WPS8558

Policy Research Working Paper 8558

The Distributional Effects of Tobacco Taxation

The Evidence of White and Clove Cigarettes in Indonesia

Alan Fuchs
Giselle Del Carmen

WORLD BANK GROUP
Poverty and Equity Global Practice
August 2018

Abstract

Despite the well-known positive impact of tobacco taxes on health outcomes, policy makers hesitate to use them because of their possible regressive effect, that is, poorer deciles are proportionally more negatively affected than richer ones. Using an extended cost-benefit analysis to estimate the distributional effect of white and clove cigarettes in Indonesia, this study finds that the long-run impact may be progressive. The final aggregate effect incorporates the negative price effect, but also changes in medical expenditures and additional working years. The analysis includes estimates of the distributional impacts of price rises on cigarettes under various scenarios using 2015–16 Indonesia National Socioeconomic Surveys. One contribution is to quantify the impacts by allowing price elasticities to vary across consumption deciles. Overall, clove cigarette taxes exert an effect that depends on the assumptions of conditional price elasticity. If the population is more responsive to tobacco price changes, then people would experience even more gains from the health and work benefits. More research is needed to clarify the distributional effects of tobacco taxation in Indonesia..

This paper is a product of the Poverty and Equity Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/research. The authors may be contacted at afuchs@worldbank.org.

The Distributional Effects of Tobacco Taxation: The Evidence of White and Clove Cigarettes in Indonesia

Alan Fuchs and Giselle Del Carmen[1]

JEL Codes: H23, H31, I18, O15

[1] Fuchs: Poverty and Equity Global Practice, World Bank (email: afuchs@worldbank.org); Del Carmen: Poverty and Equity Global Practice, World Bank (email: gdelcarmen@worldbank.org). Support in the preparation of this report has been provided by the World Bank's Global Tobacco Control Program, co-financed by the Bill and Melinda Gates Foundation and Bloomberg Philanthropies. The authors are grateful to Patricio Marquez, Daniela Paz, Maria Eugenia Genoni, Sailesh Tiwari, Jaffar Al Rikabi, Federico Gil Sander, Pandu Harimurti, and Abdillah Ahsan for offering comments and support. The findings, interpretations, and conclusions in this research note are entirely those of the authors. They do not necessarily represent the views of the World Bank Group, its Executive Directors, or the countries they represent.

1. Introduction

The World Health Organization (WHO) estimates that tobacco kills more than 7 million people worldwide each year (WHO 2017a). It is the second leading cause of death and disability worldwide (Ng et al. 2014) and is among the major preventable causes of disease and premature death globally (Doll and Hill 1956; Wynder and Graham 1950). Diseases associated with tobacco use include lung cancer, stroke, ischemic heart disease, and respiratory diseases (DHHS 2004). Nearly 80 percent of the world's smokers live in low- and middle-income countries and are less likely to be informed about the adverse health effects of tobacco use relative to individuals in high-income countries. Indonesia is a major producer and consumer of tobacco; 68.1 percent of men ages 15 or above and 2.5 percent of women use some form of tobacco (Zheng et al. 2018). Kretek cigarettes, often referred to as clove cigarettes, are the most popular tobacco products in the country. As of 2015, an estimated 40 percent of the adult population smoked kretek cigarettes (World Bank 2017a). They are made of a combination of tobacco and ground clove mixed with special sauces unique to each brand (Arnez 2009; Malson 2003). It is estimated that more than one million farmers grow cloves in Indonesia, which accounts for more than 70 percent of the world's cloves (World Bank 2017b).

Over more than a decade, the Indonesian government has been gradually raising excise taxes on tobacco products. Yet, the taxes remain below the recommended WHO threshold. While the WHO recommends total taxes on tobacco products—that is, specific excise taxes, local taxes, and the value added tax—should be at least 75.0 percent of the retail price, the average rate in Indonesia is 57.4 percent (WHO 2017b). The current cigarette excise tax encompasses 12 tiers. Each tier is based on the type of product, the number of cigarettes produced, and the per unit retail price. Inevitably, such a system leads to substitution toward lower-priced products and thus has limited impact on smoking reduction. Moreover, the Indonesian government has a preferential tax structure for hand-rolled kretek factories because these employ a significant share of kretek workers and account for more than half of the factories in the tobacco industry. As of 2018, the excise tax on hand-rolled kreteks was 24.0 percent of the minimum retail price, while the excise tax on machine-made kreteks was 45.8 percent, depending on the production volume and range of retail prices. In addition to excise taxes on the cigarettes sold in Indonesia, the government also applies a 9.1 percent value added tax, which is collected directly from manufacturers (Ahsan et al. 2013).

Even though the government has considered reforming the excise tax structure by reducing and consolidating the number of tiers and raising taxes, it is concerned this might affect the livelihoods of people in the kretek value chain. A recent World Bank (2017a) study finds that the tax increase would reduce employment in the handmade kretek industry by approximately 8 percent. Some households would lose as much as 27 percent–52 percent of total household income. Nonetheless, the reduction in employment in this industry is equivalent to 1.4 percent of the potential revenue gains from increasing cigarette taxes. The study estimates the annual revenue gain would be Rp 12.9 billion, while the employment loss in the handmade kretek industry would be 24,000 jobs.[2] Thus, the tax and price increase would not only reduce tobacco use and related health care costs, it would generate additional revenue that would more than compensate for the income loss associated with a reduction in employment and production in the kretek industry (World Bank 2017a).

Similarly, reforms in the cigarette excise tax structure have also raised concerns about the possible effects on tobacco farmers. Nonetheless, tobacco leaf is a relatively small agricultural subsector in Indonesia, representing roughly 0.30 percent of the agricultural sector and 0.03 percent of gross domestic product (GDP) (Indonesia Ministry of Agriculture 2010). Another World Bank (2017c) study analyzes the socioeconomic conditions of tobacco farmers in Indonesia and suggests that tobacco is not profitable for most farmers and that there is widespread poverty and food insecurity among tobacco farmers, as well as evidence of child labor during school

[2] The average annualized kretek income is estimated at Rp 15,500,000, and the projected decrease in wage income is 48.9 percent. The loss of 24,000 jobs in the kretek industry implies a total income loss of Rp 182 billion, equivalent to 1.4 percent of the revenue gain.

hours. Thus, given the economic and social costs of tobacco growing, additional tax revenues from a reformed tobacco excise system could be used to help tobacco farmers switch to more profitable alternative crops.

Although there are over 225,000 deaths annually from tobacco-related diseases in Indonesia, nearly 470,000 children ages 10–14 and 53 million adults ages 15 or older continue to use tobacco daily. In 2016, 21 percent of male deaths in Indonesia were caused by tobacco; this is higher than the average in countries with a medium human development index.[3] Similarly, Indonesia is among the few countries that has not signed or ratified the WHO Framework Convention on Tobacco Control (WHO 2017c). This policy creates an attractive space for the tobacco industry to continue growing because there is limited regulation of tobacco use.

Tobacco taxes are often considered regressive because the share of household budgets allocated to tobacco products is larger among low-income households than among high-income households. This paper shows that, if behavioral and indirect effects, especially health-related effects, are taken into account, this is no longer valid. The long-run benefits of not smoking offset the costs associated with tobacco taxes among low-income groups and the overall population. Potential benefits include a reduction in medical expenditures and an increase in healthy life years, factors that translate into economic benefits that outweigh the losses created by tax increases if consumers quit or never start smoking.

This paper describes and quantifies the medium- and long-run effects of tobacco tax increases on aggregate household welfare through three channels. The first implies that higher tobacco prices because of higher taxes induce a behavioral response involving a reduction and cessation in tobacco consumption that are manifest particularly among people who discontinue smoking and younger individuals who do not start smoking. The second channel is associated with a reduction in medical expenses associated with the averted treatment costs of tobacco-related diseases. The third channel is a rise in incomes because of gains in years of employment because of the prolongation of life expectancy. To assess the impact of these effects, this paper estimates the price elasticity of tobacco, simulates upper- and lower-bound scenarios, and calculates the welfare gains among various income groups.

The study is structured as follows. Section 2 reviews the literature on the health effects of tobacco, the economic costs associated with tobacco-related diseases, tobacco tax policies, and price elasticities. Section 3 presents the model. Section 4 presents an overview of the data used to estimate the impact of the tobacco tax. Section 5 examines the results. The final section concludes with a discussion on policy implications.

2. Literature review

Blecher and van Walbeek (2008) estimate that, because the mean incomes in countries grew more quickly than average tobacco prices, cigarettes became more affordable in developing countries between 1997 and 2006. This indicates that, as smoking prevalence increases, these countries are more likely to bear the major health impacts of tobacco consumption. Furthermore, low- and middle-income countries are experiencing a rise in noncommunicable diseases. Kristina et al. (2015) estimate that, in Indonesia, cancer mortality attributable to smoking represented 74,440 deaths (30.6 percent of total cancer deaths), of which 95.0 percent were men. Cancer deaths attributable to smoking were responsible for 1.2 million years of potential life lost. This has negative consequences for human capital development and imposes an increasing economic burden because smoking decreases earnings potential and labor productivity (WHO 2015a).

Several studies have quantified the economic costs of smoking, though most have been carried out in high-income countries. Annual direct health care costs attributable to tobacco use amounted to US$2.2 billion in Indonesia in 2015, which is equivalent to 2.5 percent of GDP (Kristina et al. 2018). In Bangladesh, the overall economic cost of tobacco use is estimated at Tk 110 billion (US$1.9 billion) or over 3 percent of GDP in 2004

[3] See "The Tobacco Atlas: Indonesia," American Cancer Society and Vital Strategies, Atlanta, https://tobaccoatlas.org/country/indonesia/.

(WHO 2007). In contrast, annual tobacco-related health costs are estimated at US$81 billion in the United States, nearly US$7 billion in Germany, and US$1 billion in Australia (Guindon et al. 2007). Goodchild, Nargis, and Tursan d'Espaignet (2018) find that tobacco-related diseases accounted for 5.7 percent of global health expenditure in 2012 and that the total economic costs of smoking, including health expenditure and productivity losses, were equivalent to 1.8 percent of the world's GDP (US$1.9 trillion in purchasing power parity U.S. dollars). The highest share, according to these authors, was in high-income countries (US$1.1 trillion in purchasing power parity dollars), where the tobacco epidemic is the most advanced.[4] Nearly 40 percent of these costs are concentrated in developing countries, reflecting the substantial burden experienced by this group of countries. Earlier estimates of Lightwood et al. (2000) indicate that the gross health costs of tobacco in high-income countries are between 0.1 percent and 1.0 percent of GDP. Likewise, Pichón-Riviere et al. (2014) estimate the annual direct costs of tobacco-related disease in the Chilean health system at approximately 0.6 percent of GDP.

Tobacco price increases are also associated with expansion in productive life years. Verguet et al. (2015) analyze the health effects of a price increases in China and conclude that a 50 percent rise in prices would result in 231 million life years gained over 50 years and would have a significant impact among the poor. In contrast, Pichón-Riviere et al. (2014) estimate that tobacco use in Chile would reduce life expectancy by nearly 4.0 years among women and 4.3 years among men. On Indonesia, Ahsan et al. (2013) estimate that, if taxes were increased to 57 percent of the retail price, 1.96 million tobacco-related deaths would be averted. Similarly, if taxes were raised even more, to 70 percent, the number of deaths averted would increase to over 5 million.

Similarly, exposure to secondhand smoke has a strong relationship with many respiratory diseases among children and adults (DHHS 2004, 2014; Mason, Wheeler, and Brown 2015; Öberg et al. 2011). In Indonesia, more than 97 million nonsmokers are constantly exposed to secondhand smoke (Barber et al. 2008). According to WHO (2017a), secondhand smoke is responsible for over 890,000 premature deaths per year. In the United States, exposure to secondhand smoke costs an estimated US$5 billion annually in direct medical costs and over US$5 billion more in indirect medical costs, that is, disability and lost wages (Behan, Eriksen, and Lin 2005). In the state of Indiana, the health-related costs of secondhand smoking have been estimated at more than US$1.3 billion annually (Mason, Wheeler, and Brown 2015). McGhee et al. (2006) estimate the cost of direct medical care, long-term care, and productivity losses because of secondhand smoke exposure in Hong Kong SAR, China, at approximately US$156 million annually.

Tobacco taxation has been recognized as one of the most effective tobacco control strategies. In high-income countries, a 10 percent increase in the price of cigarettes is associated with a decrease in the demand for cigarettes of approximately 4 percent (World Bank 1999). In low- and middle-income countries, an equivalent increase is associated with an average 6 percent reduction in cigarette consumption (Chaloupka et al. 2000). Higher taxes have the additional benefits of reducing exposure to secondhand smoke and increasing government revenues. Djutaharta et al. (2005) estimate that a 10 percent increase in price would reduce total cigarette consumption in Indonesia by 6 percent. The decrease would be higher (7 percent) among low-income households and lower among wealthier ones (3 percent). Moreover, the study estimates that a 50.0 percent tax increase would raise tobacco tax revenues by 27.5 percent. A similar study by Barber et al. (2008) estimates that raising cigarette taxes to 50 percent of the retail price can decrease the expected mortality rate by 2 percent–5 percent. Adioetomo, Djutaharta, and Hendratno (2005) simulate the impact of a 10.0 percent tax increase and find that the subsequent increase in cigarette prices (4.9 percent) causes a 3.0 percent decline in consumption.

Other tobacco control interventions are also relevant in decreasing demand, but have a smaller impact on tobacco consumption. Several studies have found that public health awareness campaigns contribute to a

[4] Goodchild, Nargis, and Tursan d'Espaignet (2018) estimate the economic cost of smoking-attributable diseases at US$15 billion in low-income countries, US$359 billion in lower-middle-income countries, and US$354 billion in upper-middle-income countries, all in purchasing power parity U.S. dollars.

reduction in cigarette use, but the impact has generally been small and, in some cases, temporary.[5] Levy, de Almeida, and Szklo (2012) estimate that the vast reduction in tobacco use in Brazil was mostly caused by higher tobacco prices (46 percent of the impact) and, to a lesser extent, by smoke-free policies (14 percent). WHO (2015b) argues that smoke-free environments are the only way to mitigate the harmful impacts of secondhand smoking.

Policy makers can design an effective tobacco taxation system based on information on the price elasticity of tobacco products. Tax increases tend to generate more impact on tobacco consumption in low- and middle-income countries relative to high-income ones (WHO 2015b). Several studies have estimated the relationship between tobacco prices and consumption. Chaloupka and Grossman (1996) and Lewit and Coate (1982) estimate the elasticity among the under-18 population in the United States at between −1.44 and −1.31 and, among adults ages 18 years or older, at between −0.27 and −0.42. Cigarette price elasticities across income groups in India range from −0.83 for the lowest income group and −0.26 for the highest (Selvaraj, Srivastava, and Karan 2015). Gallus et al. (2006) estimate a price elasticity of −0.46 for 52 countries in Europe. In the United Kingdom, price elasticity is estimated at −0.5 and, in Hungary, between −0.44 and −0.37 (Szilágyi 2007; Townsend, Roderick, and Cooper 1994). Denisova and Kuznetsova (2014) estimate price elasticities in Ukraine by income deciles, ranging from −0.44 for the lowest income group to −0.11 for the highest. Fuchs and Meneses (2017a) also estimate decile-level price elasticities in Ukraine and find a higher average price elasticity (−0.45), ranging from −0.33 for the richest income group and −0.59 for the poorest. In Moldova, Fuchs and Meneses (2018) find a price elasticity of -0.51 for the poorest decile and -0.26 for the richest.

The price elasticity of cigarettes in Indonesia ranges from −0.26 to −0.76. Bird (1999) uses annual aggregate data on Indonesia from 1970 to 1994 to estimate a price elasticity of the demand for cigarettes at −0.43 in the long run and −0.60 in the short run. Similarly, Djutaharta et al. (2002) use aggregate time series data on Indonesia from 1970 to 1996 to estimate an elasticity of −0.57, while, in 1970–2001, they the elasticity at −0.35. Based on the 1999 Indonesia National Socioeconomic Survey, Adioetomo, Djutaharta, and Hendratno (2005) estimate a total price elasticity of cigarette demand of −0.61 and find that price elasticity decreased in absolute terms at higher income levels: the price elasticity is −0.67 among the low-income group, −0.33 among the middle-income group, and −0.31 among the high-income group. For clove cigarettes, de Beyer and Yurekli (2000) use a log-linear model with 1980–95 data to estimate a price elasticity of demand of −0.51. Nasrudin et al. (2013) use the Indonesian Family Life Survey to estimate cigarette price elasticity: −0.15 and −0.16 among the first two income deciles and −0.20 to −0.28 among the third to ninth deciles. Witeolar, Rukumnuaykit, and Strauss use the household panel of the Indonesian Family Life Survey in 1997 and 2000 to estimate a price elasticity of −0.80.

Two key factors that determine tobacco price elasticities are age and income. Young adults and individuals in low-income groups are more responsive to price changes relative to their peers. This makes them particularly susceptible to tobacco tax increases because they tend to be less dependent on nicotine, more affected by peer effects, and possess less disposable income (Jha and Peto 2014). Several studies in the United States have consistently shown that younger groups show higher elasticities relative to older ones (CDC 1998; Chaloupka and Grossman 1996; Lewit and Coate 1982). Barkat et al. (2012) estimate that a uniform excise tax accounting for 60 percent of the retail price of cigarettes would reduce youth smoking prevalence by 27 percent, preventing over 2 million youth from taking up smoking.

3. Model

The impact of an increase in tobacco taxes in Indonesia is estimated using an extended cost-benefit analysis as in other studies (Pichón-Riviere et al. 2014; Verguet et al. 2015). The paper analyzes three factors to estimate how tobacco taxes could affect household income. First, assuming tobacco consumption does not change,

[5] Atkinson and Skegg (1973); Bardsley and Olekalns (1999); Stavrinos (1987); Sumner (1971); Townsend (1987); Townsend, Roderick, and Cooper (1994); Witt and Pass (1981).

tobacco taxes directly affect household income because the share of household budgets allocated to tobacco purchases rises as the tax increases. Second, household medical expenses could decrease as a result of reduced tobacco consumption. Third, households could also experience a positive income change because of additional years of labor recovered through the extension of life expectancy. The aggregate effect of a tax policy is estimated as follows:

Income effect = change in tobacco expenditure (A) + lower medical expenses (B) + higher income (C) (1)

For further details on the methodology, see annex A or refer to Fuchs and Meneses (2017a).

4. Data and descriptive statistics

Tobacco prices

Data on the household consumption of and expenditure on tobacco products in Indonesia come from the 2015–16 Indonesia National Socioeconomic Surveys. The surveys ask households about daily expenditure and consumption for different tobacco products. These questions allow an estimation of the average price paid by households for tobacco products and of average price elasticities among expenditure groups. However, the survey is not based on a good representative sample of higher-income groups because nonresponse rates among these groups are high.

Table 1 shows significant price variation across deciles and minimal variation by cigarette type. For instance, the poorest decile in 2016 paid an average Rp 495 for clove cigarettes, whereas the richest decile spent Rp 909. For white cigarettes, the variation across deciles is within a similar range. Using Euromonitor data, one can compare the estimated prices from the expenditure survey.[6] The most expensive 20-pack of cigarettes in 2017 cost Rp 24,300, while the cheapest cost Rp 17,200 (figure 1). Moreover, while nominal cigarette prices increased from 2011 to 2017, the real prices remained relatively unchanged (figure 2).

Table 1 – Mean and Median Price per Stick Paid by Households, by Cigarette Type and Decile, 2016

Price	*Type*	*Decile*									
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Mean	Clove cigarettes	495	530	557	587	630	691	741	781	831	909
	White cigarettes	523	559	571	615	633	714	746	792	812	884
Median	Clove cigarettes	469	511	539	574	618	671	730	733	795	863
	White cigarettes	479	535	556	597	633	689	730	730	771	821

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Prices are in 2010 real rupiah. Deciles are constructed using per capita household expenditure.

[6] See Euromonitor International (database), Euromonitor International, London, http://www.euromonitor.com/.

Figure 1 – Mean Cigarette Price, by Year and Pack Size (2010 prices)

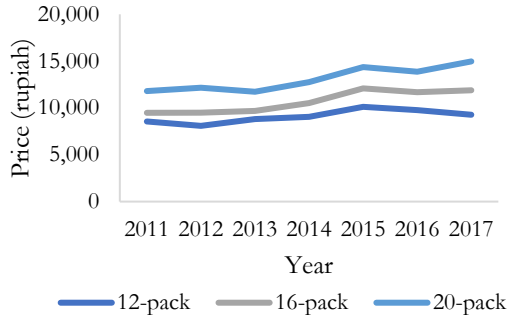
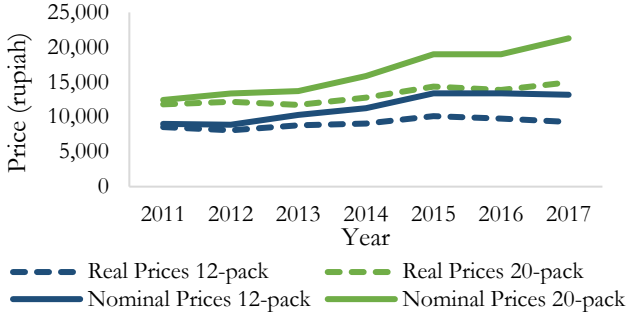


Figure 2 – Mean Cigarette Price, by Year and Pack Size, Real vs. Nominal Prices



Source: 2011–17 data, Euromonitor International (database), Euromonitor International, London, http://www.euromonitor.com/.
Note: Real prices are by pack size in 2010 prices. Euromonitor data do not allow a distinction between clove and white cigarettes.

Tobacco price elasticity by decile

Although several models have been tested to estimate decile-level elasticities, the fixed effects with controls model is preferred. (See annex B for more on the methodology and the various iterations of the estimation of tobacco price elasticities by decile.)

The estimated average white cigarette price elasticity in Indonesia is −0.63, which is within the estimated elasticities found in the literature on developing countries (a range of −0.4 to −0.8), as well as previous estimates on Indonesia. As expected, lower-income deciles exhibit higher white cigarette price elasticities relative to richer deciles. For instance, the poorest decile has a medium-bound elasticity of −0.77, whereas the richest has an elasticity of −0.55 (table 2). The standard error of these estimates is approximately 0.10, producing a 95 percent confidence interval of −0.20, +0.20.[7] The effect of a tax increase under different scenarios is shown by simulating a lower- and upper-bound elasticity for each decile. The former tends to involve income groups that would not change consumption patterns, such as rural residents or older individuals, while the latter tends to show a longer-term scenario, reflecting the effect the tobacco tax would have on younger individuals. After a few decades, only these would still be alive; the total average effect of the price increase would therefore be approximated more accurately by the upper-bound price elasticity.

Table 2 – White Cigarettes: Price Elasticities, by Decile

Price elasticity	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower bound	−0.567	−0.498	−0.468	−0.444	−0.422	−0.403	−0.393	−0.382	−0.366	−0.345
Medium bound	−0.767	−0.698	−0.668	−0.644	−0.622	−0.603	−0.593	−0.582	−0.566	−0.545
Upper bound	−0.967	−0.898	−0.868	−0.844	−0.822	−0.803	−0.793	−0.782	−0.766	−0.745

Source: Estimates based on Indonesia National Socioeconomic Survey 2015–16.
Note: Deciles were created using per capita household expenditure. Lower- and upper-bound elasticities show average differences of −0.2 and +0.2, respectively, with the medium-bound elasticity. Demographic controls include: the age, education, and gender of the household head, the share of individuals by age-group in each household, and urban status. The model also controls for year fixed effects. Only 2015–16 survey years were used to estimate price elasticities because previous surveys asked about the number of cigarette packs consumed, whereas the most recent years ask about quantities of individual cigarettes.

In contrast, average price elasticities are lower for clove cigarettes than for white cigarettes (−0.52). The poorest decile shows a medium-bound price elasticity of −0.64 for clove cigarettes, which is lower than the −0.77 for white cigarettes (tables 2–4, figures 3–4).

[7] To maintain comparability with similar studies, the same average upper and lower bounds have been applied to all deciles. Applying individual bounds by decile produces minimal changes in the results.

Table 3 – Clove Cigarettes: Price Elasticities, by Decile

Price elasticity	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower bound	−0.440	−0.386	−0.354	−0.334	−0.318	−0.302	−0.293	−0.283	−0.272	−0.256
Medium bound	−0.640	−0.586	−0.554	−0.534	−0.518	−0.502	−0.493	−0.483	−0.472	−0.456
Upper bound	−0.840	−0.786	−0.754	−0.734	−0.718	−0.702	−0.693	−0.683	−0.672	−0.656

Source: Estimates based on Indonesia National Socioeconomic Surveys 2015–16.
Note: Deciles were created using per capita household expenditure. Lower- and upper-bound elasticities show average differences of −0.2 and +0.2, respectively, with the medium-bound elasticity. Demographic controls include: the age, education, and gender of the household head, the share of individuals by age-group in each household, and urban status. The model also controls for year fixed effects. Only 2015–16 survey years were used to estimate price elasticities because previous surveys asked about the number of cigarette packs consumed, whereas the most recent years ask about quantities of individual cigarettes.

Table 4 – All Cigarette Products: Price Elasticities, by Decile

Price elasticity	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower bound	−0.447	−0.345	−0.313	−0.293	−0.276	−0.261	−0.251	−0.241	−0.230	−0.213
Medium bound	−0.647	−0.545	−0.513	−0.493	−0.476	−0.461	−0.451	−0.441	−0.430	−0.413
Upper bound	−0.847	−0.745	−0.713	−0.693	−0.676	−0.661	−0.651	−0.641	−0.630	−0.613

Source: Estimates based on Indonesia National Socioeconomic Surveys 2015–16.
Note: Deciles were created using per capita household expenditure. Lower- and upper-bound elasticities show average differences of −0.2 and +0.2, respectively, with the medium-bound elasticity. Demographic controls include: the age, education, and gender of the household head, the share of individuals by age-group in each household, and urban status. The model also controls for year fixed effects. Only 2015–16 survey years were used to estimate price elasticities because previous surveys asked about the number of cigarette packs consumed, whereas the most recent years ask about quantities of individual cigarettes.

Figure 3 – White Cigarettes: Price Elasticity, Indonesia

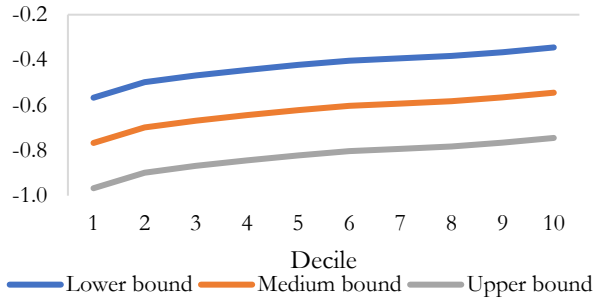
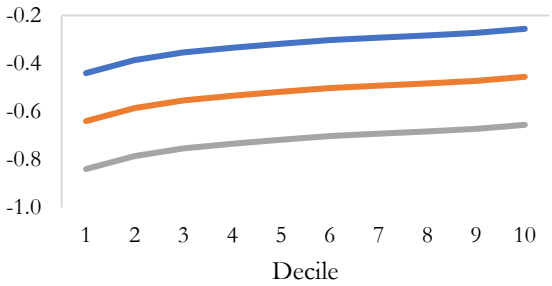


Figure 4 – Clove Cigarettes: Price Elasticity, Indonesia



Source: Estimates based on Indonesia National Socioeconomic Surveys 2015–16.
Note: Deciles were created using per capita household expenditure. Lower- and upper-bound elasticities show average differences of −0.2 and +0.2, respectively, with the medium-bound elasticity.

Mortality and morbidity

Data on mortality, years of life lost, and morbidity are obtained from the Global Burden of Disease Study.[8] Ischemic heart disease, chronic respiratory diseases, and tuberculosis are among the most prevalent diseases among men and women in Indonesia. In 2016, approximately 153,108 deaths were attributed to tobacco-related diseases, of which nearly 88 percent were men (135,368) (table 5). Nearly 2.2 million cases of tobacco-related disease were reported in Indonesia the same year (table 6). A total of 4,155,652 years of life lost were estimated for all tobacco-related deaths in 2016 (table 7).[9]

[8] See GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.
[9] Years of life lost is the estimated average number of years a person would have lived if he or she had not died prematurely.

Table 5 – Tobacco-related Deaths, by Gender and Age-Group, Indonesia, 2016

	Female					Male				
	25-34	**35-54**	**55-74**	**75+**	**Total**	**25-34**	**35-54**	**55-74**	**75+**	**Total**
Total Tobacco-related deaths	**148**	**3,797**	**8,649**	**5,147**	**17,740**	**3,901**	**40,160**	**69,136**	**22,172**	**135,368**
Ischemic heart disease	65	1,808	5,092	2,720	9,684	1,705	18,017	26,742	7,890	54,354
Cerebrovascular disease	38	1,264	2,714	2,107	6,123	1,165	14,888	27,204	7,634	50,892
Tuberculosis	11	153	357	283	804	810	4,279	5,626	2,162	12,876
Chronic obstructive pulmonary disease	9	184	282	31	507	76	916	5,057	3,281	9,329
Tracheal, bronchus, and lung cancer	12	199	114	3	328	68	1,196	3,051	839	5,153
Cervical cancer	4	62	17	0	83	-	-	-	-	-
Lip and oral cavity cancer	3	32	17	0	52	18	150	179	52	399
Larynx cancer	0	20	25	1	46	5	111	348	90	554
Stomach cancer	2	18	7	0	27	8	103	194	55	359
Nasopharynx cancer	1	16	7	0	24	11	167	244	38	460
Colon and rectum cancer	1	16	6	0	24	10	48	50	13	121
Esophageal cancer	1	15	7	0	22	3	96	152	31	282
Bladder cancer	0	4	3	0	7	2	37	118	52	209
Other chronic respiratory diseases	0	3	1	0	4	4	14	4	1	23
Leukemia	0	2	1	0	3	8	48	51	10	117
Liver cancer due to other causes	0	1	1	0	2	7	90	118	24	240

Source: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.

Table 6 – Tobacco-Related Events, by Gender, 2016

Event	*All*	*Women*	*Men*
Ischemic heart disease	673,152	269,411	403,741
Tuberculosis	622,909	244,059	378,849
Chronic obstructive pulmonary disease	500,616	166,757	333,859
Cerebrovascular disease	334,295	158,159	176,136
Cervical cancer	25,192	25,192	
Colon and rectum cancer	16,695	8,260	8,435
Tracheal, bronchus, and lung cancer	13,227	3,372	9,854
Stomach cancer	12,642	5,616	7,025
Lip and oral cavity cancer	6,429	3,395	3,034
Bladder cancer	6,177	1,750	4,426
Leukemia	4,675	2,034	2,641
Nasopharynx cancer	3,771	919	2,852
Liver cancer due to other causes	3,386	370	3,016
Larynx cancer	2,694	478	2,216
Esophageal cancer	1,729	539	1,190
Total tobacco-related events	2,227,589	890,313	1,337,275

Source: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.
Note: Incidence is defined as the number of new cases of a given disease during a given period in a specified population. It is also used for the rate at which new events occur in a defined population. It is differentiated from prevalence, which refers to all cases, new or old, in the population at a given time.

Table 7 – Years of Life Lost, by Gender, 2016

Years	*All*	*Women*	*Men*
30–34	220,583	8,060	212,523
35–39	302,657	14,839	287,819
40–44	400,801	29,242	371,559
45–49	495,617	40,812	454,805
50–54	576,637	63,748	512,889
55–59	609,999	49,992	560,007
60–64	546,819	55,091	491,729
65–69	404,476	52,486	351,991
70–74	308,666	42,070	266,596
75–79	178,786	29,140	149,645
80 plus	110,610	22,656	87,954
Total	4,155,652	408,136	3,747,516

Source: GBD Results Tool (database), Global Burden of Disease Study 2016, Global Health Data Exchange, Institute for Health Metrics and Evaluation, Seattle, http://ghdx.healthdata.org/gbd-results-tool.

Tobacco-related medical costs

The most recent study estimating the economic cost of smoking in Indonesia was conducted in 2015. The study estimates the treatment costs of 19 chronic diseases attributable to smoking. Annual direct health care costs attributable to tobacco use amount to US$2.2 billion (equivalent to 2.5 percent of GDP in 2015). The treatment costs of hypertension, chronic obstructive pulmonary diseases, and ischemic heart disease showed the highest cost burden (Kristina et al. 2018). Similarly, a 2008 study estimated the economic loss attributable to tobacco use at US$18.5 billion (NIHRD 2009). Kristina et al. (2015) estimate the indirect mortality costs of premature cancer deaths and years of potential life lost attributable to smoking in Indonesia. They estimate smoking-attributable cancer mortality at nearly a third of total cancer deaths (30.6 percent) and the years of life lost at 1.2 million. Furthermore, cancer mortality costs related to smoking amounted to US$1.3 million in 2013.

Baseline descriptive results

Table 8 summarizes the most important indicators, including total monthly household expenditures and the share of expenditures on smoked tobacco products, for 2016. As of 2016, there was at least one smoker in 64 percent of all households. The share was highest among households in deciles 4–6 (an average 69.1 percent) and lowest in high-income households (52.0 percent). Most households consume clove cigarettes (59.7 percent) rather than white cigarettes (5.6 percent). On average, households spent 6.8 percent of their total incomes on white and clove cigarettes. Lower-income households spent the highest share. For instance, the poorest decile spent 7.5 percent relative to less than 4.0 percent among the richest. The results do not significantly differ if one analyzes the expenditures for tobacco products using 2010 as the base year (see annex C).

Table 8 – Baseline Descriptive Results, 2016

Indicator	*Decile 1*	*Decile 2*	*Decile 3*	*Decile 4*	*Decile 5*	*Decile 6*	*Decile 7*	*Decile 8*	*Decile 9*	*Decile 10*	*All*
Average Household Monthly per capita Expenditure (Rupia)	233,370	310,272	374,363	449,352	532,701	631,259	764,097	947,436	1,286,670	3,952,778	*1,031,795*
Proportion of exp. on all tobacco products[a]	7.5	8.8	9.2	9.5	9.5	9.3	8.5	7.6	6.2	3.3	*6.8*
Proportion of exp. white cigarettes	0.3	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.6	*0.6*
Proportion of exp. clove cigarettes	7.2	8.3	8.7	8.9	8.9	8.6	7.8	6.8	5.3	2.7	*6.2*
Households that smoke any tobacco product (%)	57.1	64.0	66.6	69.3	69.5	68.5	66.9	65.0	60.5	51.9	*63.9*
Households that smoke white cigarettes (%)	2.3	3.3	3.7	4.6	4.9	5.5	5.9	7.1	8.6	9.5	*5.6*
Households that smoke clove cigarettes (%)	55.3	61.8	64.0	66.1	65.9	64.5	62.4	59.6	53.5	43.4	*59.7*
Woman-headed households (%)	16.5	15.0	14.6	13.8	14.2	14.2	15.0	14.6	15.2	17.1	*15.0*
Age, household head	50.3	48.9	47.9	47.8	47.7	47.4	47.6	47.1	46.4	45.4	*47.7*
Share of kids ages 0-5 in household (%)	12.0	10.7	10.7	10.1	9.6	8.8	8.2	7.8	7.0	5.3	*9.0*
Share of individuals ages 6-17 in household (%)	22.4	22.2	22.1	20.9	20.2	19.7	18.1	17.1	15.3	12.2	*19.0*
Share of adults ages 18-49 in household (%)	39.2	42.4	44.5	45.9	47.1	48.5	49.4	51.1	54.4	58.0	*48.1*
Share of individuals ages 50+ in household (%)	26.4	24.7	22.7	23.1	23.1	23.0	24.3	24.0	23.3	24.5	*23.9*

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Deciles were created using per capita household expenditure.
a. Proportional to total budget per household in each decile; households that smoke = 1 if a household member reports spending on tobacco products.

5. Results

To analyze the distributional effects of an increase in tobacco taxes, the effect is estimated on prices, medical expenditures, and years of working life, aggregating these three indicators into a single measure. The price elasticities estimated in tables 2–4, including the lower- and upper-bound elasticities, facilitate an understanding of how the results could change under different assumptions.

Tobacco price increase

Income changes that arise from an increase in tobacco prices are estimated for each decile based on lower-, medium-, and upper-bound elasticities. Using the price elasticities and the shares of household expenditure on tobacco by decile, the effects of an increase in tobacco prices can be simulated (see annex A, equation A2). To show the effect of the elasticities on prices, tables 9 and 10 also include estimates of a complete pass-through scenario, whereby the increase in prices is completely transferred to consumers without a reduction in consumption. For instance, if one assumes that the prices for tobacco products rise by 25 percent, given the medium-bound elasticity for clove cigarettes in the bottom decile (−0.64) in table 3 and the proportion of clove cigarette expenditures among the bottom decile (4.3 percent) in table 8, the expected decrease in household expenditures would be 0.36 percent (table 10).[10] This represents a loss in welfare because consumers would devote a higher share of their incomes to the purchase of the same amount of tobacco, thereby reducing the consumption of other goods. In contrast, the analysis for white cigarettes implies an overall smaller decrease, whereby, for example, the same medium-elasticity analysis for the first decile yields a 0 percent expected decrease in household expenditures. These results hold for all analyzed scenarios. The effect for white cigarettes appears to be relatively progressive, that is, it affects upper-income groups in a larger proportion, whereas, for clove cigarettes, the effect is U shaped, with an increasing effect from decile 1 through 6 that then reverses so that the top decile is less affected than the poorest decile (lower- and medium-bound elasticity cases; see figure 5 and table 10).

Table 9 – Direct Effect of a Price Increase through Taxes, White Cigarettes (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Complete pass-through	−0.07	−0.11	−0.12	−0.15	−0.16	−0.17	−0.18	−0.19	−0.21	−0.14
Lower-bound elasticity	−0.02	−0.04	−0.05	−0.07	−0.07	−0.08	−0.09	−0.10	−0.11	−0.08
Medium elasticity	0.00	−0.01	−0.02	−0.03	−0.03	−0.04	−0.05	−0.05	−0.06	−0.05
Upper-bound elasticity	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	−0.01	−0.01

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table shows the share of total consumption for each decile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices; and this does not affect the quantity purchased.

Table 10 – Direct Effect of a Price Increase through Taxes, Clove Cigarettes (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Complete pass-through	−1.81	−2.09	−2.18	−2.22	−2.23	−2.14	−1.94	−1.70	−1.33	−0.67
Lower-bound elasticity	−0.81	−1.08	−1.22	−1.29	−1.34	−1.33	−1.23	−1.10	−0.88	−0.46
Medium elasticity	−0.36	−0.56	−0.67	−0.74	−0.79	−0.80	−0.75	−0.67	−0.55	−0.29
Upper-bound elasticity	0.09	−0.04	−0.13	−0.18	−0.23	−0.26	−0.26	−0.25	−0.21	−0.12

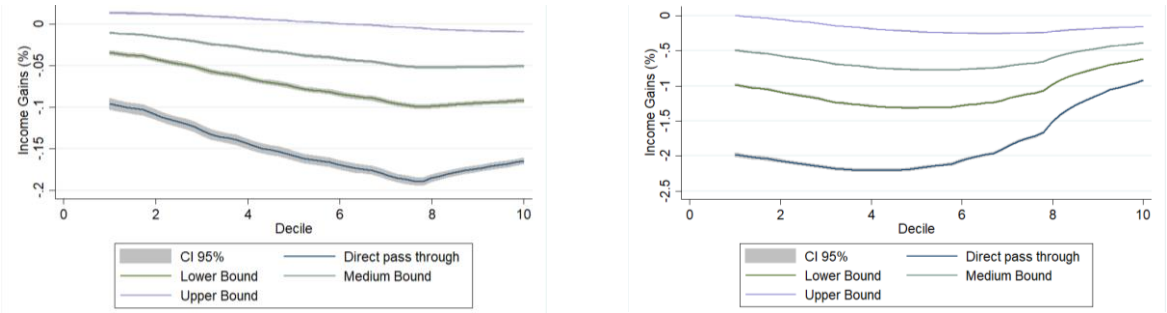
Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table shows the share of total consumption for each decile. Complete pass-through refers to elasticity equal to zero; consumers pay all the increased prices; and this does not affect the quantity purchased.

[10] The analysis assumes the prices of both clove and white cigarettes increase by 25 percent. However, given the complex tobacco-tax structure in Indonesia, there may be a scenario whereby prices increase less for clove cigarette than for white cigarettes.

Figure 5 – Income Gains: Direct Effect of Tobacco Taxes

(Increase in expenditure because of tobacco taxes)

a. White cigarettes **b. Clove cigarettes**



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent.

Medical expenses

Tables 11 and 12 and figure 6 report the income effect of a reduction in medical expenses by cigarette type. As noted above, the model assumes that the health effects of tobacco-related diseases will immediately diminish with the reduction in tobacco consumption. Although this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take time to materialize, it provides an upper-bound estimate of the effects of tax increases. Nonetheless, discounted rates of medical cost savings have been analyzed and the results hold (see annex C). The overall results indicate that, for both types of cigarettes, the reduction in medical expenditures is highly progressive, disproportionally benefiting lower-income groups, especially for clove cigarettes. This derives from two factors: (1) the higher price elasticity and (2) a lower income base that massively benefits from the reduction in medical costs.

Table 11 – Reduction in Medical Costs, White Cigarettes (%)

Price shock scenario	*Decile*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.17	0.16	0.14	0.14	0.12	0.11	0.10	0.10	0.09	0.05
Medium elasticity	0.23	0.22	0.20	0.20	0.18	0.17	0.15	0.15	0.14	0.08
Upper-bound elasticity	0.29	0.28	0.26	0.27	0.24	0.22	0.20	0.20	0.19	0.11

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile.

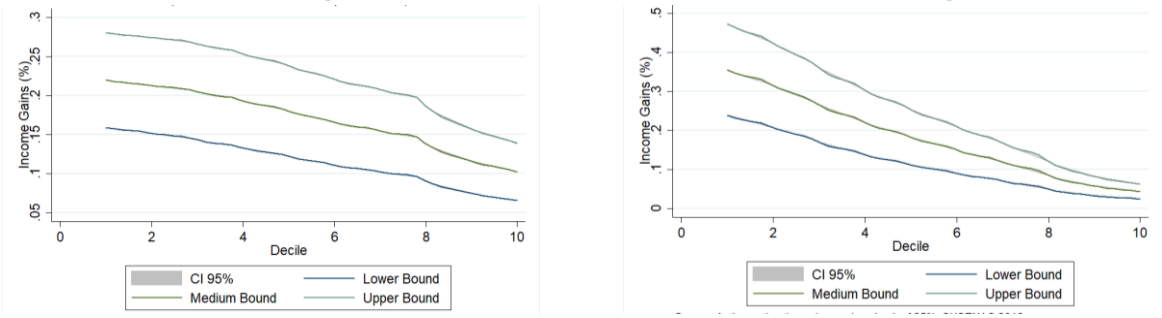
Table 12 – Reduction in Medical Costs, Clove Cigarettes (%)

Price shock scenario	*Decile*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.29	0.21	0.17	0.14	0.11	0.09	0.07	0.06	0.04	0.02
Medium elasticity	0.42	0.32	0.27	0.22	0.19	0.15	0.12	0.10	0.07	0.03
Upper-bound elasticity	0.54	0.44	0.36	0.31	0.26	0.22	0.17	0.14	0.10	0.04

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile.

Figure 6 – Income Gains: Medical Costs of Tobacco Taxes (Reduction in Medical Expenditures)

a. White cigarettes **b. Clove cigarettes**



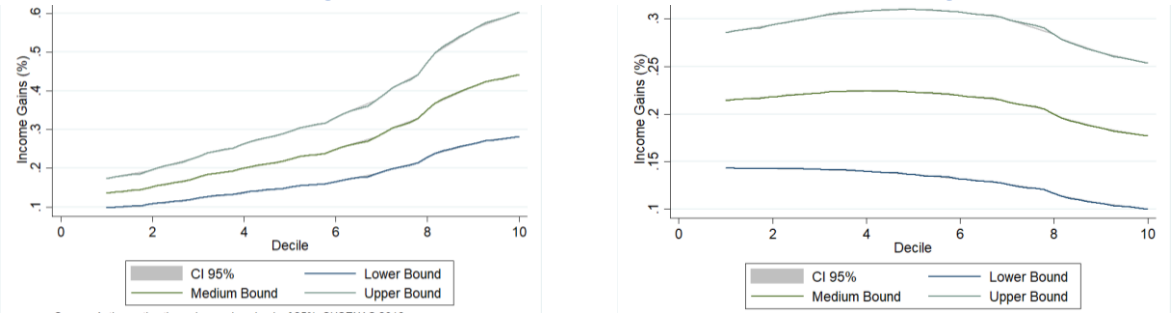
Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent.

Income gains deriving from an increase in years of working life

The study estimates the cost of working life lost because of tobacco consumption based on the assumption that the impact of lower tobacco use on health and work-generated income is direct. For each tobacco-related death, the working years lost shown in table 7 (that is, forgone income) are divided across deciles proportionately to the number of households that consume tobacco in each income group. The model anticipates that income will increase as the number of years lost because of premature deaths from tobacco consumption decline (see annex A for methodology details). The results show that the reduction in tobacco consumption and the expected reduction in years of work lost have a positive impact on welfare (see figure 7; tables 13–14). For white cigarettes, the positive impact increases with the income decile, that is, it has a highly regressive effect. In contrast, for clove cigarettes, the impact is more evenly distributed across deciles, generating an important impact on lower-income groups.

Figure 7 – Income Gains: Production during Years Lost, by Decile

a. White cigarettes **b. Clove cigarettes**



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent. Years of life lost have been estimated using all deaths from tobacco-related diseases.

Table 13 – Income Gains: Production during Years Lost, by Decile, White Cigarettes (%)

Price shock scenario	*Decile*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.08	0.11	0.12	0.14	0.15	0.16	0.18	0.21	0.26	0.30
Medium elasticity	0.11	0.15	0.17	0.21	0.22	0.24	0.27	0.32	0.40	0.47
Upper-bound elasticity	0.14	0.19	0.22	0.27	0.29	0.32	0.35	0.43	0.54	0.65

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases.

Table 14 – Income Gains: Production during Years Lost, by Decile, Clove Cigarettes (%)

Price shock scenario	*Decile*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.14	0.15	0.14	0.14	0.14	0.13	0.13	0.12	0.11	0.09
Medium elasticity	0.21	0.22	0.22	0.23	0.23	0.22	0.22	0.21	0.19	0.17
Upper-bound elasticity	0.27	0.30	0.30	0.31	0.31	0.31	0.30	0.30	0.27	0.24

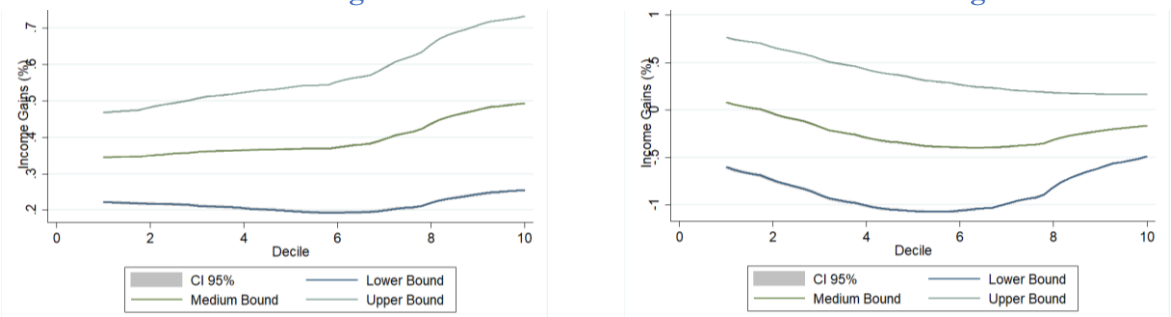
Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases.

Net effects: Total distributional impact

In this subsection, the results above have been added to estimate the aggregate effect of an increase in tobacco taxes (see equation 1). For white cigarettes, the aggregate effect of a 25 percent increase in tobacco taxes is positive, but regressive; in the long run, poorer deciles benefit less than richer ones. The positive effect of reduced medical expenses and years of life gained offset the negative price effect (figure 8; table 15).

Figure 8 – Total Income Effect: Direct and Indirect Effects of Tobacco Taxes
(Tobacco Price Increase, Medical Expenditure, and Working Years Gained)

a. White cigarettes **b. Clove cigarettes**



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent.

Table 15 – Net Effect on Household Expenditures, White Cigarettes (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.23	0.22	0.21	0.22	0.20	0.19	0.19	0.21	0.23	0.27
Medium elasticity	0.33	0.35	0.35	0.38	0.36	0.37	0.37	0.42	0.48	0.51
Upper-bound elasticity	0.44	0.49	0.49	0.54	0.53	0.55	0.56	0.63	0.72	0.75

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile.

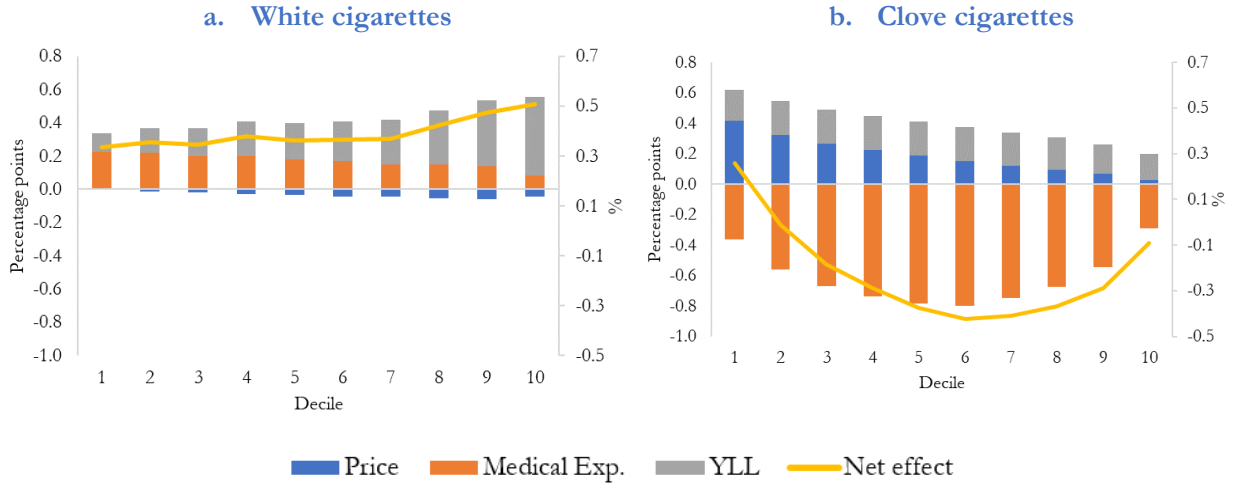
In contrast, for clove cigarettes, the effect is highly dependent on the elasticity scenario (figures 8 and 9, table 16). Using a lower-bound elasticity, the results show that the net effect of clove tax policy is negative and also regressive. A population that is not sensitive to tobacco price changes will not reduce consumption sufficiently to allow for health and work benefits to offset cost increases. In the case of the medium-bound elasticity, the tax has a progressive impact because of a positive effect on the two first deciles and a negative effect on higher-income groups. For upper-bound elasticity, the tax would have a positive effect on all income groups and show a progressive pattern, that is, benefiting lower-income groups in larger proportion. Although this effect is driven mostly by the elasticity variance among income deciles, the elasticity level is also relevant. The tax would have a positive effect on most income groups, but also show a progressive pattern, that is, greater benefits for lower-income groups.

Table 16 – Net Effect on Household Expenditures, Clove Cigarettes (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	−0.39	−0.72	−0.91	−1.01	−1.09	−1.11	−1.03	−0.92	−0.73	−0.35
Medium elasticity	0.26	−0.01	−0.18	−0.29	−0.37	−0.42	−0.41	−0.37	−0.29	−0.09
Upper-bound elasticity	0.91	0.70	0.54	0.44	0.34	0.26	0.22	0.19	0.16	0.16

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile.

Figure 9 – Total Income Effect Decomposition, Medium-Bound Elasticity
(Tobacco Price Increase, Medical Expenditure, and Working Years Gained)



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent.

In conclusion, under any tobacco price elasticity scenario, the overall effect in the case of white cigarettes is always positive and regressive. Under a low tobacco price elasticity scenario, the results for clove cigarettes show a negative overall effect. In the medium-bound elasticity scenario, the results for clove cigarettes are mixed, that is, positive among lower-income groups and negative among higher-income groups. In the case of an upper-bound elasticity scenario, the results would be income gains across all deciles and a progressive pattern. Moreover, the impact would be particularly important among lower-income deciles. The assumptions in this model do not include other possible policies, such as smoking cessation programs, antismoking advertising, youth outreach, or policies financed through the new tax revenue. These results are in line with the literature, showing the key role taxation plays in lowering tobacco usage.

6. Discussion

Despite the wealth of research on the negative effects of tobacco consumption and on the benefits of various public policy mechanisms aimed at reducing tobacco use, questions remain about the progressivity or regressivity that these entail. The implementation of tobacco taxes is considered one of the most effective ways to discourage tobacco use. Nonetheless, this policy has a direct impact on household incomes, especially among low-income households that are more likely to smoke and have more limited access to health insurance and adequate health care. Moreover, the net effect of an increase in tobacco taxes depends on the price elasticity of this product across different sectors of the population. The price elasticity determines the magnitude of the income shock and the benefits gained from a decline in tobacco consumption.

To assess the net welfare gains from this policy, one must look beyond the direct impact on household income and consider other benefits of lower tobacco consumption, including a reduction in medical costs and an increase in the potential working years associated with good health. Thus, it is critical to justify the maintenance

or intensification of the use of tobacco taxes by means of a demonstration of the aggregate monetary gains or losses generated. Moreover, the policy should focus on low-income households that are more likely to smoke and, hence, tend to be the most highly affected by consumption taxes. One of the main motivations of this study is to weigh the main costs and benefits of tobacco taxation to determine if, in the end, the policy is regressive.

The results show that, considered by itself, a price increase for tobacco through higher taxes generates negative income variations across all groups in the population because overall prices increase. For white and clove cigarettes, these negative effects are particularly acute in the scenario of lower-bound elasticity, and they are more moderate as elasticity expands in absolute terms. Based on the assumptions of a more comprehensive approach, including benefits through lower medical expenses and an increase in working years, the overall monetary effect is estimated.

The different types of cigarettes and elasticity assumptions generate four particular results. For white cigarettes, the overall effect is always positive, but not necessarily progressive. For clove cigarettes, the lower-bound elasticity generates an income loss among all decile groups of the population. The middle-bound elasticity generates income losses across all groups except the first two deciles. The upper-bound elasticity generates income gains across all groups, but particularly lower-income groups. This means that the effect of taxes on the different income groups is exacerbated if the variation in price elasticities among income deciles is greater.

The three price elasticity scenarios mimic the short- versus the long-term effects of tobacco taxes. There is evidence that adult smokers will only present small changes in their behavior if the price increases; the lower-bound elasticity tends to represent this behavior more closely. In contrast, younger groups of the population show more elastic demand, similar to the upper-bound elasticity. After a few decades, one should expect the impact of the tax policy to resemble the upper-bound elasticity scenario.

References

Adioetomo, Sri Moertiningsih, Triasih Djutaharta, and Hendratno. 2005. "Cigarette Consumption, Taxation, and Household Income: Indonesia Case Study." Economics of Tobacco Control Paper 26 (February), Health, Nutrition, and Population Discussion Paper Series, World Bank, Washington, DC.

Ahsan, Abdillah, Nur Hadi Wiyono, Ayke Soraya Kiting, Triasih Djutaharta, and Flora Aninditya. 2013. "Impact of Increasing Tobacco Tax on Government Revenue and Tobacco Consumption." SEADI Discussion Paper, Support for Economic Analysis Development in Indonesia Project, United States Agency for International Development, Washington, DC.

Arnez M. 2009. "Tobacco and Kretek: Indonesian Drugs in Historical Change." *Austrian Journal of South-East Asian Studies* 2: 49–69.

Atkinson, A. B., and J. L. Skegg. 1973. "Anti-smoking Publicity and the Demand for Tobacco in the UK." *Manchester School* 41 (3): 265–82.

Barber, Sarah, Sri Moertiningsih Adioetomo, Abdillah Ahsan, and Diahhadi Setyonaluri. 2008. "Tobacco Economics in Indonesia." International Union against Tuberculosis and Lung Disease, Paris.

Bardsley, P., and N. Olekalns. 1999. "Cigarette and Tobacco Consumption: Have Anti-smoking Policies Made a Difference?" *Economic Record* 75 (230): 225–40.

Barkat, A., A. U. Chowdhury, N. Nargis, M. Rahman, Pk. A. Kumar, S. Bashir, and F. J. Chaloupka. 2012. "The Economics of Tobacco and Tobacco Taxation in Bangladesh." International Union against Tuberculosis and Lung Disease, Paris.

Behan, D. F., M. P. Eriksen, and Y. Lin. 2005. "Economic Effects of Environmental Tobacco Smoke." March 31, Society of Actuaries, Schaumburg, IL.

Bird, K. 1999. "Industrial Concentration and Competition in Indonesian Manufacturing." PhD thesis, Australian National University, Canberra.

Blecher, E. H., and C. P. van Walbeek. 2008. "An Analysis of Cigarette Affordability." International Union against Tuberculosis and Lung Disease, Paris.

BPS (Badan Pusat Statistik, Statistics Indonesia), BKKBN (National Population and Family Planning Board), MOH (Kementerian Kesehatan), and ICF International. 2013. *Indonesia Demographic and Health Survey 2012*. Jakarta: BPS, BKKBN, MOH, and ICF International.

CDC (Centers for Disease Control and Prevention). 1998. "Response to Increases in Cigarette Prices by Race/Ethnicity, Income, and Age Groups: United States, 1976–1993." *Morbidity and Mortality Weekly Report* 47 (29): 605.

Chaloupka, F. J., and M. Grossman. 1996. "Price, Tobacco Control Policies, and Youth Smoking." NBER Working Paper 5740 (September), National Bureau of Economic Research, Cambridge, MA.

Chaloupka F. J., T. Hu, K. E. Warner, R. Jacobs, and A. Yurekli. 2000. "The Taxation of Tobacco Products." In *Tobacco Control in Developing Countries*, edited by P. Jha and F. J. Chaloupka, 237–72. Oxford, UK: Oxford University Press.

Coady, D. P., M. El Said, R. Gillingham, K. Kpodar, P. A. Medas, and D. L. Newhouse. 2006. "The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka." IMF Working Paper WP/06/247, International Monetary Fund, Washington, DC.

de Bayer, Joy, and Ayda A. Yurekli. 2000. "Curbing the Tobacco Epidemic in Indonesia." East Asia and the Pacific Region Watching Brief 6 (May), World Bank, Washington, DC.

Denisova, Irina, and Polina Kuznetsova. 2014. "The Effects of Tobacco Taxes on Health: An Analysis of the Effects by Income Quintile and Gender in Kazakhstan, the Russian Federation, and Ukraine." Discussion Paper 92765 (October), Health, Nutrition, and Population Discussion Paper Series, World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/21114.

DHHS (U.S. Department of Health and Human Services). 2004. *The Health Consequences of Smoking: A Report of the Surgeon General*. Atlanta: Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, DHHS.

———. 2014. *The Health Consequences of Smoking, 50 Years of Progress: A Report of the Surgeon General*. January. Atlanta: Office on Smoking and Health, National Center for Chronic Disease Prevention and Health

Promotion, Centers for Disease Control and Prevention, DHHS. http://www.surgeongeneral.gov/library/reports/50-years-of-progress/full-report.pdf.

Djutaharta, Triasih, Henry Viriya Surya, N. Haidy, A. Pasay, Hendratno, and Sri Moertiningsih Adioetomo. 2005. "Aggregate Analysis of the Impact of Cigarette Tax Rate Increases on Tobacco Consumption and Government Revenue: The Case of Indonesia." Economics of Tobacco Control Paper 25, Health, Nutrition, and Population Discussion Paper Series, World Bank, Washington, DC.

Doll, R., and A. B. Hill. 1956. "Lung Cancer and Other Causes of Death in Relation to Smoking." *British Medical Journal* 22 (5001): 1071–81.

Fuchs, A., and F. J. Meneses. 2017a. "Regressive or Progressive? The Effect of Tobacco Taxes in Ukraine." December 27, World Bank, Washington, DC.

———. 2017b. "Are Tobacco Taxes Really Regressive? Evidence from Chile." World Bank, Washington, DC.

———. 2018. "Tobacco Price Elasticity and Tax Progressivity in Moldova." World Bank, Washington, DC.

Gallus, S., A. Schiaffino, C. La Vecchia, J. Townsend, and E. Fernandez. 2006. "Price and Cigarette Consumption in Europe." *Tobacco Control* 15 (2): 114–19.

Goodchild, M., N. Nargis, and E. Tursan d'Espaignet. 2018. "Global Economic Cost of Smoking-Attributable Diseases." *Tobacco Control* 27 (1): 58–64.

Guindon, G. E., P. Tobin, M. Lim, and D. Boisclair. 2007. "The Cost Attributable to Tobacco Use: A Critical Review of the Literature." Tobacco Free Initiative, World Health Organization, Geneva.

Jha, P., and R. Peto. 2014. "Global Effects of Smoking, of Quitting, and of Taxing Tobacco." *New England Journal of Medicine* 370 (1): 60–68.

Kostova, Deliana, Frank J Chaloupka, Ayda Yurekli, Hana Ross, Rajeev Cherukupalli, Linda Andes, and Samira Asma.. 2014. "A Cross-Country Study of Cigarette Prices and Affordability: Evidence from the Global Adult Tobacco Survey." *Tobacco Control* 23: e3.

Kpodar, K. 2006. "Distributional Effects of Oil Price Changes on Household Expenditures: Evidence from Mali." IMF Working Paper WP/06/91, International Monetary Fund, Washington, DC.

Kristina, S., D. Endarti, Y. Prabandari, A. Ahsan, and M. Thavorncharoensap. 2015. "Burden of Cancers Related to Smoking among the Indonesian Population: Premature Mortality Costs and Years of Potential Life Lost." *Asian Pacific Journal of Cancer Prevention* 16: 6903–08.

Kristina, S., D. Endarti, C. Wiedyaningsih, A. Fahamsya, and N. Faizah. 2018. "Health Care Cost of Noncommunicable Diseases Related to Smoking in Indonesia, 2015." *Asian Pacific Journal of Cancer Prevention* 30 (1): 29–35.

Levy, D., L. M. de Almeida, and A. Szklo. 2012. "The Brazil SimSmoke Policy Simulation Model: The Effect of Strong Tobacco Control Policies on Smoking Prevalence and Smoking-Attributable Deaths in a Middle Income Nation." *PLoS Medicine* 9 (11): e1001336.

Lewit, E. M., and D. Coate. 1982. "The Potential for Using Excise Taxes to Reduce Smoking." *Journal of Health Economics* 1 (2): 121–45.

Lightwood, James, David Collins, Helen Lapsley, and Thomas E. Novotny. 2000. "Estimating the Costs of Tobacco Use." In *Tobacco Control in Developing Countries*, edited by Prabhat Jha and Frank J. Chaloupka, 63–103. Oxford, UK: Oxford University Press.

Malson, Jennifer L., Eun M. Lee, Ram Murty, Eric T. Moolchan, and Wallace B. Pickworth. 2003. "Clove Cigarette Smoking: Biochemical, Physiological, and Subjective Effects." *Pharmacology, Biochemestry, and Behavior* 74: 739–45.

Mason, J., W. Wheeler, and M. J. Brown. 2015. "The Economic Burden of Exposure to Secondhand Smoke for Child and Adult Never Smokers Residing in US Public Housing." *Public Health Reports* 130 (3): 230–44.

McGhee, S. M., L. M. Ho, H. M. Lapsley, J. Chau, W. L. Cheung, S. Y. Ho, M. Pow, T. H. Lam, and A. J. Hedley. 2006. "Cost of Tobacco-Related Diseases, Including Passive Smoking, in Hong Kong." *Tobacco Control* 15 (2): 125–30.

Nasrudin, Rus'an, Ledi Trialdi, Djoni Hartono, and Abdillah Ahsan. 2013. "Tobacco Economic of Indonesia: Poor Households' Spending Pattern, Tax Regressivity, and Economic Wide Impact of Tax Simplication." Working Paper in Economics and Business III, 2, Department of Economics, Faculty of Economics, University of Indonesia, Jakarta.

Ng, M., M. K. Freeman, T. D. Fleming, M. Robinson, L. Dwyer-Lindgren, B. Thomson, A. Wollum, et al. 2014. "Smoking Prevalence and Cigarette Consumption in 187 Countries, 1980–2012." *JAMA: Journal of the American Medical Association* 311 (2): 183–92.

NIHRD (National Institute of Health Research and Development). 2009. Study on Medical Expenditures and Burden of Major Tobacco Attributed Diseases in Indonesia. Jakarta, Indonesia: National Institute of Health Research and Development.

Öberg, M., M. S. Jaakkola, A. Woodward, A. Peruga, and A. Prüss-Ustün. 2011. "Worldwide Burden of Disease from Exposure to Second-Hand Smoke: A Retrospective Analysis of Data from 192 countries." *Lancet* 377 (9760): 139–46.

Pichón-Riviere, A., A. Bardach, J. Caporale, A. Alcaraz, F. Augustovski, F. Caccavo, C. Vallejos, et al. 2014. "Carga de Enfermedad Atribuible al Tabaquismo en Chile." Documento Técnico 8 (April), Instituto de Efectividad Clínica y Sanitaria, Buenos Aires.

Selvaraj, Sakthivel, Swati Srivastava, and Anup Karan. 2015. "Price Elasticity of Tobacco Products among Economic Classes in India, 2011–2012." BMJ Open 5 (12): e008180.

Stavrinos, V. G. 1987. "The Effects of an Anti-smoking Campaign on Cigarette Consumption: Empirical Evidence from Greece." *Applied Economics* 19: 323–29.

Sumner, M. T. 1971. "The Demand for Tobacco in the UK." *Manchester School* 39 (1): 23–36.

Szilágyi, Tibor. 2007. "Higher Cigarette Taxes: Healthier People, Wealthier State, the Hungarian Experience." *Central European Journal of Public Health* 15 (3): 122–26. http://apps.szu.cz/svi/cejph/archiv/2007-3-07-full.pdf.

Townsend, J. 1987. "Cigarette Tax, Economic Welfare, and Social Class Patterns of Smoking." *Applied Economics* 19: 355–65.

Townsend, J., P. Roderick, and J. Cooper. 1994. "Cigarette Smoking by Socioeconomic Group, Sex, and Age: Effects of Price, Income, and Health Publicity." *British Medical Journal* 309 (6959): 923–27.

Verguet, S., C. L. Gauvreau, S. Mishra, M. MacLennan, S. M. Murphy, E. D. Brouwer, R. A. Nugent, K. Zhao, P. Jha, and D. T. Jamison. 2015. "The Consequences of Tobacco Tax on Household Health and Finances in Rich and Poor Smokers in China: An Extended Cost-Effectiveness Analysis." *Lancet Global Health* 3 (4): e206–e216.

WHO (World Health Organization). 2007. "Impact of Tobacco-Related Illnesses in Bangladesh." WHO, Geneva.

———. 2011. "Economics of Tobacco Toolkit: Assessment of the Economic Costs of Smoking." WHO, Geneva. http://apps. who.int/iris/bitstream/10665/44596/1/9789241501576_eng. pdf.

———. 2015a. *Global Report on Trends in Prevalence of Tobacco Smoking, 2015*. Geneva: WHO. http://apps.who.int/iris/bitstream/10665/156262/1/9789241564922_eng.pdf.

———. 2015b. *WHO Report on the Global Tobacco Epidemic 2015: Raising Taxes on Tobacco*. Geneva: WHO.

———. 2017a. "Tobacco: Key Facts." Tobacco Fact Sheet, WHO, Geneva.

———. 2017b. *WHO Report on the Global Tobacco Epidemic, 2017: Monitoring Tobacco Use and Prevention Policies*. Geneva: WHO.

———. 2017c. "WHO Report on the Global Tobacco Epidemic, 2017, Country Profile: Indonesia." WHO, Geneva. http://www.who.int/tobacco/surveillance/policy/country_profile/idn.pdf.

Witoelar, Firman, Pungpond Rukumnuaykit, and John Strauss. 2005. "Smoking Behavior among Youth in a Developing Country: Case of Indonesia." Economic Growth Center, Yale University, New Haven, CT.

Witt, S. F., and C. L. Pass. 1981. "The Effects of Health Warnings and Advertising on the Demand for Cigarettes." *Scottish Journal of Political Economy* 28 (1): 86–91.

World Bank. 1999. "Curbing the Epidemic: Governments and the Economics of Tobacco Control." Report 19638 (May), Development in Practice Series, World Bank, Washington, DC.

———. 2017a. "The Economics of Kretek Rolling in Indonesia." Health, Population, and Nutrition Global Practice, World Bank, Washington, DC.

———. 2017b. "The Economics of Clove Farming in Indonesia." Health, Population, and Nutrition Global Practice, World Bank, Washington, DC.

———. 2017c. "The Economics of Tobacco Farming in Indonesia." Health, Population, and Nutrition Global Practice, World Bank, Washington, DC.

Wynder, E. L., and E. A. Graham. 1950. "Tobacco Smoking as a Possible Etiologic Factor in Bronchiogenic Car Cinoma: A Study of Six Hundred and Eighty-Four Proved Cases." *Journal of the American Medical Association* 143: 329–36.

Zheng, Rong, Patricio V. Marquez, Abdillah Ahsan, Yang Wang, and Xiao Hu. 2018. "Cigarette Affordability in Indonesia: 2002–2017." Global Tobacco Control Program (May), World Bank, Washington, DC.

Annexes

A. Model and Methodology

This section describes the partial equilibrium approach used to simulate the impact on consumption because of an increase in the price of cigarettes. This approach is used to evaluate the first-order effects of a change in prices. It relies mainly on household expenditure patterns. The focus is on the impacts of a rise in the price of cigarettes because this has been the focus of the potential reform of tobacco taxes.

To assess the distributional impact of an increase in the price of cigarettes, the simulation allows for differences in the responses across consumption deciles to reflect the fact that poor households likely have different price elasticities relative to households with more resources. The different elasticities, combined with the initial consumption patterns across deciles, explain whether a price reform will be more regressive, more neutral, or more progressive.

The loss of real consumption arising from the price increase in a product *i* is obtained as follows:

$$\left(\omega_{ij} + \Delta\omega_{ij}\right) * \frac{\Delta p_i}{p_{i,o}}, \qquad \text{(A1)}$$

where ω_{ij} is the share of product *i* in total household expenditure for a household in a decile *j*; Δp_i is the price increase; and $\Delta\omega_{ij}$ is the change in the consumption of the good that depends on the price elasticity of the product.[11]

Change in tobacco expenditure

To estimate the variation in cigarette consumption after the price increase, the model considers the change in prices (Δp_i), the tobacco price elasticity (ε_j) for decile *j*, and the share of cigarette expenditure in period 0 (ω_{ij}). The change in expenditure for each household in each decile is presented as a share of total expenditure and averaged by decile to quantify the overall impact, as follows:

$$\Delta\ \text{Expenditure}_{i,j} = \left((1 + \Delta P)\left(1 + \varepsilon_j * \Delta P\right) - 1\right) * \frac{\omega_{ij0}}{\text{Total expenditure}_{j0}} \qquad \text{(A2)}$$

Medical expenses

The change in medical expenses from tobacco-related diseases is estimated using equation (A3), where the cost of treatment of tobacco-related diseases for income decile i is obtained from administrative data. The cost of tobacco-related medical expenses is distributed across income decile i according to the share of households that consume tobacco in decile i. Equation (A3) shows the income gains associated with the decrease in medical expenses because of reduced tobacco consumption in the long term.

[11] For a detailed discussion of the methodology, see Coady et al. (2006); Kpodar (2006).

$$\Delta \text{ Medical expenditure}_{i,j} = ((1 + \varepsilon_j * \Delta P) - 1) * \frac{\text{Cost Treat.Tobacco Related Diseases}_i}{\text{Total expenditure}_{j0}} \quad \text{(A3)}$$

A reduction in tobacco consumption in the long run would be strongly related to a decline in the incidence of tobacco-related diseases. The model assumes that the health effects of tobacco-related diseases will immediately diminish with the reduction in tobacco consumption. Although this assumption is implausible in the short term because changes in the effects of tobacco-related diseases take time to materialize, it provides an upper-bound estimate of the effects of tax increases.

Increase in years of working life

The model estimates the impact on income arising from the increase in working years (equation A5). To estimate the increase in working years, the years of life lost (*YLL*) from tobacco-related diseases are distributed across deciles (i) proportionally to the number of households that consume tobacco (equation A4). Subsequently, the income lost is estimated as the average income per household in decile i. Overall, the model anticipates that income will increase as the number of years lost because of premature deaths from tobacco consumption decline.

$$Working\ Years_i = (YLL_i * Share\ of\ Smokers_i)/Population_i \quad \text{(A4)}$$

$$\Delta \text{ Income}_i = ((1 + \varepsilon_j * \Delta P) - 1) * \frac{\text{Working Years}_i * \text{Total Expenditure}_i}{\text{Total expenditure}_i} \quad \text{(A5)}$$

The total income gains in each income group are estimated by adding the results of the increase in tobacco expenditures, the reduction in medical treatments, and the gain in working years (equation 1 in the main text).

B. Tobacco Price Elasticity by Decile

Let Q_{id} be defined as the average quantity smoked per day by individual i in income decile d; P the average price per cigarette (unit value of tobacco use); D_i the consumption decile of individual i; and X_{id} the individual characteristics. Then, the smoking intensity equation is written as follows:

$$\ln Q_{id} = \beta_0 + \beta_1 lnP * D_i + \beta_3 X_{id} + \mu_{id} \quad \text{(A6)}$$

The empirical analysis of equation (7) assumes a log-log relationship among smoking intensity, price, and income. lnQ_{id} is observed if and only if the individual from a given decile d is a current smoker.

Several models were tested before deciding on the final elasticities that were used in the model. Table B1 considers the main equation without controls, adding demographic controls and then adding demographic controls and year fixed effects.

Table B1 – Regression Results, by Model

	No controls			*Controls*			*Controls and fixed effects*		
Variables	*White*	*Clove*	*All*	*White*	*Clove*	*All*	*White*	*Clove*	*All*
Log price	−0.69	−0.59	−0.60	−0.69	−0.60	−0.60	−0.77	−0.64	−0.65
	(0.022)	(0.0058)	(0.0056)	(0.0227)	(0.006)	(0.0059)	(0.0233)	(0.0061)	(0.006)
Decile 2*Log price	0.07	0.05	0.05	0.07	0.05	0.05	0.07	0.05	0.06
	(0.0072)	(0.0014)	(0.0014)	(0.0075)	(0.0015)	(0.0014)	(0.0075)	(0.0015)	(0.0014)
Decile 3*Log price	0.09	0.08	0.08	0.10	0.08	0.09	0.10	0.09	0.09
	(0.0066)	(0.0014)	(0.0014)	(0.0069)	(0.0014)	(0.0014)	(0.0069)	(0.0014)	(0.0014)
Decile 4*Log price	0.12	0.10	0.10	0.12	0.10	0.10	0.12	0.11	0.11
	(0.0062)	(0.0014)	(0.0013)	(0.0065)	(0.0014)	(0.0014)	(0.0065)	(0.0014)	(0.0014)
Decile 5*Log price	0.14	0.11	0.12	0.14	0.12	0.12	0.14	0.12	0.12
	(0.0062)	(0.0014)	(0.0014)	(0.0065)	(0.0014)	(0.0014)	(0.0064)	(0.0014)	(0.0014)
Decile 6* Log price	0.15	0.13	0.13	0.16	0.13	0.14	0.16	0.14	0.14
	(0.0061)	(0.0014)	(0.0014)	(0.0065)	(0.0014)	(0.0014)	(0.0065)	(0.0014)	(0.0014)
Decile 7* Log price	0.16	0.13	0.14	0.17	0.14	0.14	0.17	0.15	0.15
	(0.0061)	(0.0014)	(0.0014)	(0.0064)	(0.0015)	(0.0014)	(0.0064)	(0.0015)	(0.0014)
Decile 8* Log price	0.17	0.14	0.14	0.18	0.15	0.15	0.18	0.16	0.16
	(0.0061)	(0.0015)	(0.0014)	(0.0065)	(0.0015)	(0.0015)	(0.0065)	(0.0015)	(0.0015)
Decile 9*Log price	0.18	0.14	0.15	0.19	0.16	0.16	0.20	0.17	0.17
	(0.006)	(0.0015)	(0.0015)	(0.0065)	(0.0016)	(0.0016)	(0.0065)	(0.0016)	(0.0016)
Decile 10*Log price	0.19	0.15	0.16	0.21	0.18	0.18	0.22	0.18	0.19
	(0.0061)	(0.0016)	(0.0016)	(0.0067)	(0.0018)	(0.0017)	(0.0067)	(0.0018)	(0.0017)
Education HH				−0.01	−0.01	−0.01	−0.01	−0.01	−0.02
				(0.0017)	(0.0005)	(0.0005)	(0.0018)	(0.0005)	(0.0005)
Gender HH				−0.05	−0.17	−0.18	−0.06	−0.18	−0.19
				(0.0256)	(0.0085)	(0.0082)	(0.0259)	(0.0085)	(0.0082)
Age HH				0.01	0.01	0.01	0.01	0.01	0.01
				0.0008	0.0002	0.0002	0.0008	0.0002	0.0002
Share ages <5				0.82	0.87	0.87	0.87	0.90	0.90
				(0.0624)	(0.0171)	(0.0166)	(0.0623)	(0.0171)	(0.0166)
Share ages 6-17				0.59	0.62	0.62	0.63	0.64	0.65
				(0.0468)	(0.0118)	(0.0115)	(0.0466)	(0.0118)	(0.0115)
Share ages 18-49				0.47	0.59	0.62	0.47	0.60	0.63
				(0.0426)	(0.0103)	(0.0101)	(0.0426)	(0.0103)	(0.01)
Urban				−0.11	−0.09	−0.09	−0.10	−0.09	−0.08
				(0.0135)	(0.0039)	(0.0037)	(0.0135)	(0.0038)	(0.0037)
Dummy Year 2016							0.17	0.13	0.14
							(0.014)	(0.0039)	(0.0038)
Constant	9.26	8.84	8.88	8.61	8.06	8.05	9.00	8.28	8.28
	(0.13)	(0.034)	(0.0332)	(0.142)	(0.0381)	(0.0371)	(0.1446)	(0.0385)	(0.0375)
Observations	31,903	333,848	359,185	30,629	317,559	341,961	30,629	317,559	341,961
R-Squared	0.1	0.1	0.1	0.11	0.13	0.13	0.12	0.13	0.14

Source: Estimates based on Indonesia National Socioeconomic Surveys 2015–16.

Note: Demographic controls age, highest level of education, and gender of the household head; share of individuals by age-group in each household; and urban status. The model also controls for year fixed effects. Only 2015–16 were used to estimate elasticities because previous surveys asked about the number of cigarette packets consumed, whereas the most recent surveys ask about quantities of individual cigarettes. HH = household head.

C. Descriptive Statistics, 2010

Table C.1 – Descriptive Statistics

Indicator	*Decile 1*	*Decile 2*	*Decile 3*	*Decile 4*	*Decile 5*	*Decile 6*	*Decile 7*	*Decile 8*	*Decile 9*	*Decile 10*	*All*
Average Household Monthly per capita Expenditure (Rupia)	161,615	216,099	261,429	309,522	364,929	431,781	515,455	633,208	831,527	1,603,556	532,922
Proportion of exp. on all tobacco products[a]	5.4	6.4	6.8	6.8	7.1	6.7	6.5	6.0	5.2	2.8	5.3
Proportion of exp. white cigarettes	0.1	0.2	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.3
Proportion of exp. clove cigarettes	4.3	5.4	6.0	6.2	6.5	6.1	6.0	5.5	4.8	2.5	4.8
Households that smoke any tobacco product (%)	69.1	71.2	70.2	69.3	70.0	66.8	67.7	64.2	60.8	50.2	66.0
Households that smoke white cigarettes (%)	2.0	2.2	2.4	2.8	3.7	3.2	3.7	4.2	4.4	6.4	3.5
Households that smoke clove cigarettes (%)	43.7	53.6	57.2	59.5	60.8	59.9	61.2	58.7	55.9	43.8	55.4
Woman-headed households (%)	13.5	13.4	15.0	14.3	15.4	15.8	16.1	15.6	15.4	17.8	15.2
Age, household head	49.6	49.5	49.6	49.1	49.2	48.9	48.6	48.5	48.0	47.2	48.8
Share of kids ages 0-5 in household (%)	12.6	10.6	9.5	9.6	8.6	8.0	7.8	7.8	6.9	4.9	8.6
Share of individuals ages 6-17 in household (%)	25.5	23.7	22.2	21.8	21.3	21.0	19.6	18.6	17.1	14.3	20.5
Share of adults ages 18-49 in household (%)	39.4	41.3	43.6	43.8	44.5	45.8	47.8	48.9	51.9	54.4	46.1
Share of individuals ages 50+ in household (%)	22.5	24.4	24.7	24.8	25.6	25.1	24.8	24.7	24.1	26.4	24.7

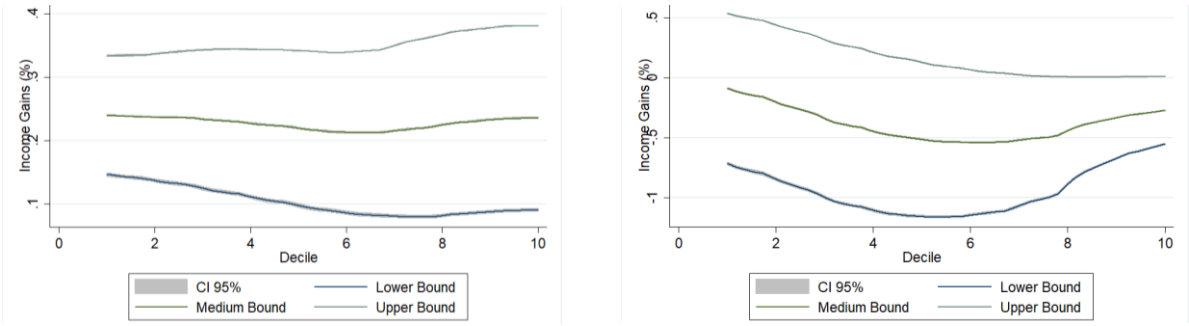
Source: Estimates based on Indonesia National Socioeconomic Survey 2010.
Note: Deciles were created using per capita household expenditure.
a. Proportional to total budget per household in each decile; households that smoke = 1 if a household member reports spending on tobacco products.

D. Robustness Checks

The reduction in medical expenses and the rise in income from longer lives and greater productivity because of reduced morbidity are unlikely to have an immediate impact on household income. Instead, the effects are likely to materialize later in the life cycle of a smoker induced to quit as a result of higher taxes. To incorporate this in the analysis, discounted values of medical costs savings and years of life lost are included in the analysis. A discount rate of 3 percent is used for medical costs, assuming the costs of smoking materialize 5 or 10 years after the tax increase. Similarly, discount rates of 3, 5, and 10 percent are applied to years of life lost. The overall results hold with the discounted values, though the impact on income is less pronounced the higher the discount rate applied (figures D1 and D2; tables D1–D4).

Figure D1 – Total Income Effect: Direct and Indirect Effects of Tobacco Taxes
(Tobacco Price Increase, Medical Expenditure, and Working Years Gained) (3 percent discount rate)

a. White cigarettes **b. Clove cigarettes**



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 3 percent discount rate has been applied to years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in five years.

Table D1 – Net Effect on Household Expenditures, White Cigarettes, 3 Percent Discount (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.16	0.14	0.12	0.12	0.10	0.09	0.08	0.08	0.08	0.10
Medium elasticity	0.24	0.24	0.23	0.24	0.22	0.21	0.20	0.22	0.24	0.24
Upper-bound elasticity	0.32	0.34	0.33	0.36	0.34	0.34	0.33	0.37	0.40	0.38

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 3 percent discount rate has been applied to the years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in five years.

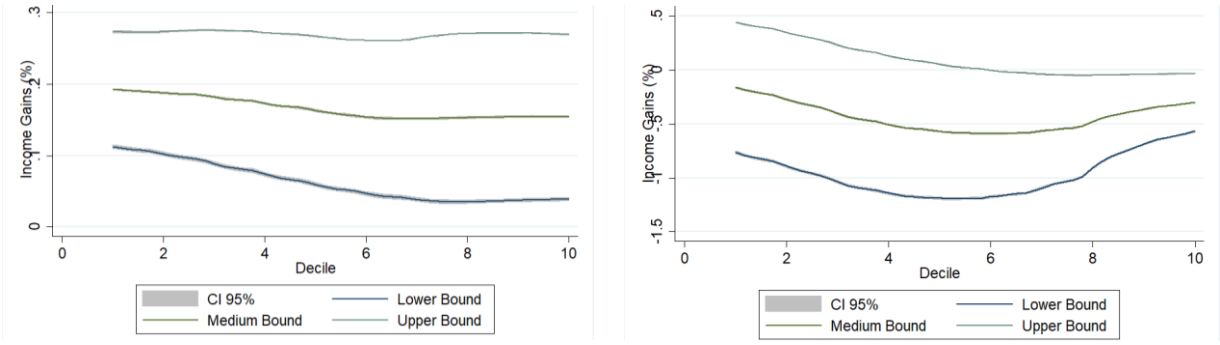
Table D2 – Net Effect on Household Expenditures, Clove Cigarettes, 3 Percent Discount (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	−0.50	−0.83	−1.01	−1.11	−1.18	−1.19	−1.11	−0.99	−0.79	−0.40
Medium elasticity	0.09	−0.18	−0.34	−0.44	−0.52	−0.57	−0.54	−0.50	−0.40	−0.19
Upper-bound elasticity	0.68	0.47	0.32	0.22	0.13	0.06	0.02	0.00	−0.01	0.02

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 3 percent discount rate has been applied to years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in five years.

Figure D2 – Total Income Effect: Direct and Indirect Effects of Tobacco Taxes
(Tobacco Price Increase, Medical Expenditure, and Working Years Gained) (10 percent discount rate)

a. White cigarettes **b. Clove cigarettes**



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 10 percent discount rate has been applied to years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in 10 years.

Table D3 – Net Effect on Household Expenditures, White Cigarettes, 10 Percent Discount (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	0.13	0.11	0.09	0.08	0.06	0.05	0.04	0.04	0.03	0.04
Medium elasticity	0.20	0.19	0.18	0.18	0.16	0.15	0.14	0.15	0.16	0.15
Upper-bound elasticity	0.27	0.28	0.27	0.28	0.26	0.26	0.25	0.27	0.29	0.26

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 10 percent discount rate has been applied to years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in 10 years.

Table D4 – Net Effect on Household Expenditures, Clove Cigarettes, 10 Percent Discount (%)

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	−0.56	−0.88	−1.05	−1.15	−1.22	−1.23	−1.14	−1.02	−0.82	−0.42
Medium elasticity	0.01	−0.25	−0.41	−0.51	−0.58	−0.62	−0.59	−0.54	−0.44	−0.22
Upper-bound elasticity	0.57	0.37	0.23	0.14	0.05	−0.01	−0.04	−0.06	−0.06	−0.02

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: The table reports the share of total consumption for each decile. Years of life lost have been estimated using all deaths from tobacco-related diseases; a 10 percent discount rate has been applied to years of life lost. Similarly, for medical cost savings, a 3 percent discount is used, assuming benefits materialize in 10 years.

E. Simulation: Tobacco Tax Revenue Redistributed to All Households

If tobacco tax revenues were redistributed to households through direct transfers, this could offset health expenditures and potentially benefit lower-income households the most because the transfers would represent a larger share of the total expenditure of these households. To test this hypothesis, a 10 percent tax increase is assumed to be equivalent to 10 percent of total tobacco tax excise revenue; this amount is redistributed to all households equally.[12] This effect is added as a fourth component in the analysis, as follows:

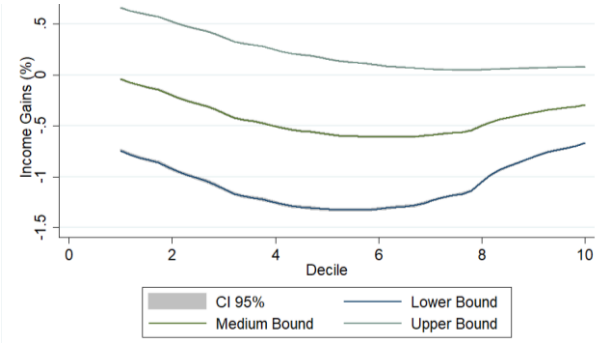
Income effect = change in tobacco expenditure (A) + lower medical expenses (B) + rise in income (C) + direct tax revenue transfer (D) (E1)

$$Direct\ Tax\ Rev.Transfer = (Tax\ Revenue/TotalHouseholds)/\text{Total expenditure}_i \quad \text{(E2)}$$

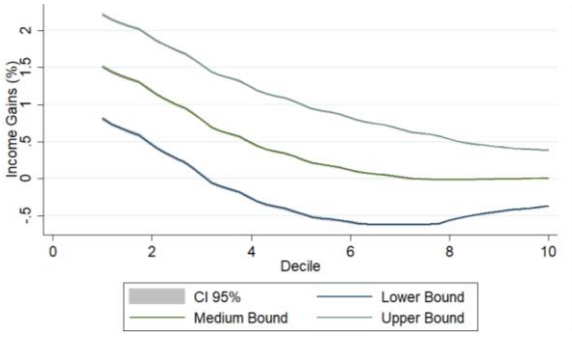
As expected, this additional revenue benefits poorer households the most (figure E1, panel b). Thus, an increase in tobacco taxes, accompanied by some redistribution, even if it is not earmarked for the poor, could result in a progressive policy outcome.

Figure E1 – Total Income Effect: All Tobacco Products

a. Tobacco price increase, medical expenditure, working years gained



b. Tobacco price increase, medical expenditure, working years gained and direct tax revenue transfer



Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent. The redistribution of 10 percent of tobacco tax excise revenue to households is assumed in panel b.

Table E1 – Net Effect on Household Expenditures (Including Direct Tax Revenue Transfer), All Tobacco Products

Price shock scenario	*Deciles*									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Lower-bound elasticity	1.42	0.47	0.05	−0.27	−0.49	−0.62	−0.66	−0.63	−0.55	−0.26
Medium elasticity	2.08	1.19	0.79	0.49	0.27	0.10	0.01	−0.03	−0.05	0.04
Upper-bound elasticity	2.73	1.92	1.54	1.25	1.02	0.83	0.68	0.57	0.45	0.34

Source: Estimates based on Indonesia National Socioeconomic Survey 2016.
Note: Estimates assume a price shock of 25 percent and a redistribution of 10 percent of tobacco tax excise revenue to all households.

[12] In 2017, tobacco excise tax revenues were approximately Rp 58.2 trillion. See "Government to Revise Indonesia's Tobacco Excise Tax Policy," Indonesia Investments, Jakarta, August 22, 2017, https://www.indonesia-investments.com/finance/financial-columns/government-to-revise-indonesia-s-tobacco-excise-tax-policy/item8118?.