.9) or from Rp2080 to Rp2640 per pack (16 pieces).

Other Factors Affecting Cigarette Price

As Table 6 shows, the dummy variable representing urban or rural location has a significant effect on price in each income group that is larger, the higher the income group (low: 0.016; middle: 0.024; high: 0.034). Households in urban areas pay 1.6 to 3.5 percent more for cigarettes than rural households (holding other variables constant). (The value is calculated as $(e^{\text{coefficient}}) - 1$, following Mao et al. 2000.) In the price equation, the education variables describe the highest level of education attained by household members, with no education or incomplete elementary school used as the base category.

In Table 6, there is a positive and significant coefficient for elementary school education for the full sample (0.051), and for low-income households (0.020). This suggests that as education increases, households pay higher price for cigarettes. But for high-income households, there is a negative and significant coefficient for elementary school (-0.039) and for junior high and above education (-0.058). This suggests that within the higher-income households, more educated households pay less for their cigarettes than non-educated high-income households.

Different types of occupation of heads of households show significant differences in the amounts paid for cigarettes. Type of occupation is categorized as white collar, blue collar,

or base (members of armed forces, job seekers, and other workers not classified in other occupations). For households overall, white-collar households paid higher cigarette prices than blue-collar households and base-group households. In the low-income group, white-collar households paid higher prices for cigarettes, followed by the base group, while blue-collar households paid the lowest prices. No significant differences were found in the prices paid by the three occupational types in the middle- and high-income groups.

Looking at regional variations, differences in cigarette prices among the islands in Indonesia were relatively small. Smoker households in Java-Bali paid the most--3.4 percent more than the base group (estimated as ($e^{0.033}$ –1), again following Mao et al. 2000). Smokers in Kalimantan paid the same price as the base group, while smoker households in Sulawesi and Sumatra paid 1 to 2 percent less than the base group. The higher cigarette price paid by households in Java-Bali may indicate that they can afford to pay for more expensive cigarette brands.

Empirical Results of Smoking Participation and Conditional Demand Function

The next step after estimating price equation 1 and tax equation 2 was to estimate a logistic regression (equation 3) to understand the factors influencing smoking participation. We first did a Hausman endogeneity test for the price variable, which showed that price is not endogenous for the full sample of households or for the income groups separately (see Appendices 2.4 and 2.5). So the smoking participation could be estimated using the price variable and other independent variables shown in Table 7.

The results show that the coefficient on the price variable has the expected sign but is not significant for all the income groups. The negative coefficient indicates that higher prices decrease the likelihood of a household including a member who smokes (ie being a smoker household). The effect of price changes on smoking participation can be seen in the results of the simulations presented later in the paper.

A comparison of our study results with the findings of studies carried out using individual level data in China (Mao et al. 2000) and California (Hu et al. 1995) shows that the participation elasticity we estimated for Indonesia is much smaller, suggesting that price has a much smaller effect on the decision to smoke in Indonesia. The effect of price on the individual decision to smoke is estimated at –0.49 in China and −0.33 in California. Our study shows price effects of 0.02 for households overall and 0.03 for the low-income group.

Table 7: Weighted Logistic Models for Smoking Participation by Income Group

(Price exogenous, dependant variable is 1 if smoking household, 0 otherwise)

Explanatory variables	Overall		Low Income		Middle Income		High Income	
	β	t value	β	t value	B	t value	β	t value
Constant	−4.13	−17.3*	−7.75	−25.3*	1.36	1.03	−2.50	−1.35
Log price/pack	−0.02	−0.56	−0.03	−1.12	0.09	1.08	0.20	1.1
Log inc/capita	0.26	14.3*	0.73	24.9*	−0.42	−3.26*	−0.11	−0.94
Proportion of household members:								
Age 0-9	1.70	28.0*	1.89	28.0*	1.33	7.47*	1.59	4.39*
Age 10-14	1.03	13.7*	1.22	14.9*	0.95	4.17*	0.36	0.84
Age 15-24	0.94	16.9*	1.21	18.0*	0.45	3.50*	0.64	2.68*
Age 25-59	0.95	19.6*	1.01	18.3*	0.84	6.94*	0.79	3.44*
Male	1.80	39.6*	1.67	31.1*	2.16	21.07*	2.50	14.57*
Elemen. Edu.	0.62	16.1*	0.53	11.9*	0.56	5.64*	0.52	2.75*
Junior high & above	0.41	7.5*	0.20	3.0*	0.46	4.01*	0.16	0.77
Urban dummy	−0.16	−7.5*	−0.14	−5.8*	−0.25	−4.59*	−0.52	−4.51*
The head of household's type of occupation (dummy variable):								
Blue collar	0.55	16.9*	0.49	13.3*	0.66	8.45*	0.80	5.19*
White collar	0.24	6.9*	0.19	4.6*	0.30	3.82*	0.39	2.73*
Other								
Number of observations	62,275		49,924		9,500		2,851	

Note: Significance of coefficients * $p < 0.01$; ** $p < 0.05$; * ** $p < 0.10$.
The results for a similar regression estimation of smoking participation estimation that assumed that price was endogenous are shown in Appendix 7.

Income and Smoking Participation

As expected, the positive and significant income variable (0.26) suggests that as income increases, the likelihood of smoking participation also increases. An interesting result is that as income increases, the likelihood of smoking participation increases strongly (0.73) for low-income households. However, the coefficient is smaller and negative in sign for middle-income (-0.42) and high-income households (-0.11), and not statistically significant for the high-income group. In other words, rising incomes increase the likelihood of smoking participation among the lowest-income group, but decrease the likelihood among middle-income households (and have little or no effect for high-income households.

Education, Age, and Smoking Participation

Significant and positive coefficients for the education dummy variables show that households with more family members with elementary school education or junior high and above education have a higher likelihood of having a smoker in the household than

households with more members who lack education. This pattern is found for households overall, as well as for each income group.

The expected pattern is evident for household age structure. Significant and positive coefficients for the age variables for households with a high proportion of children in the household (1.70 for 0-9 year olds, and 1.03 for 10-14 year olds) show that the likelihood of having a smoker in households increases as the proportion of children in the household increases. This is not surprising because households with more young children are also likely to include parents aged 25-45, and these young adult males have very high smoking prevalence rates (around 70%).

Price and Cigarette Consumption

Following the methodology recommended by Cragg (1971), the second part of the estimation examines the quantity of cigarettes smoked by households. The model is a conditional demand equation for cigarette consumption, since it includes only smoking households to estimate the factors that determine cigarette consumption. Before running the model, we again applied the Hausman test for possible endogeneity of the price variable. The results are given in Appendices 2.4 and 2.7. The significant coefficient for the price residual shows that price is endogenous for the full sample of households, low-income or middle-income households, but is not endogenous for the sub-sample of high-income households. Therefore, an ordinary least square regression was applied to estimate parameters for high-income households, and a two-stage least square analysis is used for the full sample and the low- and middle-income sub-samples.

The findings show that cigarette consumption is much more sensitive to changes in price than smoking participation. This result differs from the findings of studies done in China (Mao et al. 2000) and California (Hu et al. 1995) that used individual-level data. Those studies found that smoking participation is more sensitive to cigarette price than consumption. This will be discussed in more detail in connection with Table 9.

Table 8 shows that price has a significant effect on the quantity of cigarettes smoked for all households and for each income group. For all households, the conditional price elasticity of demand is –0.6. If cigarette prices increase by 10 percent, then the quantity of cigarettes consumed decreases by 6 percent. The conditional price elasticity of demand is higher for the low-income group (−0.66) than for both the middle-income group (−0.37) and the high-income group (−0.41).[4] If prices rise, smokers from the low-income group are more likely to cut back their consumption than those in the high-income group. Conversely if price falls, they are more likely to increase their consumption. These results are consistent with World Bank (1999, p41), which states that people with lower incomes are more sensitive to price changes.[5]

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[4] Mao et al. (2000) estimated conditional price elasticities of demand between −0.26 and −0.28 for China, using individual level data, and with much higher price elasticities of participation than in our study.

[5] The analysis does not capture substitution from higher price cigarettes to lower priced cigarettes, that may occur.

Table 8: Estimated Coefficient of Conditional Demand Equations, 1999

(Dependent variable is the number of cigarette smoked per month, in log form)

Explanatory variables	Price endogenous		Price endogenous		Price endogenous		Price exogenous	
	Overall		Low Income		Middle Income		High Income	
	β	T	B	t	β	t	β	t
Constant	0.16	1.4	−1.46	−10.2*	1.46	2.3**	3.3	4.2*
Log Predicted Price/pack	−0.60	−42.1	−0.66	−44.7*	−0.37	−8.3*	−0.41	−5.7*
Log income/capita	0.65	68.6*	0.91	67.8*	0.29	4.8*	0.09	1.8***
Proportion of household members by								
Age 0-9	−0.19	− 5.7*	−0.04	− 1.2	−0.59	−6.5*	−0.98	−5.5*
Age 10-14	−0.56	−14.5*	−0.42	−10.1*	−0.89	−7.9*	−0.81	−3.8*
Age 15-24	−0.15	− 4.3*	−0.12	− 3.3*	−0.22	−2.6*	−0.09	−0.6
Age 25-59	0.19	6.2*	0.14	4.1*	0.21	2.7*	0.42	2.9*
Elementary school	0.02	1.2	0.02	0.8	0.01	0.2	−0.12	−1.3
Junior high &above	0.05	1.9***	0.01	0.2	0.001	0.02	−0.04	−0.5
Male	0.27	10.6*	0.08	2.9*	0.73	11.7*	1.07	10.8*
Urban	0.02	2.0**	0.01	0.6	−0.01	−0.2	0.05	0.9
The head of household's type of occupation (dummy variable)								
Blue collar	0.06	3.1*	0.04	1.7***	0.12	2.8*	0.30	3.6*
White collar	0.07	3.9*	0.07	3.1*	0.10	2.3**	0.22	2.9*
Number of observations	36336		29454		5389		1493	
R-squared	0.233		0.2134		0.1141		0.2618	

Note: 1) The estimation for the high-income group uses ordinary least squares (OLS), while 2SLS is used for all other groups and for the full sample. Asterisks indicate the statistical significance of coefficients: * significant at $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$

Non-price Factors

Table 8 shows that for all households, income and the proportion of male members in a household affect the quantity of cigarettes consumed. The positive impact of income on cigarette consumption indicates that cigarettes are a normal good. For the full sample of smoker households, each 10 percent increase in income tends to increase the average quantity of cigarettes consumed by 6.5 percent. Cigarette consumption in low-income households is even more responsive to changes in income. If per capita income per month increases by 10 percent, the average quantity of cigarettes consumed increases by 9.1 percent. For middle-income households, the increase in cigarette consumption is 2.9 percent, and for high-income households, it is only 0.9 percent.

Men are more likely to smoke than women, so the greater the proportion of males in a household, the greater the average cigarette consumption per capita. The effect is

strongest in high-income households, where a 10 percent increase in the proportion of males in household increases the average quantity of cigarettes consumed by 5.5%, compared to 3.6% in middle-income households and less than 1% (0.4%) in low-income households.

The quantity of cigarettes consumed also differs according to the head of household's type of occupation (i.e., blue collar, white collar, base group). For households overall and the low-income group, households whose heads have white-collar occupations smoke the largest number of cigarettes, followed by blue-collar households. For middle-income and high-income groups, blue-collar households consume the largest quantity of cigarettes, followed by white-collar households.

Total Price Elasticity

Using the mean values for smoker households, the price elasticity of smoking participation (Table 7), and the price elasticity of cigarette consumption (Table 8), we calculated the total price elasticity to be −0.61 (Table 9). This means that a 10 percent increase in cigarette price will lead to a 6.1 percent decrease in cigarette consumption. Our result is slightly larger than found in the studies using individual-level data conducted by Mao et al. (2000) for China (−0.52) and Hu et al. (1995) for California (−0.46). Our results by income group show that the low-income group is much more price sensitive than the other two groups. Total price elasticity for the low-income group is –0.67, about twice the estimated price elasticity of –0.31 for the high-income group and –0.33 for the middle-income group.

Table 9: Price Elasticity by Income Group

	Total	Income group		
		Low	Middle	High
Elasticity of smoking participation[1]	−0.016	−0.034	0.088	0.196
Conditional price elasticity of demand[2]	−0.600	−0.659	−0.370	−0.410
Household smoking prevalence	57.9	55.6	50.8	57.2
Total price elasticity	−0.61	−0.67	−0.33	−0.31

Note: 1) not significant
2) significant at $p < 0.01$

Almost all (98.6 percent) of the total price elasticity was contributed by the effect of changes in price on the quantity of cigarette consumed by smoker household. The rest (1.4 percent) was contributed by the effect of price on decisions to smoke or not ("participation"). Although price had the expected negative sign for both participation and consumption, the small and insignificant coefficient for participation indicates that higher prices would show their impact through influencing households to smoke fewer cigarettes, rather than by encouraging smokers to quit or deterring new smokers from starting.

This finding is contrary to studies by Lewit and Coate (1982) and Wasserman et al (1991) that used individual data. They found that changes in quantity smoked accounted for one-third of the total change in cigarette consumption, while the decision to quit smoking accounted for two-thirds of the change. Hu et al. (1995) found approximately equal effects on total cigarette consumption caused by changes in the quantity smoked and decisions to participate or quit smoking, with price coefficients in both equation of −0.26. Mao et al. (2000) found a similar pattern for individuals in China, where total price elasticity was –0.525, with the effect on quantity of cigarettes being –0.280 and on participation –0.245.

The difference between this study and the other studies cited may be due to the difference in the unit of observation. This study analyzes smoking behavior using per capita household data; the unit of observation is the household, with no clear identification of which members of the household are smokers or nonsmokers. If two people in a household are smokers, and one of them quits, this does not change the status of the household as a smoker household, although it does affect the quantity of cigarettes consumed by the household. Our model would register no change in participation unless all smokers in the household quit. Although this is a drawback in some ways, from another perspective, it is desirable to use the household as the unit of analysis. Smoke-free households are beneficial to household members (in addition to the benefits that individuals themselves enjoy from not smoking). A smoke-free household means that children and other non-smoking household members are not exposed to second-hand smoke at home. Data from California suggest that smoke-free homes provide a supportive environment that helps ex-smokers to not relapse (Gilpin et al. 1999). This makes it important to understand the factors that help promote smoke-free homes.

Total Income Elasticity

As with total price elasticity, total income elasticity of demand indicates the response of changes in the quantity of cigarettes consumed to changes in income, adding the effects of changes in income on the probability of households smoking status changing, and on the quantity of cigarettes that smoker households consume.

Table 10 shows that an increase in income will increase the average quantity consumed by all households and by each income group. This indicates that cigarettes are what economists call “a normal good”. Low-income groups are highly responsive to changes in income, high-income groups are fairly unresponsive. For all households, a 10 percent increase in income increases the average quantity of cigarettes consumed by 7.6 percent. For low-income households, the increase is 12.2 percent. For the middle- and high-income households, the increases are 1.0 and 0.4 percent respectively. Compared with the study conducted in China (Mao et al. 2000), our data show greater increases in the quantity of cigarettes smoked in response to increases in income. In China, a 10 percent increase in income is associated with a 1.4 percent increase in the quantity of cigarettes smoked.

Table 10: Income Elasticity by Income Group

	Total	Income group		
		Low	Middle	High
Elasticity of smoking participation[1]	0.264	0.725	−0.421	−0.111
Conditional income elasticity of demand[2]	0.649	0.912	0.290	0.092
Household smoking prevalence	57.20	57.87	55.55	50.83
Total income elasticity of demand	0.76	1.22	0.10	0.04

Notes: 1) Coefficients for all households, low-income, and middle-income households are significant at $p<0.01$; the coefficient for the high-income group is not significant.
2) Overall, low income, and middle income are significant at $p<0.01$; high income is significant at $p<0.1$.

Simulations

Price is the single most effective variable that can be used in tobacco control policy. In this section, we describe simulations that model the effect that price increases would have on household smoking prevalence and on cigarette consumption by smoking households. We took as the starting point, or basis for comparison for the simulations, a household prevalence rate of 60%, average cigarette consumption of 11 packs/household/month and an average price of a pack of 16 cigarettes of Rp. 2,725, using the weighted data set (Appendix 3).

The coefficients shown in Table 7 for the smoking participation equation were multiplied by the mean values of all variables (Appendix 2) to generate household smoking prevalence. We increased price by 10 percent, 50 percent, and 100 percent to show the effects on household smoking prevalence (participation), assuming that other variables remain constant (and assuming no change in smuggling or illegal purchases of cigarettes). The very small effect of price on household smoking participation (Table 11) suggests that cigarette price increases will do little by themselves to encourage households to become "smoke free".

Table 11: The Impact of Price Increase on Household Smoking Prevalence

Impact of Price Increase		Price Increase (%)		
	Baseline Price	10	50	100
Household smoking prevalence	60.22	60.18	60.03	59.84
Number of smoker households	37,500	37,477	37,384	37,268
% of households that stop smoking		0.1	0.3	0.62

Source: Authors' estimates

Cigarette excise tax can be used to bring about an increase in cigarette price. The study estimated the tax elasticity with respect to price as being 0.49, which means that a 10 percent increase in tax would result in a 4.9 percent increase in average cigarette prices. Table 12 shows that a 10 percent increase in the cigarette excise tax that increases

cigarette prices by 4.9 percent would raise the average price from Rp2,725 per pack to Rp2,860 per pack. With a total price elasticity of demand of –0.61, a 4.9 percent price increase could result in a 3 percent decrease in total cigarette consumption; that is, from 2.7 packs/capita/month or 11.02 packs/household/month to 2.6 packs/capita/month or 10.69 packs/household/month (assuming 4.15 members per household and including nonsmoker households with 0 consumption). The quantity consumed decreases, but because of the increase in price, the total expenditure on cigarettes per household increases. This increases the share of cigarette consumption in total household expenditures slightly from 4.55 percent to 4.63 percent. The impact of tax changes on price changes and price changes on cigarette consumption in this study are slightly bigger than those estimated by de Beyer and Yürekli (2000). Using aggregate data for Indonesia for 1980 to 1995, they estimated price elasticity of demand at −0.51, and that a 10 percent increase in tax would cause an increase in price of over 3 percent, which in turn, would decrease cigarette consumption by nearly 2 percent.

Table 12: The Impact of Tax Increases on Cigarette Consumption, Household Expenditure, and Cigarette Excise Tax Revenue

		Simulation (effect of tax increase)		
Tax increase (%)	Base values	10	50	100
Price increase (%)		4.94	24.72	49.44
Consumption decrease (%)		−3.00	−15.00	−29.99
Price per pack (rupiah)	2,725	2,860	3,399	4,073
Tax per pack (rupiah)	770	846	1154	1539
Consumption (packs per capita)	2.658	2.58	2.26	1.86
Consumption (packs per household)	11.02	10.69	9.37	7.71
Expenditure per capita (rupiah)	7,245	7,375	7,681	7,580
Expenditure per household (rupiah)	30,032	30,571	31,838	31,419
HH expenditure on tobacco products as a % of total HH income	4.55	4.63	4.83	4.76
Tax revenue per household (rupiah)	8,500	9,000	10,800	11,900
Revenue change (%)		6.7	27.5	40.0

Notes: The percentage effect on price of the increase in tax: E_t =0.494
Total price elasticity of demand, E_D: −0.61. Number of household members: 4.15 per HH
Average monthly household income: Rp659,702
Equations: (P is price, C is consumption, EXT is expenditure)

$P_1 = P_0 * \{1+ (E_t * T/100)\}$ where T is a percentage change in tax

$C_1 = C_0 * \{1+ (E_D * X/100)$ where X is a percentage change in price

$EXP_1 = Co*Po *(1+ E_t* T/100) * (1+ E_D * X/100)$

A 50 percent increase in cigarette excise tax would increase cigarette prices by 24.7 percent to Rp3399 per pack. Cigarette consumption would decrease by 15 percent, dropping to 2.26 packs/capita/month or 9.37 packs/household/month. The share of cigarette expenditures in total household income would increase from 4.55 percent to 4.83 percent. A 100 percent increase in the cigarette excise tax would increase the price of cigarettes by 49.4 percent, which would result in a 30 percent decrease in cigarette

consumption. Cigarette expenditure would increase from 4.55 to 4.76 percent of total household income, a slightly smaller increase than the 50 percent increase in tax. The greater the increase in household expenditure for cigarettes, the greater the shift in the allocation of resources from non-cigarette expenditures to cigarette expenditures.

Substitution effects

The model aggregates over all cigarette and kretek consumption in a household, and does not estimate demand separately for different types or brands of cigarettes and kreteks, nor does it estimate "cross-price effects", that is, the effect that a price increase in one type of product will have on the demand for other types of products. Prices vary considerably, so it is to be expected that if prices rise, some consumers may switch to cheaper products. To the extent that this happens, the reduction in total consumption will be less. It is not possible, a priori, to know what the effect of substitution will be on the extent to which higher taxes raise total tax revenues. In order to estimate this, separate demand equations would have to be estimated for different types of cigarettes/kreteks (with different levels of tax), in which the prices of the other potential substitute tobacco products are included in the equations. This analysis could not be done with the Susenas data used for this study. This limitation of the study undermines the likely precision of the simulations of tax revenue changes, but empirical evidence across many countries suggests that the substitution effects are unlikely to be so large as to affect the qualitative results of the simulations (that a tax rate increase will increase total revenues).

Taxation and Government Revenue

Cigarettes generate significant revenue for Indonesia. Due to the inelastic price elasticity of cigarette demand (and relatively small share of tax in the retail price), an increase in the cigarette excise tax that raises prices would reduce cigarette consumption, but would also increase government tax revenue. Based on the simulation analysis, increases in tax per pack of 10%, 50% and 100% would increase government revenues by 6.7%, 27.5% and 40% respectively. These results suggest that the government need not fear that total tax revenue would fall at higher tax rates, despite the reduced cigarette consumption that would result from increased cigarette prices and taxes. A policy of increasing taxes and cigarette prices would help reduce cigarette consumption at the same time as boosting government tax revenue.

3. SUMMARY AND POLICY IMPLICATIONS

Summary

According to the 1999 National Socio-Economic Survey with 60,602 household observations, 57.2 percent of households in Indonesia included at least one smoker. The proportion was highest among low-income households (57.9 percent).

Average cigarette consumption was 4.32 packs/capita household/month, and the average household expenditure for cigarettes was 6.2 percent of total household income per month. The low-income group had the lowest average consumption at 3.9 packs/capita household/month. The middle-income group had an average consumption of 6.2 packs/capita household/month, and the high-income group, 7.8 packs/capita household/month. Although the low-income group had the lowest average consumption, it spent the highest percentage of total household income on cigarettes: 7.24 percent, compared to 5.5 percent for the middle-income group, and 3.0 percent for the high-income group.

The estimated average price of cigarettes was Rp2725 per pack (16 pieces). The higher the income group, the higher the cigarette price they paid. The cigarette price a household paid was also determined by its socio-economic status, regional differences, and the amount of tax included in the retail price of cigarettes. Households with heads having white-collar occupations paid higher prices than households whose heads had blue-collar occupations. Households residing in urban areas paid higher price than households in rural areas. Households located in Java paid the highest prices for cigarettes.

Tax and Cigarette Consumption

Cigarette excise tax is not only useful for generating government revenue; it can also be used as an instrument to manipulate cigarette prices to reduce consumption. A 10 percent increase in cigarette excise tax would increase the average price of cigarettes by 5 percent (although this could change if cigarette manufacturers decided to increase prices by more than, or less than the full amount of a tax increase).

Simulations of the effects of increasing the tax on cigarettes by 10, 50, and 100 percent suggested that cigarette prices per pack would increase by 4.94, 24.7, and 49.4 percent respectively. These increases would, in turn, reduce the quantity of cigarettes consumed from 2.66 packs/capita household/month to 2.58, 2.26, and 1.86 packs/capita household/month respectively. In other words, consumption would decrease by 3 percent, 15 percent, and 30 percent, respectively. Household expenditures on cigarettes as a percentage of total household income would increase from 4.55 to 4.63 percent, 4.83 percent, and 4.76 percent for tax increases of 10, 50, and 100 percent respectively, if we assume no significant switching among different types of products with different price and tax levels.

Price and Cigarette Consumption

Policy makers could use tobacco prices to reduce average cigarette consumption in Indonesia. This study found that a 10 percent increase in the price of cigarettes reduces cigarette consumption by 6.1 percent. The lower the income group, the more responsive they are to price increases. The total price elasticity is –0.67 for the low-income group, compared to –0.33 for the middle-income group and –0.31 for the high-income group.

In general, price increases affect household smoking participation (i.e., households change from being smokers to being nonsmokers—they quit smoking), and also the average quantity of cigarettes smoked. This study found that price increases, by themselves, would have very little effect on the number of households in Indonesia that include at least one smoker, but would have a significant effect on the quantity of cigarettes consumed.

Changes in income also affect cigarette consumption. Increases in income increase the average quantity of cigarettes consumed per household through increases in both household smoking participation and the quantity of cigarettes smoked. A 10 percent increase in income increases the average quantity of cigarettes consumed by 7.6 percent. Of this, 6.5 percent is attributable to an increase in the quantity of cigarettes consumed; and 1.1 percent is attributable to an increase in household smoking participation.

The low-income group is very responsive to increases in income. For that group, a 10 percent increase in income increases average cigarette consumption by 12.2 percent. Of this, 9.1 percent is attributable to an increase in the quantity of cigarettes smoked; 3.1 percent is attributable to an increase in smoking participation. Households in middle- and high-income groups are not very responsive to increases in income.

Smoking Participation and Intensity

Smoking participation is affected by a number of factors. Compared with rural households, urban households have a lower rate of smoking participation. Social and economic status also proved to have a significant influence on smoking participation. Households having heads with blue-collar occupations have a higher rate of smoking participation than those with white-collar occupations.

Education is another factor in smoking participation. An increase in the proportion of household members with elementary and junior high school or above tends to increase the likelihood that one or more of the members of a household smoke. The greater the proportion of household members with elementary education, the greater the likelihood that the household will include one or more smokers. The age composition of households also matter. Households with the highest proportion of members younger than 10 years old have the highest smoking participation rate.

The study also found that factors determining smoking participation influence the quantity of cigarettes smoked. These factors include the head of household's type of occupation, whether the household was in an urban or rural area, and the proportion of household members who are males. The largest quantity of cigarettes smoked is found in households where a high proportion of members are 25–29 years old.

Policy Implications

It has been proved in many countries that increasing the cigarette excise tax is an effective policy for reducing tobacco consumption. In Indonesia, however, changes to the cigarette excise tax are controversial because this tax contributes a relatively large portion of government income, as well as providing incentives for labor-intensive cigarette manufacturing. Many governments, including Indonesia's, are very cautious about increasing cigarette taxes/prices as a policy for reducing cigarette consumption, mainly because they are afraid of losing government revenues and jobs.

This study has determined that government tax revenue would increase and cigarette consumption would decrease if the price (including tax) of cigarettes increased. But the policy to increase cigarette taxes should be implemented carefully. We found that higher prices for cigarettes would slightly increase the share of income devoted to expenditures on cigarettes, for a large range of increases. However, very high price increases would start to reduce the share of total household income allocated to cigarettes, by having a stronger impact in reducing consumption.

The reason for seeking to reduce cigarette consumption is of course the very high risks to the health of smokers and those around them caused by smoking. Lower consumption of cigarettes thus brings gains in health outcomes and life expectancy, and possible savings in health care costs. On the other hand, lower cigarette consumption could negatively impact people whose livelihoods largely depend on manufacturing (employees), growing (farmers), and selling (retailers) tobacco and tobacco products. Therefore, for substantial excise taxes, other policies that provide safety nets to those negatively affected should be considered.

Anti-smoking campaigns should be targeted at specific groups, such as blue-collar households and low-income groups. Households whose head worked in a white-collar job paid higher prices for cigarettes, were slightly less likely to smoke, but if they did, tended to smoke more cigarettes per month. Targeted education efforts would be needed to inform households about smoking hazards and the benefits to the family of smoke-free homes.

Increases in income increase willingness and ability to pay for cigarettes. The low-income group is more responsive to increases in income than the middle- and high-income groups. For smoker households, increases in income increase the quantity of cigarettes smoked (conditional price elasticity of demand). This response is highest for the low-income group. Therefore, increases in income in the low-income group should be

accompanied by greater efforts to provide information on the health consequences and costs of smoking for smokers and their families (second-hand smokers). The information should include a discussion on alternative spending patterns that reflect healthier choices for the family.

As the proportion of young people in a household increases, the likelihood of having a smoker in a household increases. The higher likelihood of smoking participation of households with many children could be because these households are highly likely to include an adult male in prime working age, the group with the highest prevalence, but could also reflect smoking by young household members. Parents should be aware of the negative effects of tobacco use, especially when tobacco use begins at a young age. Anti-smoking policies should also focus on young people, even before they are 10 years old, because many smokers become addicted at a very young age. Young people may not make carefully informed decisions that properly take risk into account, when deciding whether to smoke, and often are poorly informed as to health risks and the addictiveness of tobacco products. Many countries have regulations that prohibit cigarette sales to people under-18, and ban vending machines and sales of individual cigarettes, since these make cigarettes more accessible to children. This would signal to parents and children that smoking is not good for health and make it harder for children to get cigarettes. In Indonesia, many parents ask their children to buy cigarettes for them. Regulations to forbid selling cigarettes at stalls or kiosks near schools would also help. Effective channels should be used to provide smokers and their families with information and education about the health hazards of smoking.

This study has shown that price alone is not enough to influence households to stop smoking in Indonesia. But increasing cigarette prices is an effective instrument for reducing the average quantity of cigarettes consumed. Low-income households spend the highest share of total household income on cigarettes, at 7.2 percent. If policies were to reduce the quantity of cigarette smoked and promote smoke-free households, especially among the low-income group, alternative spending patterns could result in better health and family well-being.

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Appendix 1: Method of calculation of variables

Variables	Description	Method of Calculation
Price	Cigarette price for each type per pack of 16 pieces. Price of each type of cigarette consumed by household treated as one observation.	$\frac{\text{Total expenditure for cigarette per week x 16}}{\text{Quantity of cigarettes consumed (in piece) per week}}$ Notes: - Questions on expenditure and quantity of cigarette are expressed in terms as one week before the survey - Price of each type of cigarette is calculated using the above 16 denotes the number of cigarettes in one pack
Income	Per capita household income per day.	Annual household income (in rupiah) 12 x 30 x household member Notes: - Household income includes earning from wage/salary (in money or in kind) from farming (food and non-food agriculture) and from non-farm activities, and other income - 12 denotes the number of months in a year - 30 denotes the number of days per month
Consumption	Cigarette consumption by type of cigarette (filtered, unfiltered, and white) in Pack/capita household/month Per capita household/month/pack of 16 pieces. household with member(s) who smoke(s) any type of cigarette is counted as one observation.	= Quantity of cigarette consumed per household per week x 30/7x 16 Household member Notes: - Questions on quantity of cigarette consumed is denoted in pieces per week - 30/7=4.29 denotes that in one month there is 4.29 weeks - Quantity of cigarette consumed by each type of cigarette is calculated using the above formula (computed for each type of cigarette) - In inferential analysis (logistic and OLS), it is assumed that behavior of each type of cigarette consumption is similar. If a household consume 2 types of cigarette, it is treated as 2 observations
Tax	The value of cigarette tax per pack in Rupiah.	Price per pieces x $\frac{\text{tax rate (in percent)}}{100}$ x 16 Note: Price per pieces = $\frac{price}{16}$ Tax is applied on per piece price of cigarette. The rate is based on Table 2.1

Appendix 2: Variable values, all households (unweighted data)

	Overall		Low income		Middle income		High income	
	Mean	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*
Household smoker (prevalence)	0.57	0.00	0.58	0.00	0.56	0.01	0.51	0.01
Cig. Cons. /pack/household	11.02	0.06	10.47	0.06	13.11	0.18	13.72	0.38
In Cig con/pack/capita	2.66		2.43		3.73		4.17	
Price/pack (Rp)	2,725.48	5.74	2,609.48	6.22	3,173.38	14.50	3,409.84	26.26
Tax paid per household[1)]	1,918.01	12.51	1,662.97	12.00	2,867.89	42.64	3,223.83	91.31
Ln Income/capita	8.58	0.00	8.34	0.00	9.34	0.00	10.17	0.01
Urban area	0.42	0.00	0.35	0.00	0.67	0.00	0.77	0.01
Male	0.49	0.00	0.49	0.00	0.50	0.00	0.52	0.01
Proportion of household members by education								
Junior high & above	0.25	0.00	0.26	0.00	0.20	0.00	0.16	0.00
Elementary school	0.12	0.00	0.11	0.00	0.15	0.00	0.14	0.00
Uneducated (base)								
Head of household's occupation (dummy variable)								
White collar	0.25	0.00	0.20	0.00	0.43	0.01	0.55	0.01
Blue collar	0.63	0.00	0.69	0.00	0.40	0.01	0.30	0.01
Proportion of household members by education								
Age 0-9	0.17	0.00	0.19	0.00	0.12	0.00	0.09	0.00
Age 10-14	0.09	0.00	0.10	0.00	0.06	0.00	0.05	0.00
Age 15-24	0.19	0.00	0.18	0.00	0.22	0.00	0.20	0.01
Age 25-59	0.44	0.00	0.42	0.00	0.50	0.00	0.56	0.01
Household size	4.15	0.01	4.31	0.01	3.52	0.02	3.29	0.04
Number of observations	60,602		48,591		9,249		2,762	

Note : unweighted data. 1) Nonsmoker households do not buy any cigarettes and therefore pay no tobacco excise taxes.

Appendix 3: Variable values, smoker households (unweighted data)

Description	Overall		Low income		Middle income		High income	
	Mean	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*
Smoker Household	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Cigarettes bought packs/capita/month	4.60	0.02	3.99	0.02	6.86	0.08	9.54	0.27
Price/pack (Rp)	2696.17	5.84	2589.95	6.26	3145.77	15.66	3380.41	27.52
Price/pack (log)			7.79	0.00	8.00	0.01	8.08	0.01
Price predicted (log)	7.83	0.00	7.79	0.00	8.00	0.00	8.08	0.01
Tax/pack (Rp)	742.91	2.81	693.60	3.04	956.18	7.21	1043.54	12.87
Income/capita/day (log)	8.56	0.00	8.35	0.00	9.34	0.00	10.16	0.01
Urban area	0.38	0.00	0.33	0.00	0.61	0.01	0.69	0.01
Male	0.53	0.00	0.52	0.00	0.55	0.00	0.60	0.01
Proportion of household members by education								
Elementary school	0.28	0.00	0.29	0.00	0.23	0.00	0.18	0.01
Junior high school & above	0.12	0.00	0.11	0.00	0.16	0.00	0.14	0.01
Head of household's occupation (dummy variable)								
White collar	0.23	0.00	0.19	0.00	0.41	0.01	0.52	0.01
Blue collar	0.69	0.00	0.74	0.00	0.48	0.01	0.38	0.01
Proportion of household members by age								
Age 0-9	0.18	0.00	0.20	0.00	0.13	0.00	0.10	0.00
Age 10-14	0.10	0.00	0.10	0.00	0.07	0.00	0.05	0.00
Age 15-24	0.19	0.00	0.18	0.00	0.20	0.00	0.19	0.01
Age 25-59	0.46	0.00	0.44	0.00	0.53	0.00	0.59	0.01
Household size	4.44	0.01	4.59	0.01	3.79	0.03	3.50	0.05
No. of observations	36336		29454		5389		1493	

Appendix 4: Variable values, all observations (weighted data)

	Overall		Low income		Middle income		High income	
Mean	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*	*Mean*	*Std. Err.*
Household smoker	0.60	0.00	0.60	0.00	0.58	0.01	0.53	0.01
Cigarette Cons./ pack/ /capita/month	2.75	0.02	2.41	0.01	4.00	0.06	5.07	0.17
Price/pack (Rp)	2696.17	5.84	2589.95	6.26	3145.77	15.66	3380.41	27.52
Price/pack (log)	7.83	0.00	7.78	0.00	7.99	0.00	8.11	0.00
Predicted Price/pack (log)	7.83	0.00	7.78	0.00	7.99	0.00	8.11	0.00
Tax/pack(Rp)	739.91	1.74	685.49	1.87	949.44	4.21	1090.47	7.07
Income/capita/day (Rp)	6485.36	27.64	4452.20	8.32	11635.11	26.63	28655.84	337.59
Income/capita/day (log)	8.55	0.00	8.32	0.00	9.34	0.00	10.17	0.01
Urban area	0.39	0.00	0.33	0.00	0.65	0.01	0.75	0.01
Male	0.49	0.00	0.49	0.00	0.50	0.00	0.51	0.01
Proportion of household members by education								
Elementary school	0.26	0.00	0.27	0.00	0.21	0.00	0.16	0.01
Junior high & above	0.11	0.00	0.11	0.00	0.15	0.00	0.14	0.00
Head of household's occupation (dummy variable)								
White collar	0.24	0.00	0.20	0.00	0.42	0.01	0.53	0.01
Blue collar	0.64	0.00	0.70	0.00	0.41	0.01	0.31	0.01
Proportion of household members by age								
Age 0-9	0.17	0.00	0.18	0.00	0.12	0.00	0.09	0.00
Age 10-14	0.09	0.00	0.10	0.00	0.06	0.00	0.05	0.00
Age 15-24	0.18	0.00	0.18	0.00	0.22	0.00	0.20	0.01
Age 25-59	0.44	0.00	0.43	0.00	0.50	0.00	0.56	0.01
Household size	4.13	0.01	4.28	0.01	3.51	0.02	3.30	0.04
Number of obs.	62275		49924		9500		2851	

Appendix 5: First stage Hausman test (predicting price variable) and 2SLS estimation.
(log price is regressed against other independent variables and tax variable, 1999)

	Overall		Low		Middle		High	
	β	*t value*	B	*t value*	β	*t value*	β	*t value*
Constant	7.076	702.4*	7.100	485.9*	6.942	81.8*	7.452	95.9*
Tax value	0.001	228.1*	0.001	206.9*	0.001	75.0*	0.001	41.2*
Income/capita (log)	0.029	22.7*	0.025	13.2*	0.049	5.4*	0.008	1.0
Urban	0.017	12.0*	0.016	10.3*	0.024	5.9*	0.034	4.3*
Head of household's occupation (dummy variable)								
Blue collar	-0.006	-3.2*	-0.009	-4.4*	0.002	0.5*	0.010	1.3
White collar	0.012	5.8*	0.010	4.3*	0.011	2.6*	0.026	4.2*
Other (base)								
Proportion of household members by education								
Elementary school	0.015	6.2*	0.020	7.5*	-0.013	-2.1**	-0.039	-3.4*
Junior high &above	0.004	1.3*	0.002	0.6*	0.020	2.6*	-0.058	-5.1*
Islands (dummy variable)								
Sumatra	-0.023	-9.8*	-0.025	-9.6*	-0.003	-0.5	-0.015	-1.1
Java and Bali	0.033	17.9*	0.039	19.2*	0.020	3.7*	-0.006	-0.5
Kalimantan	0.000	-0.2*	0.003	1.3*	-0.002	-0.3*	-0.015	-1.2
Sulawesi	-0.009	-3.7*	-0.006	-2.6*	-0.007	-1.1*	-0.034	-2.4**
Number of obs.	62275		49924		9500		2851	
R-squared	0.790		0.7886		0.6859		0.5895	

* $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$

Appendix 6: Second Stage Hausman Test, using price residual (from Appendix 5) as independent variable to test price endogeneity.
Dependent variable =1 if smoking household, 0 otherwise.

	Overall		Low		Middle		High	
	β	*t value*	B	*t value*	β	*t value*	β	*t value*
Constant	-4.201	-16.0*	-7.77	-23.9*	0.799	0.6	-3.196	-1.4
Price/ pack (log)	-0.005	-0.2	-0.03	-0.9	0.172	1.7***	0.287	1.2
Price/pack residual	-0.041	-0.7	-0.02	-0.3	-0.246	-1.4	-0.206	-0.5
Income/capita (log)	0.262	14.1*	0.72	24.8*	-0.432	-3.4*	-0.114	-1.0
Proportion of household members by age								
Age 0-9	1.697	28.0*	1.87	27.9*	1.326	7.5*	1.587	4.4*
Age 10-14	1.028	13.7*	1.22	14.9*	0.953	4.2*	0.367	0.9*
Age 15-24	0.943	16.9*	1.21	18.0*	0.445	3.5*	0.641	2.7*
Age 25-59	0.954	19.6*	1.01	18.3*	0.839	6.9*	0.781	3.4*
Area (dummy variable)								
Urban	-0.160	-7.5*	-0.14	-5.8*	-0.260	-4.7*	-0.527	-4.5*
Head of household's occupation (dummy variable)								
Blue collar	0.546	16.9*	0.49	13.3*	0.666	8.5*	0.800	5.2*
White collar	0.244	6.9*	0.19	4.6*	0.295	3.8*	0.384	2.7*
Proportion of household members by education								
Elementary school	0.619	16.05*	0.53	11.9*	0.565	5.7*	0.527	2.8*
Junior high & above	0.410	7.47*	0.20	2.9*	0.460	4.0*	0.165	0.8*
Proportion oh household members by sex								
Male	1.797	39.64*	1.67	31.1*	2.161	21.1*	2.495	14.6*
Number of obs.	62275		49924		9500		2851	

The result show that price is not endogenous in overall and by income group

* $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$

Appendix 7: Estimated smoking participation, assuming price is endogenous

	Overall		Low		Middle		High	
	β	*t value*	β	*t value*	β	*t value*	β	*t value*
Constant	-4.20	-16.0*	-7.77	-23.9*	0.80	0.6	-3.19	-1.4
Log Predicted Price/pack	-0.01	-0.2	-0.03	-0.9	0.17	1.7**	0.29	1.2
Per capita income (log)	0.26	14.1*	0.72	24.8*	-0.43	-3.4*	-0.11	-1.0
Proportion of household members by age								
Age 0-9	1.69	28.0*	1.86	27.9*	1.32	7.5*	1.59	4.4*
Age 10-14	1.03	13.7*	1.22	14.9*	0.95	4.2*	0.37	0.9
Age 15-24	0.94	16.9*	1.21	18.0*	0.44	3.5*	0.64	2.7*
Age 25-59	0.95	19.6*	1.01	18.3*	0.84	6.9*	0.78	3.4*
Area (dummy variable)								
Urban	-0.16	-7.5*	-0.14	-5.8*	-0.26	-4.7*	-0.53	-4.5*
Rural (base)								
Head of household's occupation (dummy variable)								
Blue collar	0.55	16.9*	0.49	13.3*	0.67	8.5*	0.80	5.2*
White collar	0.24	6.9*	0.19	4.6*	0.30	3.8*	0.38	2.7*
Proportion of household members by education								
Elementary school	0.62	16.1*	0.53	11.9*	0.57	5.7*	0.53	2.8*
Junior high & above	0.41	7.5*	0.20	2.9*	0.46	4.0*	0.17	0.8*
Proportion of household members by sex								
Male	1.80	39.6*	1.67	31.1*	2.16	21.1*	2.49	14.6*
Female (base)								
Number of observations	62275		49924		9500		2851	

* $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$

Appendix 8: Second stage Hausman test for endogeneity of price variable using price residual as independent variable from Appendix 5 for conditional demand equation.

	Overall		Low		Middle		High	
	β	*t value*	β	*t value*	β	*t value*	β	*t value*
Constant	0.13	1.1	-1..50	-10.0*	1.41	2.2**	3.68	3.8*
Price/pack (log)	-0.60	-42.0*	-0.66	-44.4*	-0.38	-8.5*	-0.46	-4.6*
Price residual	-0.19	-6.7*	-0.17	-5.5*	-0.27	-3.6*	0.10	0.7
Income/pack (log)	0.65	69.6*	0.92	69.6*	0.30	5.0*	0.09	1.8***
Proportion of household members by age								
Age 0-9	-0.15	-4.5*	-0.01	-0.3	-0.49	-5.5*	-0.97	-5.4*
Age 10-14	-0.53	-13.8*	-0.39	-9.6*	-0.79	-7.1*	-0.81	-3.8*
Age 15-24	-0.13	-3.9*	-0.11	-3.1*	-0.19	-2.3*	-0.09	-0.6
Age 25-59	0.19	6.4*	0.14	4.1*	0.24	3.2*	0.43	3.0*
Area (dummy variable)								
Urban	0.02	2.0**	0.01	0.5	-0.01	-0.2	0.05	1.0
Head of household's occupation (dummy variable)								
Blue collar	0.05	2.7*	0.03	1.6	0.10	2.5**	0.30	3.6*
White collar	0.07	3.6*	0.06	2.9*	0.09	2.0**	0.22	2.9*
Other (base)								
Proportion of household members by education								
Elementary school	0.03	1.4	0.02	1.0	0.02	0.4	-0.13	-1.4
Junior high & above	0.05	2.1**	0.01	0.3	0.01	0.2	-0.04	-0.5
Proportion of household members by sex								
Male	0.265	10.8*	0.08	3.0*	0.73	11.9*	1.07	10.8*
Number of obs	36336		29454		5389		1493	
Population size	30673169		25292715		4240189		1140265	

The estimation for the high-income households uses the regular price variable not the predicted price variable.

The results show that price is not exogenous in the full sample, low-income and middle-income groups; and price is not endogenous in for the high-income group.

* $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$

Appendix 9: Minimum cigarettes retail prices and excise tax rates, 1998

(Director General of Customs and Excise DECREE No. KEP-27/BC/1998)

Type of Tobacco product	Total annual Production (stick)	Manufacturer Classification	Minimum Retail Price in Rupiah/stick	Excise tax rate (%)
SKM	> 5.0 billion	Large	175	36
	> 2.5 - 5.0 billion	Medium	130	28
	> 1.0 - 2.5 billion	Medium - small	120	24
	> 0.0 - 1.0 billion	Small	85	20
SKT	> 5.0 billion	Large	120	16
	> 2.5 - 5.0 billion	Medium	80	8
	> 0.0 - 2.5 billion	Small	60	4
	> 0.0 - 15.0 million	Very small	45	2
KLB/KLM	> 5.0 billion	Large	100	8
	> 2.5 - 5.0 billion	Medium	80	6
	> 0.0 - 2.5 billion	Small	60	2
	> 0.0 - 15.0 million	Very small	45	1
SPM	Packaging	Retail price		
	Hard pack	35		
	Soft pack	30		
		Price > 125		38
		95 < price < 125		34
		50 < price <- 95		26
		30 < price < 50		20

Source: Commercial Advisory Foundation in Indonesia (CAFI) in USDA

Note:

- The Classification and Excise Tax Rate on Tobacco Products is from Minister of Finance decree No. 118/KMK.05/1998
- The minimum unit price is from Director General of Customs and Excise Decree No. kep-27/BC/1998

Appendix 10: Excise tax rates and minimum retail prices for tobacco products produced in Indonesia, 2000

(Minister of finance decree no. 89/kmk.05/2000)

Type of Tobacco Product	Manufacturer Classification	Retail Price Minimum Per stick/grm	Retail Price Maximum Per stick/grm	Excise Tax rate %
SKM-Sigarette Kretek Mesin	Large scale	Rp. 250.00	Free	40
(Machine-rolled clove cigarette)	Medium scale	Rp. 250.00	Free	38
	Medium scale	Rp. 165.00	Rp. 245.00	36
	Small scale	Rp. 250.00	Free	36
	Small scale	Rp. 165.00	Rp. 240.00	34
	Small scale	Rp. 120.00	Rp. 160.00	28
SKT-Sigarette Kretek tangan	Large scale	Rp. 165.00	Free	20
(Hand-rolled clove cigarette)	Medium scale	Rp. 165.00	Free	18
	Medium scale	Rp. 110.00	Rp. 160.00	16
	Small scale	Rp. 165.00	Free	16
	Small scale	Rp. 110.00	Rp. 160.00	14
	Small scale	Rp. 80.00	Rp. 105.00	12
	Very small scale	Rp. 65.00	Rp. 75.00	12
SPM-Sigarette Putih Mesin	Large scale	Rp. 150.00	Free	40
(White or non clove standard cigarette)	Medium scale	Rp. 150.00	Free	38
	Medium scale	Rp. 100.00	Rp. 145.00	36
	Small scale	Rp. 150.00	Free	36
	Small scale	Rp. 100.00	Rp. 145.00	34
	Small scale	Rp. 70.00	Rp. 95.00	28

Source: USDA (2000)

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