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CONSUMPTION DEMAND FOR TOBACCO PRODUCTS IN THAILAND: A CASE STUDY OF DOMESTIC CIGARETTES, IMPORTED CIGARETTES AND PIPE TOBACCO

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ABSTRACT

The three objectives of this research were to identify the influence of the factors affecting the demand for tobacco products, including domestic cigarettes (DC), imported cigarettes (IC), and hand-rolled cigarettes (HRC), and the elasticity of the demand of the three groups of consumers in the adolescent, working age, and elderly age groups; estimate the consumer surplus of each type of cigarette for each age group; and estimate the relationship in the demand model and cigarette price model with a simultaneous equation model (SEM) system by using the three-stage least squares (3SLS) method with time series data from 1989 to 2019. The research results illustrated that the demand factors had different impacts on the number of consumers of each type of cigarette in each age range. The elasticity of demand suggests that domestic cigarettes are luxury goods for adolescents but are normal goods for elderly consumers. In contrast, import cigarettes are luxury goods for working age people and hand-rolled cigarettes are normal goods for elderly consumers. Moreover, domestic cigarettes are a substitution for imported cigarettes for working age consumers and hand-rolled cigarettes customers, while imported cigarettes are a substitution for adolescent domestic cigarette customers, and hand-rolled cigarettes are also a substitution for adolescent domestic cigarette and adolescent imported cigarette customers. Price is the most sensitive factor for working age imported cigarette customers, while elderly hand-rolled cigarette customers comprise the largest customer base for Thailand's tobacco products. According to the results, the relevant agencies should be very careful in implementing measures to raise tobacco prices.

Contribution/Originality: This study is one of very few studies which have investigated the tobacco demand in nine markets, which classified by type of product and age of customer among each age range based on a simultaneous equation analysis.

1. BACKGROUND AND SIGNIFICANCE

Tobacco products are harmful to the health of consumers and people who are in contact with second-hand smoke. Moreover, smoking affects society because it is one of the main causes that degrades people's quality of life, which might indirectly lead to an economic impact (Nonthapot & Watchalaanun, 2018).

For this reason, tobacco products are controlled by the government. In Thailand, they are indirectly controlled under tax and non-tax measures, such as the labeling of tobacco packaging with shocking images, restricted smoking areas, and age restrictions for cigarette buyers. In addition, setting the tax rate and structure for each type of tobacco product by raising the price is one of the tax measures that can indirectly control tobacco consumption.

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However, tax measures might not truly control the consumption of tobacco products because consumers have alternatives to consume other types of tobacco.

In Thailand, tobacco product consumption may change from manufactured cigarettes (domestic and imported cigarettes) to hand-rolled cigarettes, which are cheaper and easy to buy. However, hand-rolled cigarettes are more harmful to health because there is no filter to reduce the level of toxins inhaled by smoking. In the past, an increase in tax caused a shift from domestic to imported cigarettes because the adjusted price after tax resulted in similar prices from a consumer perspective.

This is presented in Table 1, which shows the change in the number of domestic cigarette consumers in 2017, which is the opposite to imported and hand-rolled cigarette consumers. It is possible that the consumers of domestic cigarettes changed their behavior to consume imported or hand-rolled cigarettes, and this demonstrates the linkage between tobacco products.

Table 1. Number of tobacco product consumers during 2004–2017 (thousand prs.).

	Domestic Cigarettes (DC)		Imported Cigarettes (IC)		Hand-rolled Cigarettes (Pipe Tobacco) (HRC)	
	No	%Δ	No	%Δ	No	%Δ
2004	4,427.57	-	123.28	-	5,542.30	-
2007	4,078.77	-7.88%	86.17	-30.10%	4,776.74	-13.81%
2014	5,633.80	38.12%	444.70	416.07%	4,998.87	4.65%
2017	5,276.40	-6.34%	628.19	41.26%	5,542.30	10.87%

Source: National Statistical Office (2004); National Statistical Office (2007); National Statistical Office (2014); National Statistical Office (2017).
Note: The survey of smokers in 2017 was conducted prior to the change in cigarette excise tax collection in September 2017.

Different behaviors were also observed in regard to the age range of customers due to various factors, such as income, level of addiction, and social values, which affect consumption and the choice of product. However, since tobacco consumption affects the consumer's health in the long term, consumption during teenage years might result in health problems during the working age stage, which would affect work efficiency, or in the elderly stage in the form of chronic disease.

Consumption during the working age stage may have an impact during the final stages of life, and consumption during the final stage of life may increase the cost of healthcare; thus, the consumption of tobacco at any stage of life is very significant and varies according to age and other economic factors.

Information regarding the demand for the three types of tobacco products and the relative impacts can offer a clearer understanding about the changes in behavior in regard to tobacco product consumption.

A study on the demand of customers in various age ranges can reveal such changes and would be helpful to the implementation of appropriate policies to control tobacco consumption. To obtain a complete picture, all of the factors should be considered together. Consequently, simultaneous equation modeling (SEM) should be employed to include all of the relevant factors.

As stated above, the impacts of smoking demand varied according to the age range and product type. However, there were some limitations in this regard. The factors affecting demand for the consumption of the three tobacco products (domestic cigarettes, imported cigarettes and hand rolled cigarettes) should be taken into consideration. The demand in terms of the number of consumers of each tobacco product also needs to be considered to explain the changes in demand in terms of product choice and age range, adolescent (15–24 years), working age (25–59 years), and elderly (over 60 years) using SEM to assess the influence of current demand factors and the estimation of the consumer surplus for each type of product and age range.

The research results may be useful in setting a policy to control the consumption of tobacco products for each age range and to fill the research gap in regard to tobacco product demand in Thailand by considering product type and customer age, and by assessing the impacts on markets and by assessing the number of customers rather than the quantity of tobacco products consumed.

2. LITERATURE REVIEW

Because of the effect of smoking on health, there have been many studies conducted on tobacco product demand, especially cigarettes, in regard to smoking control and excise tax issues. The elasticity of price and income, etc. for tobacco demand was calculated to better regulate the tobacco market by employing tax and non-tax measures.

In Argentina, Rodríguez-Iglesias, Schoj, Chaloupka, Champagne, & González-Rozada (2017) estimated price and income elasticity by employing time series data with cointegration tests (Engle–Granger and Johansen) and the ECM concept. They found a - 0.279 price elasticity for cigarettes and an income elasticity of 0.4111.

Moreover, a 100% price increase by raising tax would maximize revenue and reduce cigarette consumption. The differences in price elasticity were revealed in a study by Ho, Schafferer, Lee, Yeh, & Hsieh (2018), which estimated cigarette price elasticity by using panel data from 1999 to 2015 from 22 Asia-Pacific countries. The empirical results revealed that countries with a gross national income (GNI) per capita above 6,000 US (China and Malaysia) had the highest price elasticity.

In regard to rural and urban consumption in Nigeria, Adeniji (2019) found that the rural tobacco price elasticity of demand was -0.63, which was more sensitive than the urban price elasticity for tobacco demand, which was only -0.49; and the national price elasticity of demand was -0.62.

In addition, household size, the food price index, the level of education/literacy of the household head and income were significant determinants of tobacco consumption. Although tobacco is regarded as a luxury good, which implies that demand is sensitive to price changes, previous research revealed that the price elasticity ranged from -0.2 to -0.6, which is greater than -1. However, research conducted in 28 EU countries revealed that in countries with a GNI per capita lower than US$5418, price elasticity was -1.227. This was obtained from panel data from 2005 to 2014. The result suggested that increasing cigarette prices would significantly reduce cigarette consumption as well the total death toll caused by smoking in all the observed countries, and would be most effective in Bulgaria and Romania, followed by Latvia and Poland (Yeh, Schafferer, Lee, Ho, & Hsieh, 2017).

Jackson, Shahab, West, & Brown (2018) studied the behavior of consumers of hand-rolled cigarettes. The results revealed that these smokers had lower motivation to quit and fewer attempts to quit compared with manufactured cigarette users, although there was no difference in quitting success.

In Thailand, few studies on the issue have been conducted, however, related studies on the demand for tobacco products in Thailand could not confirm the results presented above.

Cross-sectional data, which were collected in a national representative survey in Thailand in 2017, revealed that the price elasticity of demand for manufactured cigarettes was -0.49, which suggests that cigarettes are not luxury goods by using a single equation model. The study found that the price elasticity of demand for hand-rolled cigarettes was -0.32 The demand of low-income smokers for manufactured and hand-rolled cigarettes was more price-sensitive than for those with a high income (Kaufman, Persoskie, Twesten, & Bromberg, 2020). The luxury goods characteristic of cigarettes was found by employing SEM where there was found to be a -1.02 demand elasticity for cigarettes. However, no relationship was found between income and the demand for domestic cigarettes (Nonthapot & Watchalaanun, 2018).

Although hand-rolled cigarettes are the most popular tobacco product and are more harmful to health than domestic cigarettes, there were restrictions in regard to data collection. Thus, there are few studies on hand-rolled cigarettes that are limited to the substitution effects between them and manufactured cigarettes.

3. RESEARCH METHODOLOGY

This research aimed to investigate the demand for the three types of tobacco products of consumers of three age ranges, 15–24 years, 25–59 years, and over 60 years, by using time series data over 31 years, from 1989 to 2019. However, the demand factors of all product types might relate to each other, so estimation using a linear model is inappropriate.

As a result, SEM and relationship estimation with the 3SLS method were applied in order to acquire the results with the best linear unbiased estimator (BLUE). The 12 models used in the research included nine models for the demand for each type of cigarette and three price equation models.

Demand for cigarettes manufactured at a domestic factory is presented in Equations 1 to 3.

$$Qx_{15} = \beta_{0,a} + \beta_{1,a}P_x + \beta_{2,a}P_y + \beta_{3,a}P_z + \beta_{4,a}N_{15} + \beta_{5,a}GDP + u_a \qquad (1)$$

$$Qx_{25} = \beta_{0,b} + \beta_{1,b}P_x + \beta_{2,b}P_y + \beta_{3,b}P_z + \beta_{4,b}N_{25} + \beta_{5,b}GDP + u_b \qquad (2)$$

$$Qx_{60} = \beta_{0,c} + \beta_{1,c}P_x + \beta_{2,c}P_y + \beta_{3,c}P_z + \beta_{4,c}N_{60} + \beta_{5,c}GDP + u_c \qquad (3)$$

Models for the demand for imported cigarettes (Equations 4 to 6):

$$Qy_{15} = \alpha_{0,a} + \alpha_{1,a}P_x + \alpha_{2,a}P_y + \alpha_{3,a}P_z + \alpha_{4,a}N_{15} + \alpha_{5,a}GDP + v_a \qquad (4)$$

$$Qy_{25} = \alpha_{0,b} + \alpha_{1,b}P_x + \alpha_{2,b}P_y + \alpha_{3,b}P_z + \alpha_{4,b}N_{25} + \alpha_{5,b}GDP + v_b \qquad (5)$$

$$Qy_{60} = \alpha_{0,b} + \alpha_{1,c}P_x + \alpha_{2,c}P_y + \alpha_{3,c}P_z + \alpha_{4,c}N_{60} + \alpha_{5,c}GDP + v_c \qquad (6)$$

Model for the demand for hand-rolled cigarettes (Equations 7 to 9):

$$Qz_{15} = \theta_{0,a} + \theta_{1,a}P_x + \theta_{2,a}P_y + \theta_{3,a}P_z + \theta_{4,a}N_{15} + \theta_{5,a}GDP + w_a \qquad (7)$$

$$Qz_{25} = \theta_{0,b} + \theta_{1,b}P_x + \theta_{2,b}P_y + \theta_{3,b}P_z + \theta_{4,b}N_{25} + \theta_{5,b}GDP + w_b \qquad (8)$$

$$Qz_{60} = \theta_{0,b} + \theta_{1,c}P_x + \theta_{2,c}P_y + \theta_{3,c}P_z + \theta_{4,c}N_{60} + \theta_{5,c}GDP + w_c \qquad (9)$$

Models for tobacco product prices (Equations 10 to 12):

$$P_x = \gamma_0 + \gamma_1 T_x + \gamma_2 CPI + \gamma_3 J + e_x \qquad (10)$$

$$P_y = \omega_0 + \omega_1 P_x + \omega_2 Ex + \omega_3 J + e_y \qquad (11)$$

$$P_z = \rho_0 + \rho_1 T_z + \rho_3 J + e_z \qquad (12)$$

where Qx_{15} is the number of consumers of cigarettes manufactured at a domestic factory aged 15–24, Qx_{25} is the number of consumers of cigarettes manufactured at a domestic factory aged 25–59, Qx_{60} is the number of consumers of cigarettes manufactured at a domestic factory aged over 60; Qy_{15} is the number of consumers of imported cigarettes aged 15–24, Qy_{25} is the number of consumers of imported cigarettes aged 25–59, Qy_{60} is the

number of consumers of imported cigarettes aged over 60; Qz_{15} is the number of consumers of hand-rolled cigarettes aged 15–24, Qz_{25} is the number of consumers of hand-rolled cigarettes aged 25–59 years, and Qz_{60} is the number of consumers of hand-rolled cigarettes aged over 60. P_x is the price of cigarettes manufactured at a domestic factory, P_y is the price of imported cigarettes, P_z is the price of hand-rolled cigarettes (pipe tobacco), N_{15} is the number of people in Thailand aged 15–24 years, N_{25} is the number of people in Thailand aged 25–59 years, N_{60} is the number of people in Thailand aged over 60 years, GDP is the primary gross domestic product, T_x is the commercial cigarette excise rate, T_z is the hand-rolled cigarette excise rate, CPI is the consumer price index, Ex is the exchange rate, and J is the change of the domestic excise rate collection (dummy variable). All data to be analyzed were transformed into a logarithm in order to be interpreted for elasticity. Moreover, all models qualified for the clarity test and test of rank conditions. All equations were applicable.

The number of consumers of each type of cigarette and age range was gathered from the documents of the National Statistical Office (2004); National Statistical Office (2007); National Statistical Office (2014); and National Statistical Office (2017), whereas the data on prices of domestic and imported cigarettes were gathered from the notification of the Excise Department (1989 to 2019).

The data on pipe tobacco price was compared with that of Charoenphandhudhu (2009) and the information related to the pipe tobacco price. The data on the population structure and gross domestic product, exchange rate, and consumer price index were retrieved from the World Bank (2020), while the tobacco excise rate was retrieved from the Tobacco Product Control Act B.E. 2560 (2017).

After estimating the relationship using the above models, the models were then used to estimate the consumer surplus using the integration technique from the price where there were no consumers (demand was zero) to the current price. Since the data used had a logarithm base of 10, the estimation of the consumer surplus was estimated using Equation 13.

$$\int_{P_z}^{P_0} 10^{C_1 + C_2 x P}\, dP \tag{13}$$

where P_0 is the price (in a logarithm form) that had no consumer (acquired from the solving of the demand equation), P_z is the current price (in a logarithm form), C_1 is the static value acquired from the estimation of the mean of previous data from the model without price influence, and C_2 is the coefficient of the price from the demand equation model.

Table 2. Estimation of the demand for tobacco products.

Type	No. of Domestic Cigarette Consumers			No. of Imported Cigarette Consumers			No. of Hand Rolled Cigarette Consumers		
	15–24	25–59	Over 60	15–24	25–59	Over 60	15–24	25–59	Over 60
Constant	22.6145 (1.6791)*	12.2249 (4.2152)*	-10.7929 (-4.0805)***	-98.0419 (-2.4627)**	117.0092 (-2.4627)***	-68.7855 (-6.1493)***	47.3976 (2.9109)***	23.1482 (7.4687)***	-4.5729 (-2.4399)**
Price of domestic cigarettes (Px)	-2.6047 (-6.0593)***	0.9546 (4.8379)***	-0.4189 (-2.1687)**	-0.8377 (-0.7220)	8.254 (9.0605)***	-5.1002 (-5.9035)***	-2.1106 (-4.0568)***	1.2201 (5.7544)***	-0.1832 (-1.2768)
Price of imported cigarettes (Py)	1.3198 (3.1433)***	-0.9019 (-3.7689)***	-0.1393 (-0.6682)	4.4683 (4.4673)***	-8.1221 (-7.3399)***	0.8194 -0.9679	0.416 -0.8238	-1.42 (-5.5186)***	-0.5184 (-3.6516)***
Price of hand-rolled cigarettes (Pz)	0.7525 (2.5552)**	-0.8755 (-8.9203)**	-0.9423 (-8.7810)***	1.6788 (2.1377)**	0.4835 -1.3755	-2.7968 (-7.1240)***	2.1865 -6.1458	0.938 -0.9672	-0.6067 (-8.7262)***
No. of people aged 15–24 (N15)	-5.5113 (-2.9518)***	-	-	13.5497 (2.3361)**	-	-	-6.3368 (-2.7769)***	-	-
No. of people aged 25–59 (N25)	-	-1.9858 (-5.1793)***	-	-	-21.311 (-9.6274)***	-	-	-1.9828 (-4.4936)***	-
No. of people aged over 60 (N60)	-	-	2.6244 (7.0378)***	-	-	15.2534 (6.9810)***	-	-	1.6564 (5.0488)***
GDP	2.0243 (3.1289)***	0.8673 (4.5983)***	-0.0356 (-0.1478)	-0.0442 (-0.0396)	4.3222 (7.1100)***	-2.0814 (-2.1414)**	0.3381 -0.5951	-0.0951 -0.5199	0.0688 -0.4146
Diagnostic Statistic									
R²	0.8715	0.8812	0.8673	0.7389	0.4577	0.8208	0.8638	0.6462	0.3595
Adjusted R²	0.8458	0.8575	0.8407	0.6867	0.3492	0.785	0.8365	0.5755	0.2314
S.E.	0.0952	0.0367	0.0459	0.238	0.1962	0.1853	0.1161	0.0435	0.0358
D.W. stat	1.3398	2.1957	1.2259	1.1339	1.8782	1.3795	1.4066	1.5461	1.6835

Note: *** Reliability 99%; ** Reliability 95%; * Reliability 90%.

4. RESULTS

Table 2 shows that the tobacco products manufactured domestically and the influence of the demand factors on the number of domestic cigarette consumers at each age range were clearly different. For consumers aged 25–59 years, the price of domestic cigarettes corresponded with the number of consumers, which was different from that of consumers aged 15–24 years and over 60 years. This was because consumers aged 15–24 were more flexible in regard to price. Consequently, domestic cigarettes were considered as a luxury product for consumers in that age range, but a necessary product for consumers aged over 60. When considering the influence of the price of imported cigarettes on the number of consumers of domestic cigarettes, it had a positive relationship with consumers aged 15–24 but had a negative relationship with consumers aged 25–59. It could be said that imported cigarettes were considered as complementary goods to domestic cigarettes of consumers aged 15–24 but were substitute goods for the domestic cigarettes of consumers aged 25–59.

When considering the influence of the price of hand-rolled cigarettes to the number of consumers of domestic cigarettes, it had a positive relationship with consumers aged 15–24 but had a negative relationship with consumers aged 25–59 and over 60. That being said, hand-rolled cigarettes were considered as complementary goods to domestic cigarettes of consumers aged 15–24 but were substitute goods for consumers aged 25–59 and over 60.

In regard to the influence of GDP on the increasing number of consumers of domestic cigarettes, the relationship with consumers aged 15–24 and 25–59 was in the same direction, i.e., domestic cigarettes were considered as normal goods. When considering the population of the age ranges, it had a negative relationship with consumers aged 15–24 and 25–59 but had a positive relationship with consumers aged over 60.

The influence of imported cigarettes on the number of imported cigarette consumers had a negative relationship with consumers aged 25–59 but had a positive relationship with consumers aged 15–24. Since the elasticity of consumers aged 25–59 was high, they considered imported cigarettes as luxury goods. In terms of the influence of the price of domestic cigarettes, there was a negative relationship with consumers aged over 60 and a positive relationship with consumers aged 25–59. That being said, for consumers aged over 60, domestic cigarettes were considered as substitute goods but were complementary goods for consumers aged 25–59.

Regarding the influence of hand-rolled cigarettes on the number of imported cigarette consumers, this had a negative relationship with consumers aged over 60 but a positive relationship with consumers aged 15–24. That being said, for consumers aged over 60, hand-rolled cigarettes were considered as substitutes for imported cigarettes, while they were complementary goods for consumers aged 25–59.

In regard to the influence of GDP on the number of imported cigarette consumers, this had a positive relationship with consumers aged 25–59. This implied that imported cigarettes were considered as normal goods for consumers in this age range. However, for consumers aged over 60, this had a negative relationship, which reflected that they were inferior goods for the elderly. When considering the population of each age range, the relationship was negative for consumers aged 25-59 but was positive for consumers aged 15–24 and over 60.

In terms of the demand for hand-rolled cigarettes, this had a negative relationship with the price and the number of consumers aged over 60. When considering the elasticity of the demand, hand-rolled cigarettes were considered as normal goods for the elderly. For the price of domestic cigarettes, it had a negative relationship with consumers aged 15–24, but a positive relationship with consumers aged 25–59. It could be said that domestic cigarettes were considered as substitute goods for consumers aged 15–24 but were complementary goods for consumers aged 25–59.

The influence of the price of imported cigarettes on hand-rolled cigarettes had a negative relationship with consumers aged 25–59 and over 60 as they considered imported cigarettes as substitute goods. Moreover, there was a negative relationship between the number of people in each age range with the number of pipe tobacco consumers

among the 15–24 and 25–59 age ranges. Simultaneously, this had a positive relationship with consumers aged over 60.

The model for the price of domestic cigarettes showed that the cigarette excise tax, consumer price index, and the results of the tax structure changes in 2017 had a positive relationship with the price of domestic cigarettes. Likewise, the price of domestic cigarettes, exchange rate and the results of the tax structure changes in 2017 had a positive relationship with the price of imported cigarettes. Only the cigarette excise rate had a positive relationship with the price of pipe tobacco (see Table 3).

Table 3. Estimation results of the tobacco products price equation.

Type	Age Range		
	Price of Domestic Cigarettes	**Price of Imported Cigarettes**	**Price of Pipe Tobacco**
Constant	-2.8346 (-12.5194)***	1.2672 (20.0393)***	0.944 (9.7670)***
Cigarette excise tax	0.5711 (1.7857)*	-	-
Pipe tobacco excise tax	-	-	0.6864 (4.6565)***
Price of domestic cigarettes	-	0.6864 (33.5996)***	-
Consumer price index	1.7349 (8.0459)***	-	-
Exchange rate	-	-0.3618 (-8.5110)***	-
Change of tax collection structure	0.3342 (2.9049)***	0.0619 (5.1949)***	-0.0331 (-0.3196)
R²	0.9826	0.978	0.3436
Adjusted R²	0.9807	0.9755	0.2967
S.E. of Regression	0.1319	0.1319	0.1319
Durbin–Watson stat.	1.5381	1.8161	0.2434

Note: *** Reliability 99%; ** Reliability 95%; * Reliability 90%.

As the estimation results of some models were inconsistent with the theory of demand, they were inefficient to utilize for considering the consumer surplus. However, the models that were consistent with the theory showed that the consumer surplus of domestic cigarettes for consumers aged 15–24 was 7,582.70 Baht, while that of consumers aged over 60 was 160,932.76 Baht. Additionally, the consumer surplus of imported cigarettes for consumers aged 25–59 was 0 Baht, whereas the consumer surplus of hand-rolled cigarettes for consumers aged over 60 was 525,753.06 Baht.

5. CONCLUSIONS AND DISCUSSIONS

The relationship between the number of consumers of some cigarette types, age ranges, and the prices of such products was inconsistent with the theory of demand. That is to say, the number of consumers from the models had no relationship with the price or had reacted positively to the price. However, only domestic cigarettes of consumers aged 15–24 and over 60, imported cigarettes of consumers aged 25–59, and hand-rolled cigarettes of consumers aged over 60, where the price of each type affected the number of consumers negatively, was in accordance with the theory of the demand. It was likely that some models were inconsistent with the theory of the demand because the number of consumers was used as the demand factor in the research, instead of the quantity of each cigarette type, to facilitate the consideration of the influence of the demand factors on the number of consumers in each age range of each cigarette type. The analysis based on various dimensions gave different results. Though a price increase minimized the consumption for some consumers, it could not be assumed that they stopped

their consumption. Nevertheless, an increase in price might inspire some consumers to stop consumption. Nonetheless, such behavior had a different impact due to age and other factors aside from those stated in the model. Consequently, the analysis results were different from the conventional theory.

Simultaneously, for cigarette consumers who were influenced by the price, which included consumers of domestic cigarettes aged 15–24 and consumers of imported cigarettes aged 25–59, this type of cigarette was considered as luxury goods for that age group because of the price compared to the consumer's income. Most consumers of domestic cigarettes aged 15–24 were students or at the early working age stage, so they had limited income. As a result, they were concerned about the price of domestic cigarettes and the economic situation (income). This was similar to the consumers of imported cigarettes aged 25–59 who had to pay a higher price though they earned a higher income than other groups. Furthermore, the number of imported cigarette consumers increased dramatically when the price of domestic cigarettes was higher, which reflected the high rate of substitution. However, Nonthapot & Watchalaanun (2018) and Yeh et al. (2017) considered cigarettes as luxury goods but this contrasts with Rodríguez-Iglesias et al. (2017); Ho et al. (2018) and Adeniji (2019) who did not identify them as luxury goods. This may be the result of differences in the age ranges and that the studies were conducted to determine the effects of price and income.

Concurrently, when considering the cross-demand, the substitute goods were evident in the group of consumers aged 15–24 and 25–59, but not in the group of over 60s, of all cigarette types. The substitution was related to the deviant behavior from one product to another when the price increased to maintain satisfaction. Thus, it might be explained that in the cases of consumers aged over 60, other types of cigarette might not fulfill their needs as well as the one they were currently consuming. Consequently, they did not want to consume other types. At the same time, consumers aged 15–24 and 25–59 were willing to consume new products or did not retain the product type. Therefore, their consumption behavior deviated, and this was dependent on consumer age and type of cigarette.

The results showing that all types of cigarettes were complementary products, which was the same for all age ranges, particularly consumers aged over 60, implied that consumers consumed more than one type of cigarette with the same consumption behavior. That being said, if they consumed one type less, they did the same for the other types regardless of maintaining the satisfaction of smoking. However, they might choose to consume other products in order to fulfill the decreasing satisfaction.

Regarding the gross domestic product (GDP) or overall income, such factors did not impact hand-rolled cigarettes because they were the cheapest product. Although the price had risen, there was a long period between increases, so they were a cheap product for consumers compared to economic change. For this reason, consumers did not take income into consideration when they decided to buy hand-rolled cigarettes.

In terms of population, the number of consumers of each type of cigarette was affected by the size of the population in that age range in two different ways. First, the number of cigarette consumers of an age range increased if the population in the age range increased, and the number of cigarette consumers decreased if the size of the population of that age range increased. The second influence was mostly found among consumers aged over 60 with the three types of cigarette and the imported cigarette consumers aged 15–24. In the case of consumers aged over 60, they might not have minimized their consumption and have continued smoking since they were 25–59. For this reason, the number of consumers aged over 60 has increased accordingly. Furthermore, the number of imported cigarette consumers aged 15–24 was affected by the increasing number of consumers in this age range as they were eager to try smoking. When considering the model of imported cigarette consumers aged 25–59, it could be seen that when the consumers turned this age, the number decreased. It is remarkable that the increasing number of people in the 15–24 age range was only a temporary increase.

Nevertheless, the estimation of the consumer surplus revealed that the consumer surplus of cigarettes who considered cigarettes as luxury goods was low, and that of imported cigarettes for consumers aged 25–59 was zero. It could be explained that the increased price mitigated the benefits these consumers acquired from imported cigarettes. However, the calculation used data from the previous period to compare with the current price. At the same time, if cigarettes are considered as a necessary good, as was the case for domestic and hand-rolled cigarettes for consumers aged over 60, the consumer surplus was high when compared to the current price. However, the results were different from those of Nonthapot & Watchalaanun (2018) where the consumer surplus was 50 billion Baht. Such a difference was the result of the variables representing the different demand factors in the analysis.

6. RECOMMENDATIONS

1) Domestic cigarettes are considered as substitute goods for imported and hand-rolled cigarettes by consumers aged 25-59, which was the largest group of consumers. Because a 1% increase would increase the number of consumers by more than 1%, the deviant consumption behavior of other types of cigarettes should be taken into consideration prior to the implementation of any measures to raise the price of domestic cigarettes.

2) Since the number of consumers of all cigarettes who were aged over 60 increased, the campaign to minimize cigarette consumption for smokers aged 25–59 should be more active to mitigate the influence of population size.

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