New-consumer margin at work: Exposure to television ads as driver of smoking prevalence

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Abstract

Tobacco epidemic kills more than 8 million people every year. Despite a global decline in smoking rate, smoking prevalence is rising in many developing countries. This paper exploits the temporal and regional variation in the proliferation of television reception across Indonesia in the 2000s to examine the impact of advertising on electronic media on smoking participation by young adults. Applying the marketing theory drawn from international trade, I find evidence of a new-consumer margin in tobacco consumption due to improvement in marketing technology. Living in a subdistrict with one standard deviation higher television exposure increases male young adults smoking participation by 4-6%. This impact is especially significant for those of 17 to 19 years old but not older persons.

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1 Introduction

> Tobacco is not just a threat to health, it is also a threat to sustainable human development. (The Lancet, 2015)

Killing more than 8 million people every year, the World Health Organization states that the tobacco epidemic is one of the biggest public health threats that the world ever faced (WHO, 2020). Despite a general decline in the global smoking prevalence, the epicentrum of the epidemic now occurs in developing countries, many of which experience rising smoking prevalence. In fact, low- and middle-income countries account for more than 80% of 1.3 billion world's tobacco consumers.[1] Tobacco consumption is not only costly due to the burden of diseases but also due to the impact of reverting expenditure from more productive uses. Given the rising rate of smoking in developing countries and the cost it bears, it is important to understand what determines the new generations of smokers.

This paper investigates how an improvement in marketing technology used to advertise tobacco products affects smoking pevalence. In particular, this paper finds that higher relative local exposure of televisions (TV), which proliferates the broadcasts of tobacco advertisements, increases smoking participation of young adults. This research contributes to the literature and inform policy makers as it is the first study with nationally-representative data that focuses on the impact of marketing to smoking participation in developing countries setting, where smoking prevalence has been on the rise.

In order to answer the research question, I derive the theoretical prediction of the impact of improvement in marketing technology to market shares based on the theory of marketing in international trade as in Arkolakis (2010). The model introduces a new margin in gains from trade, the new-consumer margin, which represents additional consumers as trade, including marketing costs, declines. I collect three empirical facts that may affect the new-consumer margin in the context of the Indonesian economy in 1990 to 2010. First, there is no substantial change in the tobacco industry's average productivity. Second, as private TV stations started to broadcast in 1993, there has been an improvement in marketing technology as such TV stations advertised tobacco products. Third, real prices of cigarettes, the most common tobacco products consumed in Indonesia, have been relatively stable during the period of study. Hence, the Indonesian economy in this period is an excellent context in which to study the impact of an increase in advertising exposure to smoking prevalence.

Then, I empirically test the theoretical prediction that improvement in marketing technology generates more consumers. I focus on understanding the impact of marketing technology on young adults aged 17 to 23 years old, as preferences, including smoking habits, are formed during this life phase (Chaloupka et al., 1997). I exploit the spatial and time variation of relative local TV

[1] Ibid.

exposure in 2000 and 2007. Using this measure of TV exposure, I perform a difference-in-difference method to study the evidence of new-consumer margin by finding the impact of TV exposure to smoking participation of young adults. In addition, I explore whether smoking behavior has economic consequences. Since I use the Indonesian Family Life Survey (IFLS) data, a longitudinal household survey, I can observe the respondents' economic outcomes seven or fourteen years after being young adults in 2000 or 2007. In order to overcome the endogeneity issue, I instrument current smoking participation with smoking participation during young adulthood to study the impact of smoking to two economic outcomes: college-degree attainment and working status.

There are two main findings. First, I empirically confirm the theoretical prediction that improvement in marketing technology creates new consumers. This paper finds the evidence of the new-consumer margin, in which young male adults living in subdistricts with higher relative TV exposure have a higher chance of smoking. Furthermore, heterogeneity across age groups matters. The impact is significant for younger male adults, especially those of 17 to 19 years of age. An increase of local TV exposure by one standard deviation increases smoking participation by 4%, 5%, and 6%, respectively, for young male adults of 17, 18, and 19 years old. The evidence on new-consumer margin is robust using a different measure of TV exposure, controlling for changes in price of cigarettes, as well as if we include young adults who are also household heads in the sample.

Second, I observe evidence of the long-run economic consequences of smoking. Using the instrument variable approach, I find that male adults who smoke have less probability of attaining a college degree. This result may reflect the role of tobacco consumption in diverting away resources from investment in human capital such as education. Meanwhile, young male adults in the year 2000 also have less chance of having a job in 2014 if they smoke. However, I do not find a significant impact for young male adults in the year 2007. Such result may reflect the mechanism that smoking is perceived well in the society, it may facilitate casual or informal networks. However, I do not find any significant positive impact of smoking in the chance of getting a job.

This paper contributes to several topics in globalization and development literature. First, it contributes to the literature on the impact of introduction and proliferation of electronic media, an inherent aspect of globalization, to human and social capital outcomes. The paper fills in the gap by studying how exposure to advertising through TV increases smoking participation within a developing-country context, where smoking prevalence is rising. It is closest to the study on the impact of the introduction of TV to smoking prevalence in the US by Thomas (2019). However, instead of comparing smoking prevalence before and after the introduction of television, I compare the relative intensity of TV exposure, which is a relevant context in today's society. I also follow Olken (2009), who studies the proliferation of private TV stations in Indonesia and finds that more time spent in consuming electronic media is associated with less social capital outcomes, such as lower participation in social organization and lower self-reported trust. Meanwhile, Kearney and

Levine (2015) find that media may have positive influence on social outcomes by showing that the "16 and Pregnant" TV show reduced teen births as it increased interest in contraceptive use and abortion.

Second, this paper contributes to a wide and active literature on smoking behavior. Chaloupka and Warner (1999) provided a comprehensive survey of literature on the economics of smoking, while Wellman et al. (2006) surveyed recent tobacco-related studies in the public health field. From the context of Indonesia, Setyonaluri et al. (2008) presented comprehensive descriptions and a survey of literature. Many empirical works in this stream of literature focuses in analyzing the impact or changes in prices and taxes as tobacco-control policies.[2] Hence, they focus more on smoking cessation and intensive margin of tobacco consumption. I contribute to this literature by studying an important margin in smoking prevalence, i.e., smoking participation among young adults, that stem from advertising exposure. As Warner et al. (1992) emphasized, despite advertisement is not the sole determinant that young adults start smoking, it is the most policy tractable. Hence, understanding the impact of advertising contributes directly to providing evidence-based tobacco-control policies.

Lastly, this paper also relates to the literature on the role of advertising in international trade and firm dynamics. In particular, I find evidence of the new-consumer margin, as introduced by Arkolakis (2010), for a particular industry within a market. Using smoking participation as indication of new consumers, I show that improvement in marketing technology enlarges the consumer base of tobacco products in Indonesia. Recent studies in understanding how firms grow have emphasized the substantial roles of advertising. Using detailed consumption data and TV advertising data, Argente et al. (2021), for example, showed that the growth of firms in market share within a market is driven more by advertising, rather than markups. Meanwhile, Cavenaile and Roldan-Blanco (2021) incorporate advertising decision into endogeneous growth with research and development (R&D) and show that advertising and R&D are substitutes. Importantly, they find that bigger firms rely more on advertising than on R&D.

The rest of the paper is structured as follows. In Section 2, I describe the recent development in tobacco consumption, the tobacco industry, as well as tobacco-control policies in the world and in Indonesia. In Section 3, I lay out the basics of the marketing theory in international trade based on Arkolakis (2010), and derive the theoretical predictions of the impact of improvement in marketing technology to market shares. Based on the theoretical framework, I document the trend of three factors that may affect the number of tobacco consumers in Indonesia. Then, I empirically test the theoretical prediction of the existence of the new-consumer margin. I explain the data as well as the empirical strategy in Section 4. In Section 5, I present and discuss the evidence of the new-consumer margin as well as explore the long-run economic impacts of smoking. In Section 6, I provide the conclusions of the paper and propose some implications from the findings.

[2]See for example Becker et al. (1994) and Cotti et al. (2016) using US data and Ross and Chaloupka's (2006) survey for developing countries.

2 The economics of smoking

In this section, I provide some background in terms of tobacco consumption, the tobacco industry, and tobacco-control policies in the world in general and in Indonesia in particular.

2.1 Tobacco consumption

Globally, we have witnessed a general decline of smoking prevalence over time. Figure 1 shows adult male smoking prevalence by countries in the years 2000, 2005, 2010, and 2015. Red colors depict higher smoking prevalences while yellow colors depict lower rates. We can see that in the span of 15 years, many countries have turned from red to yellow. The decreasing trend in smoking prevalence is especially starker in developed economies.

Despite such an encouraging development, there is a wide variety in the achievement of or failure to reduce smoking prevalence. Figure 2 shows that many developing countries, especially those in Africa and Asia, either have lower decline rates or have experienced increases in smoking prevalence. Congo experienced the largest growth in smoking rates with 37.2 percentage point increase between the years 2000 and 2015. Meanwhile, in the same period, smoking prevalence increased by 14.6 percentage points in Indonesia. The country jumped up to the second highest in smoking prevalence in 2015, with a 75.2 percent smoking prevalence rate for adult males, from the sixteenth place in 2000.

In conjuction with the high smoking prevalence in Indonesia, tobacco products have been documented as one of the main commodities in Indonesian households consumption basket. Indeed, tobacco products contribute the third biggest share in households consumption basket after rice and prepared foods. Table 1 also shows that in both rural and urban households, expenditure shares on tobacco products have been around 4-6% in urban area and 7-8% in rural areas throughout 2000 to 2015. In addition, households spend on average more on tobacco products compared to education or health services. Spending on tobacco products constitutes at least twice of household's average spending on health services.

The real expenditures on tobacco products per capita have increased as well. Constructed from the Indonesia Family Life Survey (IFLS), a longitudinal panel of households data, Figure 4 shows that the distribution of per capita consumption on tobacco products has shifted to the right from 1993 to 2014.

There is substantial variation in smoking prevalence across regions in Indonesia. Figure 3 shows the smoking prevalence in populations of 15 years or older, retrieved from the Indonesia's Social and Economic Household Survey (*Susenas*) in 2016 across districts and provinces. Comparing districts, the median is 30%, while the 10th percentile and 90th percentile are 22.5% and 35%, respectively.

Table 2 compares the increases in smoking prevalence across age groups and sex in 1995, 2001,

and 2004. Two facts stand out: first, smoking participation is more common among males. Second, the younger age male groups experienced the highest percentage change increase with an increase of 139% and 49% for the age groups 15 to 19 years old and 20 to 24, respectively.

In addition, 97% of tobacco consumption take the form of cigarettes in Indonesia. Clove cigarettes or *kreteks* are more popular among tobacco users in Indonesia, compared to white cigarettes. As 60 to 70% of the ingredients in clove cigarettes are tobacco, they have the same health risks as other types of tobacco products (Setyonaluri et al., 2008).

2.2 Tobacco industry

The global tobacco industry can be categorized as oligopolistic, with several key players in the industry, with the top five companies accounting for more than 80% of the world cigarette market.[3] It is widely studied that these firms grew by opening foreign affiliates or acquiring local tobacco manufacturing firms to penetrate markets. These firms rely on expanding their consumer base to especially to less-mature markets in Africa, Asia, and the Middle East (Gilmore et al., 2015).[4] Lee et al. (2012) survey the literature that documents and analyzes how the trans-national tobacco companies penetrate markets in the low- and middle-income economies. These firms actively build presence through influencing tobacco-control policies as well as promoting tobacco use by foreign direct investment and customized marketing and advertisement of tobacco brands and products to each market environment.

The tobacco manufacturing industry is not a new industry in Indonesia; it established its footing in the early 20th century, even before the country's independence in 1945. The tobbacco industry has many small firms with a few large fims. Figure 5 plots those firms' ranks in revenue and log revenue in 1994 and 2004. We can see that the characteristics persists over time. Indeed, just like the structure in the global market, the tobacco industry in Indonesia is also an oligopoly, with the three biggest firms accounting for more than 70% of the market share (Setyonaluri et al., 2008).

There are a few firms with some foreign ownership. Table 4 shows the evolution of the number of foreign and domestic firms over time, which are part of the medium and large manufacturing survey. In our period of interest, the 1990s and 2000s, there are hundreds of domestic firms but less than a dozen firms with any foreign ownership. Comparing firms by status of foreign ownership, Figure 6 shows that the industry production has been dominated by domestic firms.

The tobacco industry is also concentrated in two provinces: Central Java and East Java. These two provinces account for 90% of all tobacco manufacturers.[5] It seems that these tobacco manufactureres cluster to get access to their main inputs as these provinces are also the main

[3] See Table 3 for market shares of the top tobacco manufacturing firms.

[4] Other studies which document such globalisation strategies by the main trans-national tobacco companies, for example, include Lee and Eckhardt (2017) and Stuckler et al. (2012).

[5] Calculated from Manufacturing Survey data.

producers of tobacco leaves. The top seven districts in tobacco farming are located in the Central and East Java provinces. They account for 84% of national tobacco leaves production (Sahadewo et al., 2021).

In terms of international trade, most of tobacco manufacturers, including the foreign-owned ones, sell domestically. Only around 2 to 4% report to sell products overseas. Meanwhile, they also source their raw materials mostly from domestic suppliers. Between 1990 and 2010, on average 6% of firms reported they have imported materials, with an average of 16% of their materials are imported. Specifically for cigarettes, Indonesia's imports fluctuate but range between 0.5% to 6% relative to the domestic cigarette productions (Setyonaluri et al., 2008).

Lastly, another characteristic that stands out is that the (ln) output per labor, as a raw proxy for productivity, positively correlated with the market size of the firm as indicated by (ln) revenue. This pattern is robust over time. For instance, Figure 7 shows this positive correlation in 1994 and 2004.

2.3 Tobacco-control policies

The global decline in smoking prevalence has been driven by a stronger commitment to implement tobacco control policies. In 2003, the World Health Assembly adopted the WHO Framework Convention on Tobacco Control (WHO FCTC). The treaty is the first international treaty under the auspices of the WHO. The WHO FCTC came into force in 2005. There are 168 countries which signed the FCTC (WHO, 2021). Countries ratifying the treaty commit to conduct measures to control tobacco use, including by reducing demand for tobacco, regulating marketing activities, and providing alternatives to those growing and producing tobacco (WHO, 2015).

Indonesia, despite being a member of the WHO, has not ratified the FCTC. Tobacco-control policies and regulation are governed by the central government although there are some local governments which impose stricter tobacco-control policies. The numbers of local governments with stronger regulations unfortunately are still very limited.[6]

Setyonaluri et al. (2008) compiled and documented tax regimes imposed on tobacco products and argued that the complexity of the tiered tax system based on production volumes, that aims to protect relatively smaller tobacco manufacturers, contributes to the industry's characteristics of having many small firms. They also showed that the main tax rate changes were imposed in 2008. In addition, they argued that in comparison to other low-income countries and regional averages, Indonesia's cigarette taxes and prices are relatively low.

In terms of age limit, Indonesia started to have a minimum age for tobacco products procurement in 2012. Since then, one has to be 18 years or older to be able to purchase tobacco products. There were no age limits before 2012.

[6]The main regulations are Goverment Regulation No. 81 Year 1999, Government Regulation No. 38 Year 2000, Government Regulation No. 19 Year 2003, and Government Regulation No. 109 Year 2012.

Furthermore, there are no complete smoking bans on tobacco advertisements in the national-level regulation. Regulations for advertising on electronic media began 2000. Specifically, tobacco advertising can only be aired on television between 9:30 pm to 5:00 am local time. The regulations also impose obligations on tobacco packaging and labelling. Pictorial health warnings have only beeen required since 2012.[7]

3 Theoretical framework and empirical facts

In order to answer the research question of how improvement in marketing technology to advertise tobacco products affects smoking prevalence, I apply the theory of marketing cost in international trade as developed by Arkolakis (2010). I use this framework especially in understanding how exposure to advertising, both directly and indirectly, affects the decision to start smoking. In this framework, such margin is called the new-consumer margin. This margin is distinct from the other two more common margins in gains from trade, the intensive margin and the extensive margin.

By focusing on the new-consumer margin, I acknowledge that, especially for an addictive substance like tobacco, the utility function may need to take into account factors such as past consumption and/or a high or varying discount rate in explaining the amount of tobacco consumpotion. Hence, I do not aim to focus on understanding the intensive margin due to improvement in advertising as the main focus. Chaloupka and Warner (1999) provide an excellent summary on various utility functions which explain the addiction aspects of smoking consumption. They categorize economic models of addiction into three groups: imperfectly rational models of addictive behavior such as Strotz (1955) and Thaler and Shefrin (1981), models of myopic addictive behavior such as Farrell (1952), and models of rational addictive behavior such as Becker and Murphy (1988) and Becker et al. (1991). In addition, since I focus on one particular market, I also do not focus on whether the improvement in marketing technology creates new producers and importers, i.e., the extensive margin.

3.1 Theory of marketing cost in international trade à la Arkolakis (2010)

Arkolakis (2010) develops a theory of marketing cost in international trade that generalizes the international trade model with heterogenous firms as in Melitz (2003) and Chaney (2008).[8] In this environment, heterogenous firms operate with constant-return-to-scale (CRS) technology with productivity ϕ. These firms sell their products under monopolistic competition.

The main difference in Arkolakis's (2010) setup is that firms incur marketing costs to reach individual consumers in each market. Let us define S as the number of advertisements (ads) sent

[7]For more further summarized details on tobacco-control policies, please refer to for Tobacco Free Kids.
[8]I describe only the most relevant aspects of the environment of the model here.

by a firm, L as the numbber of consumers, and $n(S)$ refers to the probability that a particular consumer sees the ad at least once after S ads have been sent.

There are three assumptions to capture the nature of the marketing technology. First, the number of consumers who see each ad is given by $L^{1-\alpha}, \alpha \in [0,1]$. The parameter α is the main parameter of interest in this paper. When α equals to one, each add is read by one consumer. This case mimics the use of advertising with flyers. Meanwhile, when α is equal to zero, then one ad can reach a given share of consumers in a market. An example of such marketing technology is television ads. I refer to improvement in marketing technology as a decrease in α.

The second assumption captures the decreasing return or increasing marginal cost of marketing. In particular, Arkolakis (2010) assumes that the probability that a new ad is seen by a consumer for the first time is $[1-n(S)]^{\beta}, \beta \in [0,+\infty)$. This assumption is relevant for the case of cigarette consumption. Brown (1978) and Thomas (1989), for example, show evidences tha thet cigarette industry faces diminishing returns in advertising.

Lastly, the third assumption governs the production function in marketing services. Specifically, firms employ a Cobb-Douglas techology that combines labor services in the source country i, l_i, and the labor services in the desination country j, l_j as the following: $S = l_j^{\gamma} l_i^{1-\gamma}$, with $0 \leq \gamma \leq 1$.

Meanwhile, a consumer in country j consumes a composite good from combining differentiated commodities using a CES aggregator with elasticity of substitution $\sigma > 1$. . The consumer receives income, y_j, from her labor income, w_j, and profits earned, π_j. Hence, the demand for each variety as a function of productivity, ϕ, is the following:

$$c_{ij}(\phi) = \frac{p_{ij}(\phi)^{-\sigma}}{P_j^{1-\sigma}} y_j, \tag{1}$$

where p_{ij} is the price of that variety and P_j is the price index for all variety consumed by the consumer in market j.

Firms operate using a constant returns to scale technology with productivity ϕ and produce outputs using labor as the only factor of production. In selling to overseas markets, firms face iceberg trade cost, τ_{ij}. The optimal pricing is then a constant markup over marginal cost, or as below:

$$p_{ij}(\phi) = \frac{\sigma}{\sigma - 1} \frac{\tau_{ij} w_i}{\phi}. \tag{2}$$

Firms maximizes profits, which is the difference between revenue with labor cost of production and marketing cost. Hence, provided that the firm enters the market, i.e. $\phi \geq \phi_{ij}^*$, where ϕ_{ij}^* is the entry threshold, the optimal consumers to be reached, n_{ij}, solves the equation below. This equation shows that the marginal revenue (after differencing out labor cost for production) on the left-hand side equals to the marginal cost per consumer on the right-hand side:

$$\frac{y_j}{\sigma}\frac{\left[\tilde{\sigma}\left(\tau_{ij}w_i/\phi\right)\right]^{1-\sigma}}{P_j^{1-\sigma}} = \frac{w_j^{\gamma}w_i^{1-\gamma}}{\psi L_j^{1-\sigma}}\frac{1}{(1-n_{ij})^{\beta}}, \tag{3}$$

where $\tilde{\sigma} = \frac{\sigma}{\sigma-1}$, is the constant mark-up, and $\frac{1}{\varphi} = \gamma^{\gamma}\left(1-\gamma\right)^{1-\gamma}$, is the per-unit advertisement costs. Solving equation 3 above for ϕ by setting $n_{ij} = 0$, we can derive the entry threshold ϕ_{ij}^*:

$$\left(\phi_{ij}^*\right)^{\sigma-1} = w_j^{\gamma}w_i^{1-\gamma}L_j^{\alpha-1}/\left[\frac{y_j}{\sigma}\frac{\left(\widetilde{\sigma}\tau_{ij}w_i\right)^{1-\sigma}}{P_j^{1-\sigma}}\psi\right]. \tag{4}$$

Arkolakis (2010) provides three propositions. The first proposition is related to the optimal market penetration decision, which is the focus of this paper. This proposition states that if marketing technology is subject to diminishing returns, i.e. $\beta > 0$, then there exists entry threshold ϕ_{ij}^*, such that:

$$\phi \leq \phi_{ij}^* \Rightarrow n_{ij}(\phi) = 0 \text{ and } \phi_1 > \phi_2 \geq \phi_{ij}^* \Rightarrow n_{ij}(\phi_1) > n_{ij}(\phi_2) \geq 0. \tag{5}$$

While, if marketing technology is not subject to diminishing returns, i.e. $\beta = 0$, then there exists entry threshold ϕ_{ij}^*, such that:

$$\phi \leq \phi_{ij}^* \Rightarrow n_{ij}(\phi) = 0 \text{ and } \phi > \phi_{ij}^* \Rightarrow n_{ij}(\phi) = 1. \tag{6}$$

Thus, the optimal market penetration decision for a firm with productivity ϕ for $\beta \geq 0$ can be expressed as below:

$$n_{ij}(\phi) = \max\left\{1 - \left(\frac{\phi_{ij}^*}{\phi}\right)^{(\sigma-1)/\beta}, 0\right\} \tag{7}$$

3.2 Productivity growth

Let us analyze the implication of an increase in a firm's productivity, ϕ. Based on the proposition of market penetration as shown by equation 5 and 6, as well as the optimal market penetration equation that they infer as shown by equation 7, we can draw two results. First, if the firm faces diminishing returns marketing technology, i.e. $\beta > 0$, then the increase in productivity ϕ, increases the firm's optimal market penetration n_{ij}. We can use the first argument in equation 7 to take the derivative of n_{ij} with respect to ϕ and find that the derivative has a positive sign. Equation 5 also shows this relationship, as it says that conditional on entering the market, a more productive firms has higher optimal market share.

3.3 Improvement in marketing technology

Conditional on passing the entry threshold, ϕ^*_{ij}, we can predict the impact of the changes in α to the optimal market penetration by taking the derivative of equation 7 and 4 with respect to the marketing technology parameter α. The result is shown below. Since the sign is negative, we can infer that as it gets easier to reach more consumers per ad, or as α declines, then the optimal market share or market penetration, n_{ij}, increases. This is the theoretical prediction that I would like to test empirically in this paper.

$$\frac{dn_{ij}(\phi^*_{ij})}{d\phi^*_{ij}}\frac{d\phi^*_{ij}}{d\alpha} = -\frac{\ln \phi^*_{ij}}{\beta\phi}\left(\phi^*_{ij}\right)^{\frac{\sigma-1}{\beta}} \tag{8}$$

3.4 Empirical facts on smoking environment in Indonesia

We can collect two parameters and one variable that may affect optimal market shares. The two parameters are productivity and marketing technology. While an outcome variable that may affect demand is price, here, I document three empirical facts on productivity of tobacco manufacturers, marketing technology, and prices of cigarettes from the Indonesian economy from 1990 to 2010.

Fact 1: Exposure to marketing through television has expanded and varied spatially.

In 1993, Indonesia started to have private-owned television stations. Before 1993, there was only one state-owned television, TVRI. The state-owned television station does not broadcast TV ads, while private-owned TV stations can. Figure 13 compares the average number of TV stations captured in each district in 2003 and 2005.

There are two things we can infer from the figure. First, in both periods, there are substantial spatial variations across subdistricts. Second, the number of private TV stations increased between 2003 and 2005 as there were new TV stations broadcasted. Hence, districts with a given level of exposure in 2003 may still experience some *relative* increase or decrease of exposure due to the addition of these new TV stations.

Fact 2: Industry's average TFP has been relatively stagnant.

I analyze the trend and distribution of total factor productivity (TFP) of firms in the tobacco industry in Indonesia.[9] There are two facts that we can infer from the trend of TFP in the tobacco industry in Indonesia. First, in general, there was no substantial increase of TFP over time in the sample period of 1990 to 2012, except for the last years in the series. Figure 9 shows the simple and weighted average of TFP of the tobacco industry. Both charts show a relatively stagnant level of industry-average productivity.

[9]Please see subsection "Data Appendix: Estimating Total Factor Productivity" in Appendix for details.

Second, there are a few firms that grew their TFP substantially in the last years of the sample period. Most of these firms are domestically-owned. Figure 10 shows a panel of estimated TFP with color indication for foreign-ownership status. Comparing domestic firms with firms with any non-zero foreign ownership, we can infer that they have relatively the same level of productiviy.[10]

Several public health studies show that foreign direct investment by trans-national tobacco companies has been the driver of growing market penetration especially in developing countries.[11] In the context of Indonesia from 1990 to 2010, I do not particularly analyze such flows as the drivers in determining smoking prevalence. In addition, despite there having been some major foreign investments, such as the acquisition of Sampoerna by Philip Morris International[12], I do not see any substantial jump or structural break in the industry-average TFP in the data.

Hence, for the period of study in this paper, I do not consider TFP growth as the drivers of tobacco consumption growth.

Fact 3: Real prices of cigarettes has been relatively stable.

Another factor that determines tobacco consumption is price of tobacco products, especially cigarettes. WHO, supported by various studies, argues that price increase of tobacco products is the single most effective tobacco control measure WHO et al. (2019). I collect two sources of data to document the trend of prices of cigarettes in Indonesia.

First, the national statistic books provide data on prices of clove and white cigarettes in main markets in Indonesia.[13] Figure 11 shows that both types of cigarettes experienced price increases following the high inflation during the 1997-1998 Asian Financial Crisis. As the economy improved and inflation has been moderated, prices have been relatively stagnant in the 2000s.

Second, I also compute the observed average price of cigarettes from households consumption data in IFLS. Figure 12 presents the trend of this statistics over the five waves of IFLS survey between 1993 to 2014. Echoing the previous finding, we also do not see substantial price increase observed from the households spending on cigarettes.

Both sources of data on prices of cigarettes show that there is no significant price increase over time. As explored earlier, the only substantial tax hike happened in 2008. Supporting the observation that the real prices of cigarettes have been stagnant in Indonesia, Setyonaluri et al. (2008) also found that the real prices of cigarettes have been stable between 1970 to 2005 in Indonesia. Nevertheless, I will include the interaction of province and national price average variable as one of the potential determinants of smoking participation in the robustness analysis.

[10] There is no guarantee that domestic firms do not get foreign loans for new investments as we cannot observe such non-ownership foreign financial flows because the dataset only record ownership characteristics.

[11] See for example: Bettcher et al. (2003) and WHO et al. (2012).

[12] PMI (2005).

[13] In earlier years, data was only collected from markets in Jakarta.

4 Data and empirical strategy

4.1 Data and sample construction

The main datasets used for the outcome of interests, smoking participation, are the Indonesian Family Life Survey (IFLS). IFLS is a longitudinal panel of households constructed from nationally representative household surveys. IFLS represents 83% of Indonesia's population with a more than 90% recontact rate. It has six waves of survey years: 1993, 1997, 2000, 2005, 2010, and 2014. Meanwhile, the main datasets used to extract changes in marketing technology improvement are the Village Census (*Podes*) for the years 2003 and 2005/2006. The Village Census covers the universe of villages, the lowest administrative units in Indonesia, and are conducted triennially.

Individual data recorded in IFLS allow us to capture various determinants of smoking participation that have been studied in the literature. These determinants include not only the individual characteristics but also the parents' characteristics. Since the dataset is a longitudinal panel, we can also study the long-term impact of smoking participation as young adults.

In particular, I will exploit the difference between a set of young adults from two different IFLS survey waves. Since private televisions broadcast stations were introduced in 1993 in Indonesia, it would be interesting to also study smoking behavior pre-television ads, as captured by the first wave of IFLS in 1993. However, this wave only interviewed a selection of respondents in 1993 for its smoking-behavior module. Hence,in terms of smoking behavior responses, the sample from 1993 is not comparable with the sample from the later waves. In addition, given the substantial change in tax on tobacco products in 2008 as well as wider proliferation of other electronic media such as the internet in 2010s, I focus on two waves of the IFLS: 2000 and 2007.

Despite the fact that there was no age limit in purchasing tobacco products in Indonesia before 2012, I focus on understanding the smoking behavior of young adults, i.e., respondents of 17 to 23 years old of age. In the analysis, I include the full sample with both male and female respondents. However, for most of the analysis, I will focus on males as smoking behavior is more acceptable for males in Indonesia. Ng et al. (2007), for example, found that there was a social stigma that discourages females from smoking in Java and Bali, two of the most populous islands in Indonesia.

In addition to using age as one of the selection criteria, I also select respondents who are not heads of their households. The reason for this is because it is important to take into account parents' characteristics in understanding smoking behavior, as is shown im studies such as Witoelar et al. (2005). Since some respondents live with extended families instead of with their own biological parents, I find that the characteristics of the heads of households with whom the respondents live to be the relevant parental characteristics, whether or not the heads of households are or are not the respondents' biological parents. In the robustness analysis, I include all respondents between ages 17 to 23, without selecting on their household member status.

In order to find the causality between exposure to marketing of tobacco products, I follow

Olken (2009) in using variation in local reception of television signal strength. Olken shows that local reception is not entirely driven by the endogenous decision of placing TV towers, but is also determined exogenously by geographical features such as terrain and topography. These features affect the strength of reception that can be captured locally. Olken (2009) exploits the timing of the introduction of private TV stations in 1993 as well as the spatial variations in TV signal reception.[14] Since the outcome variable of smoking participation is not completely surveyed in the first wave of IFLS in 1993, I cannot compare the impact of the introduction of television ads by comparing before and after such introduction. Instead, I compare the temporal and regional variation in relative intensity of exposure to televisions. I believe, such a comparison is more relevant as it may not be feasible to eliminate all aspects of marketing through electronic media such as TV in the contemporary world.

In order to get the measure of exposure to TV ads, I compute the number of TV channels received by each village, as recorded in the Village Census in 2003 and 2006. Then, I take the subdistrict average of the number of TV channels captured across each village.[15] Since there have been improvements in TV reception in general between 2003 and 2005 as well as more private TV broadcasting stations, I compute the standardized value of the average number of TV channels received for each subdistrict. The standardized values have a mean of zero and standard variation of one in each survey wave. This measure is the preferred measure to capture relative intensity of exposure to marketing through television ads. An increase of such measure can be perceived as improvement in marketing technology. Using the theoretical framework previously explained, we can consider an increase in relative intensity of TV exposure as a decrease of α, i.e., one unit of TV ads can reach a bigger fraction of a population.

The main sample includes respondents of aged 17 to 23 years of age from IFLS surveys in 2003 and 2007. Table 6 presents the summary statistics of the outcome and control variables between the selected sample from two survey waves. For each variable, I also present the t-test statistics. Lastly, the table also shows the joint-F test for all variables.

The two groups are comparable in several main variables such as education attainment, working status, share of urban residence, and head of household's real annual income. The main outcome of interest, smoking participation, is significantly higher in 2000 compared to 2007. But the head of households' smoking participation status is statistically higher in 2007. Some other individual and head of households characteristics are also statistically different between the two survey waves. I will include all of these variables as controls in the analysis.

[14] Olken (2009) showed that, after controlling for disrict fixed effecrs, the number of television channels received in each village was only correlated with three out of 24 geographic, and socio-economic variables. These three variables are: the presence of any social welfare group in 1990, the log number of hamlets, and whether the subdistrict is coastal. Since I use a different dataset than the one used by Olken for the outcome variables, I control for province fixed effects instead of district fixed effects. Olken also explored the impact of the introduction of TVs, while I explore the impact of relative TV exposure.

[15] Subdistrict is the next higher administrative level above the village level.

4.2 DiD estimates of the impact of TV exposure on smoking participation

In order to study the evidence of the new-consumer margin due to improvement in marketing technology, I run a difference-in-difference (DiD) method as shown by the following empirical specification:

$$Smoke_{icst} = \alpha + \sum_{c} \beta_c TV_{st} \cdot \mathbb{I}_c + \gamma \mathbb{X}_{icst} + \delta_c + \delta_{prov} + \delta_t + \delta_{prov} \times \delta_t + \epsilon_{icdt}. \tag{9}$$

The outcome variable, $Smoke_{icst}$, is whether individual i, with age cohort c, living in subdistrict s, from survey wave t, smokes or not. This variable is 1 if the person smokes, and 0 otherwise. The main explanatory variable is the relative exposure to ads through televisions, TV_{st}. This variable varies across subdistricts and survey waves. In order to capture the heterogeneity of the impact of exposure through TV across age group, I interact the exposure variable with indicator variable for each age group c, where $c \in \{17, 18, 19, 20, 21, 22, 23\}$. I include a set of individual control variables which consists of individual characteristics and the characteristics of the head of household with whom the individual lives. The specification also includes age or cohort fixed effects, δ_c, province fixed effects, δ_{prov}, survey wave fixed effects, δ_t, and province-survey wave fixed effects, $\delta_{prov} \times \delta_t$. There are two survey waves, with $t \in \{2000, 2007\}$. Hence, the coefficients of interest, β_cs, explore the variation across subdistricts within each age groups.

Which mechanisms represent the impact of TV exposure on smoking participation? First, as Olken (2009) shows, the TV exposure used here correlates with radio reception as well. Hence, we should take the impact as a general effect of broadcast media. In terms of public health mechanism, Warner et al. (1992) provides several direct and indirect mechanisms of how advertisement can affect smoking prevalence. Since the exposure variable is constructed at the community level, in particular, across subdistricts at a given period of time, I consider the impact of TV exposure on smoking participation represents both the direct impact and indirect mechanisms of how advertising affects smoking. These direct mechanisms include reducing motivation to stop smoking, enticing smoking initiation, and encouraging relapse. Meanwhile, the indirect mechanisms include discouraging the provision of full discussion on the hazards of smoking in the media and increasing social acceptance to smoking behavior.

In the specification above, I allow the exposure to ads through televisions to vary across age. Belk et al. (1982) and Moore and Stephens (1975), for example, show that there are certain age ranges, especially during adolescence, in which preferences are formed. For comparison, I also run a simpler specification without differentiating the impact of TV exposure by age groups. In addition to the impact of TV exposure, the age cohort fixed effects, δ_c, would capture the inclination of each age group on average towards smoking.

The set of individual controls consists of two groups of controls: the individual socio-economic

variables and the head of household's socio-economic variables. The individual characteristics include whether the individual is still in school, education attainment, working status, marital status, and whether the individual lives in an urban or rural village. In the full sample with both male and female respondents, I also include the gender of the individual. Meanwhile, the socio-economic characteristics of the heads of households include whether they smoke as well as their gender, education attainment, real income, working and marital status.

Furthermore, the specification has province fixed effects, survey wave fixed effects, and province-survey wave fixed effects. The time-invariant province fixed effects will capture all aspects that are province-specific, including inclinations towards smoking behavior in general across provinces. Meanwhile, survey wave fixed effects take care of all time-specific variables that affect all respondents in each survey year, such as general macroeconomic conditions, the growth of industry-average productivity in the tobacco industry, and overall prices of tobacco products. In addition, province-survey year fixed effects will control confounding factors, such as changes in tobacco-control policies imposed by local governments, local economic conditions, and other time-varying province specific variations.

4.3 IV Estimates of young adults smoking participation on long-run outcomes

Smoking behavior may have economic consequences. For example, since more income is spent on tobacco consumption and less on investment in nutrition and/or education, one may accumulate less skills. This lower level of skills may then affect one's performance in the labor market. However, it is challenging to investigate this due to the endogeneous relation between current smoking behavior and current labor market performance. I propose to use smoking status in adolescence and young adulthood as an instrument variable (IV) to current smoking behavior to study the impact of smoking to economic outcomes.

This IV approach depends on the variation across individuals in their prolonged smoking prevalence. The dataset that I use here allows me to investigate such prolonged tobacco consumption, as IFLS follows each respondent over time. In particular, I study the several economic outcomes in the most recent IFLS survey wave in 2014 for the respondents selected in the surveys in years 2000 and 2007. For the selected sample in 2000, I explore respondents' economic outcomes 14 years later. While for the selected sample in 2007, I study respondents' economic outcomes after seven years later.

Specifically, the IV approach is performed using the a two-stage linear least square approach. In the first stage, smoking behavior documented in 2014 is regressed on smoking behavior in individuals ages 17 to 23. Then, the second stage estimates the impact of smoking using the instrumented smoking behavior to outcome variables, such as working status and college-degree attainment.

5 Results

5.1 Evidence of the new-consumer margin

Improvement in marketing technology represented by exposure to television ads expands smoking prevalence by inducing more new smokers. This impact is especially significant for young male of 17 to 19 years of age. The impact of TV exposure on these age groups is significant after controlling for age-specific inclination to smoke as captured by the age fixed effects. Table 7 shows the results for the estimated coefficients of interests from running equation 9, i.e., the sensitivity to smoking participation through TV exposure, in order to investigate the evidence of new-consumer margin due to expansion of exposure to ads on TVs.

First, the impact of TV exposure to smoking participation is not significant for the full sample which includes both male and female respondents. The results for the full sample are shown in columns one to three in Table 7. Such contrast between the full sample and male-only sample is not surprising, as female smoking prevalences across age groups is a lot less compared to the males. As previously mentioned, according to Ng et al. (2007), there is a widespread stigma against females smoking, as smoking represents a manly behavior in Indonesia. Such social acceptance on smoking for males is also present in India as shown by Sen and Basu (2000) as well as in Pakistand and Bangladesh as shown by Bush et al. (2003). Thus, from this point forward, I will focus more on studying the results for the sample set with only male respondents.

Second, the heterogeneity across age groups turns out to be meaningful. The age fixed effects show that the average smoking participation varies across age, even amon young adults as the focus of this study. Figure 14 presents the coefficients and their 95% confidence interval for the age fixed effects for male respondents. These estimated coefficients are quite high to begin with. Among 17-year old males (the age group with the lowest coefficient), there is, on average, a 50% chance of smoking.

Let us explore the results of the main coefficients of interest: the impact of TV exposure to smoking participation. Columns four and five on Table 14 show the estimated coefficients for male respondents. First, column four shows that without taking account the heterogeneity of impact across age group, the impact of TV exposure is not statistically significant. However, living in subdistricts with higher TV exposure increases the chance of smoking participation for the younger group.

In Table 15, column one presents the main result that shows the evidence of new-consumer margin due to improvement in marketing technology. This column shows the marginal effect of TV exposure for each age group, i.e., how much the chance of smoking changes for an increase of one standard deviation of TV exposure. For the age group 17, 18, and 19 years old, an increase in TV exposure significantly increases the chance of smoking participation. In particular, for those of 17 years of age, increasing TV exposure by one standard of deviation increases the chance of

smoking by 3.7%. The marginal effect of TV exposure is higher for the age group 18 and 19 years of age, with an increase of 5.6% for chance of smoking due to one standard deviation increase of TV exposure for age group 19 years of age, Meanwhile, the marginal effect of TV exposure is not statistically significant for the older age groups between 20 to 23 years old. Figure 15 illustrates these marginal impacts of TV exposure to smoking participation for each age group across the distribution of TV exposure.

This result is consistent with the impact of introduction to television in the United States to smoking participation as shown by Thomas (2019). Thomas demonstrated that the impact is significant for the youth as well. In addition, TV exposure may not matter much in the smoking participation decision of the older groups in this study as their preference to smoke are formed when they are younger. Holbrook and Schindler (1989), who studied the construction of preference to popular music for example, showed that sensitivity of preference may peak around 24 years of age.

The findings on the evidence of the new-consumer margin here contributes to the understanding of the impact of the different magnitude of exposure through television ads to smoking participation. Previous studies focus on comparing the change in smoking prevalence with and without such marketing channels. Hence, instead of focusing on such a structural break, I focus on how varying relative exposure presents a different impacts. Understanding how the magnitude of exposure matters is important in informing policy makers, especially in regulating tobacco advertisements in the current environment of high accessibility and affordability of media.

Furthermore, I also contribute to the discussion on whether advertisements influence only current smokers or also produce a new generation of smokers. Warner et al. (1992) mentioned that tobacco companies usually argue that the role of advertisement is to encourage switching to their brands or to increase loyalty to their brands. This evidence of the new-consumer margin confirms that advertisements not only affect current smokers but also generate new smokers.

In all specifications, I control for various individual characteristics and head of households' characteristics. The results for these controls are consistent with the literature. Figure 16 illustrates the estimated coefficients for these controls that are factor variable. The blue coefficients refer to the result for the full sample as part of the specification on column two of Table 7, while the yellow coefficients are the results for the male-only sample as part of the specification on column five of Table 7.

In both sets of samples, attending school decreases the chance of smoking for the population of between 17 to 23 years of age. In contrast, working status increases the chance of smoking. Importantly, individuals who live with household heads who smoke, also have a higher chance of smoking. This is consistent with the findings studied by Witoelar et al. (2005) which show that having parents who smoke increases youth's chance of smoking in Indonesia. A study on smoking behavior in youths in Taiwan by Wen et al. (2005) also show the important role of parental smoking

behavior. In addition, living in an urban area decreases the chance of smoking, echoing the same result presented by Adioetomo et al. (2005).

Furthermore, Table 9 presents the estimated coefficients for education and income. Especially for our main specification with male-only sample, educational attainment is negatively associated with smoking participation. Likewise, head of households' education attainment is also negatively associated with chances of smoking for the population in 17 to 23 years old of age. In contrast, in the male-only sample, head of household income does not have a statistically significant impact to chances of smoking. The negative association of education and non-significant association of income to smoking participation is consistent with the literature, as shown by Witoelar et al. (2005).

5.2 Long-run impacts

The IFLS surveys allow us to observe the dynamic of socio-economic condition over life cycles. This feature allows us to explore the long-run impact of smoking participation when one is young to their condition later in life. I investigate the consequences of smoking behavior to several economic outcomes using the instrument variable (IV) approach to tackle the endogeneity issue inherent in studying the impact of smoking to economic outcomes.

The endogeneity issue rises because individuals may smoke due to stress or lack of access to means that can support them.[16] Stress or lack of access of support may stem from weak performance in the labor market including unemployment and job loss. In addition, the individual may find it harder to find a job with less educational attainment such as a college degree. On the other hand, since smoking is societally well accepted for males, individuals who smoke may find it easier to build a social network, which is a resource in finding a job. In addition, those who work may find it easier to retain working status due to better social networks. Hence, it is not straightforward to which direction the impact of smoking to economic outcome would be. Thus, instrumenting current smoking status with past smoking status allow us to estimate the impact of smoking in the form of the cost from spending less on productive means such as education and nutrition. However, I also include the channel in which one may actually be able to build stronger social networks.

In order to control for path dependence, such as household economic condition when the respondents were young adults as well as other socio-economic confounding variables, I control for a set of variables. First, I control for current socio-economic conditions such as education attainment, marital status, urban or rural residence, and whether the individual is a head of household or not. Second, I control for socio-economic conditions when the respondents were young adults. In particular, I control for the head of household income, whether the respondents were attending school as well as rural or urban residence during young adulthood. In all specifications, I add age

[16] See for example Kouvonen et al. (2005) and Westman et al. (1985).

fixed effects and province fixed effects.

First, I find that individuals who smokes have a lower probability of possessing a college degree. Table 10 presents the estimates for smoking status for respondents who were young adults in 2000 in columns one and two, and for those who were young in 2007 in columns three and four. For both sets of respondents, the OLS estimates are biased downward. Instrumenting current smoking participation with past smoking participation results in an estimated 11 to 13% lower chance of having a college degree when the individual smokes.

Second, the impact of smoking on working status is not as conclusive. Table 11 shows the estimates for smoking status on working status in 2014. Using OLS, the estimates are not significant for both groups of respondents from survey waves in 2000 and 2007. However, instrumenting current smoking participation with past smoking participation is associated with 9% less chance of having a job for respondents who were 17 to 23 years of age in 2000. The estimates using IV approach are not significant for those who were young adults in 2007. These results are consistent with the prediction that smoking behavior, despite may cause less investment on human capital, may promote the accumulation of social capital. Thus, the impact of smoking on working status may not be straightforward.

5.3 Robustness analysis

I perform several robustness analyses to support the evidence of the new-consumer margin due to improvement in marketing technology represented by TV exposure. First, instead of using the relative exposure, I also use the actual average of TV exposure as the main variable of interest. Second, I include prices of cigarettes as controls. Lastly, I relax one of the selection criteria in the sample construction. In particular, instead of focusing on males who are not heads of households, I include males who are also heads of household as part of the robustness check.

The evidence of new-consumer margin due to the improvement in marketing technology prevails if we use the actual and not-standardized subdistrict-average number of TV channels received. Table 12 shows the results of running equation 9 using this measure of TV exposure on both the full sample and male-only sample. The coefficient estimate is not significant if we do not take into account the heterogenous impacts of TV exposure across age groups. However taking into account such heterogeneity, TV exposure significantly increases the chance of smoking for thee younger age group. The second column of Table 8 provides the marginal effect of TV exposure on smoking participation for the male-only sample. Increases in the number of TV broadcasting stations received is associated with higher smoking participation for those who are 17 and 19 years old.

Controlling for prices of cigarettes also do not change the results. In order to capture variation in prices, I interact real national prices of clove cigarettes with province fixed effects. If there are any time invariant trade costs, the interaction with province fixed effects can capture that. This

strategy was chosen due to the unavailability of data on regional prices of cigaretters. Prices of clove cigarettes are chosen, instead of the prices of white cigarettes, as most Indonesian smokers consume clove cigarettes. Nevertheless, there is a high correlation between the prices of these two types of cigarettes as illustrated in Figure 11.

Columns three and six on Table 7 present the coefficients of interest from running the DiD estimation. We can see that there are no substantial changes in the estimated coefficients. In addition, no substantial changes in estimated coefficients can be observed in other control variables as well. Columns three and six in Table 9 provides the estimated coefficients for education and income variables, once we control for prices.

The insignificant impact on of controlling for prices is consistent with the findings in other studies, such as Adioetomo et al. (2005). They find that prices are not a significant determinant in smoking participation. Yet, prices affect the amount of tobacco consumption. In addition, Witoelar et al. (2005) also finds insignificant impact of prices to youth smoking participation. Concerning such results, Setyonaluri et al. (2008) argue that there is not much regional variation in prices of cigarettes, on top of relatively stable real prices of cigarettes in Indonesia. Hence, we may not see any significant impact of prices to smoking participation.

Lastly, the evidence of new-consumer margin also persists if we relax one of the selection criteria in the sample construction. In particular, I run equation 9 on all male-only samples of 17 to 23 years old, including those who are household heads in their households. Given this selection criteria, there are less variables in the set of individual controls. In particular, I do not control the characteristics of the proxy for parents, which is the socio-economic variables of household heads if the individu is not a household head.

Table 13 presents the marginal effect of TV exposure to smoking participation by age. Younger age groups, especially the ones with 18 and 19 years of age, have higher chance of smoking if they live in subdistricts with relatively higher TV exposure. In this setup, the impact of TV exposure to smoking participation of young adults, with age 21 to 23 years old, are not significant either. These results echo the evidence of the new-consumer margin due to improvement in marketing technology. Such margin, across several robustness checks, are especially active for adolescents.

6 Conclusion

Improvement in marketing technology allows firms to generate new consumers. This paper investigates this theoretical prediction, derived from the theory of marketing cost in international trade built by Arkolakis (2010). In particular, I test the prediction by estimating the impact of exposure to television, representing ads through television and other broadcasted media, on smoking prevalence among young adults in Indonesia. In general, as predicted, higher local exposure to TV generates more smokers especially the younger adults. This finding is robust across different

measuremenst of TV exposure as well as sample construction.

This evidence on new-consumer margin in the form of smoking participation can inform policymakers in regulating the advertisements and marketing of tobacco products. First, the result emphasizes that the impact takes the form of new smokers. This fact stands in contrast to the argument that the purpose of tobacco advertisement is to strengthen branding, i.e., advertisements only affect the smoking intensity or the intensive margin of tobacco consumption. Indeed, despite the relatively limited hours of allowance for tobacco ads to be broadcasted, I find a statistically significant impact in increasing smoking participation in young adults. Second, I also show that smoking is associated with worse performance in the labor market. Given that exposure to advertising entices smoking participation to especially younger adults, the worse performance of this productive labor force in the labor markets, in the long run, can create a bigger cost to the economy. This economic cost is on top of the high cost of burden of disease of smoking. Third, despite the declining global smoking prevalence, as many developing economies have a higher share of the young population, advertising efforts of tobacco companies in such economies would have bigger macro consequences.

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Tables

Table 1: Percentages of average per capita monthly expenditure by commodity groups

Commodity group	2000		2010		2015	
	urban	rural	urban	rural	urban	rural
Rice and other cereals	11.97	20.89	6.24	13.07	5.53	11.59
Tobacco products	5.67	8.29	4.39	6.61	5.12	8.40
Education costs	4.89	2.11	4.38	2.48	4.59	2.77
Health costs	2.10	1.76	2.79	2.47	3.36	3.17

Source: Statistik Indonesia 2001, 2011, and 2016.

Table 2: Smoking prevalence by age group and sex in 1995, 2001, 2004

Age	1995			2001			2004		
group	males	females	average	males	females	average	males	females	average
10-14	0.5	0.1	0.3	0.7	0.0	0.4	na	na	na
15-19	13.7	0.3	7.1	24.2	0.2	12.7	32.8	1.9	17.3
20-24	42.6	1.0	20.3	60.1	0.6	28.8	63.6	4.1	30.6
25-29	57.3	1.1	27.4	69.9	0.6	33.7	69.9	4.5	34.7
30-34	64.4	1.2	31.5	70.5	0.9	35.3	68.9	3.8	37.3
35-39	67.3	1.7	35.6	73.5	1.3	36.6	67.7	5.0	39.7
40-44	67.3	2.3	34.2	74.3	1.9	39.6	66.9	4.9	40.1
45-49	68.0	3.1	35.7	74.4	2.2	41.3	67.9	5.8	41.0
50-54	66.8	3.4	34.5	70.4	2.6	34.8	67.9	4.9	38.8
55-59	66.1	3.3	33.9	69.9	3.0	36.3	64.1	6.2	36.8
60-64	64.7	2.8	32.2	65.6	2.8	32.6	60.0	6.2	31.3
65-69	64.3	3.8	34.0	64.7	2.7	32.2	58.7	4.4	30.9
70-74	56.9	3.1	30.6	59.2	2.1	30.0	55.3	3.8	27.0
75+	53.3	1.9	24.8	48.5	2.1	23.5	47.4	4.1	24.9
Average	53.4	1.7	27.0	62.2	1.3	31.5	63.1	4.5	34.4

Source: Susenas 1995, 2001, 2004, calculated and presented as Table 2.2 and Annex 2.1 by Setyonaluri et al. (2008).
Notes: Aceh and Maluku not included in 2001. Respondents in 2004 were 15 years and older.

Table 3: Market shares of main tobacco companies in global cigarette market

Tobacco companies	share of world cigarette volume (%)
Chinese National Tobacco Company	43.2
Philip Morris International	14.3
British American Tobacco	11.6
Japan Tobacco International	9.4
Imperial Tobacco	4.9

Source: Euromonitor, compiled and presented as "Table: The global tobacco industry (2013 data)" by Gilmore et al. (2015).
Notes: Data for 2013.

Table 4: Number of tobacco manufacturers in Indonesia by foreign ownership status

Year	domestic firms	foreign ownership	
		any foreign ownership	more than 50% ownership
1990	955	6	2
1995	808	7	6
2000	799	5	3
2005	850	8	6
2010	973	8	7

Source: Manufacturing Survey 1990, 1995, 2000, 2005, 2010. Author's calculation.
Notes: Domestic firms are firms with zero foreign ownership.

Table 5: Coefficients of production function

Variable	AK		Updated AK		
	OLS	OP	OP 1	OP 2	OP 3
Labor	0.159	0.105	0.150	0.150	0.150
Materials	0.875	0.875	0.907	0.907	0.907
Capital	0.036	0.000	0.040	0.028	0.034
Period	1991-2001	1991-2001	1990-2012	1990-2012	1990-2012
Exporter FE	X	X	X	X	X
Importer FE	X	X	X	X	X
Crisis FE	X	X	X	X	X
Foreign-ownership FE			X	X	X
Optimization method			BFGS	NM	DFP

Notes: Production function is assumed to be Cobb-Douglas production function as shown by equation 10. OLS refers to ordinary-least square method in estimating the coefficients. Meanwhile, OP refers to the Olley-Pakes method in estimating production function as in Olley and Pakes (1992). The estimated coefficients of production fuction for AK are taken from Table 2 in Amiti and Konings (2007) for the tobacco industry. BFGS refers to Broyden-Fletcher-Goldfarb-Shanno optimization, NM refers to Nelder-Mead optimization, and DFP refers to Davidon-Fletcher-Powell optimization.

Table 6: Balance table

Variable	(1) 2000 Mean/SE	(2) 2007 Mean/SE	T-test Difference (1)-(2)
Smoking	0.271	0.249	0.022**
	(0.006)	(0.007)	
Male	0.445	0.415	0.029***
	(0.007)	(0.008)	
Age	19.784	20.038	-0.254***
	(0.029)	(0.032)	
Education	7.190	7.035	0.154
	(0.061)	(0.072)	
Attending school	0.242	0.213	0.029***
	(0.006)	(0.006)	
Working	0.396	0.401	-0.005
	(0.007)	(0.008)	
Married	0.277	0.337	-0.060***
	(0.007)	(0.007)	
Urban	0.533	0.519	0.013
	(0.007)	(0.008)	
HH head, smoking	0.514	0.548	-0.034***
	(0.007)	(0.008)	
HH head, education	4.399	4.760	-0.361***
	(0.061)	(0.067)	
HH head, real annual income	1.28e+05	2.83e+05	-1.55e+05
	(43384.549)	(1.09e+05)	
HH head, male	0.881	0.872	0.009
	(0.005)	(0.005)	
HH head, working	0.705	0.746	-0.040***
	(0.007)	(0.007)	
HH head, married	0.721	0.754	-0.034***
	(0.007)	(0.007)	
N	4733	4142	
F-test of joint significance (F-stat)			7.246***
F-test, number of observations			8875

Notes: The value displayed for t-tests are the differences in the means across the groups. The value displayed for F-tests are the F-statistics. Standard errors are robust. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 7: Dependent var: smoking

	(1)	(2)	(3)	(4)	(5)	(6)
TV channels, std	0.003	0.018	0.018	0.016	0.037*	0.037*
	(0.008)	(0.012)	(0.012)	(0.013)	(0.023)	(0.023)
age=18 x TV		-0.001	-0.001		0.012	0.012
		(0.017)	(0.017)		(0.030)	(0.030)
age=19 x TV		-0.007	-0.007		0.018	0.018
		(0.019)	(0.019)		(0.032)	(0.032)
age=20 x TV		-0.007	-0.007		-0.043	-0.043
		(0.019)	(0.019)		(0.033)	(0.033)
age=21 x TV		-0.033*	-0.033*		-0.065**	-0.065**
		(0.018)	(0.018)		(0.031)	(0.031)
age=22 x TV		-0.039**	-0.039**		-0.062*	-0.062*
		(0.019)	(0.019)		(0.032)	(0.032)
age=23 x TV		-0.027	-0.027		-0.044	-0.044
		(0.018)	(0.018)		(0.033)	(0.033)
N	8251	8251	8251	3557	3557	3557
Sample	all	all	all	male	male	male
Province x Wave	X	X	X	X	X	X
Price x Province			X			X

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Full sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are not household heads. Number of TV channels is the subdistrict average of number of TV channels. This variable is standardized to have zero mean and a standard variation of one in each survey year. In column 2, 3, 5, and 6, the coefficient of "TV channels, std" refers to the coefficient for the interaction between TV exposure and age group of 17 years old which is the base group. The coefficient for the interaction between TV exposure and age groups for age 18 to 23 are relative to the coefficient for the TV exposure and the age group for 17 years old. All specifications include age fixed effects, province fixed effects, and survey wave fixed effects. Robust standard errors are used.

Table 8: Marginal effect of exposure to televisions on smoking participation in 17-23 years old

	Slope	
	TV channels, std	TV channels
main		
age = 17	0.037*	0.012*
	(0.023)	(0.006)
age = 18	0.049**	0.011
	(0.025)	(0.007)
age = 19	0.056**	0.013*
	(0.027)	(0.007)
age = 20	-0.005	0.001
	(0.028)	(0.007)
age = 21	-0.028	-0.000
	(0.025)	(0.007)
age = 22	-0.024	-0.005
	(0.027)	(0.008)
age = 23	-0.007	-0.001
	(0.028)	(0.007)
Observations	3557	3557

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are males and not household heads. Number of TV channels is the subdistrict average of number of TV channels. In the first column, this variable is standardized to have zero mean and a standard variation of one in each survey year. Meanwhile, in the second column, the variable of TV channels is the actual subdistrict averages. Slope refers to the changes in the probability of smoking participation for an increase of one standard deviation in exposure to televisions in the first column and of one unit of extra TV channels received in the second column. The specification includes age fixed effects, province fixed effects, survey wave fixed effects, and province and survey wave fixed effects. Robust standard errors are used.

Table 9: Estimates for education and income

	(1)	(2)	(3)	(4)	(5)	(6)
Education	0.001	0.001	0.001	-0.005**	-0.005**	-0.005**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
HH head, education	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
HH head, income	-0.000**	-0.000**	-0.000**	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	8251	8251	8251	3557	3557	3557
Sample	all	all	all	male	male	all
TV x Age		X	X		X	X
Province x Wave	X	X	X	X	X	X
Price x Province			X		X	X

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are not household heads. All specifications include age fixed effects, province fixed effects, and survey wave fixed effects. Robust standard errors are used.

Table 10: Long-run economic impacts of smoking: college degree

	(1)	(2)	(3)	(4)
Smoking	-0.089***	-0.128**	-0.076***	-0.112***
	(0.025)	(0.051)	(0.024)	(0.040)
N	1208	1208	1147	1147
Wave	2000	2000	2007	2007
Model	OLS	IV	OLS	IV

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample includes individuals of 17 to 23 years old in IFLS suveys in 2000 and 2007 who are male and not household heads. The dependent variable is whether the individu has a college degree as reported in IFLS survey in 2014. Regressions are run separately for each group of sample based on survey waves. OLS refers to regression using ordinary-least squares while IV refers to instrumenting smoking status in 2014 with smoking status in year 2000 or 2007, i.e. when the individu was 17 to 23 years old. All specifications include age fixed effects and province fixed effects. Robust standard errors are used.

Table 11: Long-run economic impacts of smoking: working status

	(1)	(2)	(3)	(4)
Smoking	-0.016	-0.088**	-0.015	-0.045
	(0.019)	(0.040)	(0.024)	(0.040)
N	1208	1208	1147	1147
Wave	2000	2000	2007	2007
Model	OLS	IV	OLS	IV

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample includes individuals of 17 to 23 years old in IFLS suveys in 2000 and 2007 who are male and not household heads. The dependent variable is the individu's working status reported in IFLS survey in 2014. Regressions are run separately for each group of sample based on survey waves. OLS refers to regression using ordinary-least squares while IV refers to instrumenting smoking status in 2014 with smoking status in year 2000 or 2007, i.e. when the individu was 17 to 23 years old. All specifications include age fixed effects and province fixed effects. Robust standard errors are used.

Table 12: Robustness analysis using average TV channels received, dependent variable: smoking

	(1)	(2)	(3)	(4)	(5)	(6)
TV channels	0.002	0.006*	0.006*	0.005	0.012*	0.012*
	(0.002)	(0.003)	(0.003)	(0.004)	(0.006)	(0.006)
age=18 x TV		-0.001	-0.001		-0.001	-0.001
		(0.005)	(0.005)		(0.008)	(0.008)
age=19 x TV		-0.003	-0.003		0.001	0.001
		(0.005)	(0.005)		(0.008)	(0.008)
age=20 x TV		-0.003	-0.003		-0.011	-0.011
		(0.005)	(0.005)		(0.009)	(0.009)
age=21 x TV		-0.007	-0.007		-0.012	-0.012
		(0.005)	(0.005)		(0.008)	(0.008)
age=22 x TV		-0.013***	-0.013***		-0.017*	-0.017*
		(0.005)	(0.005)		(0.009)	(0.009)
age=23 x TV		-0.006	-0.006		-0.013	-0.013
		(0.005)	(0.005)		(0.009)	(0.009)
N	8251	8251	8251	3557	3557	3557
Sample	all	all	all	male	male	male
Province x Wave	X	X	X	X	X	X
Price x Province			X			X

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Full sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are not household heads. Number of TV channels is the subdistrict average of number of TV channels. In column 2, 3, 5, and 6, the coefficient of "TV channels" refers to the coefficient for the interaction between TV exposure and age group of 17 years old which is the base group. The coefficient for the interaction between TV exposure and age groups for age 18 to 23 are relative to the coefficient for the TV exposure and the age group for 17 years old. All specifications include age fixed effects, province fixed effects, and survey wave fixed effects. Robust standard errors are used.

Table 13: Robustness analysis with household heads in the sample, dependent variable: smoking

	Slope
TV channels, std	
age = 17	0.031
	(0.022)
age = 18	0.049**
	(0.024)
age = 19	0.053**
	(0.025)
age = 20	-0.010
	(0.024)
age = 21	-0.031
	(0.022)
age = 22	-0.001
	(0.024)
age = 23	-0.000
	(0.023)
Observations	4342

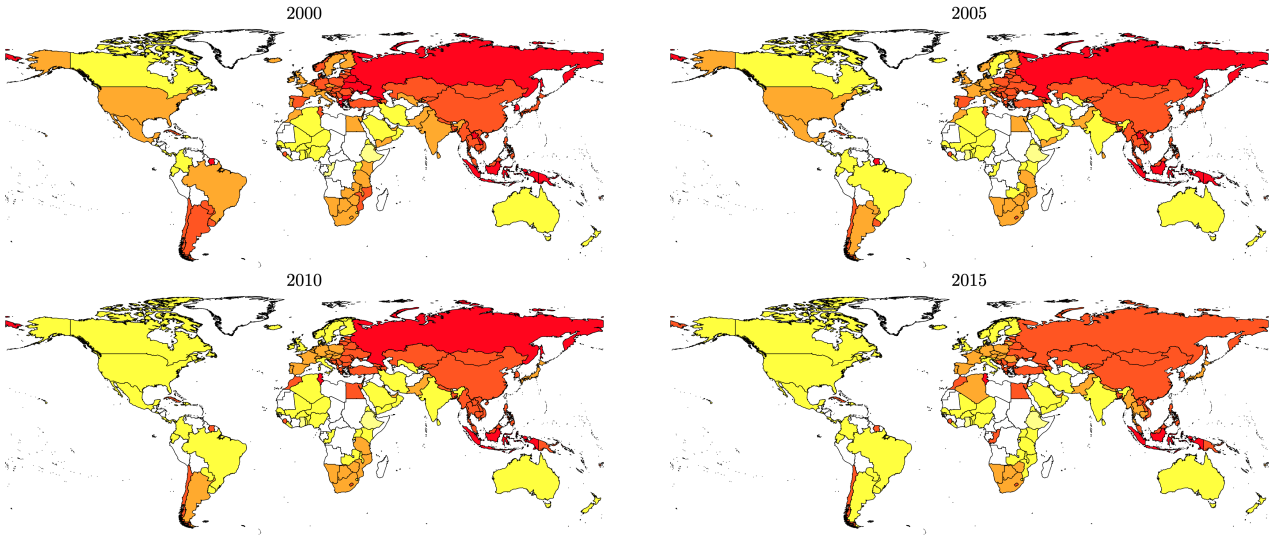
Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are males. Number of TV channels is the subdistrict average of number of TV channels. This variable is standardized to have zero mean and a standard variation of one in each survey year. Slope refers to the changes in the probability of smoking participation for an increase of one standard deviation in exposure to televisions. The specification includes age fixed effects, province fixed effects, survey wave fixed effects, and province and survey wave fixed effects. Robust standard errors are used.

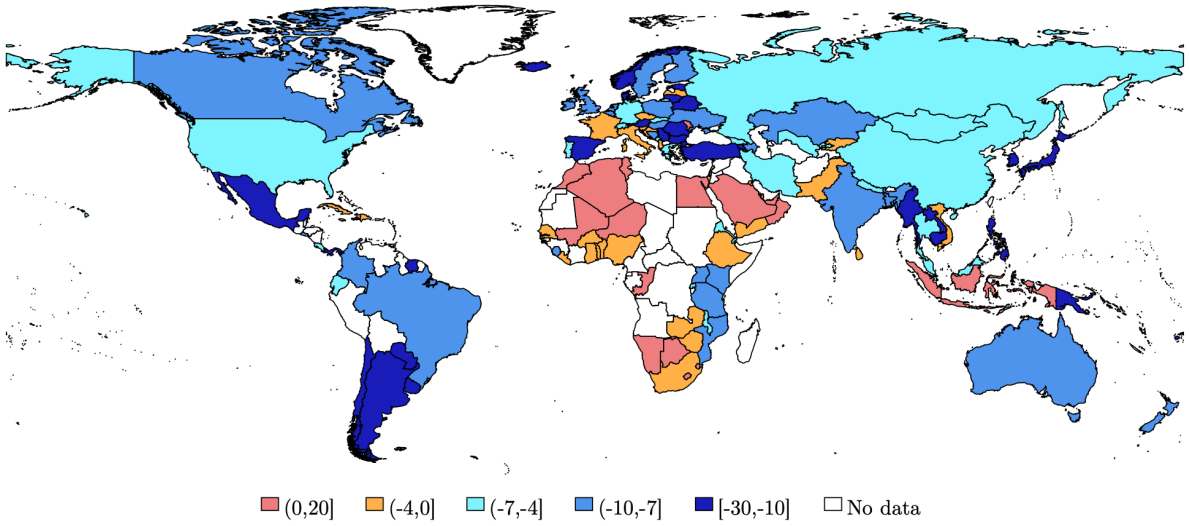
Figures

Figure 1: Global smoking prevalence over time (% of adult male)



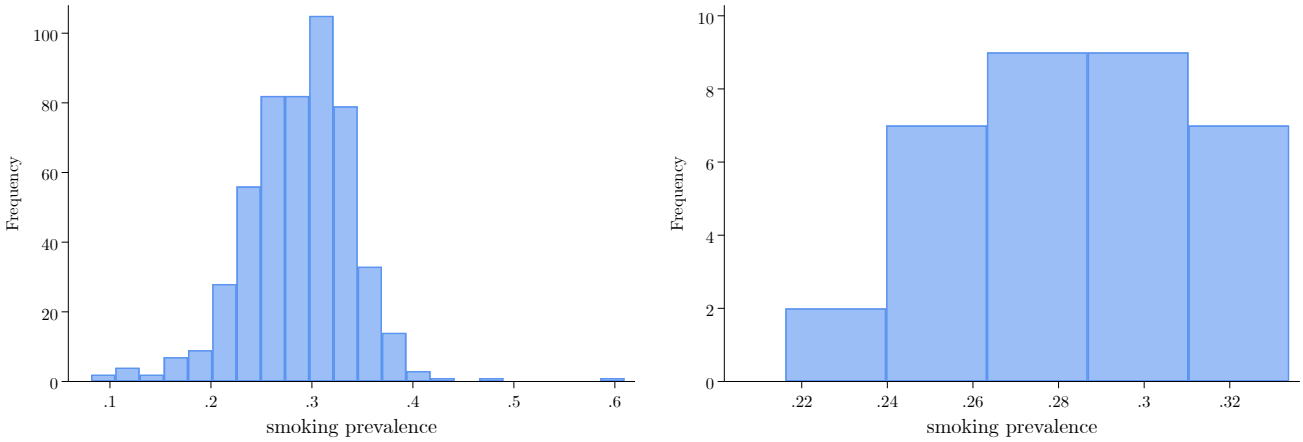
Source: WHO.
Notes: The maps show the smoking prevalence for adult males. The cutoffs are from yellow to red: [0, 10], (10, 30], (30, 40], (40, 60], (60, 100]. Yellow colors represent lower smoking rates while red colors represent higher smoking rates.

Figure 2: Percentage point changes in adult male smoking prevalence 2000-2015



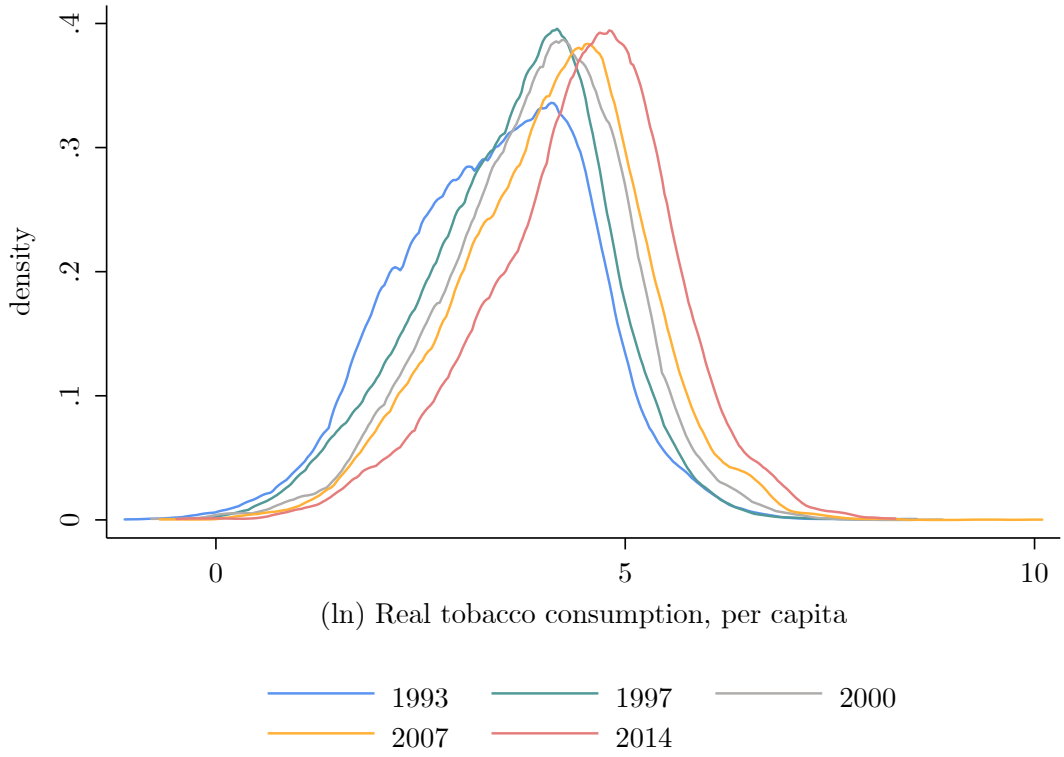
Source: WHO, author's calculation.
Notes: Please note that the color ranges are not equal. Countries with increases in rates of smoking prevalence are in pink.

Figure 3: Smoking prevalence by district (left) and province (right) in 2016



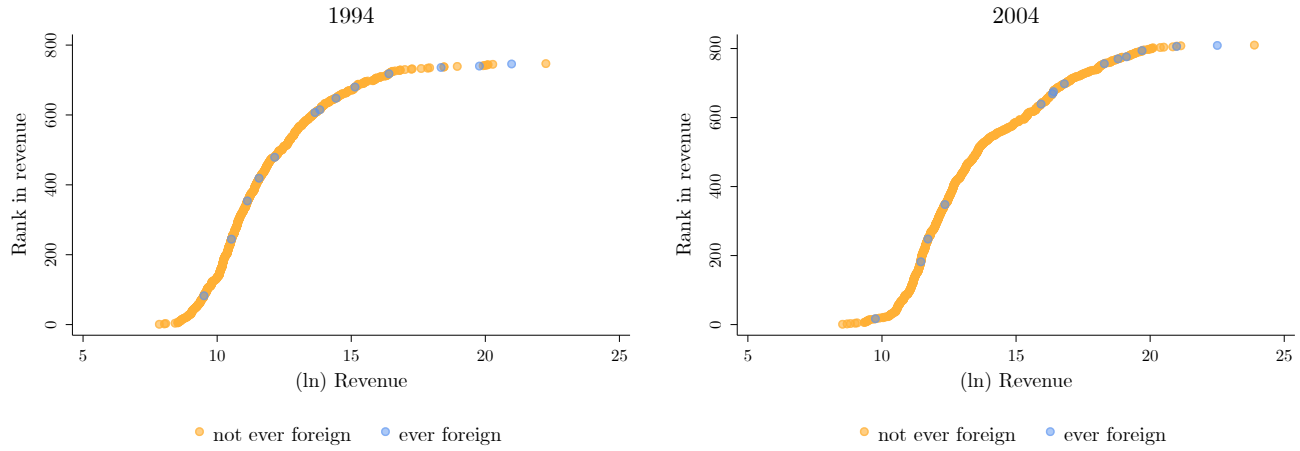
Source: Susenas 2016, author's calculation.
Notes: Smoking prevalence for population of 15 years or older.

Figure 4: Per capita real consumption on tobacco products



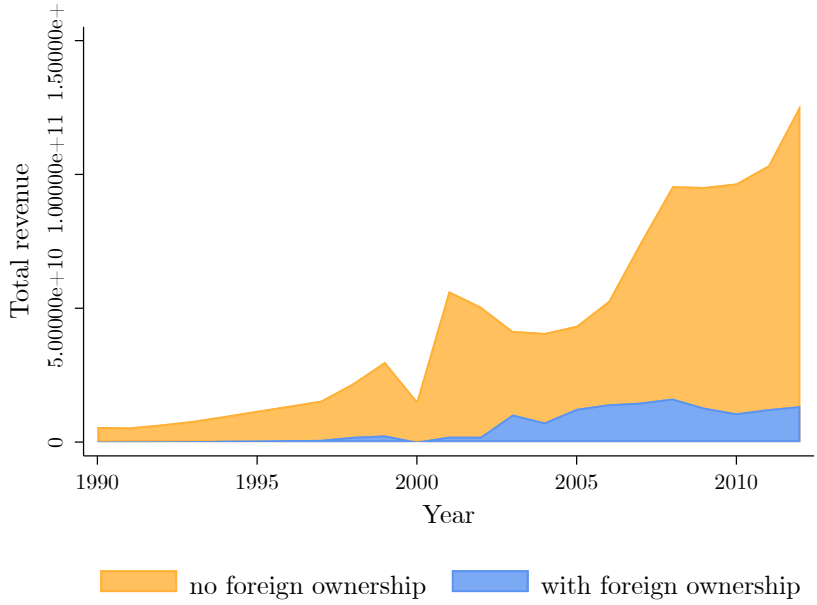
Source: IFLS and Indonesia's CPI, author's calculation.

Figure 5: Size and rank of firms by revenue in 1994 (left) and 2004 (right)



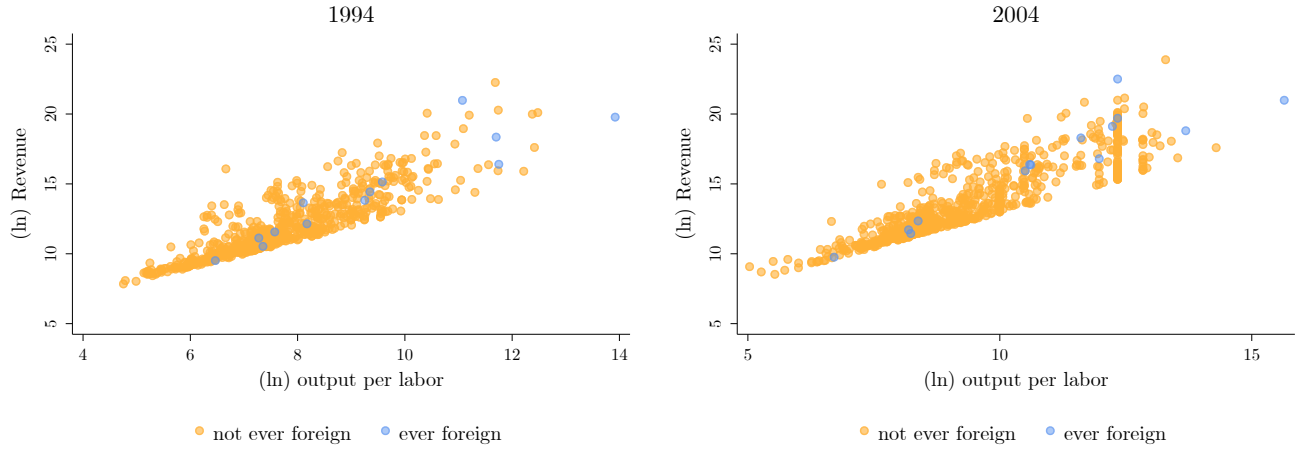
Source: Manufacture survey, author's calculation.

Figure 6: Production of Indonesian tobbacco manufacturers



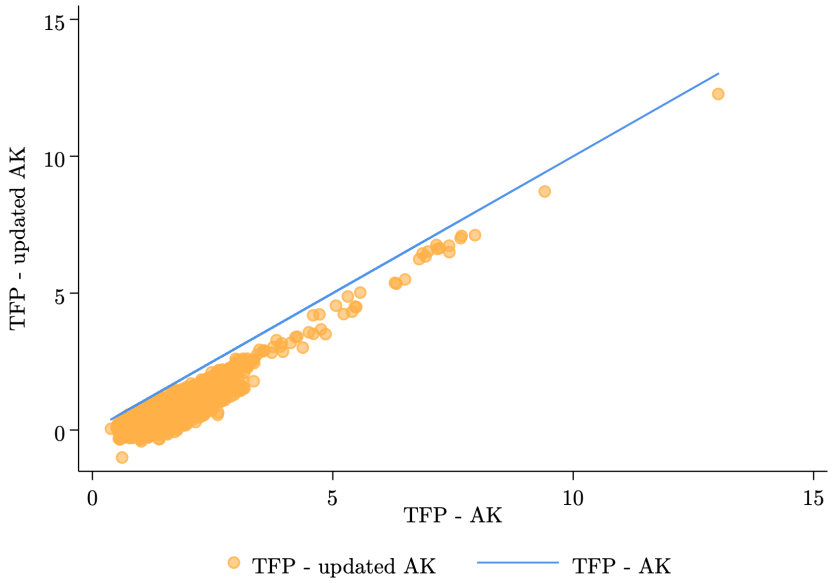
Source: Manufacture survey, author's calculation.

Figure 7: Output per labor and revenue in 1994 (left) and in 2004 (right)



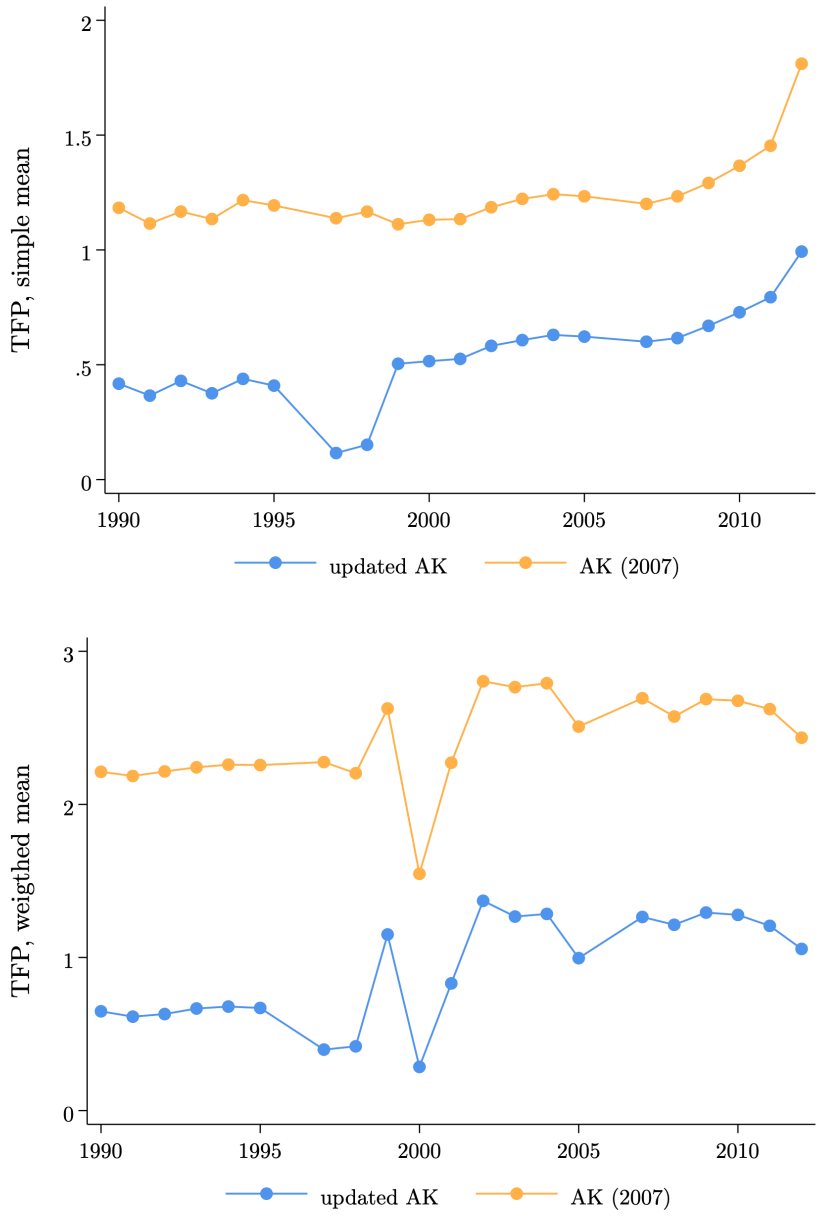
Source: Manufacture Survey, author's calculation.

Figure 8: Comparison of estimated TFP



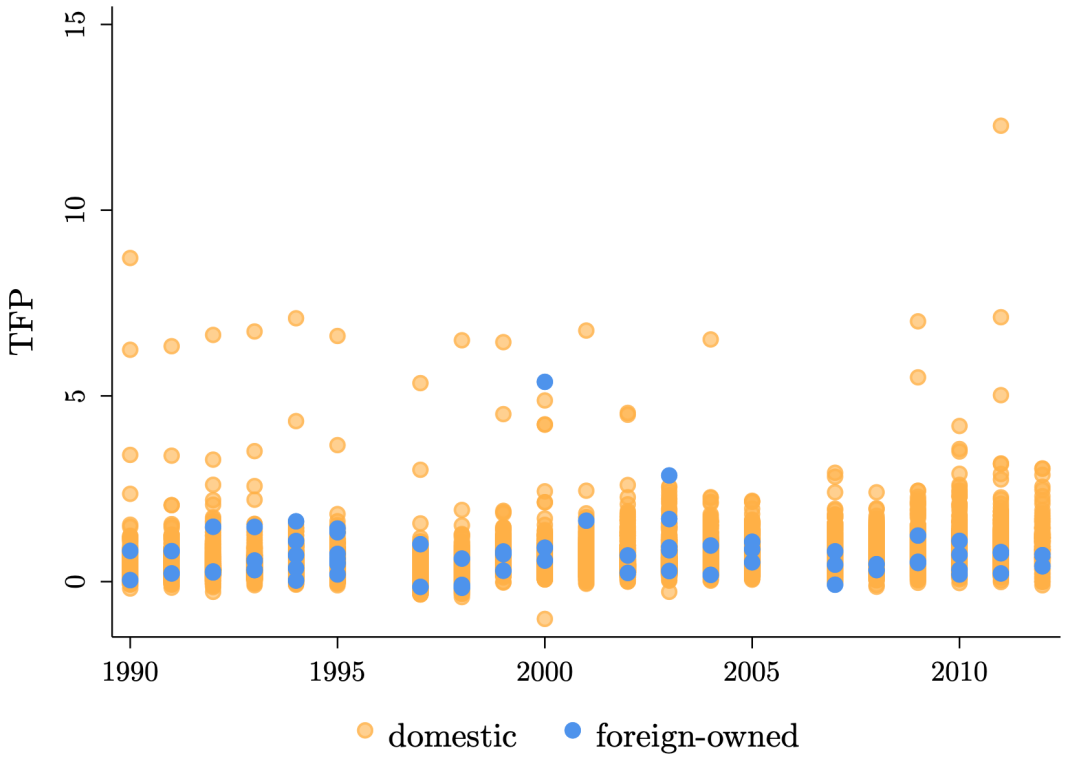
Notes: Each unit is estimated TFP for firm i in year t. Sample period is 1990 to 2012. Estimated TFP labelled "TFP - Updated AK" refers to the estimated TFP using the coefficients of production function from column "OP 1" on Table 5. Meanwhile, estimated TFP labeled "TFP - AK (2007)" refers to estimated TFP using the coefficients of production from column "OP" on Table 5 as calculated by Amiti and Konings (2007) for the tobacco industry.

Figure 9: Industry-average TFP



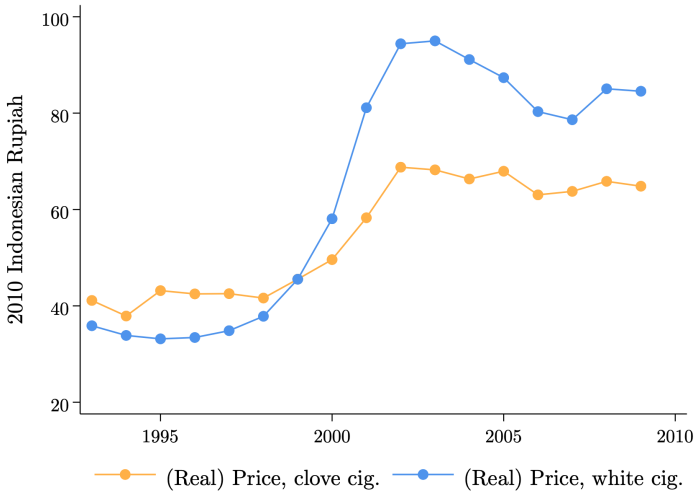
Source: Manufacture Survey and Table 5, author's calculation.
Notes: Estimated TFP for AK (2007) uses the estimated production function for tobacco industry performed by Amiti and Konings (2007). Meanwhile, estimated TFP for updated AK uses the estimated production function using the Broyden-Fletcher-Goldfarb-Shanno optimization as shown by Table 5. For weighted averages, I use gross output as weights.

Figure 10: Estimated TFP by foreign ownership over time



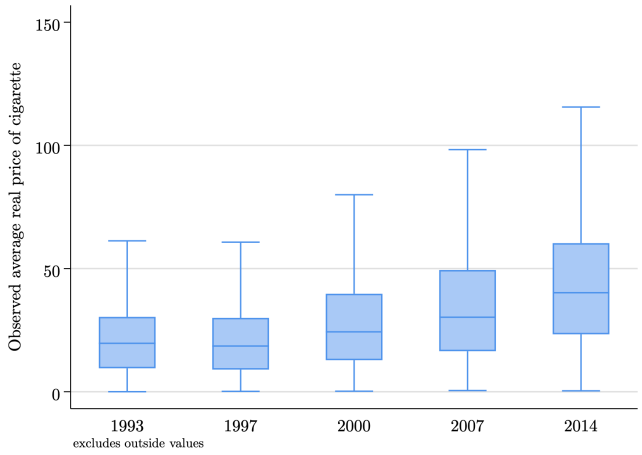
Source: Manufacture survey and coefficients from column "OP 1" on Table 5, author's calculation.
Notes: Each unit is estimated TFP for firm i in year t. Sample period is 1990 to 2012. Firms with any non-zero foreign ownership are colored in blue.

Figure 11: Real prices of cigarettes



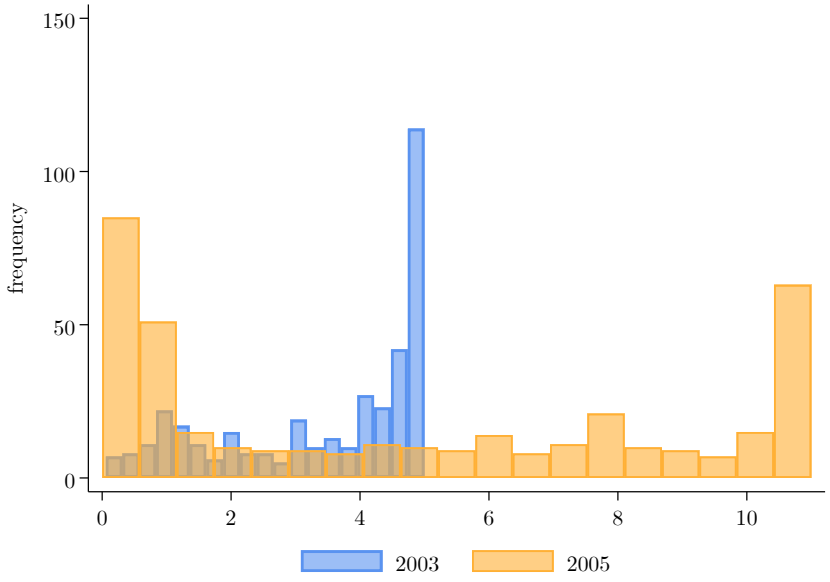
Source: Statistik Indonesia, author's calculation.

Figure 12: Observed real price of cigarettes spent by households



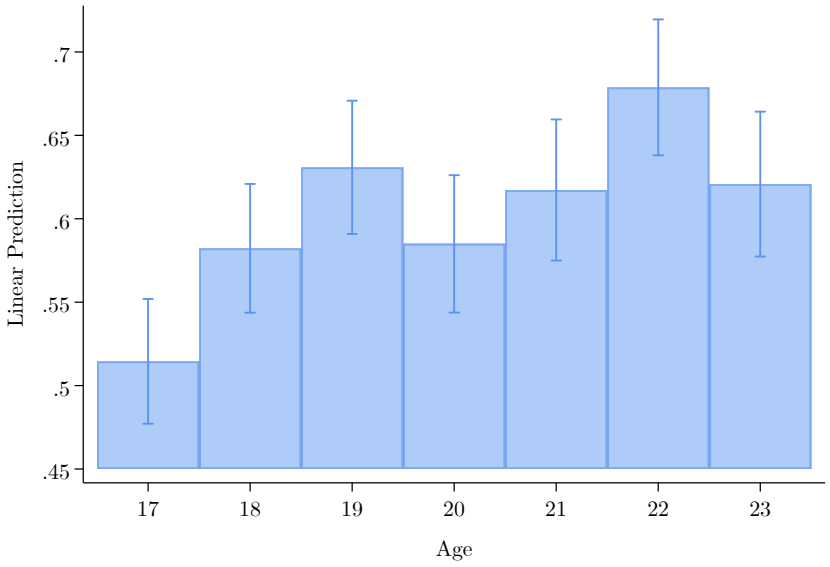
Source: Indonesia Family Life Surveys, author's calculation.

Figure 13: Variation in number of TV channels across districts



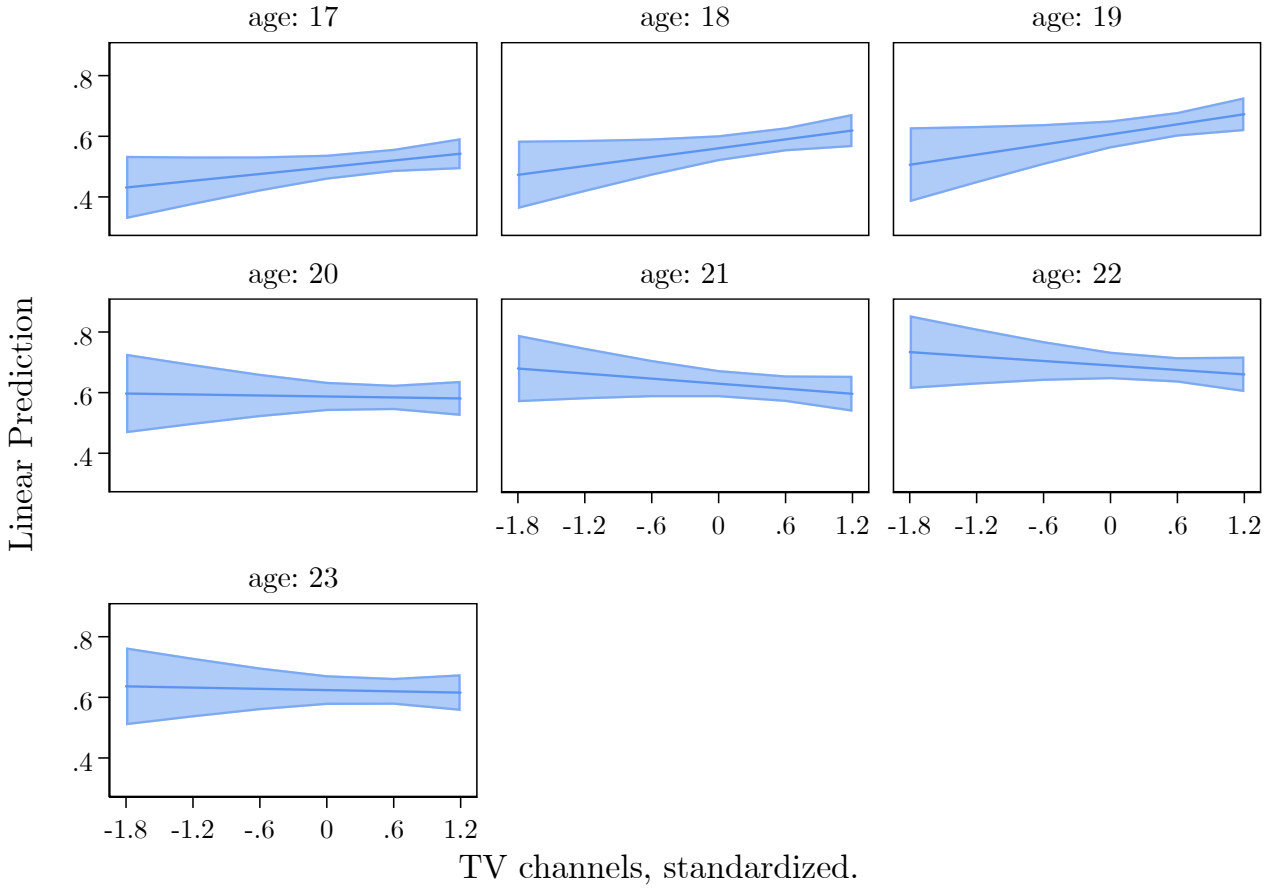
Source: Village Census 2003 and 2006, author's calculation.
Notes: Number of TV channels is the district average of number of TV channels received in villages within a district.

Figure 14: Coefficient estimates for age fixed effects to smoking participation in 17-23 years old



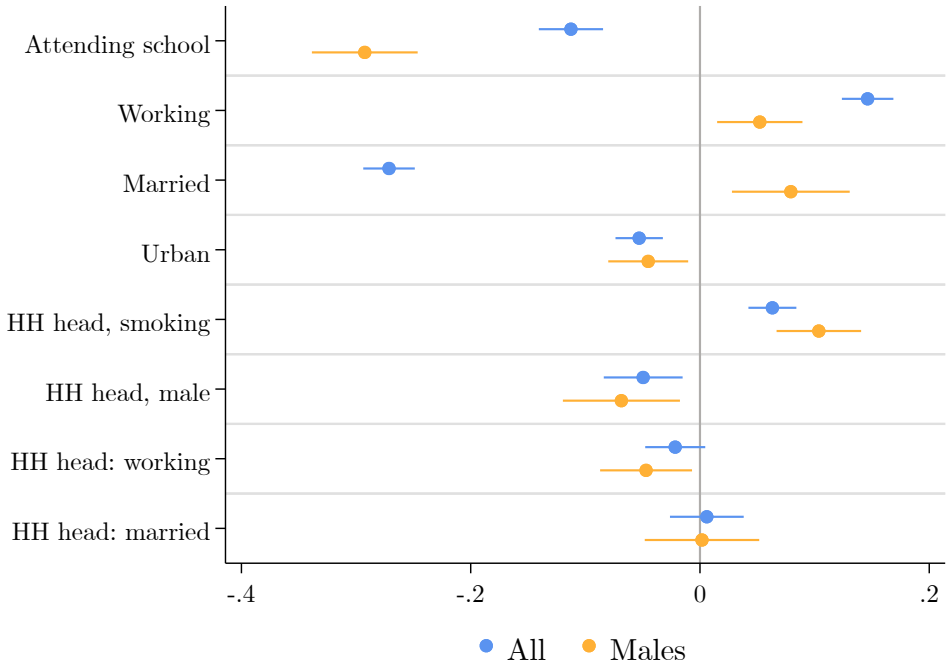
Notes: Sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are males and not household heads. The ranges show the 95% confidence interval of the estimated coefficients. The specification includes age fixed effects, province fixed effects, survey wave fixed effects, and province and survey wave fixed effects. Robust standard errors are used.

Figure 15: Effects of TV exposure by age group



Notes: Dependent variable is smoking status to sample of 17-23 years old who are male and not household heads. Sample includes inviduals of 17 to 23 years old in IFLS surveys in 2000 and 2007 who are males and not household heads. The ranges represents the 95% confidence interval of the estimated impact of exposure to TV to smoking participation. The specification includes age fixed effects, province fixed effects, survey wave fixed effects, and province and survey wave fixed effects. Robust standard errors are used.

Figure 16: Estimates of control variables on smoking



Notes: Dependent variable is smoking status to sample of 17-23 years old who are not household heads. The range represents the 95% confidence interval. All specifications include age fixed effects, province fixed effects, survey wave fixed effects, and province and survey wave fixed effects. The 95% confidence intervals for coefficients are shown by the range plots. All specifications use robust standard errors.

Data Appendix: Estimating Total Factor Productivity

In order to estimate firm-level total factor productivity (TFP), I replicate the estimation strategy conducted by Amiti and Konings (2007), or henceforth AK. They estimate TFP using the same dataset with the one that I use to analyze the tobacco industry in Indonesia, i.e., the Indonesian Manufacturing Survey. AK analyzed thee TFP trend for the period between 1991 to 2001 for each three-digit industry classification. AK used the Olley-Pakes method and assumed that there are fixed costs in exporting and importing, as in Melitz (2003). AK also took into account the effect of the Asian Financial Crisis in from 1997-1998 by including fixed effects for crisis. I follow AK's strategy and add fixed costs of being a foreign affiliates as in Helpman et al. (2004).

Let us assume that each firm i in year t operates with a Cobb-Douglas production function as shown in equation 10 below. In producing output Y_{it}, each firm combines several factors of production: capital (K), labor (L), and materials (M). The firm's level of productivity is A_{it}.

$$Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m} \tag{10}$$

I follow AK in performing the method introduced by Olley and Pakes (1992) in estimating the production function. In particular, I estimate the log-linearized production function as shown by equation 11, where $x = ln(X)$, for each variable. TFP of firm i of industry k in year t is then computed as the difference between its observed output, y_{it}, and its estimated output as shown in equation 12.

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \epsilon_{it} \tag{11}$$

$$tfp_{it}^{k} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} - \hat{\beta_m} m_{it} \tag{12}$$

Table 5 compares the estimated coefficients of each factors of production with the coefficients estimated by AK for the tobacco industry.[17] These coefficients are relatively comparable across different types of optimization methods. Figure 8 also confirms the comparability between the estimated TFP using AK's coefficients and the estimated TFP using updated AK's coefficients. I select the Broyden-Fletcher-Goldfarb-Shanno optimization method as the basis of estimated TFP throughout the paper.

[17] I follow the suggestions from Márquez-Ramos (2020) in taking into account attrition in Manufacturing Survey data and suggestions from Amiti and Konings (2007) in checking the consistency across the sample period to improve confidence on the results.