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**PASSIVE SMOKING BEHAVIOR AND INDIVIDUAL
PRODUCTIVITY IN INDONESIA**

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Disclaimer:

This document represents part of the author's study program while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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Dedication Page



For my Mother, Ludia and my Father, Saleh Kadir

For my Sister and Brother

I Love you 3000 times

Kurre Sumanga ‘



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Abstract

This research tries to examine the effect of passive smoking behavior at the household level in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives measured by income and number of working hours. Statistically, smoking male prevalence in Indonesia is around 67% while female smoking prevalence is only 2.1%. To do so, this research uses the panel data sourced from Indonesia Family Life Survey (IFLS) 4 and IFLS 5, and compares the results of three statistical methods: OLS, Fixed Effect, and IV method. Overall, the results show that the smoking behavior of husbands is negatively associated with the income of their wives and that there is no correlation with the number of working hours of their wives. This research also finds evidence that the increase of smokers in wives' community significantly and negatively correlates with their income pointing to community-wide spillover effects.

Relevance to Development Studies

Smoking has been increasing in many developing countries. Based on the WHO Report in 2018, Indonesia, as a developing country, will experience an increase in the number of smokers in the future due to sustainable population growth and dynamic economic development. In fact, the adverse health effect of smoking has been well documented: the leading cause of several chronic diseases, and also the primary cause of preventable deaths in the world. Those problems arising from smoking behavior can in turn affect the economic productivity of individuals, which can indirectly have an adverse impact on the economic development in Indonesia in the future. Therefore, this study aims to analyze the effect of smoking behavior on individual productivity in Indonesia by focusing on the impact of passive smoking because some researchers have analyzed that passive smoking is even more dangerous than active smoking. The analysis of this research may give a contribution to further policy improvements related to smoking behavior.

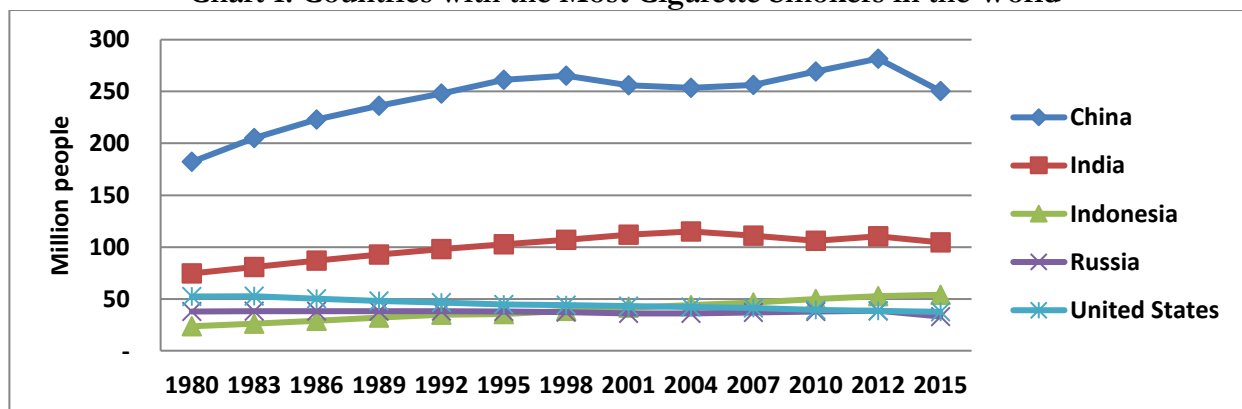
Chapter 1 Introduction

1.1 General Outlook

Smoking is the primary cause of preventable deaths all over the world (Sung et al. 2006: 5; Zagorsky 2004: 370). However, globally, more than one billion people around the globe are current smokers (Jeffrey and Neil 2018:4). That figure consists of 175 million (15.67%) women and 942 million (84.33%) men aged 15 years and over. Even though cigarette consumption of some countries shows a downward trend mainly in developed countries, cigarette consumption has increased especially in lower and middle-income countries such as Africa and South-East Asia (Jeffrey and Neil 2018:21). The success of several countries in reducing the amount of cigarette consumption is due to the role of government in strengthening tobacco control policies such as raising cigarette taxes to increase the price of cigarettes. In developing countries like Indonesia, people are straightforward to find cigarette sellers at low prices. They seemed to ignore the horrific images of smoking and warnings of health effects written on cigarette packs.

Based on the data from the Institute for Health Metrics and Evaluation (IHME) in 2015 as provided in Chart 1, Indonesia is the third-largest with the most cigarette smokers in the world after China and India. In 2015, the number of cigarette smokers in Indonesia was around 54 million or increased by 130% compared to data in 1980, which only numbered approximately 23.5 million people. That figure is predicted to increase by around 24 million people in 2025. Moreover, according to the World Health Organization (WHO) report in 2018, around 35% or about one-third of the population over the age of 15 in Indonesia is tobacco smokers. Not only Indonesia will experience an increase in the number of smokers in the future, but also most countries with a low and moderate Human Development Index (HDI) will be experiencing the same problem due to sustainable population growth and dynamic economic development. However, the increase in the number of smokers in Indonesia is precisely the opposite of the downward trend in the countries with the highest amount of smokers in the world such as China, India, Russia and the United States as shown in chart 1. Even India, which is still classified as a low-HDI developing country, has experienced a downward trend with the negative growth in the number of smokers in 2015 compared to 2012. Based on those facts, it is not impossible in the future that the number of smokers in Indonesia will surpass India even though the total population of India equals four times of Indonesia's population.

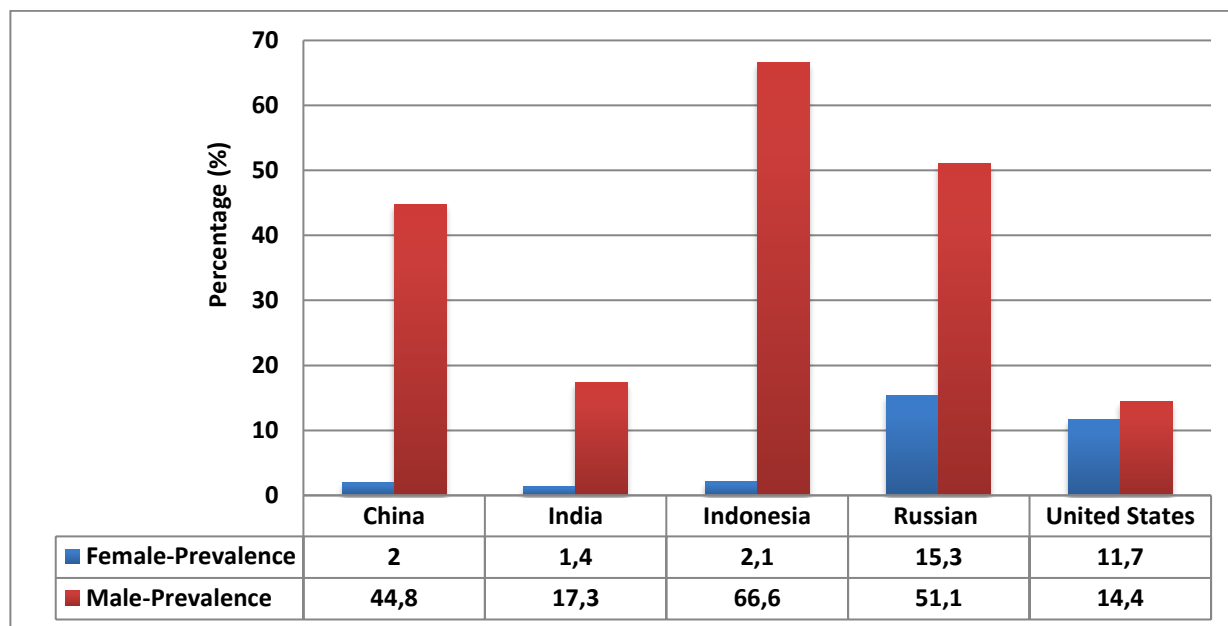
Chart 1: Countries with the Most Cigarette Smokers in the World



Source: Institute for Health Metrics and Evaluation (IHME) data accessed May 10, 2019, in website <https://ourworldindata.org/smoking>

Statistically, there are more male smokers than female smokers. From the number of smokers in the world that reach more than 1 billion, 942 million or 84.33% of those numbers are male whereas female smokers only contribute to 175 million or 15.67% (Jeffrey and Neil 2018:4). According to chart 2, Indonesia has the highest smoking male prevalence among the other four countries. On the contrary, female smoking prevalence in Indonesia is only 2.1%. In Western countries such as the United States, the percentage of female smoking prevalence is almost the same as male smoking prevalence. The increasing number of female smokers in Western countries is caused not only by the increase of women's social and economic status but also smoking for women is considered as a symbol of emancipation and independence (Amos and Haglund 2000: 6).

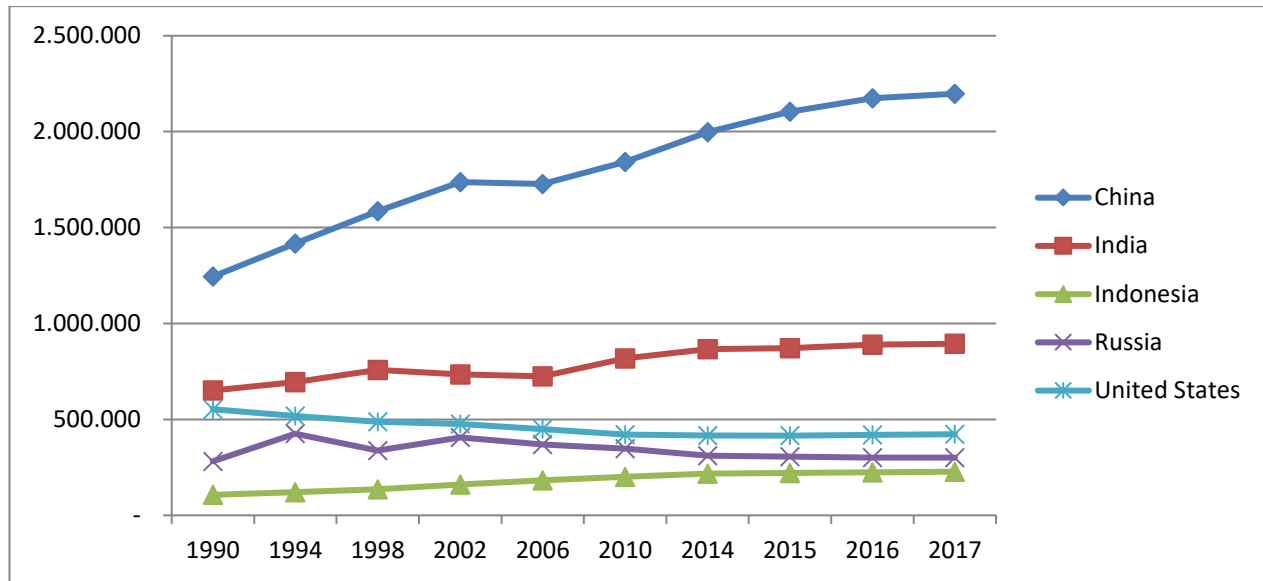
Chart 2: Smoking Prevalence Based on Gender in Countries with the Most Cigarette Smokers in the World In 2015



Source: The Tobacco Atlas data accessed May 10, 2019, in website <https://tobaccoatlas.org/topic/prevalence/>

Tobacco use through cigarette consumption is one of the causes of premature death in the world. More than six million people worldwide die each year from consuming tobacco through cigarettes (Jeffrey and Neil 2018:25). In Indonesia, smoking-attributable mortality is estimated at 225,720 per year or contributes 14.7% of all deaths (WHO Report 2018). Based on the chart 3, although the death rate from tobacco smoking in Indonesia is not as much as the number of deaths in other countries with the most cigarette smokers in the world, there is an increasing trend of the number of deaths in Indonesia. That upward trend needs to be watched out because, in the future, the number of smokers in Indonesia is predicted to increase, which can also cause the death rate following that trend.

Chart 3: Number of Deaths from Tobacco Smoking



Source: Institute for Health Metrics and Evaluation (IHME) data accessed May 10, 2019, in website <https://ourworldindata.org/smoking>

There is no doubt that smoking has an adverse impact on health. Many studies have been conducted related to the impact of smoking on health. Heart disease, lung cancer, and stroke, which are the diseases with the highest probability of death in the world, are strongly associated with smoking habits (Jeffrey and Neil 2018:24). Smoking not only adversely affects physical health but can also cause mental health problems. Based on the research conducted by Liew and Gardner in 2016, smoking can lead to depression because of the effects of nicotine in cigarettes. Smoking behavior that affects individual health can be classified into two types; active smoking and passive smoking. Passive smoking or commonly known as Environmental Tobacco Smoke (ETS) or Second-Hand Smoke (SHS) refers to non-smokers who inhale accidentally smoke produced by active smokers, both from the smoke exhaled by smokers (mainstream smoke) and smoke from burning cigarette (side-stream smoke) (WHO Report 2003). The International Agency for Research on Cancer classifies secondhand smoke as a dangerous carcinogen that can cause respiratory disorders, lung cancer and other diseases for non-smokers (McGhee et al. 2002: 842). Therefore, both active and passive smoking behavior is associated with many adverse health problems.

Besides affecting health, active smoking behavior also indirectly has an impact on the other sector, such as individual productivity. Levina et al. (1997), who researched the effect of smoking on wage and employment, explained that workers who are non-smoker earn an average of 6% more than smoking workers. Another research conducted by Halpren et al. (2001) studied the impact of smoking on workplace productivity and absenteeism in the US. In this research, current smoker tends to have a high level of absenteeism and low productivity compared to non-smoking workers, while the results for former smokers are among smokers and non-smokers. In this research, the level of productivity is measured by income, the number of hours lost, working hours, and the potential flow segment towards 300 employees at an office of a major US airline reservation.

However, most research on passive smoking behavior only analyzes the impact of SHS on health. A study conducted by Dartanto et al. in 2018 explains a case of passive smoking by showing the effects on the weight and height of children whose parents are smokers. The results of this study

indicate that heavy smoker parents tend to have stunted children and lighter children by 1.5 kg compared to children of non-smoker parents. In addition, passive smoking cases in households are not only come from parent and children relationships but can also be investigated from partner relationships. Yang et al. (2016) have researched the effect of husband smoking on wife's health status as measured by cases of hypertension. The results of this study indicate that there is a positive influence on hypertension cases by women in China aged 20 to 49 years when their husbands are smokers. Therefore, this research will try to examine the association between passive smoking behavior and individual productivity in Indonesia because both active and passive smoking have a similar adverse impact on health so that the productivity of non-smokers can also be affected by exposure to cigarette smoke from active smokers.

1.2 Contribution to the Literature

Many researchers have analyzed the impact of smoking on health. The effect of consuming tobacco on health can be direct impact by lowering health status, indirect impact by reducing health status leading to lower education attainment or even death and lead to mental health by causing depression (Prasetyoputra and Irianti 2014). However, still fewer researchers analyzed the impact of smoking on individual productivity, particularly the effect of passive smoking behavior on individual productivity.

Globally, around 25% of people in the world are exposed to SHS, and almost 900,000 people of them die each year from exposure to cigarette smoke (Jeffrey and Neil 2018: 22). Also, the majority of those exposed to SHS are non-smoking women and communities with low socio-economic strata. Compared with the other countries in chart 1, Indonesia has a high prevalence level of exposure to SHS due to the prevalence of smokers, which continues to increase each year. Based on the data from the Global Adult Tobacco Survey during 2011 to 2015, In Indonesia, the prevalence of exposure of SHS at home is around 78% ((Jeffrey and Neil 2018:22). In other words, more than three quarters of non-smokers at the household level were exposed to cigarette smoke from active smokers at home. Therefore, this research tries to examine the effect of passive smoking behavior in the household level by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives. Based on existing literature, there has been no research related to that topic.

Furthermore, the smoking behavior of husbands in this study is measured in two ways. First, smoking behavior tries to capture smoking intensity measured by how many cigarettes are consumed per day. Second, the smoking behavior is classified into four categories, namely non-smokers, light smokers, heavy smokers and former smokers. The definition of light and heavy smokers will utilize the definition from Liew and Gardner (2016). The individuals are classified as light smokers if they are smoke one until fourteen cigarettes per day, while the individuals are categorized as heavy smokers if they are smoking more than fourteen cigarettes per day. Also, individual productivity in this research will be measured based on the number of working hours and income.

1.3 Research Questions and Objective

This research will focus on the main research question to find out the impact of passive smoking behavior on individual productivity in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives.

The main research question will be divided into the following sub-questions:

- a. What is the association of smoking behavior of husbands on income of their wives?
- b. What is the association of smoking behavior of husbands on number of working hours of their wives?

The main objective of this study is to examine the extent of the association of passive smoking behavior on individual productivity in Indonesia. Therefore, the results of this study are expected to give contributions to the direction of government policies related to the cigarette prices, the rules of smoking in public places, and the sustainability of the tobacco industry because that industry also contributes significantly to the Indonesia economy.

1.4 Structure of Research Paper

This research paper consists of six chapters, which are all related to one another to examine the impact of passive smoking behavior on individual productivity in Indonesia. Chapter one presents the introduction which discusses the general outlook and fundamental problems of research; contribution to the literature; and the research questions and objective. Chapter two explains the literature reviews and theoretical framework of this research paper broadly. In the next section, this paper will focus on explaining the source of data, the variables as well as the research methodology or econometric techniques that will be used to answer the research objective and questions. Also, this section includes a descriptive analysis of the variables used. Then, the results and findings of this research will be discussed in chapter four. Finally, the last section of this research paper will end by the conclusion.

Chapter 2 Literature Review and Theoretical Framework

2.1 Cigarette Smoking

2.1.1 Historical Background

Tobacco, a type of plant which is part of the *Solanaceae* family and genus *Nicotiana*, was first cultivated by the native people of Mesoamerica in 6000 BC (WHO atlas 2019: 18). Furthermore, since 1 BC, the Indigenous people of America have started the habit of smoking using tobacco plants through pipes in both religious (incense-burning ceremonies) and social events (WHO atlas 2019: 18; Robicsek 2004: 30). Tobacco smoking spread to the European region due to the exploration of Christopher Columbus to the “New World” in 1492 based on his journal that “the Spaniards upon their journey met with great multitudes of people, men and women with firebrands in their hands and herbs to smoke after their custom” (WHO atlas 2019: 18; Robicsek 2004: 30). Tobacco then spread to Asia brought by Spanish and Portuguese sailors after the discovery of America by Columbus, while tobacco smoking in Asia was introduced for the first time by expatriates in the Philippines in 1570 (Suzuki 2004: 77). In 1830 tobacco rolled in a paper called “sigaret” was first produced in France which became the forerunner of the word “cigarette” (Azanella 2018).

In Indonesia, cigarettes were first produced in 1906 by Nitisemito with the brand “Tjap Bal Tiga” called *kretek*, a type of cigarettes by mixing tobacco with cloves (Hanusz 2000:152). Before being commercially produced, *kretek* cigarettes were first manufactured in Kudus, Central Java in 1880 as a medicine for asthma and sore throat. Moreover, *kretek* or clove cigarettes dominate around 90% of the cigarette market in Indonesia, with a total of approximately 500 independent manufacturers spread throughout Indonesia ((Hanusz 2000:140). The process of making clove cigarettes is very traditional, using the hand-rolled method. Therefore, the cigarette industry is vital in Indonesia because it can absorb numerous labors in its production process.

2.1.2 Definition of Cigarette

In general, cigarettes are defined as paper rolled in a narrow cylindrical form containing psychoactive material, usually tobacco that has been cut and preserved or can also contain ingredients and other chemicals, including ingredients to add different flavors (Rabinoff et al. 2007:1981). In Indonesia, the definition of cigarette is also regulated by the government through the Regulation of the Government of the Republic of Indonesia Number 109 of 2012 in article 1 point 3 concerning the Safeguarding of Ingredients Containing Addictive Substances in The Form of Tobacco Products for Health, stating that “cigarettes are one of the tobacco products intended to be burned and smoked and /or inhaled smoke, including clove cigarettes, white cigarettes, cigar or other forms produced from *nicotiana tabacum*, *nicotiana rustica*, and other species or syntheses which their smokes contain nicotine and tar, with or without additional ingredients.”

Cigarettes are hazardous for health because their smokes contain around 7,000 chemicals, and some of them are carcinogenic (Jeffrey and Neil 2018: 24; Herawati 2010:640). The gas component of cigarette smoke is very harmful not only for smokers, but also for people around them (passive smokers) because it contains *carbon monoxide*, *ammonia*, *hydrocyanic acid*, *nitrogen oxide*, and *formaldehyde*. The particles are *tar*, *indole*, *nicotine*, *carbazole*, and *cresol*, which are toxic, irritating and carcinogenic substances that cause cancer. Here are some addictive elements in cigarettes based on that literature.

a. Nicotine

Nicotine is a substance contained in tobacco that can increase blood pressure, poison the body's nerves, cause constriction of blood vessels, and also induce pleasure and the desire to continue smoking. The nicotine level, which can make adults addicted, is around 4 until 6 mg, while the nicotine content per cigarette produced in Indonesia is approximately 17 mg.

b. Tar

Tar is a carcinogenic substance that can damage lungs and cause respiratory problems, bronchitis and, cancers which come from solid components of cigarette smoke. Tar enters the body through the oral cavity as solid steam and will form sediments in the teeth, lungs and respiratory tract.

c. carbon monoxide (CO)

Carbon Monoxide (CO) gas produced by cigarette smoke causes the decrease of Oxygen level in blood. The level of CO in smokers' blood is around 4 to 15%, whereas the level of CO in non-smoker blood is only less than one percent. Basically, the binding between Hemoglobin and Oxygen is essential for breathing the body's cells. However, CO has a strong tendency to bind with Hemoglobin in red blood cells. CO damages the lining of blood vessels and also elevates fat deposits in the walls of blood vessels. As a result, the flow of blood is blocked which can lead to incline the risk of a heart attack.

2.1.3 Laws of smoking cigarette in Indonesia

Every year, on 31 May, the world communities initiated by the WHO commemorate “The World No Tobacco Day”. This movement aims to disseminate information about the adverse effects of smoking throughout the world and also on that date, smokers are encouraged not to consume cigarettes for 24 hours (WHO report 2019). Furthermore, the theme presented at The World No Tobacco Day is different every year. In 2019, the WHO will focus on the topic “tobacco and lung health”.

In Indonesia, the government plays an active role in formulating regulations related to smoking bans which control not only for smokers but also for the cigarette industry. Some of the rules set by the Indonesian government as follows.

a. Law of Republic of Indonesia number 36 of 2009 concerning Health

Articles 113 to 116 of this law regulate the security of products containing addictive substances such as tobacco. In this law, every cigarette industry that sells its products in Indonesia is obliged to include warnings of health problems due to smoking. The rules regarding health warning on cigarette packs are further regulated in the Minister of Health of the Republic of Indonesia Number 28 of 2013 concerning the inclusion of health warnings and health information on tobacco product packaging. In that policy, health warnings on cigarette packaging not only include sentences about the dangers of smoking but also must include images of the dangers of smoking such as images of oral cancer, throat cancer, lung cancer and other images.

In addition, Law of Republic of Indonesia number 36 of 2009 also regulates areas that must be free from cigarette smoke such as education area, health service, transportation, worship places and workplaces. The implementation rule of that law was then jointly compiled by the ministries of health and the ministry of interior through a joint regulation number 188 and number 7 of 2011 concerning Guidelines for Implementing Non-smoking Areas. Smoking areas are allowed as long as the place is separate from the area used for activities, far from the entrance and exit and has good air circulation.

b. Regulation of the Government of the Republic of Indonesia Number 109 of 2012 concerning The Safeguarding of Ingredients Containing Addictive Substances in The Form of Tobacco Products for Health

This rule is the implementation rule, which explains in more detail of law number 36 of 2009 article 113 to 116 concerning Health. In addition to regulating the obligations of cigarette producers to test *tar* and *nicotine* content per cigarette and showing the results of testing on cigarette packaging,

this rule also explains the prohibition on the sale of cigarettes to pregnant women and children less than 18 years old. Moreover, the government also controls tobacco product advertisements in broadcast media, print media, information technology media, and sponsorship activities for an event.

2.2 The definition and factor that affect productivity

Based on the OECD report in 2001, generally, productivity is an indicator to measure the level of efficiency or performance of production inputs such as capital and labor, used in the production process to yield a level of output. In the business sector, productivity is a concept that is closely related to the idea of economic growth, partial productivity, profitability, quality and it is part of economic activity (Saari 2006: 1). Productivity measurement aims not only to identify efficiency changes in the production process, but also useful in terms of tracking technical changes, economies of scale, learning by doing, capacity utilization, and also as a major factor in assessing the standard of living as commonly measured by per capita income (OECD Report 2001:11).

There are many types of productivity measurements which depend on the availability of data and also the objectives of measuring productivity. In macroeconomics, the measurement of productivity can be divided into two. First, single-factor productivity or partial productivity is a measurement of productivity which only uses one type of input such as labor productivity as measured by the number of hours worked or capital productivity as quantified by interest income per dollar of capital (Sumanth 1997: 5). Second, total factor productivity (TFP) is a productivity measurement that uses the sum of all input factors in producing output levels to calculate the simultaneous impact of all inputs on the output level (Saari 2006: 1). In other words, TFP is a rough measurement of productivity, whose contribution to economic growth still depends on other factors such as organization and technical innovation (Freeman 2008: 11). Also, Multi-factor productivity (MFP) is another term for TFP, although some literature distinguishes between those two types of productivity measurements.

Labor productivity, one measure of individual productivity, is an example of partial productivity measurement, which is generally quantified by comparing the volume of output produced with the used input (Freeman 2008: 5). Based on analysis from a production point of view by ignoring the differences in quality, the best measurement of labor input is the number of hours worked. The alternative measures that can be used are hours paid, which can be reflected as labor income (OECD Report 2001: 39). Although labor productivity only describes the meaning of productivity partially, labor productivity remains an essential element to explain the principal economic foundations that offer effective measures of living standards and competitiveness that also affect economic growth (Freeman 2008: 5).

Besides, the level of individual productivity is also influenced by several factors. Based on research conducted by Yuniarsih and Suwatno (2013: 160) and Simanjuntak (1985: 30), individual productivity in workplace is influenced by internal factors such as motivation, level of education, training, discipline, health, physical abilities of employees and work ethics that support the achievement of targets; suitability between tasks with educational background, experience, interests, expertise, and skills mastered; and the circumstances and atmosphere of the work environment supported by adequate workplace facilities and infrastructure. While external factors that affect individual productivity such as Government policies and regulations related to employment; and also the support of stakeholders in the work environment.

2.3 Types of Cigarette Smokers and The impact of Their Productivity

Smoking behavior can be classified into two types; active smokers and passive smokers. Based on the WHO report (2003), the California Environmental Protection Agency (2005) and research conducted by Bonita et al. (1998: 157), an active smoker is defined as people who smoke at least one cigarette a day and inhale the smoke produced by that cigarette; while passive smokers or commonly

referred to as Environmental Tobacco Smoke (ETS) or Second-Hand Smoke (SHS) is a person who inhales accidentally smoke produced by active smokers, both from the smoke exhaled by smokers (mainstream smoke) and smoke from burning cigarette (side-stream smoke). Not only active smokers are negatively correlated with health, but passive smokers can also cause health problems similar to active smokers such as lung cancer, cardiovascular diseases and respiratory diseases (Bonita et al. 1998: 159; California Environmental Protection Agency 2005: 1209). Passive smoke consists of two main components, namely side-stream smoke, which is the smoke that results from the tip of a burning cigarette, and main-stream smoke, which is the smoke inhaled and exhaled activities by active smokers.

However, some researchers explained that passive smoking is more dangerous than active smoking (Schick and Glantz 2005; Raupach et al. 2005). People who inhale side-stream smoke will be contaminated with four times as much toxic substance as the smoke that is inhaled by active smokers (main-stream smoke). The amount of poisonous substances inhaled by passive smokers over a long period can cause fatal damage to their respiratory tract (Schick and Glantz 2005: 396). Moreover, side-stream smoke is more harmful than mainstream smoke because the size of particles in side-stream smoke are smaller so that they are easier to enter into the lung compared to particles in the mainstream smoke (Schimid and Sinzinger 1995 as cited in Raupach et al. 2005: 387). Besides, passive smokers also have a higher probability of death due to chronic heart failure because side-stream smoke inhaled by non-smokers can reduce heart rate variability reversibly and consistently (Raupach et al. 2005: 389).

2.3.1 Active Smokers

Smoking habits not only have an impact on physical health but also affect the economic sector and the mental health of smokers. However, research on the impact of smoking on other sectors, especially in smokers' productivity is not as much as research related to the health effects of smoking. Based on several studies conducted by Levina et al. (1997), Ours (2004), Kvasnica (2010), and Bondzie (2016) stated that smoking habits negatively affect wages or income of smoker. Levina et al. (1997) who research the effects of smoking on labor outcomes, one of which is wage, concluded that smoking lowers wages. Smoking workers have lower income than non-smoker workers by 4 until 8%. This study used data from the National Longitudinal Survey of Youth (NLSY79), a continuous survey for more than 12,000 individuals born between 1957 and 1964 in the US that began in 1979 and sponsored by the US Department of Labor. When the research was conducted, the majority of these individuals had entered the labor force. Furthermore, this study also utilized several explanatory variables to explain the relationship of individual characteristics on outcomes and smoking behavior such as age, years of education, marital status, race, and the number of children.

Another research by Bondzie (2016) who also examined the effect of smoking on wages using continuous survey data from the European Community Household Panel (ECHP), explained that the range of gap wages between smokers and non-smokers is 1 to 22.7% with non-smoker labors have more income than smoker labors. Aside from using personal characteristics as explanatory variables such as marital status, education level, gender and age, this study also adopts variables related to health indicators such as body weight and the number of times the individual is hospitalized. Those health indicators explain the possibility that smoking behavior leads to health problems, which affects the level of individual productivity. Health variables used in this study are treated as Instrumental Variable (IV) to overcome endogeneity problems between income and smoking behavior or unobservable variables that lead to biased estimates.

Based on several works of literature, all researchers agree that smoking habits have a negative effect on wages. However, different results had been found that the impact of smoking behavior on the number of working hours can be concluded differently by various researchers. Using data Health

and Work Questionnaire (HWQ) for approximately 300 employees of airlines in the US, Halpren et al. (2001) examined the effect of smoking behavior on productivity, one of which is measured by absenteeism by using indicators of the number of worked hours. Smoking behavior in this study is classified into three: current smoker, former smoker, and non-smoker. The results of this study indicate that current smoker tends to have a high level of absenteeism and low productivity compared to non-smoking workers, while the level of absenteeism of former smokers is between the smoker and non-smoker. The results of the study are almost the same as the research conducted by Bunn III et al. (2006). They also found that the current smoker missed more workdays than the former and non-smoker former because of health factors. Within one year, the current smoker has missed an average working day of 6.7 days, while former smokers and non-smokers are 4.9 and 4.4 days respectively. In contrast, by applying panel data techniques (Individual Fixed Effects), Levina et al. (1997) discovered that changes in smoking behavior did not affect changes in working hours, although based on descriptive analysis showed that smokers had fewer hours of work than non-smokers.

2.3.2 Passive Smokers

Smoking habits not only have a negative impact on the health and productivity of smokers themselves but can also have an impact on the health and productivity of people around them (passive smokers). However, researches on the effects of passive smoking have focused more on health impacts. In the workplace, people who are intensively exposed to secondhand smoke or ETS, have an increased risk of lung cancer and also increase health expenses by non-smoker workers due to complaints of respiratory illness (Well 1998; McGhee et al. 2002). To overcome that problem, the majority of countries throughout the world, including Indonesia, have implemented smoking ban policies in public places, including workplaces.

Although smoke-free policies have succeeded in reducing the risk of exposure to secondhand smoke in workplaces (Wortley et al. 2002; Lawhorn et al. 2013), this policy is difficult to implement in the household level as evidenced by research showing that smoking behavior of one family member has a negative correlation with the health and other outcomes of other family members. Yang et al. (2016) tried to examine the health effects of wives as measured by hypertension status when having a smoker husband. The result shows that there is a positive relationship between the smoking behavior of husband with hypertension prevalence of wives. Also, the risk of wives hypertension will rise with an increase in the duration of exposure by secondhand smoke. This research was conducted in China with a questionnaire method and blood pressure measurement using electronic devices for more than 5 million women between 20 and 49 years old.

Besides, parental smoking can also bring a negative effect on health and influence the cognitive abilities of children. A research conducted by Pattenden et al. in 2006 by using data from The Pollution and The Young (PATY) project in 12 countries in Europe, explained that smoking habits of parents lead an adverse impact on the respiratory health of children, both prenatal and postnatal exposure, such as asthma, wheeze, nocturnal cough and bronchitis. Furthermore, parental smoking also affects the weight and height of children (Čavlek et al. 2010). Children whose parents are both smokers tend to have lighter weight and lower height than children whose parents are non-smokers, while the weight and height of children of paternal or maternal smoking are among those two conditions. Moreover, secondhand smoke exposure causes a decrease in cognitive abilities of children and adolescents (Yolton et al. 2004). The cognitive abilities in that research were measured by academic abilities in the form of numeracy and reading tests for children and adolescents between 6 and 16 years old in the US using survey data from the Third National Health and Nutrition Examination Survey (NHANES III).

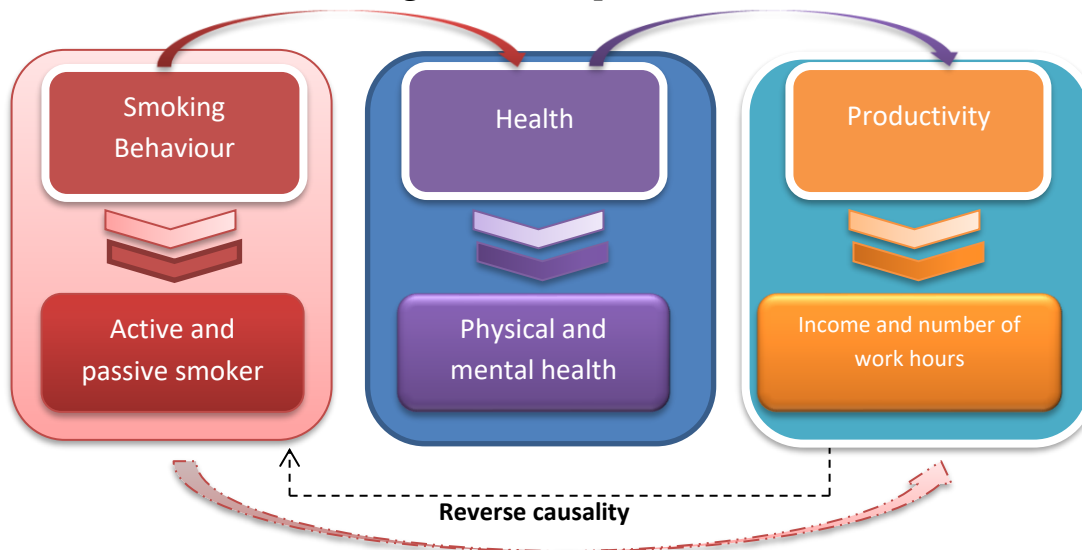
2.4 Conceptual Frameworks

Several studies have explained how smoking behavior can affect individual productivity. Based on the research conducted by Heijdra and Van der Ploeg (2002) as cited in Bondzie (2016: 6), illustrate that marginal individual productivity correlates with the amount of salary they receive, i.e. high salaries indicate high individual marginal productivity and vice versa. In addition, health economists also describe that the marginal productivity of individuals relates to health that can be generated from smoking or alcohol drinking. Individuals who have good health will have a high level of productivity, which will positively correlate with their income.

Similarly, Kang et al. (2002) describe that smoking habits, both passive and active smokers, generally cause four major diseases such as gastrointestinal, cardiovascular, respiratory diseases, and cancers. Those diseases caused by smoking lead to direct and indirect cost. Direct costs that must be borne by smokers are hospital costs while indirect cost that must be borne is loss of productivity in the form of absence from work, which is measured from loss of working hours. Based on literature reviews, this research theorizes, as depicted in figure 1 that smoking habits, both passive and active, can affect the level of individual health due to diseases caused by smoking habit. Then, those health problems will influence the level of individual productivity, which can be measured from their income and the number of working hours.

However, theoretically, health factors and individual productivity such as income can also influence smoking habits. In 2011, Leinsalu et al. studied the effect of income on smoking habits in Hungary, which is one of the less developed countries in Europe. The results of that study concluded that low-income people tend to be positively correlated with smoking continuation. Based on the reverse causality problems, this study will use several econometric techniques to overcome that problem of endogeneity.

Figure 1: Conceptual Framework

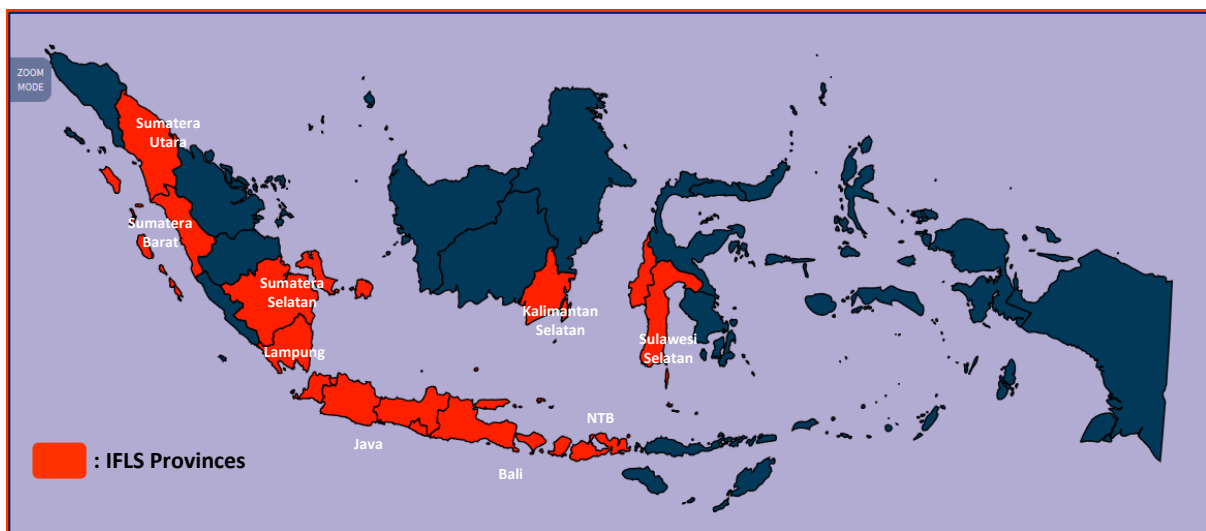


Chapter 3 Data and Methodology

3.1 Data

The data used in this study is secondary data, data-guided by information collected from existing sources and accessed through the internet, tracking documents or publishing information. Specifically, this research uses data sourced from the Indonesian Family Life Survey (IFLS), a survey conducted by RAND (Research AND Development) which is a non-profit organization based in the United States that is concerned in public policy research, in collaboration with the Universitas Indonesia (UI) and Universitas Gajah Mada (UGM). IFLS data can describe more than 80% of socio-economic and demographic conditions in Indonesia conducted in 15 provinces, as seen in figure 2 with more than 30,000 individuals surveyed on an ongoing basis.

Figure 2: Data Coverage of Indonesia Family Life Survey (IFLS)



Source: Picture was taken from RAND website accessed May 22, 2019, in website <https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html> and was edited by using <https://www.mapchart.net>

IFLS is ongoing surveys on socio-economic and health conditions in Indonesia and has been implemented in 5 waves. The first wave or IFLS 1 was carried out in 1993, IFLS 2 in 1997, IFLS 3 in 2000, IFLS 4 in 2007 and IFLS 5 as the latest survey conducted in 2015. This research only utilizes the data from the last two waves of the survey, IFLS 4 and IFLS 5. Although this survey contains a lot of information on economic and non-economic welfare indicators at the community, household and individual levels such as personal data characteristics, employment data, consumption, migration, assets, health status and other data, this research focuses on smoking behavior and health status data available in book 3B, also employment and personal data available in book 3A in IFLS 4 and IFLS 5.

3.2 Variables

Based on the research questions, this study attempts to focus on examining the association of smoking behavior of husbands on productivities of their working and non-smoking wives in Indonesia. In this research, passive smoking behavior is analyzed at the household level, which tries to

explain the association of the smoking behavior of husbands on the productivity of their non-smoking and working wives. Therefore, some variables use the data of wives, and some variables use the data of husbands, which are described as follows:

a. Dependent Variables

As explained in the previous chapter, in this paper, individual productivity is measured by income and the number of working hours. Hence, the data of dependent variables used in this study are only data of individuals as a non-smoking wife who has a job as evidenced by the answer of respondents to the question in book 3A (tk01a) IFLS section employment “During the past week, did you do any of these activities?” Respondents are categorized as having jobs if they choose the option “work for pay”.

1. Income

In this research, income is defined as the amount of money generated from the primary job and the additional job obtained from the respondent's answer in book 3A IFLS section employment.

- a) For employees, income is defined as the amount of money generated from the primary job (tk25a2) and the additional job (tk25b2) by the question “Approximately what was your salary/wage during the last year (including the value of all benefits)?”
- b) For self-employed, income is defined as the amount of money generated from the primary job (tk26a3) and the additional job (tk26b3) by the question “Approximately how much net profit did you gain last year, after taking out all your business expenses?”

In the regression model, the variable income is transformed into a log function after adding up the total income of the respondent and changing it into weekly income.

2. Number of working hours

Similar with income, the number of working hours is the sum of the number of working hours per week from primary job (tk22a) and the additional job (tk22b) from the respondent's answer in book 3A IFLS section employment “Normally, what is the approximate total number of hours you work per week?” In the regression model, the variable number of working hours is also transformed into a log function.

b. Independent Variables

There are several types of independent variables in this research: smoking behavior of husbands, human capital and personal characteristics of wives and the percentage of smokers in the wives' community. All of those variables are used to explain the effect on outcomes.

1. Smoking behavior of Husbands

Respondents as husbands are categorized as smokers based on their answers from the question “Have you ever chewed tobacco, smoked a pipe, smoked self-rolled cigarettes, or smoked cigarettes/cigars?” in book 3B (km01a) IFLS section Smoking Behavior. Furthermore, this research defines the smoking behavior of husbands into two types. First, smoking behavior tries to capture smoking intensity measured by how many cigarettes are consumed by the respondent. The data is taken from the respondent's answer to the question in book 3B (km08) IFLS section Smoking Behavior “In one day about how many cigars/cigarettes did you consume now/before totally quitting?” Second, smoking behavior is classified into four categories:

- a) Non-smokers (0) are respondents who do not smoke proven by their answers to the question “Have you ever chewed tobacco, smoked a pipe, smoked self-rolled cigarettes, or smoked cigarettes/cigars?” in book 3B (km01a) IFLS.
- b) Former smokers (1) are respondents who are quit to smoke proven by their answer to the question “Do you still have the habit or have you totally quit?” in book 3B (km04) IFLS.

- c) Light smokers (2) are respondents who smoke one until fourteen cigarettes per day.
- d) Heavy smokers (3) are respondents who smoke more than fourteen cigarettes per day. The definition of light and heavy smokers refers to research conducted by Liew and Gardner in 2016.

2. Human capital and Personal Characteristics of Wife

Human capital can be interpreted as a stock of traits owned by individuals or groups of individuals in the form of knowledge, talents, skills, and social attributes that can produce economic value (Goldin 2014:1). Based on Becker (2009:12) in his book entitled “Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education (3rd Edition)”, education, which is one of the essential aspects in his human capital model, has a positive correlation with income. The higher the education, the greater the income received. Therefore, according to Becker (2009: 12) investment in human capital, especially in education, is significant to alleviate unemployment. In this research, educational level is classified into four categories:

- 1) Never attend school (0) proven by respondents’ answer to the question “Have you ever attended/are you attending school?” in Book 3A (DL04) IFLS section education.
- 2) Up to elementary school (1), Up to senior high school (2) and up to higher education (3) proven by respondents’ answer to the question “What is the highest education level attended?” in Book 3A (DL06) IFLS section education.

Furthermore, a personal characteristic of wife such as age is also able to explain the effect of that characteristic on their productivities as measured by income and number of working hours (Levina et al. 1997; Ours 2004; Braakman 2008, Kvasnica 2010; Bondzie 2016; Amalia 2018). Age and Age Squared are treated as numerical variables. The Squared variable, which is a quadratic form of Age, is included in this model because it has a turning point that can explain the relationship between age and the outcomes. The data of personal character is taken from book 3B (b3b cov) IFLS.

3. Percentage of Smokers in the Wives’ Community

This research also utilizes the number of smokers in the wife’s community as an explanatory variable to analyze if there is a relationship between the numbers of smokers around the wives’ environment on their productivity. This variable is measured by using the percentage of smokers in the wives’ community obtained by dividing the total number of smokers in each community with the total number of people in that community. The community codes are obtained from the book Htrack (Household Track) IFLS and then merged with smoking behavior data in book 3B IFLS to acquire the number of smokers in each community¹. This variable is essential to be included in the model because, in daily life, the intensity of wives exposed to cigarette smoke does not only come from the husband but also from the surrounding environment. A study conducted by McGhee et al. in 2002 regarding the effect of passive smoking on workers in Hong Kong showed that the majority of non-smoker workers were exposed to secondhand smoke in the workplace rather than at home. Therefore, the percentage of smokers in the community as an explanatory variable could represent the impact of cigarette smoke from the environment around the wife.

3.3 Methodology

In order to answer the research questions, this paper applies three statistical methods: Ordinary Least Square (OLS), Fixed Effect, and Instrumental Variables (IV) method by using panel data. Based on previous studies, as described in table 1, research on the effect of smoking behavior on income causes

¹ The community codes are digits for the 312 communities in the IFLS which each code consists of 4 digits: two digits represent province, the third digit represents district within province and the fourth sub-district within district.

endogeneity problems. That problem arises because the explanatory variable correlates with the error term which can be caused by measurement error, the omitted variable, or simultaneity so that OLS results become inconsistent and biased (Wooldridge 2016: 758).

In this research, the endogeneity problem exists because of reverse causality between outcomes and smoking behavior. For example, the income level of wives influences the smoking habit of their husbands. Conversely, the smoking behavior of husbands can also negatively affect the income of their wives because of long-term inhalation of cigarette smoke results in health problems that can reduce the performance of their wives at work. Also, the endogeneity problem occurs because there are potential unobserved characteristics (confounding variables) that affect both outcomes and smoking behavior, in which case by applying OLS method lead to biased estimates (Levina et al. 1997:4) such as the lifestyle of people. Based on research conducted by Kaleta et al. (2009), smokers generally do not implement and adhere to a healthy lifestyle. In other words, smoking behavior is negatively correlated with a healthy lifestyle, which causes the direction of omitted variable bias will occur in a downward. Therefore, Fixed Effect and IV method are utilized in this study to overcome the endogeneity problems.

Table 1: The Methodology Used by Some Research to Tackle the Endogeneity Problem in Examining the Effect of Smoking Behavior on Income

Authors	Title	Outcomes	How to overcome the endogeneity problems	Main Effect
Levina et al. 1997	“More Bad News For Smoker? The effects of Cigarette Smoking on Labour Market Outcomes.”	Log of Wage	Panel data technique by using two periods of data.	<ul style="list-style-type: none"> • OLS: Smoking negatively affects the income of workers by around 4.3 percentage points. • Panel data: Smoking adversely affects the income of workers by approximately 5.4 percentage points.
Anger & Kvasnica (2010)	“Does smoking really harm your earnings so much? Biases in current estimates of the smoking wage penalty.”	log of gross hourly wages	This research applies Two-Stage Least Squares (2SLS) regressions by including a dummy for the early age of smoking initiation as an Instrumental Variable. This instrument is used to find out the systematic differences between individuals behavior at a young age that affects the likelihood of early smoking initiation when they were still living with parents.	<ul style="list-style-type: none"> • OLS: Current smokers are estimated to have lower salaries than non-smokers by 4.5 percentage points. • IV: Current smokers are expected to have lower wages than non-smokers by 9.9 percentage points (more than twice than OLS result).
Bondzie (2016)	“Effect of smoking and other economic variables on wages in the Euro Area.”	Log of wages	This research utilizes the Instrumental Variable method by using two health status indicators: individual body weight and the number of times the individual was hospitalized in the study period.	<ul style="list-style-type: none"> • OLS: smokers earn 6.3 percentage point less than non-smokers • IV: smokers earn 22.7 percentage point less than non-smokers (the effect is more than tripled than OLS)

Jan C. Van Ours (2004)	“A pint a day raises a man’s pay; but smoking blows that gain away.”	Log of wages	<p>This research uses “early start” and “partner” as Instrumental Variables in the form of dummy variable.</p> <ul style="list-style-type: none"> • For “early start to smoke”: 1 if respondents start to smoke before 16 years old and 0 otherwise. • For “partner”: 1 if respondents have a partner and 0 otherwise. 	<ul style="list-style-type: none"> • OLS: Male smokers tend to have lower salaries by 3 to 11 percentage points compared to non-smokers. However, there is hardly any effect of smoking on wages for females • IV: Male smokers tend to have lower salaries by around 12 percentage points compared to non-smokers.
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3.3.1 Ordinary Least Square (OLS)

This research still runs OLS regression as a benchmark against Fixed Effect and IV regressions even though the OLS method produces biased estimates due to endogeneity problems. Then, the formula for OLS regression is as follows:

$$PS_i = \alpha_0 + Smoke_i\beta_1 + X_i\beta_2 + \varepsilon_{it}$$

Where:

PS : Individual productivity of working and non-smoker wives (Passive Smokers) as a dependent variable is measured into two ways: income and number of working hours.

Smoke : There are two ways to define smoking behaviour of her husbands:

1. Smoking behavior tries to capture smoking intensity measured by how many cigarettes are consumed by the respondent per day (Continuous)
2. Smoking Behavior is classified into four categories (Categorical)
 - a) Non-smoker (0)
 - b) Former smoker (1)
 - c) Light smoker (2)
 - d) Heavy smoker (3)

X_i :

Education : Educational level of wife is classified into four categories:

1. Never attend school (0)
2. Up to elementary school (1)
3. Up to senior high school (2) and
4. Up to higher education (3)

Age and Age² : Age of wife

Percentage of Smoker in Community : Percentage of Smoker in Wives’ Community

3.3.2 Fixed Effect and Instrumental Variable

As explained earlier, the Fixed Effect and IV method are used in this study to overcome the endogeneity problems in the model. Based on the research of Levine et al. (1997), applying individual Fixed Effects or panel data techniques is useful to account the effects of the unobservable heterogeneity. In addition, analysing the relationship between changes in smoking behaviour and changes in outcomes over time will control individual characteristics that are constant over time. Then, the equation for the Fixed Effect method by using two waves of IFLS is as follows:

$$PS_{it} = \alpha_0 + \text{Smoke}_{it}\beta + X_{it}\gamma + \delta_i + \varepsilon_{it}, \text{ or}$$

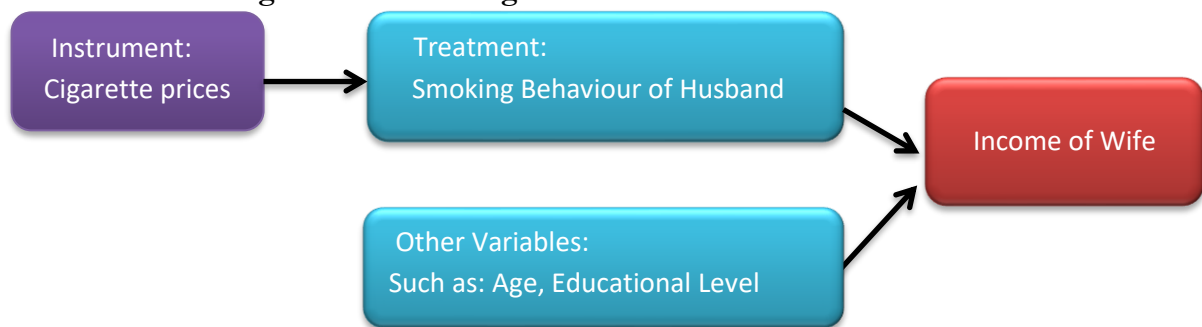
$$\Delta PS_i = \alpha_0 + \Delta \text{Smoke}_i\beta + \Delta X_i\gamma + \Delta \varepsilon_i; \text{ Where } \delta_i \text{ describes Individual Fixed Effect.}$$

However, Fixed Effect method is not the best method to overcome the problem of endogeneity in the model because this method eliminates time-constant explanatory variables so that it does not solve the problem of "time-varying omitted variables" (Wooldridge 2016: 461). He also stated that the best and most popular method to conquer the endogeneity problem in the model is by applying Instrumental Variable or commonly known as IV method.

Two requirements must be fulfilled to obtain a valid and strong IV that can tackle the endogeneity problems in the model (Wooldridge 2016 464; Leigh and Schembri 2004: 286). First, that instrument correlates with the treatment variable. If the correlation between those two variables is strong, then the instrument can be described as having a robust in the first stage. Second, the instrument variable must not correlate with error terms or may not have a direct relationship with outcomes.

A research conducted by Leigh and Schembri (2003) explains that cigarette price is a valid and robust instrument to measure the effect of smoking on health because that instrument meets the two conditions above. First, cigarette price affects smoking behavior. Logically, when the price of cigarettes increases, the consumption of cigarettes will decrease. Second, the price of cigarettes does not correlate directly with an individual's health. By using the same way of thinking, the cigarette price is also a valid variable instrument that can be used to overcome the problem of endogeneity in explaining the influence of smoking behavior on income as described in figure 3. The price of cigarettes influences the decision of the respondents as husbands to smoke, but that price does not directly affect the income of their wives.

Figure 3: Price of Cigarette as a Valid Instrument



However, the instrumental variable (IV) used in this research paper is quite different from that previous research. The previous studies use cigarette price as IV while this paper utilizes the price of cigarettes in the year when the respondents as husbands started to smoke for the first time as IV because that price may be a factor for people to start their smoking behavior. Then, the category of respondents identified with the IV is the respondents as husbands who are still current smokers. That

IV is used in this paper because the data of cigarette prices is not available in IFLS and also the price of cigarettes in all regions of Indonesia is almost the same. Nevertheless, that IV still has weaknesses because maybe the price of cigarettes is not one of the main considerations for people to start smoking, there are many other factors such as environmental conditions, parental smoking and so on.

The data of respondents when they started smoking for the first time are obtained from book 3B IFLS through the question “At what age do you start to smoke on a regular base?” and the price of cigarettes per year is sourced from Tobacco Economics in Indonesia Report² and Cigarette Affordability in Indonesia Report³. Moreover, the price of cigarettes used as IV is the real prices of cigarettes which can describe people's purchasing power because those prices take into account the inflation rate in the year concerned. The conversion of the nominal price to the real price of cigarette uses the following formula:

$$Real\ Price\ at\ time\ t = \frac{Nominal\ Price\ at\ time\ t}{\left(\frac{CPI\ at\ time\ t}{100}\right)}$$

Where:

CPI is the Consumer Price Index which describes changes in the price level of goods and services purchased by households. The reference base period of CPI used in this study is 2010, which is sourced from the World Bank Database.

3.4 Descriptive Analysis

In examining the association of smoking behavior of husbands on individual productivity of their wives measured by income and number of working hours, this research paper utilizes panel data. The panel data used is the combined data of IFLS 4 and IFLS 5. The number of observations after making several adjustments, as described in table 2 is 1,416 observations. The first stage of adjustment is to remove the missing responses (empty columns) of income and number of working hour data to evade the incompatibilities in data and analysis. There are 1,019 respondents in IFLS 4 and 750 respondents in IFLS 5 whose income data are not available (including zero income). The second stage of adjustment is to trim the data outliers. A kind of data outliers in this paper is unreasonable nominal income, which may be caused by errors in input data. After examining the data summary of income (see Appendix I), the data observations are deleted by 5% of below and 1% upper data based on the amount of income. Also, respondents who have a number of working hours exceeding 168 hours per week are removed because the total hours in one week are 168 hours. The next step is to combine observational data from IFLS 4 and IFLS 5. In this process, there are some respondents who were not interviewed in IFLS 5 but interviewed in IFLS 4 and vice versa (such as new respondents in IFLS 5). As a result, there are 1,416 observations from 708 respondents interviewed both on IFLS 4 and IFLS 5.

² Barber, S., Adioetomo, S. M., Ahsan, A., and Setyonaluri, D. (2008) ‘Tobacco economics in Indonesia’, *Paris: International Union Against Tuberculosis and Lung Disease*, 39.

³ Zheng, R., Marquez, P. V., Ahsan, A., Hu, X., and Wang, Y. (2018) ‘Cigarette affordability in Indonesia: 2002-2017’.

Table 2: The Process of Combined Data of IFLS 4 and IFLS 5

		IFLS 4	IFLS 5	IFLS 4 + IFLS 5
1	Number of raw data	2,960	3,456	
2	Missing income and other outliers	1,239	1,066	
3	Number of observation (1 - 2)	1,721	2,390	4,111
4	Not matched			2,695
5	Matched observations (3 -4)			1,416

Descriptive statistics for 1,416 observations are presented in table 3. According to that table, the average income of respondents as wives is IDR 246,085 per week and the average of working hours is 47 hours per week. Moreover, almost half of those wives only graduated from elementary school, while 15% of them graduated from tertiary education, as illustrated in chart 4. On the other hand, the mean number of cigarettes consumed by the respondents as husbands are 12 cigarettes per day with the maximum amount of cigarettes consumed per day is 64 cigarettes. By classifying the smoking behavior of the husband into four categories as seen in chart 5, 63% or the majority of respondents as husbands are light smokers while the proportion of heavy smokers, former smokers and non-smokers are 24%, 10%, and 3% respectively.

Chart 4: The Educational Level of Wives

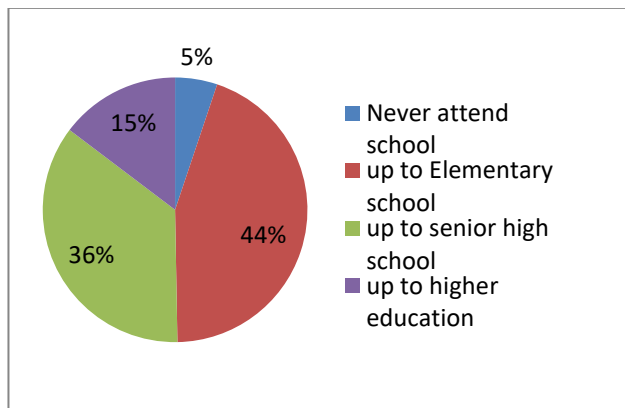


Chart 5: Smoking Behavior of Husbands

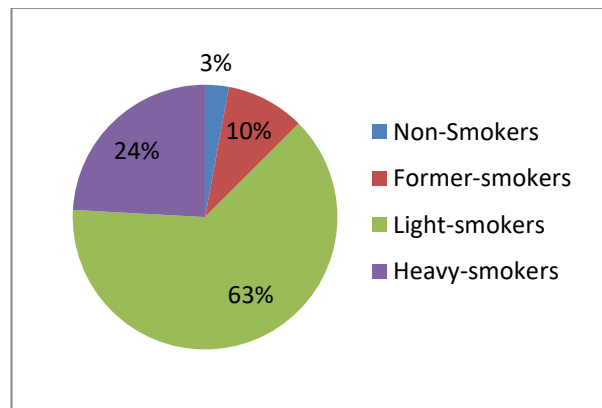


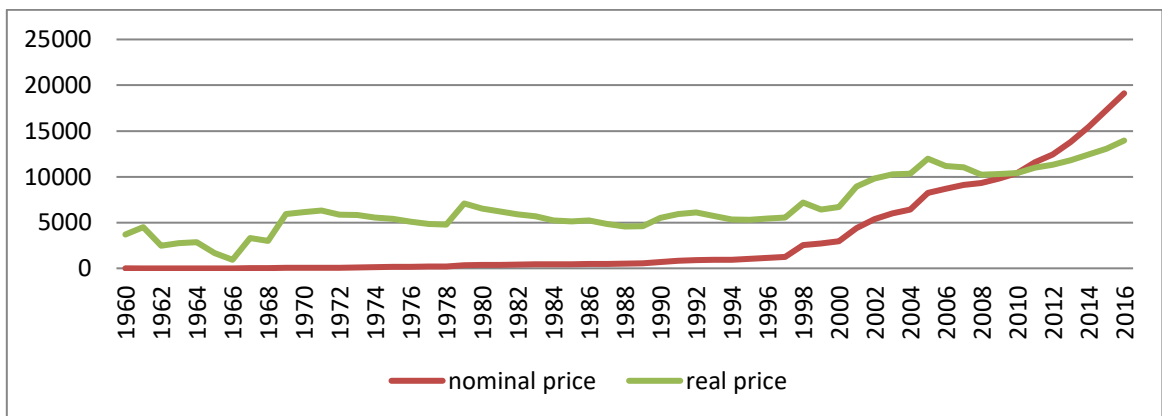
Table 3: Descriptive Statistics

Variables	Description	Mean	St. Dev	Min	Max
Income	weekly income of wife	246,085	33,0442.2	5000	2,076,923
Log Income	Log of weekly wife's income	11.70	1.24	8.51	14.54
Working Hours	Weekly working hours of wife	46.99	23.53	9	126
Log Working Hours	Log of weekly wife's working hours	3.72	0.53	2.19	4.84
Number of cigarette	Number of cigarette consumed per day of husband	11.81	7.78	0	64

Smoking Behaviour	Smoking behavior of husband: <ul style="list-style-type: none"> • Non-smoker (0), • Current Smoker (1), • Light Smoker (2), • Heavy Smoker (3) 	2.69	0.67	0	3
Age start to smoke	the age of the husband when he first started smoking	19.63	6.63	4	73
Educational Level	The educational level of wife: <ul style="list-style-type: none"> • Never attend school (0) • Up to elementary school (1) • Up to senior high school • Up to higher education (3) 	1.59	0.79	0	3
Age	Age of wife	41.62	9.87	19	75
Age^2	Age Squared of wife	1,829.65	845.38	361	5,625
Percentage of Smokers in Community	Percentage of Smokers in Wives' Community	0.506	0.19	0.12	1
Respiratory problem	health effects on the respiratory tract felt by the wife	0.73		0	1
Price of Cigarettes	Real price of cigarettes	5,699	1,664	931.63	12,417

Furthermore, the mean price of cigarette as an instrumental variable in this research is IDR 5,699 with the real minimum price occurred in 1966 was IDR 931, and the maximum real price occurred in 2018 was IDR 12,417 as seen in table 3 and as illustrated clearly in chart 6. That chart describes changes in nominal and real prices of cigarettes from 1960 to 2016. According to that chart, the nominal price of cigarettes was fairly stable during the period 1960 to 1997 and experienced a rapid increase in 1998 when the financial crisis in Asia harmed the Indonesian economy. On the other hand, changes in real cigarette prices fluctuated slightly, although overall there was an increase in real cigarette prices in 2016 compared to 1960.

Chart 4: Nominal and Real Prices of Cigarette in Indonesia from 1960 to 2016



Source: Nominal prices of cigarettes are taken from Tobacco Economics in Indonesia Report and Cigarette Affordability in Indonesia Report. Nominal prices of that cigarettes are prices a pack of cigarettes containing 20 individual pieces.

Chapter 4 Results and Discussions

This research focuses on identifying the association of smoking behavior of husbands on the individual productivity of their wives measured by income and number of working hours. Therefore, to answer those research questions, this chapter provides the result of regressions and also discusses the relationship between outcomes and independent variable based on the regression results and previous studies. This chapter consists of three parts. Part one will describe the correlation between smoking behavior of husbands on the health status of their wives. Part two and three will explain the association of smoking behavior of husbands on income and number of working hours of their wives by comparing the regression results of three statistical methods: OLS, Fixed Effect, and Instrumental Variable.

4.1 The Association of Smoking Behavior of Husbands on Health of Their Wives

There is no debate that smoking harms health conditions both for active and passive smokers. Besides being able to cause chronic diseases such as lung cancer and heart failure, generally, passive smokers will be affected by respiratory tract disorders due to inhaled side-stream smoke for a long time (Schick and Glantz 2005; Well 1998; McGhee et al. 2002; Kang et al. 2002). First of all, this chapter will explain the association of husbands smoking habits on the health status of their wives because it has been demonstrated previously in the conceptual framework that smoking affects individual productivity through health factors. In this research, the health effects of wives due to their husbands smoking habits are measured by acute morbidity associated with respiratory problems experienced by wives such as cough (dry cough, cough with phlegm or bloody cough), difficulty breathing (Wheezing or short, rapid breath), or feel chest pains. The data is obtained from the book 3B section Acute Morbidity in IFLS 4 and IFLS 5.

Furthermore, the statistical method used to measure the health impact of wives due to the smoking behavior of their husbands is logistic regression. The logit function, the natural log of the odds (probability/ (1-probability)), is utilized when the dependent variable is categorical data. In this study, the health level of wives as an outcome is categorized in the binomial variable (1, 0). The wife who has experienced at least one of the acute comorbidities associated with respiratory tract disorders can be categorized as 1 while the wife who has never suffered from severe comorbidities can be classified as 0. Then, the model of logistic regression is as follows:

$$\text{Log} \left(\frac{p}{1-p} \right) = \alpha_0 + \text{Smoke}_i \beta_1 + \varepsilon_i$$

Where: p is the probability of the wife suffering from acute comorbidity related to the respiratory tract.

Odd ratio (OR) is often used in medical research papers because it is very convenient to interpret case-control studies through OR (Bland and Altman 2000). In this analysis, OR is defined as the ratio of two probabilities: the probability of the wife suffering from acute comorbidity related to the respiratory tract (p) to the likelihood of the wife not suffering from severe comorbidity associated with the respiratory tract ($1-p$). In addition, as a comparison, this study also uses the Linear Probability Model (LPM) with Fixed Effect to analyze the association of smoking behavior of husbands on respiratory health of their wives.

Table 4: The Regression Results in Examining the Association of Smoking Behaviour of Husbands on Respiratory Health of Their Wives

Variables	Odd Ratios						LPM with Fixed Effect	
	IFLS 5		IFLS 4		IFLS 4 + IFLS 5		(7)	(8)
	(1)	(2)	(3)	(4)	(5)	(6)		
Number of cigarette	1.018*** (0.00628)		1.011 (0.00763)		0.999 (0.00762)		-0.00126 (0.00145)	
Baseline: Non-smokers								
1. Former smokers		1.804** (0.480)		1.222 (0.341)		1.294 (0.477)		
2. Light smokers		2.567*** (0.632)		1.938*** (0.440)		1.777* (0.585)		0.0617* (0.0347)
3. Heavy Smokers		3.743*** (0.975)		2.321*** (0.579)		1.869* (0.642)		0.0499* (0.0386)
dIFLS4							0.0282** (0.0115)	0.0326*** (0.0118)
Constant	3.048*** (0.266)	1.467 (0.347)	2.400*** (0.235)	1.444* (0.313)	2.702*** (0.293)	1.562 (0.500)	0.0594*** (0.0182)	-0.00870 (0.0324)
Observations	2,390		1,721		1,416		1,416	

Note: Data of IFLS 4 + IFLS 5 is panel data. In the process of combined data, some respondents were not interviewed in IFLS 5 but interviewed in IFLS 4 and vice versa (such as new respondents in IFLS 5). As a result, there are 1,416 observations from 708 respondents interviewed both on IFLS 4 and IFLS 5. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 4 describes OR in measuring how strong the association between smoking behavior of husbands as exposure and health status of their wives as an outcome. If OR > 1, means that exposure associated with higher odds of the outcome. Overall, the majority of OR numbers in table 4 are greater than 1. In other words, the smoking habit of husbands associated with higher odds of wives exposed to respiratory problems. If the smoking behavior of husbands is measured by the number of cigarettes consumed, the regression result by using IFLS 5 data shows that for one unit increase in the number of cigarettes consumed by husbands, the odds of wives getting acute comorbidities in respiratory problems increased by 1.018 times. Whereas, the regression results by using the data of IFLS 4 and the combined data of IFLS 4 and 5 cannot be concluded as a substantial relationship between two variables because the odd ratio data are not significant. On the other hand, if the smoking behavior of husbands is measured by categorical variables, consistent results are presented by all kinds of data. Husbands categorized as heavy smokers have the greatest odds ratio of having a wife affected by acute comorbidities in respiratory problems.

Furthermore, the regression results by using LPM with fixed effect method are almost the same with the result of odd ratios. According to table 4 column (8), the probability of Husbands categorized as light and heavy smokers has a wife suffered by acute comorbidities associated with respiratory problems are 6.1 and 4.9 percentage points respectively more likely than non-smoker husbands. If the smoking behavior of husbands is measured by the number of cigarettes consumed, as seen in table 4 columns (7), the coefficient is negative but statistically insignificant. As a result, both the regression results by using odd ratios and LPM with Fixed effect generally explain that the probability of smokers having a wife affected by respiratory problems is higher than non-smokers. In other words, smoking habits of husbands negatively correlate with the health status of their wives.

4.2 The Association of Smoking Behavior of Husbands on Income of Their Wives

After analyzing the association between the smoking behavior of husbands and the health effects of their wives, this study concluded that smoking husbands adversely affect the respiratory system of their wives. Therefore, this research will then examine the association of husbands smoking habits on the productivities of their wives to answer the research questions. In measuring the correlation between outcomes and independent variables, this research utilizes three statistical methods: OLS, Fixed effect and Instrumental Variable. Moreover, the data used is a panel data for respondents interviewed both on IFLS 4 and IFLS 5.

4.2.1 OLS and Fixed Effect Method

This section reports the results of OLS and Fixed Effects regression in analyzing the association between smoking behavior of husbands and income from their wives by involving several explanatory variables such as age, educational levels and percentages of smokers in wives' community. The results of the regressions are presented in table 5 (see Appendix II for complete results). On that table, column (1) and (2) describe the regression results if the smoking behavior of husbands is measured by the number of cigarettes consumed per day, while column (3) and (4) illustrate the regression results if smoking behavior of husbands classified into four categories: Non-smokers, former smokers, light smokers and heavy smokers. Based on the estimation results in column (1) and (2), there is a positive correlation between the income of wives and the number of cigarettes consumed by their husbands both using OLS and Fixed Effect method. In other words, the increase of one unit cigarette consumed by their husband will increase the weekly income of wives by 1.45 percentage points at 1% significance level (OLS) and 0.97 percentage points at 10% significance level (Fixed Effect). Based on the study conducted by Braakman (2008: 11), there are two possible explanations for positive correlations between smoking behavior and wages through health status. First, the effects of smoking on health, especially chronic diseases, will appear in the future and are not a problem for people in the group age 20 to 55 years old. Second, the health status is more critical to the question of whether people can find work or not than the amount of wages received. Moreover, According to standardized regression coefficients (see Appendix III), the OLS estimates means that a one standard deviation unit increase in cigarettes consumed by husbands would lead to a 0.09 standard deviation increase in the predicted income of their wives. Compared to the standardized coefficient of other variables, the coefficient of the number of cigarettes consumed by husbands is the smallest among the other variables.

On the other hand, by using categorical variables to measure smoking behavior of husbands as shown in column (3) and column (4), OLS coefficient estimates that being light smokers' husbands decrease the income of their wives by 6.8 percentage points compared to being non-smokers husbands, while the Fixed Effect coefficient almost doubles that OLS effect. Also, by using the Fixed Effect method, husbands categorized as heavy smokers are negatively associated with the income of their wives. In other words, having a smoking husband has an adverse impact on the wife's income. However, those results are not significant, so it can be concluded that the smoking behavior of husbands is not significantly correlated with the level of income of their wives.

Table 5: Regression Results in Examining the Association of Smoking Behavior of Husbands on Income of Their wives

(Dependent Variable: Log weekly Income of Wives)

VARIABLES	(1) OLS	(2) Fixed Effect	(3) OLS	(4) Fixed Effect
Number of Cigarettes (Husband)	0.0145*** (0.00378)	0.00977* (0.00539)		
Base: Non Smoker (Husband)				
1. Former Smoker			0.291 (0.197)	
2. Light Smoker			-0.0686 (0.177)	-0.131 (0.300)
3. Heavy Smoker			0.197 (0.184)	-0.00417 (0.309)
Age (Wife)	0.139*** (0.0209)	0.120* (0.0649)	0.138*** (0.0209)	0.111* (0.0653)
Age ² (Wife)	-0.00147*** (0.000244)	-0.00102*** (0.000336)	-0.00148*** (0.000244)	-0.000976*** (0.000338)
Base: Never attend school (Wife)				
1. Up to Elementary School	0.404*** (0.139)	-0.209 (0.293)	0.410*** (0.139)	-0.223 (0.295)
2. Up to Senior High School	0.874*** (0.145)	-0.556 (0.367)	0.860*** (0.145)	-0.588 (0.369)
3. Up to Higher Education	1.742*** (0.155)	-0.748 (0.450)	1.712*** (0.155)	-0.808 (0.453)
Percentage of smokers in wives' community	-1.056*** (0.155)	-0.582** (0.244)	-1.039*** (0.155)	-0.597** (0.245)
dIFLS4		0.712* (0.399)		0.774* (0.400)
Constant	8.223*** (0.465)	8.217*** (2.287)	8.413*** (0.502)	8.727*** (2.323)
Observations	1,416	1,416	1,416	1,416
R-squared	0.227	0.361	0.231	0.362

Standard errors in parentheses

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

Nevertheless, the regression results of OLS are different from the previous studies conducted by Levina et al. (1997) and Bondzie (2016) who research the impact of active smoking behavior on individual productivity. Both of those papers also use the OLS method as comparison results with other methods. By using the categorical variable of smoking behavior, their OLS results stated that smokers significantly earn less compared to non-smokers. As explained in the previous chapter, the use of OLS method in examining the effect of smoking on income results in endogeneity problems. According to Wooldridge (2016: 461), the best method for dealing with endogeneity problems in models is applying the IV method. Therefore, in the next section, this research tries to use the IV method and compares the regression results with the OLS and Fixed Effect models.

Furthermore, the other explanatory variables show the regression results with expected signs and in line with previous studies (Levina et al. 1997; Ours 2004; Braakman 2008, Kvasnica 2010;

Bondzie 2016; Amalia 2018). The increase of the age of wives will increase their income by around 12 until 13.9 percentage points, but the age has a turning point or parabolic shape described in the age square variable. For the education level, the higher the educational level of the wives, the higher the income they earn. OLS estimates in columns (1) and (3) imply that respondent graduated from higher education earn approximately 170 percentage points more income compared to respondents who never attended school. That significant and positive correlation results between the educational level and income result are in line with the study conducted by Becker (2009). However, by applying the Fixed Effect method, there is no correlation between changes in the educational level of wives on changes their income.

Another explanatory variable that is important to discuss based on the results of regression is the percentage of smoker in the wives' community. This variable can represent the impact of cigarette smoke from the surrounding environment on the productivities of wives. Based on table 5, there is a negative and significant correlation between percentage smoker in wives' community and their income both using OLS and Fixed Effect. The OLS coefficient in column (1) and (3) estimates that a one percentage points increase in the percentage of smoker in wives' community would yield a 105.6 and 103.9 percentage points decrease in the income of wives respectively. According to standardized regression coefficients (see Appendix III), the OLS estimates for this variable means a one standard deviation unit increase in the percentage of smoker in wives' community would expect to a 0.16 standard deviation decrease in the income of their wives. That figure is almost double the standardized coefficient of the variable number of cigarette smoking of husbands. It means that this variable has a stronger coefficient than the variable number of cigarette smoking of husbands. Similar to the OLS estimates, the Fixed Effect regression results as illustrated in column (2) and (4) point to a negatively sizeable effect of the percentage of smoker in wives' community on their income. As a result, it can be concluded that the increase in the amount of smoker in the environment around the wives results in greater intensity of exposure to cigarette smoke which ultimately harms their income through health factor.

4.2.2 Instrumental Variable

Based on the previous research that have examined smoking effects on income, the endogeneity problems exist because reverse causality between smoking and income and also there are potential unobservable characteristics that affect both wages and smoking behaviors. One example of unobserved characteristics of individuals explained in research conducted by Levina et al. (1997: 4) is "measure of judgment". If people with poor assessment tend to choose to smoke and there are no variables in the model related to the size of that assessment, then low wages due to poor judgment will always be associated with smoking habits.

Because of the endogeneity problems, applying OLS methods lead to biased estimates. Therefore, the application of the IV method is needed as the best and most popular method for overcoming the problem of endogeneity in the model compared to the fixed effect method (Wooldridge 2016: 461). As explained in the previous chapter, the price of cigarettes in the year when the respondents as husbands start smoking is utilized as IV because that price may be a factor for people to start their smoking behavior. Then, the category of respondents identified with the IV is the respondents as husbands who are still current smokers. The result is presented in table 6 by showing regression in stages to investigate changes in the coefficient of income while adding another explanatory variable and comparing the result with the OLS estimates. By using the IV method, there is a negative correlation between smoking behavior of husbands measured by the number of cigarettes on the income of their wives. The direction of that coefficient is different between the regression results of the IV method and OLS method.

Overall, the smoking behavior of husbands negatively associated with the income of their wives by 11.5 to 21 percentage points at 5 and 10 percent significance level only in columns 2, 3 and 4. By

adding the variable percentage of smokers in the wives' community, the correlation between numbers of cigarettes and income of wives is still negative but statistically insignificant. The direction of that correlation is in line with the previous studies, as shown in table 6. Also, the results of the firsts stage regressions revealed that the price of cigarettes as an instrumental variable is significant statistically (see Appendix IV). Based on that result in Appendix IV, if the price of cigarettes increases by 10.000 Rupiah or equal with approximately 0.6 Euro then the number of cigarettes consumed by the husband decreases by two until four sticks per day. It means that the price of cigarettes correlates negatively with the smoking behavior of husbands measured by the number of cigarettes consumed.

Besides, the direction of the coefficient of other control variables by utilizing IV method is consistent with the OLS estimates, while the magnitude of the coefficient is bigger than OLS. For example, the coefficient variable percentage of smokers in wives' community decreases by 10.28 percentage points compared to the OLS result. The IV estimate for that variable implies that a one percentage point increase in the percentage of smoker in wives' community would significantly decrease the income of wives by 114 percentages points.

Table 6: Result of IV Estimates in Examining the Association of Smoking Behavior of Husbands on Income of Their Wives
(Dependent Variable: Log weekly Income of Wives)

VARIABLES	IV					OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Cigarettes (Husband)	-0.137 (0.0915)	-0.210** (0.106)	-0.202** (0.102)	-0.115* (0.0647)	-0.0723 (0.0525)	0.0145*** (0.00378)
Age (Wife)		0.0135** (0.00617)	0.203*** (0.0544)	0.172*** (0.0373)	0.151*** (0.0314)	0.139*** (0.0209)
Age ² (Wife)			-0.00229*** (0.000655)	-0.00174*** (0.000440)	-0.00157*** (0.000372)	-0.00147*** (0.000244)
Base: Never attend school (Wife)						
1. Up to Elementary School				0.680*** (0.250)	0.554*** (0.210)	0.404*** (0.139)
2. Up to Senior High School				1.322*** (0.301)	1.098*** (0.249)	0.874*** (0.145)
3. Up to Higher Education				2.183*** (0.309)	1.952*** (0.255)	1.742*** (0.155)
Percentage of smokers in wives' community					-1.147*** (0.197)	-1.056*** (0.155)
Constant	13.41*** (1.118)	13.75*** (1.344)	9.927*** (1.105)	8.062*** (0.703)	8.866*** (0.639)	8.223*** (0.465)
Observations	1,341	1,341	1,341	1,341	1,341	1,416

Note: the category of respondents identified with the IV is the respondents as husbands who are still current smokers. Therefore, total observations in IV method are 1,341 after dropping observations where the husband smokes zero currently. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4.3 The Association of Smoking Behavior of Husbands on Number of Working Hours of Their Wives

Based on the research questions, in addition to analyzing the association between smoking behavior of husbands and income of their wives, this research also examined the association of husbands

smoking habits on the number of working hours of their wives. The similar method used in analyzing the association of smoking on income, this section also uses three estimations techniques: Pooled OLS; and Fixed Effect and IV method to control reverse causality in the model. The results of those regressions are shown in table 7. Using the OLS method, there is a difference in the direction of coefficient between smoking behavior of husband measured by the number of cigarettes consumed in column (1) and classified with categorical data in column (3). However, due to endogeneity problems, the estimates generated by the OLS method are biased. By using Fixed Effect method presented in column (2) and (4), the estimated relationships between changes in smoking behavior of husbands and changes in the number of working hours of their wives show a negative correlation, but the coefficient is quite small and statistically insignificant. The Fixed effect estimates in column (2) imply that a one percentage point increase in the change in the number of cigarettes consumed by husband is associated with a 0.028 percentage points decrease in the change of income of their wives.

Table 7: Result of Regressions Estimates in Examining the Association of Smoking Behavior of Husbands on Number of Working Hours of Their Wives
(Dependent Variable: Log weekly Working Hours of Wives)

VARIABLES	(1) OLS	(2) Fixed Effect	(3) OLS	(4) Fixed Effect	(5) IV
Number of Cigarettes (Husband)	-0.000147 (0.00181)	-0.000280 (0.00308)			-0.0118 (0.0256)
Base: Non Smoker (Husband)					
1. Former Smoker			0.184* (0.0945)		
2. Light Smoker			0.187** (0.0849)	0.00207 (0.171)	
3. Heavy Smoker			0.158* (0.0882)	-0.0313 (0.176)	
Age (Wife)	0.0100 (0.0100)	0.0702* (0.0371)	0.0104 (0.01000)	0.0731* (0.0373)	0.0233* (0.0129)
Age ² (Wife)	-0.000154 (0.000117)	-0.000389** (0.000192)	-0.000154 (0.000117)	-0.000410** (0.000193)	-0.000319** (0.000153)
Base: Never attend school (Wife)					
1. Up to Elementary School	0.137** (0.0666)	-0.0612 (0.167)	0.136** (0.0665)	-0.0628 (0.168)	0.154* (0.0917)
2. Up to Senior High School	0.134* (0.0694)	-0.0650 (0.210)	0.133* (0.0693)	-0.0610 (0.211)	0.166 (0.113)
3. Up to Higher Education	-0.0737 (0.0744)	-0.150 (0.257)	-0.0730 (0.0745)	-0.139 (0.258)	-0.0336 (0.117)
Percentage of smokers in wives' community	-0.00392 (0.0741)	0.290** (0.139)	0.00623 (0.0743)	0.284** (0.140)	-0.0481 (0.0836)
dIFLS4		-0.199 (0.228)		-0.213 (0.228)	
Constant	3.488*** (0.223)	1.537 (1.306)	3.292*** (0.241)	1.461 (1.325)	3.375*** (0.280)
Observations	1,416	1,416	1,416	1,416	1,341
R-squared	0.026	0.016	0.029	0.017	

As the best method of controlling the endogeneity problems, the direction of IV coefficient as seen in column (5) is similar with Fixed Effect, there is a negative correlation between smoking behaviors of husbands on the number of working hours of their wives, and remains statistically insignificant. The IV estimates means that an increase one unit of cigarette consumed by husbands lead to decrease the number of working hours of their wives by 1.18 percentage points. However, the size of the IV coefficient is bigger than Fixed Effect. Therefore, overall, it can be concluded that the husband's smoking habits do not correlate with the number of working hours of the wife. The results of this study are similar with the results of a study conducted by Levina et al. (1997: 13), who concluded that active smoking has not significantly correlated with the number of working hours. The possible explanations of that relationship might be because on the one hand cigarette smoke contains hazardous substances that have a negative effect on health so that it has an impact on the physical health of both active and passive smokers. On the other hand, the nicotine content in cigarette smoke also provides benefits which can improve performance, focus, memory, attention, and speed (Heishman et al. 2010: 453).

Furthermore, there are mixed results in analyzing the association of the education level of wives on the number of their working hours, but mostly the association between those variables is negative and statistically insignificant. For example, the IV estimates illustrate that being higher education graduates lower the number of working hours by 3.36 percentage points compared to people who never attend school while being elementary school graduates significantly increase the number of working hours by 15.4 percentage points. That might be explained logically that the higher the level of education, the higher the salary generated so that people with high-level education do not need to work long hours in a day to meet their daily needs. Also, there are mixed results in analyzing the impact of the percentages number of smokers in the wives' community on the number of their working hours. Nevertheless, by using the IV method, the coefficient is negative by 4.8 percentage points but remains statistically insignificant.

Chapter 5: Conclusion and Recommendations

5.1 Conclusion

There is no debate that smoking behaviour, both active and passive, has an adverse effect on health. Moreover, some researchers have analyzed that passive smoking is even more dangerous than active smoking (Schick and Glantz 2005; Raupach et al. 2005) because people who inhale side-stream smoke will be contaminated with four times as much toxic substance as the smoke that is inhaled by active smokers. Besides affecting the health sector, smoking behavior also indirectly influences individual productivity (Levina et al. 1997; Halpren et al. 2001; Ours 2004; Braakman 2008, Kvasnica 2010; Bondzie 2016; Amalia 2018). However, those studies only focus on the impact of active smoking behavior, while research related to passive smoking behavior mostly focuses on the health sector (Well 1998; McGhee et al. 2002; Bazikov 2010; Yolton et al. 2004; Yang et al. 2016; Dartanto et al. 2018).

Therefore, this research tries to examine the association between passive smoking behavior and individual productivity at the household level in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives measured by income and number of working hours. Based on existing literature, there has been no research related to that topic. By comparing the result of three statistical methods: Ordinary Least Square (OLS), Fixed Effect, and Instrumental Variables (IV) and using the panel data sourced from IFLS 4 and IFLS 5, this paper tries to answer two sub research questions and main research question:

First sub research question: “What is the association of smoking behavior of husbands on income of their wives?” Before answering that question, this paper analyzed first the impact of husbands smoking habits on the health status of their wives because it has been explained in the conceptual framework that smoking affects individual productivity through health factors. By using Odd Ratios and LPM with Fixed Effect method, both those regression results describe that smoking habits of husbands negatively affect the health of their wives measured by acute morbidity associated with respiratory problems. Then, this paper examines the association of husbands smoking habits on the income of their wives. Based on the analyses in Chapter 4, by implementing the price of cigarettes as Instrumental Variable to overcome the endogeneity problems in the model, this research finds that smoking behavior of husbands affects negatively on the income of their wives by 11.5 to 21 percentage point at 5 and 10 percent significance level. Also, by using the Fixed Effect method, there is a negative correlation between smoking behavior of husbands measured by categorical data on the income of their wives. However, those correlations are statistically insignificant. The direction of that coefficient is in line with the previous studies (Levina et al. 1997; Ours 2004, Kvasnica 2010; Bondzie 2016). Moreover, the positive association between smoking behavior and income through health status as shown by OLS results might be explained by two possible explanations. First, the effects of smoking on health, especially chronic diseases, will appear in the future and are not a problem for people in the group age 20 to 55 years old. Second, the health factor is more critical to the question of whether people can find work or not than the amount of wages received.

Second sub research question: “What is the association of smoking behavior of husbands on number of working hours of their wives?” Overall, the smoking behaviors of husbands do not correlate with the number of working hours of their wives. Both using Fixed Effect and IV method show a negative correlation between smoking behavior of husbands and number of working hours of their wives, but the coefficient is quite small: 0.0028 and 1.18 percentage points respectively and statistically insignificant.

Furthermore, the other explanatory variables such as age and the educational level show the regression results with expected signs and in line with previous studies (Levina et al. 1997; Ours 2004; Kvasnica 2010; Bondzie 2016; Amalia 2018). The increase of the age of wives leads to an increase in their income and number of working hours, but the age has a turning point or parabolic shape described in the age square variable. However, there is a difference in the direction of coefficient between the impact of education on income and the number of working hours. If the outcome is income, the higher the educational level of the wives, the higher the income they earn. If the outcome is the number of working hours, mostly the association between the education level of wives and the number of working hours is negative and statistically insignificant. That might be explained logically that the higher the level of education, the higher the salary generated so that people with high-level education do not need to work long hours in a day to meet their daily needs.

Another essential explanatory variable that must be considered is the percentage of smoker in the wives' community. All regression results agree that the increase in the number of smoker in the environment around the wives results in greater intensity of exposure to cigarette smoke, which ultimately harms their income. By using standardized regression coefficients in OLS estimates, this variable has a stronger coefficient than the variable number of cigarette smoking of husbands. That result in line with the research in Hong Kong conducted by McGhee et al. in 2002 explained that the majority of non-smoker workers were exposed to secondhand smoke in the workplace rather than at home.

In sum, this paper has been able to answer the main research questions: "What is the impact of passive smoking behavior on individual productivity in Indonesia by focusing on the association of smoking behavior of husbands on productivities of their working and non-smoking wives?". By combining all the findings in sub research questions, the results show that the smoking behavior of husbands is negatively associated with the income of their wives and that there is no correlation with the number of working hours of their wives. This paper also finds evidence that the increase of smokers in wives' community significantly and negatively correlates with their income pointing to community-wide spillover effects.

5.2 Implications and Recommendations for Future Policy

The findings in this research may provide substantial empirical evidence about the association of being passive smokers on their productivity, especially in Indonesia. Although many studies have analyzed the impact of smoking behavior on individual productivity, those studies only focus on the impact of active smokers on their productivity. The Empirical essential evidence in this study related to the effect of exposure to cigarette smoke obtained from people in the surrounding environment has a more significant impact on individual productivity compared to exposure to cigarette smoke obtained in the household.

Therefore, for policy recommendations, the government must be more stringent in sanctions against people who smoke in public places because so far the implementation of the Law of the Republic of Indonesia number 36 of 2009 that regulates areas that must be free from cigarette smoke such as education areas, health services, transportation, worship places and workplaces have not been implemented well. In addition, based on IFLS data used in this study, approximately 33% of total respondents start smoking at the age of under 18 years. In this case, the government must tighten the rules on buying and selling cigarettes in stores. One way that can be implemented by the government so that children under the 18 years old do not consume cigarettes is by formulating regulations regarding the purchase of cigarettes by showing the identity card. That regulation has been enforced in several countries in the world and success in reducing the number of child smokers.

5.3 The Limitation of Research

There are several limitations in this research considering the source of data and the methodology that have been applied to answer research questions. Explicitly, this study uses the Indonesian Family Life Survey (IFLS) data that represents more than 80% of social, economic and demographic conditions in Indonesia and can be accessed freely through the website. However, IFLS data do not reflect the population in eastern Indonesia because the survey is only conducted in the majority of provinces in western and central Indonesia.

Besides, there is an endogeneity problem in this research in examining the relationship between outcomes and smoking behavior. Based on the Wooldridge (2016), the best technique for managing the endogeneity problem is by using Instrumental Variable (IV). The instrumental variable (IV) used in this research paper is quite different from that previous research. The previous studies use cigarette price as IV while this paper utilizes the price of cigarettes in the year when the respondents as husbands started to smoke for the first time as IV because that price may be a factor for people to start their smoking behavior. That IV is used in this paper because the data of cigarette prices is not available in IFLS and also the price of cigarettes in all regions of Indonesia is almost the same. Also, the IV in this research still has weaknesses because maybe the price of cigarettes is not one of the main considerations for people to start smoking, there are many other factors such as environmental conditions, parental smoking and so on.

5.4 Future Research

The future work might be able to analyze the impact of smoking behavior on individual productivity by comparing smokers who use e-cigarettes and conventional cigarettes in Indonesia. Electric cigarettes are becoming increasingly popular among the public so it is necessary to know whether e-cigarettes are less dangerous compared to conventional cigarettes or vice versa. In addition, the future research can also examine the same topic using other data sources such as Indonesia National Socio Economic Survey data because as explained in the limitation, IFLS data do not reflect the population in eastern Indonesia because the survey is only conducted in the majority of provinces in western and central Indonesia.

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Appendix

Appendix I: Summary of Income Data

a. Summary of income per year of IFLS 5

total_income				
	Percentiles	Smallest		
1%	100000	5000		
5%	400000	16000		
10%	960000	20000	Obs	2,706
25%	2580000	20000	Sum of Wgt.	2,706
50%	7200000		Mean	1.61e+07
		Largest	Std. Dev.	3.20e+07
75%	1.85e+07	3.36e+08		
90%	3.87e+07	4.02e+08	Variance	1.03e+15
95%	5.94e+07	6.72e+08	Skewness	13.01369
99%	1.08e+08	8.96e+08	Kurtosis	292.9391

b. Summary of income per year of ILFS 4

total_income				
	Percentiles	Smallest		
1%	70000	4000		
5%	260000	15000		
10%	500000	20000	Obs	1,941
25%	1350000	21000	Sum of Wgt.	1,941
50%	3600000		Mean	7663121
		Largest	Std. Dev.	1.35e+07
75%	9100000	1.64e+08		
90%	1.80e+07	1.80e+08	Variance	1.84e+14
95%	2.60e+07	1.80e+08	Skewness	7.082492
99%	5.00e+07	2.00e+08	Kurtosis	77.0736

Appendix II: OLS and Fixed Effect Estimates: Smoking Behaviour of Husbands on Income of Their Wives

Table II.1
 OLS Estimates in examining the Association of Smoking Behavior of Husbands on income of their Wives
 (Dependent Variable: Log weekly Income of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Number of Cigarettes	0.0210*** (0.00422)	0.0216*** (0.00422)	0.0200*** (0.00417)	0.0158*** (0.00384)	0.0145*** (0.00378)
Age		0.00844** (0.00333)	0.151*** (0.0230)	0.148*** (0.0212)	0.139*** (0.0209)
Age ²			-0.00168*** (0.000269)	-0.00151*** (0.000248)	-0.00147*** (0.000244)
Base: Never attend school					
1. Up to Elementary School				0.424*** (0.141)	0.404*** (0.139)
2. Up to Senior High School				0.938*** (0.147)	0.874*** (0.145)
3. Up to Higher Education				1.813*** (0.157)	1.742*** (0.155)
Percentage smokers in community					-1.056*** (0.155)
Constant	11.46*** (0.0597)	11.10*** (0.153)	8.264*** (0.477)	7.347*** (0.454)	8.223*** (0.465)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.017	0.022	0.048	0.202	0.227

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table II.2
 OLS Estimates in examining the Association of Smoking Behavior of Husbands on Income of their Wives
 (Dependent Variable: Log weekly Income of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Base: Non Smoker					
1. Former Smoker	0.605*** (0.219)	0.632*** (0.219)	0.626*** (0.216)	0.377* (0.200)	0.291 (0.197)
2. Light Smoker	-0.0499 (0.196)	0.00510 (0.198)	0.00931 (0.195)	-0.0332 (0.180)	-0.0686 (0.177)
3. Heavy Smoker	0.349* (0.203)	0.411** (0.205)	0.392* (0.202)	0.244 (0.187)	0.197 (0.184)
Age		0.00664** (0.00337)	0.149*** (0.0228)	0.146*** (0.0212)	0.138*** (0.0209)
Age^2			-0.00168*** (0.000267)	-0.00151*** (0.000248)	-0.00148*** (0.000244)
Base: Never attend school					
1. Up to Elementary School				0.429*** (0.141)	0.410*** (0.139)
2. Up to Senior High School				0.919*** (0.147)	0.860*** (0.145)
3. Up to Higher Education				1.777*** (0.158)	1.712*** (0.155)
Percentage smokers in community					-1.039*** (0.155)
Constant	11.59*** (0.192)	11.26*** (0.254)	8.414*** (0.517)	7.530*** (0.492)	8.413*** (0.502)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.035	0.037	0.064	0.206	0.231

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table II.3
 Fixed Effect Estimates in examining the Association of Smoking Behavior of Husbands on
 Income of their wives
 (Dependent Variable: Log weekly Income of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Number of Cigarettes	0.0111** (0.00543)	0.0111** (0.00543)	0.0100* (0.00541)	0.00999* (0.00541)	0.00977* (0.00539)
Age		0.0171 (0.0574)	0.114* (0.0650)	0.122* (0.0651)	0.120* (0.0649)
Age^2			-0.00104*** (0.000334)	-0.00108*** (0.000336)	-0.00102*** (0.000336)
Base: Never attend school					
1. Up to Elementary School				-0.274 (0.293)	-0.209 (0.293)
2. Up to Senior High School				-0.605 (0.368)	-0.556 (0.367)
3. Up to Higher Education				-0.804 (0.451)	-0.748 (0.450)
Percentage smokers in community					-0.582** (0.244)
dIFLS4	0.798*** (0.0428)	0.681* (0.397)	0.610 (0.395)	0.578 (0.396)	0.712* (0.399)
Constant	11.17*** (0.0682)	10.52*** (2.192)	8.429*** (2.280)	8.657*** (2.288)	8.217*** (2.287)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.344	0.344	0.353	0.356	0.361
Number of pidlink	708	708	708	708	708

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table II.4
 Fixed Effect Estimates in examining the Association of Smoking Behavior of Husbands on
 Income of their Wives
 (Dependent Variable: Log weekly Income of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Base: Non Smoker					
1. Former Smoker					
2. Light Smoker	-0.153 (0.302)	-0.153 (0.302)	-0.107 (0.301)	-0.139 (0.301)	-0.131 (0.300)
3. Heavy Smoker	-0.00443 (0.311)	-0.00481 (0.312)	0.0238 (0.310)	-0.00716 (0.310)	-0.00417 (0.309)
Age		0.0113 (0.0576)	0.106 (0.0654)	0.113* (0.0656)	0.111* (0.0653)
Age^2			-0.00101*** (0.000336)	-0.00104*** (0.000338)	-0.000976*** (0.000338)
Base: Never attend school					
1. Up to Elementary School					
2. Up to Senior High School				-0.290 (0.294)	-0.223 (0.295)
3. Up to Higher Education				-0.636* (0.370)	-0.588 (0.369)
Percentage smokers in community				-0.864* (0.454)	-0.808 (0.453)
dIFLS4	0.818*** (0.0444)	0.741* (0.398)	0.664* (0.397)	0.635 (0.398)	0.774* (0.400)
Constant	11.42*** (0.293)	10.99*** (2.218)	8.885*** (2.315)	9.183*** (2.324)	8.727*** (2.323)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.344	0.344	0.352	0.356	0.362
Number of pidlink	708	708	708	708	708

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Appendix III: Unstandardized and standardized estimates (OLS)

	b	T	P>t	bStdX	bStdY	bStdXY	SDofX
Number of Cigarettes	0.0145	3.832	0.000	0.113	0.012	0.091	7.788
age	0.1393	6.668	0.000	1.375	0.112	1.103	9.874
age2	-0.0015	-6.038	0.000	-1.246	-0.001	-0.999	845.382
Base: Never Attend School							
1. Up to Primary School	0.4043	2.908	0.004	0.201	0.324	0.161	0.497
2. Up to Senior High School	0.8744	6.039	0.000	0.419	0.701	0.336	0.479
3. Up to Higher Education	17.422	11.225	0.000	0.617	1.397	0.495	0.354
Percentage Smokers in Community	-10.561	-6.824	0.000	-0.206	-0.847	-0.165	0.195
constant	82.232	17.672	0.000

Appendix IV: First Stage Regressions

Table IV.1

First Stage Regressions in examining the effect of smoking behavior of husbands on income of their wives
(Dependent Variable: Number of Cigarettes)

Variables	(1)	(2)	(3)	(4)	(5)
Real price of cigarettes	-0.000244* (0.000125)	-0.000279** (0.000130)	-0.000282** (0.000130)	-0.000334** (0.000131)	-0.000359*** (0.000132)
Age (Wife)		-0.0213 (0.0229)	0.245 (0.163)	0.232 (0.162)	0.218 (0.163)
Age ² (Wife)			-0.00321* (0.00194)	-0.00275 (0.00194)	-0.00271 (0.00194)
Base: Never attend school (Wife)				2.449**	2.424**
1. Up to Elementary School				(1.051)	(1.050)
2. Up to Senior High School				3.654***	3.555***
3. Up to Higher Education				(1.081)	(1.082)
Percentage smokers in community				3.779***	3.673***
				(1.154)	(1.155)
					-1.732 (1.092)
Constant	13.49*** (0.740)	14.56*** (1.373)	9.357*** (3.435)	6.388* (3.521)	7.976** (3.659)
Observations	1,341	1,341	1,341	1,341	1,341
R-squared	0.003	0.003	0.005	0.017	0.019

Appendix V: OLS and Fixed Effect Estimates: Smoking Behaviour of Husbands on Number of Working Hours of Their Wives

Table V.1
 OLS Estimates in Examining the Association of Smoking Behavior of Husbands on Number of Working Hours of their Wives
 (Dependent Variable: Log weekly Working Hours of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Number of Cigarettes	0.000124 (0.00182)	-9.28e-05 (0.00182)	-0.000240 (0.00182)	-0.000142 (0.00181)	-0.000147 (0.00181)
Age		-0.00313** (0.00143)	0.0105 (0.0100)	0.0101 (0.00999)	0.0100 (0.0100)
Age^2			-0.000160 (0.000117)	-0.000154 (0.000117)	-0.000154 (0.000117)
Base: Never attend school					
1. Up to Elementary School				0.137** (0.0666)	0.137** (0.0666)
2. Up to Senior High School				0.134* (0.0692)	0.134* (0.0694)
3. Up to Higher Education				-0.0734 (0.0742)	-0.0737 (0.0744)
Percentage smokers in community					-0.00392 (0.0741)
Constant	3.718*** (0.0257)	3.850*** (0.0660)	3.580*** (0.208)	3.485*** (0.214)	3.488*** (0.223)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.000	0.003	0.005	0.026	0.026

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table V.2
Pooled OLS Estimates in Examining the Association of Smoking Behavior of Husband on Number
of Working Hours of Their Wives
(Dependent Variable: Log weekly Working Hours of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Base: Non Smoker					
1. Former Smoker	0.178*	0.167*	0.166*	0.183*	0.184*
	(0.0947)	(0.0948)	(0.0947)	(0.0942)	(0.0945)
2. Light Smoker	0.208**	0.184**	0.185**	0.187**	0.187**
	(0.0849)	(0.0856)	(0.0856)	(0.0848)	(0.0849)
3. Heavy Smoker	0.174**	0.148*	0.146	0.158*	0.158*
	(0.0878)	(0.0888)	(0.0888)	(0.0881)	(0.0882)
Age		-0.00281*	0.0109	0.0104	0.0104
		(0.00146)	(0.0100)	(0.00998)	(0.01000)
Age^2			-0.000162	-0.000154	-0.000154
			(0.000117)	(0.000117)	(0.000117)
Base: Never attend school					
1. Up to Elementary School				0.136**	0.136**
				(0.0665)	(0.0665)
2. Up to Senior High School				0.132*	0.133*
				(0.0692)	(0.0693)
3. Up to Higher Education				-0.0734	-0.0730
				(0.0743)	(0.0745)
Percentage smokers in community					0.00623
					(0.0743)
Constant	3.528***	3.667***	3.393***	3.297***	3.292***
	(0.0830)	(0.110)	(0.227)	(0.232)	(0.241)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.005	0.007	0.009	0.029	0.029

Standard errors in parentheses

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

Table V.3
Fixed Effect Estimates in Examining the Association of Smoking Behavior of Husbands on
Number of Working Hours of their wives

(Dependent Variable: Log weekly Working Hours of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Number of Cigarettes	0.000307 (0.00308)	0.000315 (0.00308)	-0.000103 (0.00308)	-0.000167 (0.00308)	-0.000280 (0.00308)
Age		0.0324 (0.0325)	0.0704* (0.0370)	0.0713* (0.0372)	0.0702* (0.0371)
Age ²			-0.000407** (0.000190)	-0.000421** (0.000191)	-0.000389** (0.000192)
Base: Never attend school					
1. Up to Elementary School				-0.0938 (0.167)	-0.0612 (0.167)
2. Up to Senior High School				-0.0892 (0.210)	-0.0650 (0.210)
3. Up to Higher Education				-0.179 (0.257)	-0.150 (0.257)
Percentage smokers in community					0.290** (0.139)
dIFLS4	-0.0179 (0.0243)	-0.240 (0.225)	-0.268 (0.225)	-0.266 (0.226)	-0.199 (0.228)
Constant	3.725*** (0.0387)	2.489** (1.243)	1.671 (1.298)	1.757 (1.305)	1.537 (1.306)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.001	0.002	0.009	0.010	0.016
Number of pidlink	708	708	708	708	708

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table V.4
 Fixed Effect Estimates in examining the Association of Smoking Behavior of Husbands on
 Number of Working Hours of their Wives
 (Dependent Variable: Log weekly Working Hours of Wives)

VARIABLES	(1)	(2)	(3)	(4)	(5)
Base: Non Smoker					
1. Former Smoker					
2. Light Smoker	-0.0178 (0.171)	-0.0172 (0.171)	0.00209 (0.171)	-0.00199 (0.172)	0.00207 (0.171)
3. Heavy Smoker	-0.0396 (0.177)	-0.0407 (0.177)	-0.0285 (0.176)	-0.0327 (0.177)	-0.0313 (0.176)
Age		0.0331 (0.0326)	0.0735** (0.0372)	0.0743** (0.0373)	0.0731* (0.0373)
Age^2			-0.000429** (0.000191)	-0.000442** (0.000193)	-0.000410** (0.000193)
Base: Never attend school					
1. Up to Elementary School					
				-0.0945 (0.168)	-0.0628 (0.168)
2. Up to Senior High School					
				-0.0841 (0.211)	-0.0610 (0.211)
3. Up to Higher Education					
				-0.166 (0.258)	-0.139 (0.258)
Percentage smokers in community					
					0.284** (0.140)
dIFLS4	-0.0221 (0.0252)	-0.249 (0.226)	-0.282 (0.226)	-0.279 (0.227)	-0.213 (0.228)
Constant	3.748*** (0.166)	2.485** (1.257)	1.587 (1.316)	1.677 (1.324)	1.461 (1.325)
Observations	1,416	1,416	1,416	1,416	1,416
R-squared	0.002	0.003	0.010	0.011	0.017
Number of pidlink	708	708	708	708	708

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1