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Research Paper

Investigating the Effects of Tax on Cigarette Smoking: Evidence From 58 Countries

Habib Ansari Samani[1*], Hassan Mohebbi[1]

1. Department of Economics, Faculty of Economics, Management and Accounting, Yazd University, Yazd, Iran.

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ABSTRACT

Background: One of the most essential requirements for economic and political development and stability is considering the health of the society. Annually, about 13% of people worldwide die because of smoking (use of tobacco). Tax is a price tool to reduce tobacco use; however, the effectiveness of tax on smoking may vary according to the socio-economic status of different societies. This study investigates the effects of four components of absolute price (AP), affordability change (AC), tax share (Sh), and tax structure (St) on the percentage of smokers at a global level.

Materials and Methods: This investigates the data provided by the Tobacconomics team, including four components on tobacco use. A total of 58 countries were selected and analyzed based on data availability. Since data for some countries was not available for some years, 2018 (most of the data for this year is available) was considered the reviewed year. Cross-sectional data have been used to estimate the model. This study uses the ordinary least squares regression for the model.

Results: The results showed that AP and tax did not affect the percentage of smokers in the sample countries; however, St had a negative impact on smoking, while AC had a positive and significant effect on the number of smokers. Also, smoking increased due to increasing poverty. As a result, the price alone did not affect the percentage of smokers, but the relative and AC became important in smoking. In addition, St affected smoking more than tax.

Conclusion: The estimation results of the model showed that Sh had no significant effect on the percentage of smokers. Meanwhile, Sh had no reducing impact on the percentage of smokers. In addition, increasing Sh can lead to an increase in cigarette smuggling. The results showed that tax alone cannot be a factor in reducing smoking; however, a suitable St can be considered an essential factor in reducing smoking. Hence, countries should focus more on the structure of the tax system than on the tax rate or revenue.

*** Corresponding Author:**
Habib Ansari Samani, Associate Professor.
Address: *Department of Economics, Faculty of Economics, Management and Accounting, Yazd University, Yazd, Iran.*
Tel: *+98 (913) 1836963*
E-mail: *h.samani@yazd.ac.ir*

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Introduction

Annually, more than 8 million people worldwide die because of smoking. This comprises around 13% of all deaths [1]. Global economies spend more than 1.4 trillion US dollars to mitigate the effects of tobacco use [2]. This equals 1.8% of the world's gross domestic product annually. According to a World Bank report, 15% of healthcare costs in high-income countries are related to smoking [3]. One of the most essential requirements for a country's development, economic, and political stability is considering its health status. One of the concerns of health and social policymakers is the prevalence of tobacco addiction behaviors [4].

In addition to having a specific price, each product has a tax [5, 6]. Tax is a vital price tool to reduce tobacco consumption, which depends on the price elasticity of demand [7]. Tobacco tax, one of the tobacco control policies, is an essential source of revenue for states [8]. Accordingly, this revenue should be managed for the well-being and independence of the nation [5, 9]. Global evidence confirms that tobacco tax policy is one of the most effective tools to reduce smoking. However, the effectiveness of tax on smoking prevalence and consumption may vary depending on the socio-economic status of different societies [1].

In 2020, the tobacconomics team released the cigarette tax scorecard for the first time. This scorecard for each country is evaluated based on four components: Absolute price (AP), affordability change (AC), tax share (Sh), and tax structure (St) [2, 8]. Accordingly, during 2014-2018, most countries did not effectively tax tobacco. Almost half of them scored less than 2. In 2021, the second edition of the scorecard was published. It indicated that some countries have improved their tobacco tax systems; however, smoking has not decreased significantly [10]. This is the first study that examines the latest available data (2018) for 58 countries. The present study uses tax indicators instead of tax indexes. Therefore, the explanatory variables of the study have been used for the first time in this study. Hence, the objective of the present study is to investigate the effect of the four components of the tax scorecard on the prevalence of tobacco use at the global level. For this purpose, the following hypotheses were proposed and tested:

- An increase in AP has a negative impact on smoking;
- AC has a positive effect on smoking;
- Sh has a negative impact on smoking;
- St has a negative impact on smoking.

Materials and Methods

According to the literature review, this study investigated the effect of the data provided by the Tobacconomics team, including four components, on tobacco use. Since data for some countries was not available for some years, 2018 (most of the data is available in this year) was considered the reviewed year. Cross-sectional data was used to estimate the model. This study used the ordinary least squares and estimated the research model. Accordingly, a model based on four components and other essential indicators was investigated.

Study variables

According to the research objectives, the dependent variable is the prevalence of current tobacco use (% of adults). The data of this variable was extracted from the world development indicators. Hence, the percentage of adults who use tobacco is known as the dependent variable of the research. Explanatory variables were AP, AC, Sh, St, human development index (HDI), the population of individuals aged 15 to 64 years to the total population, the percentage of the people below the national poverty line, the percentage of the population with income of less than $6.85 per day.

Study data

The data related to the variables of the percentage of smokers, the percentage of the population with 15 to 64 years of age to the total population, the population below the national poverty line, and the percentage of the people with income less than 6.85 per day were extracted from the world development indicators and HDI of United Nations. Table 1 shows the mean, minimum, and maximum number of research variables for 58 countries whose data were complete. On average, about 23% of adults smoke cigarettes in the sample countries. The lowest tobacco consumption (3.9%) was for Nigeria, and the highest (40.1%) was for Serbia. HDI classified countries based on income, education, and health levels. Accordingly, the mean HDI was 0.77. Norway was the most developed country (0.962), and Niger was the least developed country (0.399). The highest total population (70.83) was for Thailand, and the lowest percentage (48.55) was for Niger, and the mean was 63.35. The sample countries' mean population below the national poverty line was about 22%. Sierra Leone had the high-

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Table 1. Descriptive statistics

Variables	Mean	Maximum	Minimum
Tobacco use (% of adults)	22.98	40.1	3.9
AP	2.55	5	0
AC	1.34	5	0
Sh	2.77	5	0
St	3.09	5	1
HDI	0.77	0.96	0.4
P	63.52	70.83	48.55
L	21.9	56.8	1.7
PD	28.14	95	0.1

Abbreviations: AP: Absolute price; AC: Affordability change; Sh: Tax share; St: Tax structure; HDI: Human development index; P: The total population; L: The population below the national poverty line; PD: The percentage of the population with income of less than $6.85 per day.

est population percentage below the national poverty line (56.8), and China had the lowest percentage (1.7). Niger (95) and Slovenia (0.1) had the lowest and highest percentage of the population with income of less than $6.85 per day, respectively. The mean of this index for the sample countries was also 28.14.

As shown in Table 1, the three components of AP, AC, and Sh have the lowest and highest possible limits, i.e. 0 and 5. Only in the St, the lowest index is 1. A large number of countries have allocated these amounts, the mention of which is not helpful. However, the mean components can give an understanding of these variables' levels between 0 and 5. As shown, St has the best mean (3.09), and AC has the lowest average (1.34) in the sample. Therefore, sample countries have performed poorly regarding the AC in tobacco. The expenses of this product in the household budget have reduced in proportion. Nevertheless, in terms of St, they have shown good performance. The mean AC (2.55) and Sh (2.77) are also acceptable regarding St.

Results

Table 2 shows the study data according to the desired model. As shown, the desired model is statistically significant, and the explanatory variables show 54% of the changes in the dependent variable. Three significant coefficients include the Sh, total population, and the population below the national poverty line. In cross-sectional models, the critical problem is the heteroscedasticity of the variance in the error component. The heteroscedasticity of variance has been tested. By performing the White test, the null hypothesis of non-heteroscedasticity of variance is not rejected; therefore, the model has homogeneity of variance. Accordingly, ordinary least squares regression is suitable for estimating the desired model. As a result, we can rely on estimated parameters.

As shown in Table 2, the AP of cigarettes does not affect the percentage of smokers; however, AC can increase smoking. In countries where income has risen rapidly, cigarette tax should be advanced enough to raise prices more than the amount that income has increased to reduce AC. Affordability is defined as the percentage of gross domestic product per capita required to purchase 2000 cigarettes from top-selling brands, increasing, which shows that cigarettes become cheaper over time. Therefore, AP and tax cannot affect smoking, but AC affected by the AP increased compared to the increase in income, causing an increase in its use.

The estimation results of the model showed that the Sh had no significant effect on the percentage of smokers. Sh is part of the retail price of cigarettes taxed, between two-thirds and four-fifths announced by the World Bank [2]. Hence, Sh can reduce the percentage of smokers, but the studied sample showed that the percentage of smokers increases by moving from countries with a lower Sh to a higher Sh. These people place the increase in the Sh in their price expectations and increase their current use with the expectation that there is a possibility of increasing the Sh of cigarettes in the future. As a result, the opposite happens, and increasing Sh does not reduce

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Table 2. Results of the model

Explanatory Variables	Coefficient	t Statistics	Probability of t Statistics
AC	1.59	2.60	0.00***
AP	0.01	0.02	0.97
St	-3.73	-3.50	0.00***
Sh	0.00	0.00	0.99
HDI	-7.00	-0.36	0.71
P	0.41	1.78	0.08*
L	0.24	2.08	0.04**
PD	0.02	0.35	0.72
F-statistic		0.03**	
Coefficient of determination (R^2)		0.54	
White test		0.31 (non-homogeneity of variance)	
Jarque-Bera test		0.88 (normal distribution of errors)	

Abbreviations: AP: Absolute price; AC: Affordability change; Sh: Tax share; St: Tax structure; HDI: Human development index; P: The total population; L: The population below the national poverty line; PD: The percentage of the population with income of <$6.85 per day.

***Significance at the level of 1%, **Significance at the level of 5%, **Significance at the level of 10%.

smoking. The issue of smuggling can also be raised. Increasing Sh increases smuggling since its smuggled price is much lower than the domestic equivalent. Therefore, this becomes an incentive to increase the number of smokers in these countries.

However, St of a country in the studied sample significantly reduced the percentage of smokers. St determines its effectiveness in achieving public health and tax revenue goals, with simple and uniform tax structures having the most significant effect. This component of the scorecard assesses the multiple dimensions of the St based on how effective the system is as a deterrent. The highest scores are given to countries with tax systems with a specific flat rate tax system with automatic inflation adjustment and a tax system with a flat mixed system with an increasing tax with automatic adjustment for retail prices. A lower score is for countries that either have a specific tax on a fixed number per unit of cigarettes or have no tax on cigarettes. Hence, the tax alone cannot reduce smoking, but a suitable St can be considered an essential factor.

Based on the estimated model, the development of a country had no significant effect on the percentage of smokers. The percentage of smokers and smoking in countries is more dependent on the culture, customs, economy, and St of those countries. As shown, 40% of the population of Serbia, which has an HDI of 0.8, smokes, but in a country such as Malaysia with the same HDI, only 22% smoke. Therefore, it strengthens the attitude that there is no relationship between smoking and the development of a country. Also, the total population was significant at the error level of 10%. Hence, countries with a population of 15 to 64 years of age had more tobacco users.

The two variables of the population below the national poverty line and the percentage of people with an income of less than $6.85 per day are related to the poverty indicators in the countries. As shown in Table 2, the first variable positively and significantly affects the dependent variable; however, the other variable is not statistically significant. Therefore, the daily income of people in the studied countries did not affect the percentage of smokers. Accordingly, the cigarette is an independent product of income, and the percentage of the low-income population does not affect the reduction or increase in the use of this product. Still, countries with a higher percentage of the people below the L had a higher percentage of smokers.

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Discussion

According to the results of the research, it can be said that this research, contrary to studies [1, 3, 10], shows that the increase in cigarette tax does not have a significant effect on the reduction of smoking. But on the other hand, this research in line with the study [6] shows that the affordability of cigarettes has a positive and significant effect on smoking. Therefore, in order to better explain this issue, future researches can be useful.

Conclusion

One of the easiest and sometimes the most effective solutions that policymakers offer to reduce the use of a product is the use of price tools, especially tax. On the one hand, an increase in the price of a product will reduce its use, and on the other hand, these policies can be significant sources of income for states. Hence, with available data, the present study investigated the effect of tax and other variables on tobacco use in 58 countries.

According to the study results, the AP of cigarettes did not affect the percentage of smokers, but its affordability can increase smoking. In countries where income has risen rapidly, cigarette tax should increase enough to raise prices more than income increases to reduce the affordability of cigarettes.

Also, the estimation results of the model showed that Sh had no significant effect on the percentage of smokers. This result indicates that Sh had no reducing impact on the percentage of smokers. In addition, increasing Sh can cause an increase in cigarette smuggling. The results showed that tax alone cannot be a factor in reducing smoking, but a suitable St can be considered an essential factor in reducing smoking. Hence, countries should focus more on the structure of the tax system than on the tax rate or revenue.

In addition, the increase in the country's income had no significant effect on the percentage of smokers in that country, and the percentage of smokers and smoking in countries depends more on their culture and customs, AC and St. Also, the daily income of people in the studied countries did not affect the percentage of smokers. Still, the countries with the percentage of population below a population below the national poverty line had a higher percentage of smokers. The study results showed that various factors, such as the AP, AC, St, culture, customs of society, economic status, income, and the role of smuggling in countries, significantly affected the percentage of smokers.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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List the selected sample countries

1	Albania	Finland	Montenegro	Switzerland
2	Argentina	Ecuador	Malta	Sierra Leone
3	Austria	Estonia	Mexico	Slovakia
4	Belarus	Georgia	Mongolia	Slovenia
5	Belgium	Greece	Norway	Spain
6	Benin	Hungary	Netherlands	Sweden
7	Bulgaria	Indonesia	Niger	Türkiye
8	Burkina Faso	Italy	Portugal	Tanzania
9	Chad	Kazakhstan	Pakistan	Thailand
10	China	Kyrgyzstan	Panama	Togo
11	Costa Rica	Latvia	Peru	Lao People's Democratic Republic
12	Côte d'Ivoire	Lithuania	Philippines	Russian Federation
13	Croatia	Malaysia	Romania	Dominican Republic
14	Cyprus	Mali	Seychelles	
15	Czechia	Nigeria	Serbia	

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