

Global Alliance Against Tobacco Marketing: Do Increased Taxation of Tobacco Products Decrease Tobacco Consumption?

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The prevailing wisdom in tobacco control literature is that adroit use of taxation policy will reduce the prevalence of tobacco use because when tobacco prices go up, consumption goes down. Empirical evidence of this axiomatic inverse relationship has been sparse. This paper analyzes the effects of increased taxation on consumption of tobacco products in 136 countries during 2009-2015. Results indicate that there is weak negative relationship between change in adult smoking prevalence and change in taxation suggesting that higher tax rates on tobacco products tend to lower adult smoking prevalence, but in a modest rather than robust sort of way.

INTRODUCTION

The prevailing wisdom in scholarly and policy-making institutions dealing with tobacco control is that adroit use of price and taxation policy will reduce the prevalence of tobacco use because when tobacco prices go up, consumption goes down. For example, the Framework Convention on Tobacco Control (FCTC) of the World Health Organization (WHO) states in Article 6, “Price and tax measures are an effective and important means of reducing tobacco consumption ... Each Party should ... adopt ... tax policies and ... price policies on tobacco products, so as to contribute to the health objectives aimed at reducing tobacco consumption.” Likewise, the Office of the Surgeon General, Centers for Disease Control, in a landmark study on reducing tobacco use states “An optimal level of excise taxation on tobacco products will reduce the prevalence of smoking, the consumption of tobacco, and the long-term health consequences of tobacco use.”

However, empirical evidence of this axiomatic inverse relationship between price increase and tobacco consumption has been rather sparse. Building on new (2017) cross-country data from the WHO database, this paper aims to analyze the effects of increased taxation on consumption of tobacco products in the FCTC member countries during the period 2009-2015. In order to understand whether taxation plays any role in reducing adult smoking prevalence, we have used biennial data (2009-2015) for 136 countries and calculated the correlation coefficient between the two variables. In addition, we also investigated whether different policies used to discourage smoking have had any impact on adult smoking prevalence. Results indicate that although relationship between change in adult smoking prevalence and change in taxation between 2009 and 2015 is very weak, there is a negative relationship between change

in adult smoking prevalence and change in taxation. This suggests that higher tax rates on tobacco products tend to lower adult smoking prevalence, but in a modest rather than robust sort of way.

LITERATURE REVIEW

As mentioned previously, there is paucity of research exploring the effect of increased taxation (or increased price) on adult tobacco consumption. However, a number of research has concluded that a substantial tobacco price increase has a negative effect on tobacco consumption in pre-adults (Gallet and List, 2003). Using data from the 1976 National Health Interview Survey (NHIS), Lewit and Coate (1982) estimated a smoking participation price elasticity estimate for adults ages 35 and over of -0.15. With updated data from the same periodic survey, Evans and Farrelly (1998) and Farrelly et al. (2001) found that younger smokers were more responsive to tobacco price increase through taxes, but reported no association between increased taxes and tobacco consumption for adults over the age of 40. Ohsfeldt et al. (1998) used data from the Current Population Survey Tobacco Use Supplements (CPS-TUS 1992-93) to estimate the association between cigarette taxes and cigarette consumption for males. Participation tax elasticity estimate for adults ages 45 and over was -0.07. Using nine iterations of the CPS-TUS (1992-99) Tauras (2006) reported participation price elasticity estimates for adults ages 18 and older of -0.12. DeCicca and McLeod (2008) used data from the Behavioral Risk Factor Surveillance System (BRFSS) to estimate the association between cigarette tax increases in the 2001-2006 period, and smoking prevalence among adults ages 45-59 and 45-64. The authors reported participation elasticities of -0.3 for 45-59 year olds and -0.2 for 45-64 year olds. Finally, Callison and Kaestner (2012) using Current Population Survey Tobacco Use Supplements (CPS-TUS 1995-2007) found that for adult smokers ages 18 to 74, a 10% tax increase is associated with between a 0.3% to a 0.6% decrease in smoking participation. The authors concluded “that there is insufficient justification for the widespread belief that raising cigarette taxes will significantly reduce cigarette consumption among adults, even young adults. Our evidence suggests that, at best, increases in cigarette taxes will be associated with a small decrease in cigarette consumption and that it will take very sizable tax increases, on the order of 100%, to decrease smoking by as much as 5%.”

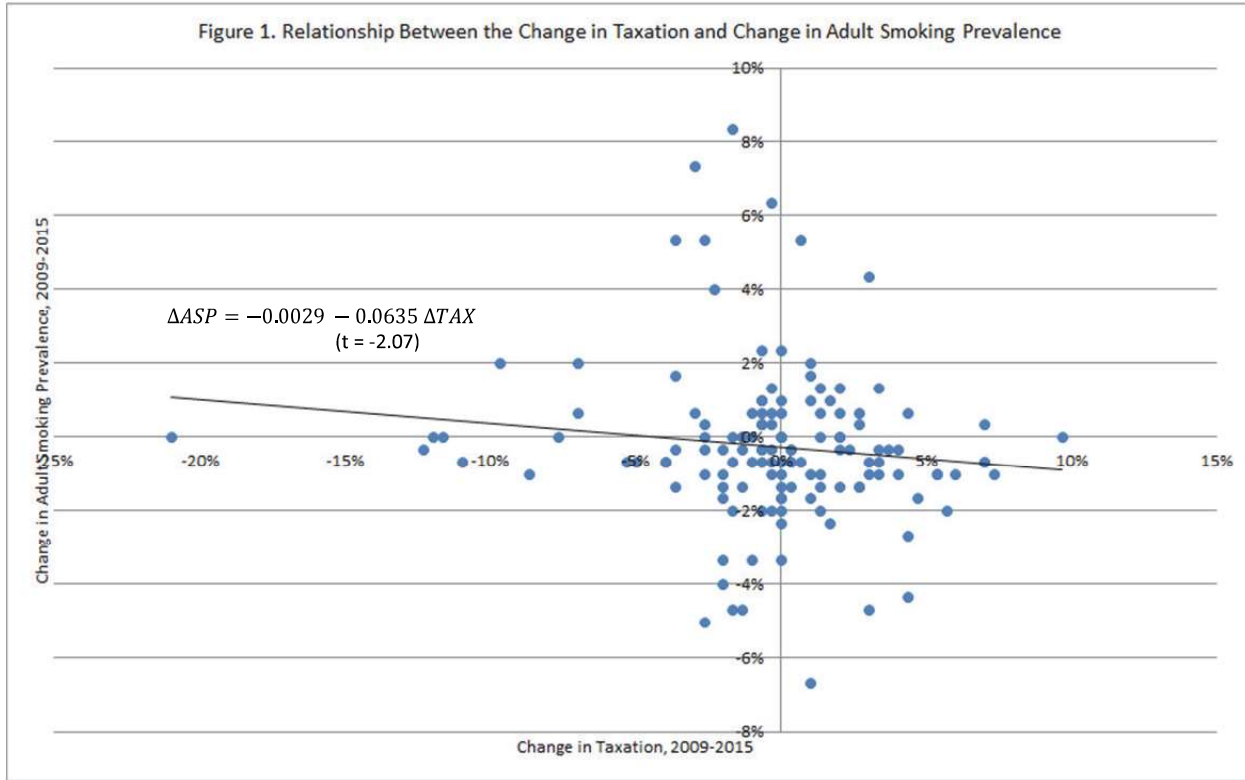
BACKGROUND AND DATA SOURCE

FCTC is a multilateral treaty under the auspices of the WHO. It was adopted by WHO in 2003, entered into force in 2005 and by December 2017, has 181 parties to the Treaty representing more than 91% of the world population. The FCTC contains both demand reduction and supply reduction provisions. Key obligations in the treaty are to (a) enact comprehensive bans on tobacco advertising, promotion and sponsorship; (b) increase tobacco taxes; (c) adopt and implement large, clear, visible, legible and rotating health warnings on tobacco products and their packaging; (d) protect people from exposure to tobacco smoke from indoor work and public places; and (e) ban the use of terms such as ‘light’ and ‘mild’. In 2008, WHO introduced a package of six evidence-based tobacco control demand reduction measures, known as the MPOWER to assist countries to fulfil their WHO FCTC obligations. MPOWER refers to M: Monitoring tobacco use and prevention policies; P: Protecting people from tobacco smoke; O: Offering help to quit tobacco use; W: Warning about the dangers of tobacco; E: Enforcing bans on tobacco advertising, promotion and sponsorship, and R: Raising taxes on tobacco.

Success in the primary objective of establishing the FCTC regime having been achieved, now there is a major thrust to implement provisions of the treaty and MPOWER measures, monitor implementation and stigmatize non-implementation in the member-countries. To this end, all member-countries are required to provide to the WHO secretariat biennial comprehensive reports containing data on their progress toward the M-Power objectives. We use this compendium of data for the years 2009-2015 to conduct our research.

RESEARCH RESULTS

FIGURE 1
RELATIONSHIP BETWEEN CHANGE IN TAXATION AND CHANGE IN ADULT SMOKING PREVALENCE



Note: This figure shows the relationship between the change in adult smoking prevalence (ASP) and the change in taxation (TAX) between 2009 and 2015.

Table 1 illustrates the changes in the average adult smoking prevalence and the average taxation between 2009 and 2015 in relation to each of the five policy variables. The average adult smoking prevalence and the average taxation were calculated after ranking the countries by each of the five policy variables by their degree of intensity. For example, in order to find averages for smoke-free policies variable, all countries in the sample were ranked first by the four levels of the variable. Then the average for each level was calculated by taking the average of adult smoking prevalence and taxation for the countries that fall under each level. For example, 17.9% in 2009 at Level 1 represents the average adult smoking prevalence of countries which maintained the smoking-free legislation at level 1, namely, complete absence of ban, or up to two public places completely smoke-free. The average tax rate of 49.7% was also calculated for the same group of countries. The correlation coefficient of 0.491 in 2009 at Level 1 represents the correlation between the adult smoking prevalence rate and the tax rate of the countries that belong to Level 1.

TABLE 1
CHANGES IN AVERAGE ADULT SMOKING PREVALENCE AD AVERAGE TAXATION,
2009-2015

| Policy | Level | Average Adult Smoking Prevalence | | | | Average Taxation | | | | Correlation Coefficient | | | |
|---------------------|-------|----------------------------------|-------|-------|-------|------------------|-------|-------|-------|-------------------------|--------|--------|--------|
| | | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 |
| Smoke-Free Policies | 1 | 17.9% | 17.5% | 17.0% | 15.0% | 49.7% | 47.6% | 46.8% | 45.8% | 0.491 | 0.482 | 0.460 | 0.515 |
| | 2 | 19.9% | 18.3% | 21.9% | 20.5% | 52.1% | 48.8% | 51.3% | 51.6% | 0.465 | 0.639 | 0.366 | 0.478 |
| | 3 | 14.9% | 18.5% | 16.6% | 18.2% | 54.9% | 49.8% | 51.3% | 55.5% | 0.380 | 0.640 | 0.664 | 0.381 |
| | 4 | 20.3% | 18.7% | 18.4% | 17.1% | 53.4% | 54.5% | 55.8% | 55.4% | 0.243 | 0.210 | 0.211 | 0.147 |
| Cessation | 1 | 12.3% | 11.3% | 19.8% | 16.4% | 42.9% | 34.5% | 39.0% | 34.7% | 0.327 | -0.188 | -0.581 | -0.216 |
| | 2 | 17.8% | 16.6% | 18.5% | 16.2% | 43.0% | 41.0% | 42.5% | 42.4% | 0.287 | 0.481 | 0.208 | 0.515 |
| | 3 | 20.6% | 20.1% | 18.8% | 18.4% | 60.6% | 55.1% | 53.6% | 53.9% | 0.574 | 0.363 | 0.511 | 0.524 |
| | 4 | 20.0% | 17.4% | 17.3% | 15.4% | 64.7% | 62.0% | 61.3% | 61.5% | 0.496 | 0.496 | 0.571 | 0.272 |
| Health Warnings | 1 | 14.6% | 14.7% | 15.0% | 14.8% | 40.9% | 38.2% | 40.6% | 42.2% | 0.289 | 0.374 | 0.476 | 0.432 |
| | 2 | 22.6% | 21.0% | 21.9% | 18.3% | 58.1% | 55.7% | 54.9% | 51.6% | 0.305 | 0.512 | 0.276 | 0.683 |
| | 3 | 22.7% | 19.6% | 18.6% | 17.2% | 64.0% | 51.6% | 52.7% | 43.2% | 0.444 | 0.496 | 0.568 | 0.332 |
| | 4 | 16.7% | 16.0% | 16.1% | 18.1% | 58.1% | 59.4% | 56.4% | 60.6% | 0.504 | 0.308 | 0.287 | 0.307 |
| Mass Media | 1 | 17.5% | 17.3% | 18.7% | 16.7% | 46.7% | 46.9% | 48.9% | 48.3% | 0.424 | 0.427 | 0.478 | 0.494 |
| | 2 | 17.9% | 19.8% | 14.8% | 14.4% | 55.7% | 60.2% | 61.5% | 45.1% | 0.595 | 0.454 | 0.845 | -0.245 |
| | 3 | 20.9% | 23.0% | 18.7% | 21.0% | 62.1% | 55.1% | 50.2% | 55.7% | 0.274 | 0.755 | 0.031 | 0.425 |
| | 4 | 22.0% | 17.5% | 18.6% | 17.6% | 58.1% | 51.2% | 54.6% | 57.2% | 0.268 | 0.380 | 0.325 | 0.230 |
| Advertising Bans | 1 | 16.8% | 14.1% | 17.3% | 15.0% | 43.3% | 39.1% | 39.2% | 42.1% | 0.425 | 0.386 | 0.332 | 0.467 |
| | 2 | 19.8% | 18.0% | 20.3% | 20.3% | 29.3% | 39.0% | 48.0% | 50.3% | 0.991 | 0.263 | 0.263 | 0.263 |
| | 3 | 20.8% | 21.0% | 19.3% | 18.7% | 58.1% | 57.4% | 57.9% | 56.6% | 0.328 | 0.319 | 0.397 | 0.415 |
| | 4 | 13.3% | 13.8% | 16.9% | 15.0% | 48.8% | 41.0% | 46.3% | 45.8% | 0.559 | 0.365 | 0.210 | 0.249 |

Note: The calculations are based on data for 136 countries. Averages are calculated using the data for all countries that belong to each policy level. Correlation coefficient represents the correlation between the adult smoking prevalence and taxation.

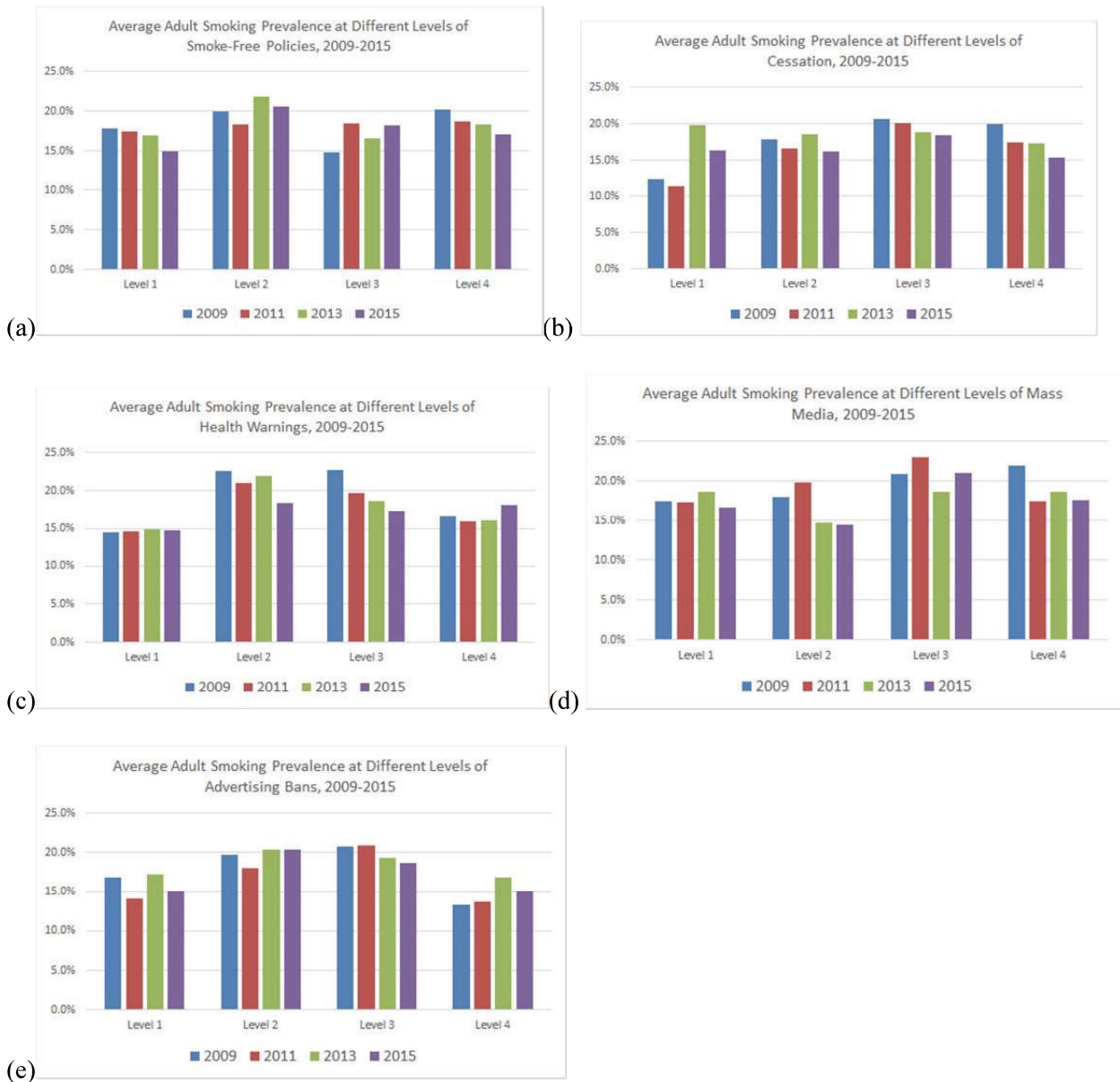
Policy variables and their levels are defined as follows:

| Policy | Level | Description |
|-------------------------|-------|--|
| Smoke-Free Legislation | 1 | Complete absence of ban, or up to two public places completely smoke-free. |
| | 2 | Three to five public places completely smoke-free. |
| | 3 | Six to seven public places completely smoke-free. |
| | 4 | All public places completely smoke-free. |
| Cessation | 1 | None |
| | 2 | Nicotine replacement therapy and/or some cessation services (neither cost covered) |
| | 3 | Nicotine replacement therapy and/or some cessation services (at least one of which cost-covered) |
| | 4 | Nicotine replacement therapy and/or some cessation services (cost covered) |
| Health Warnings | 1 | No warnings or small warnings. |
| | 2 | Medium size warnings, missing some appropriate characteristics or large warnings missing many appropriate characteristics. |
| | 3 | Medium size warnings, missing some appropriate characteristics or large warnings missing many appropriate characteristics. |
| | 4 | Large warnings with all appropriate characteristics. |
| Anti-Tobacco Mass Media | 1 | No national campaign conducted with a duration of at least 3 weeks. |
| | 2 | Campaign conducted with one to four appropriate characteristics. |
| | 3 | Campaign conducted with five to six appropriate characteristics. |
| | 4 | Campaign conducted with at least seven appropriate characteristics including airing on television and/or radio. |
| Advertising Bans | 1 | Complete absence of ban, or ban that does not cover national television, radio and print media. |
| | 2 | Ban on national TV, radio and print media only. |
| | 3 | Ban on national TV, radio and print media as well as on some other forms of direct and indirect advertising. |
| | 4 | Ban on all forms of direct and indirect advertising. |

Source: World Health Organization, *WHO Report on the Global Tobacco Epidemic, 2017: Monitoring Tobacco Use and Prevention Policies*.

The results presented in Table 1 do not show any clear relationship between adult smoking prevalence and taxation. In order to identify whether there is clear pattern in the change in adult smoking prevalence at each levels of the five policy variables, we have presented the results in a series of graphs. Figure 2, shows the change in adult smoking prevalence between 2009 and 2015 at each level of the five policy variables. Figure 2(a) shows that there has been a gradual reduction in adult smoking prevalence when the smoke-free policies become more widespread. Similar pattern can be found in Figure 2(b), as the levels of cessation become more affordable. As Figure 2(c) illustrates, as the health warnings become larger in size, they tend to lower the adult smoking prevalence. Mass media and advertising bans appear to have mixed effects on adult smoking prevalence, as Figures 2(d) and 2(e) illustrate.

FIGURE 2
AVERAGE ADULT SMOKING PREVALENCE AT DIFFERENT LEVELS OF POLICIES, 2009-2015



MODEL SPECIFICATION AND DATA

In order to investigate whether taxation and other policies to discourage adult smoking have any impact on adult smoking prevalence we specify the following model:

$$ASP_{it} = \mu_i + \beta_1 TAX_{it} + \beta_2 ADV_{it} + \beta_3 CES_{it} + \beta_4 HEA_{it} + \beta_5 MAS_{it} + \beta_6 SMO_{it} + \varepsilon_{it} \quad (1)$$

where ASP_{it} is the adult smoking prevalence, TAX_{it} is the taxation, ADV_{it} is the advertising ban, CES_{it} is the cessation, HEA_{it} is the health warnings, MAS_{it} is the mass media, SMO_{it} is the smoke-free legislation, $i = 1, 2, 3, \dots, 136$ for each of the country in the panel and $t = 1, \dots, 4$ refers to the time period, μ_i is

the country-specific fixed effects, and ε_{it} is denote the estimated residuals which represent deviations from the long-run relationship.

In addition to the model specified in Equation (1), we have also specified a model representing the change in adult smoking prevalence and the change in taxation. Changes in other variables are not included since the levels of each of these five policy variables have not changed during the study period. The second model is specified as:

$$\Delta ASP_{it} = \mu_i + \beta_1 \Delta TAX_{it} + \beta_2 ADV_{it} + \beta_3 CES_{it} + \beta_4 HEA_{it} + \beta_5 MAS_{it} + \beta_6 SMO_{it} + \varepsilon_{it} \quad (2)$$

Each of the five policy variables take values 1, 2, 3, or 4 depending on the intensity of each policy in each country. Advertising bans (ADV) variable takes value 1 when there is complete absence of ban, or ban that does not cover national television, radio and print media; value 2 when there is a ban on national TV, radio and print media only; value 3 when there is a ban on national TV, radio and print media as well as on some other forms of direct and indirect advertising; and value 4 when there is a ban on all forms of direct and indirect advertising. Cessation (CES) variable takes value 1 if there is no Nicotine replacement therapy or some cessation services available; value 2 if Nicotine replacement therapy and/or some cessation services (neither cost covered); value 3 if Nicotine replacement therapy and/or some cessation services (at least one of which cost-covered); and value 4 if Nicotine replacement therapy and/or some cessation services (cost covered). Health warnings (HEA) variable takes value 1 if there are no warnings or small warnings; value 2 if there are medium size warnings, missing some appropriate characteristics or large warnings missing many appropriate characteristics; value 3 if there are medium size warnings, missing some appropriate characteristics or large warnings missing many appropriate characteristics; and value 4 if there are large warnings with all appropriate characteristics. Anti-tobacco mass media (MAS) variable takes value 1 if there is no national campaign conducted with a duration of at least 3 weeks; value 2 if a campaign is conducted with one to four appropriate characteristics; value 3 if a campaign is conducted with five to six appropriate characteristics; and value 4 if a campaign is conducted with at least seven appropriate characteristics including airing on television and/or radio. Smoke-free legislation (SMO) variable takes value 1 if there is a complete absence of ban, or up to two public places completely smoke-free; value 2 if there are three to five public places completely smoke-free; takes value 3 if there are six to seven public places completely smoke-free; and value 4 if all public places completely smoke-free. The expected sign of parameter β_1 can either be negative or positive depending on whether taxation deter or encourage adult smoking. The expected signs of parameters β_2 , β_3 , β_4 , β_5 , and β_6 are negative given that stricter policies to discourage smoking could lower prevalence of adult smoking.

All the data used in this study were collected from the World Health Organization (WHO) reports on global tobacco epidemic. These reports include *WHO Report on the Global Tobacco Epidemic, 2017: Monitoring Tobacco Use and Prevention Policies*; *WHO Report on the Global Tobacco Epidemic, 2015: Raising Taxes on Tobacco*; *WHO Report on the Global Tobacco Epidemic, 2013: Enforcing Bans on Tobacco Advertising, Promotion and Sponsorship*; and *WHO Report on the Global Tobacco Epidemic, 2011: Warning about the Dangers of Tobacco*.

EMPIRICAL RESULTS

The specified models are estimated using panel least squares estimation method. Our panel data covers 136 countries and 4 years (2009, 2011, 2013, and 2015). Due to some missing observations on some of the variables, we do not have a balanced panel. The estimated results are presented in Tables 2-5. Table 2 presents the results of the full sample. The left panel shows the estimated results of Equation (1) and the right panel shows the estimated results of Equation (2).

TABLE 2
ADULT SMOKING PREVALENCE AND TAXATION: PANEL LS ESTIMATIONS (2009-2015)

| Variable | Dependent Variable : ASP | | Variable | Dependent Variable : ΔASP | |
|---------------------------------|--------------------------|---------|---------------------------------|---------------------------|---------|
| | Coefficient | t-value | | Coefficient | t-value |
| <i>Constant</i> | 0.1255*** | 6.80 | <i>Constant</i> | 0.0702** | 2.15 |
| <i>TAX</i> | 0.2228*** | 10.80 | <i>ΔTAX</i> | 0.2213*** | 8.54 |
| <i>Advertising Ban</i> | -0.0620 | -1.21 | <i>Advertising Ban</i> | -0.0653 | -0.82 |
| <i>Cessation</i> | -0.0161*** | -2.73 | <i>Cessation</i> | -0.0073 | -0.70 |
| <i>Health Warnings</i> | -0.0035 | -0.77 | <i>Health Warnings</i> | -0.0065 | -0.82 |
| <i>Mass Media</i> | 0.0035 | 1.07 | <i>Mass Media</i> | -0.0018 | -0.30 |
| <i>Smoke – Free Legislation</i> | -0.0085 | -0.22 | <i>Smoke – Free Legislation</i> | -0.0056 | -0.93 |
| Number of Observations | 520 | | Number of Observations | 372 | |
| Adjusted R ² | 0.405 | | Adjusted R ² | 0.215 | |
| Random/Fixed Effects? | FE | | Random/Fixed Effects? | RE | |
| Hausman Test | 36.53*** | | Hausman Test | 1.33 | |

Note: Asterisks *, ** and *** indicate the statistical significance at the 10% level, 5% level and 1% level, respectively.

In order to identify whether fixed-effects model or random-effects model is appropriate, we have conducted the Hausman test. Since the Hausman test statistic is statistically significant, Equation (1) was estimated using the fixed-effects model. Since the Hausman test statistic is not statistically significant, Equation (2) was estimated using the random-effects model.

Results presented in Table 2 shows that the sign of the taxation variable is positive and it is statistically significant at 1% level of significance. Therefore, taxation is found to have a positive effect on adult smoking prevalence. In the first model four of the five policy variables have the expected negative signs while in the second model all policy variables have the expected negative sign. Of these policy variables, only cessation variable is statistically significant at the 5% level of significance. Though they are not statistically significant, the negative signs indicate that these policies tend to lower the prevalence of adult smoking.

After analyzing the effect of taxation on adult smoking prevalence for the full sample, we have also estimated the effects by separating the countries into three groups, namely, the countries that increased the tax rate on tobacco, the countries that that did not change the tax rate on tobacco, and the countries that decreased the tax rate on tobacco. These results are presented in Tables 3-5. Table 3 presents the empirical results for the countries that increased the tax rate on tobacco and both models were estimated using the fixed-effects model.

TABLE 3
ADULT SMOKING PREVALENCE AND TAXATION: PANEL LS ESTIMATIONS (2009-2015)
(Countries that increased the tax rate on tobacco)

| Variable | Dependent Variable : ASP | | Variable | Dependent Variable : Δ ASP | |
|---------------------------------|--------------------------|---------|---------------------------------|-----------------------------------|---------|
| | Coefficient | t-value | | Coefficient | t-value |
| <i>Constant</i> | 0.2059*** | 5.89 | <i>Constant</i> | 0.2439*** | 3.54 |
| <i>TAX</i> | 0.1983*** | 6.14 | Δ <i>TAX</i> | 0.2233*** | 5.50 |
| <i>Advertising Ban</i> | -0.0017 | -0.24 | <i>Advertising Ban</i> | -0.0074 | -0.05 |
| <i>Cessation</i> | -0.0318*** | -3.29 | <i>Cessation</i> | -0.0563*** | -2.63 |
| <i>Health Warnings</i> | -0.0252*** | -3.56 | <i>Health Warnings</i> | -0.0344** | -2.40 |
| <i>Mass Media</i> | 0.0063 | 1.30 | <i>Mass Media</i> | 0.0025 | 0.24 |
| <i>Smoke – Free Legislation</i> | 0.0112* | 1.88 | <i>Smoke – Free Legislation</i> | 0.0028 | 0.02 |
| Number of Observations | 216 | | Number of Observations | 158 | |
| Adjusted R ² | 0.407 | | Adjusted R ² | 0.382 | |
| Random/Fixed Effects? | FE | | Random/Fixed Effects? | FE | |
| Hausman Test | 10.88* | | Hausman Test | 10.90* | |

Note: Asterisks *, ** and *** indicate the statistical significance at the 10% level, 5% level and 1% level, respectively.

Results presented in Table 3 shows that the sign of the taxation variable is positive and it is statistically significant at 1% level of significance, as in the case of full sample. In both models three of the five policy variables have the expected negative signs. Of these policy variables, cessation and health warnings variables are statistically significant at the 1% or 5% level of significance. Mass media and smoke-free legislation variables have positive signs and they are not statistically significant.

Table 4 presents the empirical results for the countries that did not change the tax rate on tobacco and the first model was estimated using the fixed-effects model while the second model was estimated using the random-effects model. These results also show that the sign of the taxation variable is positive and it is statistically significant at 1% level of significance. In the first model one of the five policy variables has the expected negative signs while in the second model three of the five policy variables have the expected negative sign. None of these variables are statistically significant.

TABLE 4
ADULT SMOKING PREVALENCE AND TAXATION: PANEL LS ESTIMATIONS (2009-2015)
(Countries that did not change the tax rate on tobacco)

| Variable | Dependent Variable : ASP | | Variable | Dependent Variable : ΔASP | |
|---------------------------------|--------------------------|---------|---------------------------------|---------------------------|---------|
| | Coefficient | t-value | | Coefficient | t-value |
| <i>Constant</i> | -0.0616 | -1.06 | <i>Constant</i> | -0.0211 | -0.21 |
| <i>TAX</i> | 0.2329*** | 4.45 | <i>ΔTAX</i> | 0.3528*** | 4.63 |
| <i>Advertising Ban</i> | 0.0091 | 0.60 | <i>Advertising Ban</i> | 0.0017 | 0.06 |
| <i>Cessation</i> | 0.0212 | 1.37 | <i>Cessation</i> | 0.0248 | 0.88 |
| <i>Health Warnings</i> | -0.0212 | -1.20 | <i>Health Warnings</i> | -0.0088 | -0.30 |
| <i>Mass Media</i> | 0.0091 | 0.08 | <i>Mass Media</i> | -0.0016 | -0.78 |
| <i>Smoke – Free Legislation</i> | 0.0101 | 0.93 | <i>Smoke – Free Legislation</i> | -0.0047 | -0.21 |
| Number of Observations | 54 | | Number of Observations | 39 | |
| Adjusted R ² | 0.558 | | Adjusted R ² | 0.551 | |
| Random/Fixed Effects? | FE | | Random/Fixed Effects? | RE | |
| Hausman Test | 12.99** | | Hausman Test | 2.88 | |

Note: Asterisks *, ** and *** indicate the statistical significance at the 10% level, 5% level and 1% level, respectively.

Table 5 presents the empirical results for the countries that decreased the tax rate on tobacco and both models were estimated using the random-effects model. Results presented in Table 5 also shows that the sign of the taxation variable is positive and it is statistically significant at 1% level of significance. In the first model two of the five policy variables have the expected negative signs while in the second model three of the five policy variables have the expected negative sign. In the first model none of five policy variables are statistically significant while in the second model two of the five policy variables are statistically significant.

TABLE 5
ADULT SMOKING PREVALENCE AND TAXATION: PANEL LS ESTIMATIONS (2009-2015)
(Countries that decreased the tax rate on tobacco)

| Variable | Dependent Variable : ASP | | Variable | Dependent Variable : ΔASP | |
|---------------------------------|--------------------------|---------|---------------------------------|---------------------------|---------|
| | Coefficient | t-value | | Coefficient | t-value |
| <i>Constant</i> | 0.0893*** | 4.03 | <i>Constant</i> | 0.0611 | 1.38 |
| <i>TAX</i> | 0.1718*** | 6.40 | <i>ΔTAX</i> | 0.1990*** | 5.46 |
| <i>Advertising Ban</i> | -0.0010 | -0.18 | <i>Advertising Ban</i> | -0.0066 | -0.60 |
| <i>Cessation</i> | -0.0091 | -1.19 | <i>Cessation</i> | -0.0309** | -2.05 |
| <i>Health Warnings</i> | 0.0014 | 0.24 | <i>Health Warnings</i> | 0.0205* | 1.82 |
| <i>Mass Media</i> | 0.0071 | 1.63 | <i>Mass Media</i> | 0.0041 | 0.47 |
| <i>Smoke – Free Legislation</i> | 0.0029 | 0.58 | <i>Smoke – Free Legislation</i> | -0.0083 | -0.87 |
| Number of Observations | 250 | | Number of Observations | 177 | |
| Adjusted R ² | 0.174 | | Adjusted R ² | 0.224 | |
| Random/Fixed Effects? | RE | | Random/Fixed Effects? | RE | |
| Hausman Test | 4.90 | | Hausman Test | 4.16 | |

Note: Asterisks *, ** and *** indicate the statistical significance at the 10% level, 5% level and 1% level, respectively.

TABLE 6
SAMPLE DATA FILE OF FIVE SELECTED COUNTRIES
(Complete 136-county data set available from the authors)

| Country | Adult Smoking Prevalence | | | | Taxation | | | | | | | |
|--|--------------------------|------|------|------|---------------------|------|------|------|------------------|------|------|------|
| | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 | | | | |
| Australia | 17% | 16% | 14% | 13% | 64% | 60% | 60% | 60% | | | | |
| Bangladesh | 22% | 23% | 20% | 20% | 68% | 71% | 77% | 77% | | | | |
| Brazil | 15% | 15% | 13% | 11% | 60% | 63% | 65% | 68% | | | | |
| Chile | 34% | 27% | 28% | 26% | 76% | 81% | 81% | 89% | | | | |
| China | 23% | 23% | 22% | 22% | 41% | 41% | 51% | 51% | | | | |
| Smoking Prevention Policies: | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Monitoring | | | | Smoke-Free Policies | | | | Cessation | | | |
| Country | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 |
| Australia | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Bangladesh | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 |
| Brazil | 1 | 1 | 2 | 4 | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Chile | 1 | 3 | 3 | 4 | 2 | 1 | 4 | 4 | 2 | 2 | 2 | 2 |
| China | 1 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 |
| Smoking Prevention Policies (Continued) | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | Health Warnings | | | | Mass Media | | | | Advertising Bans | | | |
| Country | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 | 2009 | 2011 | 2013 | 2015 |
| Australia | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| Bangladesh | 2 | 2 | 4 | 4 | 1 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| Brazil | 4 | 4 | 4 | 4 | 1 | 2 | 3 | 2 | 3 | 4 | 4 | 4 |
| Chile | 4 | 4 | 4 | 4 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 |
| China | 2 | 2 | 2 | 2 | 1 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |

Source: World Health Organization, *WHO Report on the Global Tobacco Epidemic, 2017: Monitoring Tobacco Use and Prevention Policies*.

TABLE 7
LIST OF COUNTRIES INCLUDED IN THE STUDY

| | | | |
|------------------------|---------------------------|---------------------|-------------------------------|
| Albania | Ethiopia | Morocco | Thailand |
| Andorra | Fiji | Mozambique | Tonga |
| Argentina | Finland | Myanmar | Tunisia |
| Armenia | France | Namibia | Turkey |
| Australia | Gabon | Nauru | Uganda |
| Austria | Gambia | Nepal | Ukraine |
| Azerbaijan | Georgia | Netherlands | United Kingdom and N. Ireland |
| Bahrain | Germany | New Zealand | United Republic of Tanzania |
| Bangladesh | Ghana | Niger | United States of America |
| Barbados | Greece | Nigeria | Uruguay |
| Belarus | Hungary | Niue | Uzbekistan |
| Belgium | Iceland | Norway | Vanuatu |
| Benin | India | Oman | Viet Nam |
| Bolivia | Indonesia | Pakistan | Yemen |
| Bosnia and Herzegovina | Iran | Palau | Zambia |
| Botswana | Israel | Panama | Zimbabwe |
| Brazil | Italy | Papua New Guinea | |
| Brunei Darussalam | Jamaica | Paraguay | |
| Bulgaria | Japan | Philippines | |
| Burkina Faso | Jordan | Poland | |
| Cabo Verde | Kazakhstan | Portugal | |
| Cambodia | Kenya | Republic of Korea | |
| Cameroon | Kiribati | Republic of Moldova | |
| Canada | Kuwait | Romania | |
| Chad | Kyrgyzstan | Russian Federation | |
| Chile | Lao People's Dem. Rep. | Samoa | |
| China | Latvia | Saudi Arabia | |
| Colombia | Lebanon | Senegal | |
| Comoros | Liberia | Serbia | |
| Congo | Lithuania | Seychelles | |
| Cook Islands | Luxembourg | Sierra Leone | |
| Costa Rica | Malawi | Singapore | |
| Croatia | Malaysia | Slovakia | |
| Czechia | Maldives | Slovenia | |
| Dem. Rep. of the Congo | Mali | South Africa | |
| Denmark | Malta | Spain | |
| Dominican Republic | Mauritania | Sri Lanka | |
| Egypt | Mauritius | Swaziland | |
| Eritrea | Mexico | Sweden | |
| Estonia | Mongolia | Switzerland | |
| Albania | Ethiopia | Morocco | |
| Andorra | Fiji | Mozambique | |
| Argentina | Finland | Myanmar | |
| Armenia | France | Namibia | |
| Australia | Gabon | Nauru | |
| Austria | Gambia | Nepal | |
| Azerbaijan | Georgia | Netherlands | |

| | | |
|------------|---------|-------------|
| Bahrain | Germany | New Zealand |
| Bangladesh | Ghana | Niger |
| Barbados | Greece | Nigeria |

CONCLUSION

In this paper, we revisited the issue of tobacco taxes and adult smoking prevalence and extended the literature from domestic to global public health policy. Overall, our analyses indicate that the association between tobacco taxes and smoking participation is negative, small and not usually statistically significant.

The small negative association indicates that perhaps it will take very large tax increases to meaningfully affect adult smoking. This is because with incremental small increase in taxation, tobacco companies often partially offset the effect of tax increase by discounts and promotions (Chaloupka FJ et. Al. 2012) and the pool of smokers seemingly harden and adjust rather than abandon smoking. Our research ultimately raises questions about claims that, at the current time, tobacco tax increase WILL have an important beneficial health impact through reduced smoking participation.

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