HHS Public Access

Author manuscript

Tob Control. Author manuscript; available in PMC 2015 October 20.

Published in final edited form as:

Tob Control. 2015 July ; 24(0 3): iii88–iii93. doi:10.1136/tobaccocontrol-2014-051771.

The Association between Tax Structure and Cigarette Price Variability: Findings from the International Tobacco Control Policy Evaluation (ITC) Project

Ce Shang[1], **Frank J. Chaloupka**[1,2], **Geoffrey T Fong**[3,4], **Mary Thompson**[5], and **Richard J O'Connor**[6]

[1]Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, Chicago, IL

[2]Department of Economics, University of Illinois at Chicago, Chicago, IL

[3]Department of Psychology, University of Waterloo, Waterloo, Canada

[4]Ontario Institute for Cancer Research, Toronto, Ontario, Canada

[5]Department of Statistics and Actuarial Science, University of Waterloo, Waterloo, Ontario

[6]Department of Health Behavior, Division of Cancer Prevention and Population Sciences, Roswell Park Cancer Institute, Buffalo, NY

Abstract

Background—Recent studies have shown that more opportunities exist for tax avoidance when cigarette excise tax structure departs from a uniform specific structure. However, the association between tax structure and cigarette price variability has not been thoroughly studied in the existing literature.

Objective—To examine how cigarette tax structure is associated with price variability. The variability of self-reported prices is measured using the ratios of differences between higher and lower prices to the median price such as the IQR-to-median ratio.

Methods—We used survey data taken from the International Tobacco Control Policy Evaluation (ITC) Project in 17 countries to conduct the analysis. Cigarette prices were derived using individual purchase information and aggregated to price variability measures for each surveyed

Corresponding Author: Ce Shang, Visiting Senior Research Specialist, Health Policy Center, Institute for Health Research and Policy, University of Illinois at Chicago, 1747 W. Roosevelt Rd, Chicago, IL. cshang@uic.edu. Phone: 312-996-0774.

Provenance and peer review: Not commissioned; externally peer reviewed.

Patient consent: Obtained.

Competing interest: None declared.

Ethics approvals:
All ITC surveys were conducted with ethics clearance from the Office of Research Ethics at the University of Waterloo, Canada and the respective internal ethics boards for each country.

Contributorship Statement:
CS, FC, GF, MT, and RO planned and conducted the work described in the article. CS reported the work after discussion with other authors and is responsible for the overall content as guarantor.

country and wave. The effect of tax structures on price variability was estimated using Generalised Estimating Equations after adjusting for year and country attributes.

Findings—Our study provides empirical evidence of a relationship between tax structure and cigarette price variability. We find that, compared to the specific uniform tax structure, mixed uniform and tiered (specific, ad valorem or mixed) structures are associated with greater price variability ($p \leq 0.01$). Moreover, while a greater share of the specific component in total excise taxes is associated with lower price variability ($p \leq 0.05$), a tiered tax structure is associated with greater price variability ($p \leq 0.01$). The results suggest that a uniform and specific tax structure is the most effective tax structure for reducing tobacco consumption and prevalence by limiting price variability and decreasing opportunities for tax avoidance.

Keywords

tax structure; cigarette price variability

Introduction

The effectiveness of increased cigarette excise taxes in reducing smoking has been studied extensively in the past several decades [1]. However, despite ubiquitous findings on increased taxes being the single most effective tobacco control measure, very few studies have focused on how the structure of excise taxation on tobacco products may impact its effectiveness. Economic theory and a handful of recent empirical studies indicate that, compared with a uniform specific excise tax system, other systems are associated with greater opportunities for tax avoidance.[2–8] For example, *Ad valorem* excises will increase the price difference between products with different pretax prices and are more likely to lead to greater price variability and opportunities for tax avoidance compared with specific excises. In addition, differential or tiered tax rates based on either product prices or characteristics allow manufacturers to implement pricing strategies in response to increased taxes by manipulating these prices or characteristics. One report by the International Agency for Research on Cancer (IARC) suggests that complicated tax structures in some low-income and middle- income countries (LMICs) may impede the effectiveness of increased taxes (prices) for reducing smoking. [1]

Cigarette excise tax structure is defined by the tax base and whether different rates are imposed. A specific excise tax is a monetary tax levied on the quantity of tobacco products (e.g. per package, or by weight) and an ad valorem excise tax is a tax levied as a percentage of the value of tobacco products (e.g. manufacturer's price or retail price). A number of countries also impose a minimum specific tax and specific taxes may also vary in their application across product price tiers. [2,5,6]. For example, since 2010, European Union (EU) countries were required by the Council of the EU to impose mixed taxes (a mix of both specific and ad valorem excises) with a tax burden of 60% of retail price of the most popular price category (except for countries where the total excises exceed €115 per 1000 cigarettes) and a specific tax floor of € 90 per 1000 cigarettes.[9]

In general, cigarette excise systems can be one of the following: uniform specific tax systems, tiered specific tax systems, ad valorem uniform systems, ad valorem tiered

systems, mixed uniform systems, or mixed tiered systems. According to the *2013 WHO Report on the Global Tobacco Epidemic* [10] *and the WHO Report on the Relationship between Tax and Price and Global Evidence* [11], as of 2012, out of 186 countries with tax information available, 20 countries have not yet imposed cigarette excise taxes, 56 countries employ a purely specific tax system, 50 countries use a purely ad valorem system and 60 use a mixed tax system. In addition, 34 out of 169 countries for which detailed information on tax structure is available are imposing differential rates based on a variety of characteristics.

Several recent studies present descriptive evidence of the association between tax structure and price variability. Using data from the Global Adult Tobacco Survey in 13 countries and the US National Adult Tobacco Survey, one study showed that countries applying a uniform tax rate and with more emphasis on specific taxes exhibit less variability in cigarette prices [5]. Similar findings were reported in another study that used 16 countries taken from the International Tobacco Control Policy Evaluation (ITC) Project to compare specific uniform tax structure with others' more complicated tax structures [6]. In addition to these two studies, which used self-reported prices, one study collected retail prices in five Southeast Asian countries and found that ad valorem tax structures tend to have larger price variability than tiered specific tax structures [7], and another study found that cigarette tax harmonisation in the EU may reduce price variability [8].

There is only one recent study that assessed the association between tax structures and price variability using regression analysis. The authors employed tax and price data from 21 European Union (EU) countries and found that the price gap between premium and low-priced cigarette brands is smaller in countries with a greater specific component [3]. However, that study could not conduct a proper comparison among pure specific, pure ad valorem, and mixed systems because all EU countries are required to have both specific and ad valorem tax components in their excise tax structure.

Given the very limited empirical evidence, studies that use more rigorous analytical methods and that encompass all common tax structures are needed. This study was designed to conduct an extensive analysis of the association between tax structures and price variability, using data from ITC surveys in 17 countries. We compared the specific uniform tax system with all other possible systems with respect to price variability. Such empirical evidence can help guide the selection of tax structures that are most likely to improve the effectiveness of tax increases for reducing smoking.

Data

We use self-reported prices from the International Tobacco Control Policy Evaluation Project (the ITC Project) survey data to construct price variability measures. The ITC Project consists of parallel longitudinal surveys of smokers and other tobacco users (and non-users in some countries) conducted in 22 countries inhabited by more than 50% of the world's population, 60% of the world's smokers, and 70% of the world's tobacco users. The ITC Surveys are designed to evaluate the policies of the WHO Framework Convention on Tobacco Control (FCTC) [12]. We employed all survey waves in 17 countries where cigarette purchase information was collected from smokers, including ITC-4 (the US, the

UK, Australia, and Canada) waves 1–8, the Netherlands waves 1 and 3–7, Germany waves 1–3, France waves 1–3, Republic of Korea waves 1–3, Mexico waves 1–6, Brazil waves 1–2, Uruguay waves 1–4, Mauritius waves 1–3, India wave 1, Bangladesh waves 1–2, China waves 1–3, and Thailand and Malaysia waves 1–5. The calendar years when these countries were surveyed are reported in Appendix I. In the ITC survey, a respondent may choose to report the price paid per pack or the price paid per stick. If the respondent bought cigarettes in carton, the total cost/money paid was reported. In addition, the number of sticks in a pack and the number in a carton were also asked. These questions allowed us to derive price per standard pack of 20 cigarettes in local currencies.[1]

We collected detailed information on tax structures for each country, including the type of structure (exclusively specific, exclusively ad valorem, and mixed structure, with either uniform or tiered rates) and the shares of specific or ad valorem component among total excises from a variety of sources. Tax information during 2008–2012 was obtained from Table 9.1.0 of the *2013 WHO Report on the Global Tobacco Epidemic*, which summarizes the price of a 20-cigarette pack of the most popular brands and ad valorem and/or specific taxes as a percent of the price of most popular brand for each of the 162 countries [10,11]. For earlier years, the share of specific or ad valorem components among total excises for EU countries came from the Excise Duty Tables constructed by the European Commission and the share for other countries came from WHO country reports or was imputed using linear interpolation (see online supplementary appendix I). Information on whether a tiered tax structure existed was collected by Tobacco Merchants Association (TMA) and documented by a WHO report [11] and *the Technical Manual on Tobacco Tax Administration* [2]. These tax structure measures were further verified using information from some journal articles and reports [13–23] and Euromonitor International's country specific reports[2]. When there are discrepancies in the reported type of structure, we chose the type that was confirmed at least by two different sources. The details of the data sources and methods are shown in online supplementary appendix I.

Tax structures of the 17 countries are presented in table 1. As of 2012, countries that impose tiered structures have various bases of tiers. For example, in Bangladesh, tiers are based on retail prices; in Brazil, tiers are based on whether the packaging is soft/hard; in China, tiers are based on manufacturers' prices; in India, tiers are based on cigarette length, whether they carry a filter, and whether they are hand-made or machine-made. [11] During the study period, most countries did not change their type of tax structure. The two exceptions are Mexico, which switched its tax system from an ad valorem uniform to a mixed uniform structure in 2009, and Brazil, which switched its tax system from a specific tiered to a mixed tiered system in 2012. Therefore in our analysis, we employed both cross-country variation and variation within the same country over time in tax structure to identify the association of tax structure with price variability. In addition, for each type of tax structure other than the ad valorem tiered structure, we have data from at least two countries, which better represent those structures than do data from a single country.

[1]0 and values used by ITC to fill missings such as 7,7777, 9, 9999 were coded into missing. In rare cases, extreme values (3 observations) were dropped if they were about 20 times larger than the average value reported in the wave.
[2]http://www.euromonitor.com/

In order to estimate the association between tax structure and price variability, we constructed aggregated price variability measures at the national level using self-reported prices for each wave of the ITC countries. We first ranked prices and calculated the price difference between the upper and lower 25 percentiles (75 percentile minus 25 percentile), that is also called the IQR; between the upper and lower 10 percentiles; between the upper and lower 5 percentiles; and between the upper and lower 1 percentiles. Price variability was then calculated using the ratios of these differences to the median price. Similar measures such as the IQR-to-median ratio have been used to measure price variability in previous literature [6].

Although sometimes an ITC survey wave was conducted across calendar years, in each wave a majority of respondents were surveyed within one calendar year. In order to link the price variability constructed from ITC surveys to the corresponding tax structure measures, we assigned the year when most respondents were surveyed to the price variability measures we constructed for a wave (see online supplementary appendix I). Since survey months and years were not available in the Brazil and India surveys, we used the reported survey period on the ITC Project website (www.itcproject.org) to decide which year to assign based on the number of survey months in each year. Next, using the assigned year, ITC data were linked to tax structure measures to carry out the analyses. In this way, we obtained a panel sample of 78 observations from 17 ITC countries, with each observation consisting of price variability and tax structure measures.

Methods

GEE[24] were used in assessing the association between different tax structures and price variability in order to account for the correlation within the same country over time [25]. An identity link, Gaussian (normal) family, and exchangeable correlations were applied in estimating the GEE parameters. The analyses were conducted using the XTGEE command in Stata SE version 13.1.The model can be presented as the following equation:

$$Variability_{it}=\alpha_0+\alpha_1 SpecificTiered_{it}+\alpha_2 AdvaloremUniform_{it}+\alpha_3 AdvaloremTiered_{it} +\alpha_4 MixUniform_{it}+\alpha_5 MixTiered_{it}+\alpha_6 Y_t+\alpha_7 C_i+\varepsilon_{it} \quad (1)$$

where $SpecificTiered_{it}$, $AdvaloremUniform_{it}$, $AdvaloremTiered_{it}$, $MixUniform_{it}$, $MixTiered_{it}$ are dichotomous indicators for specific tiered, ad valorem uniform, ad valorem tiered, mixed uniform, and mixed tiered tax structures, respectively, with specific uniform tax structure as the omitted category.

The covariates (C_i) are a dummy for EU countries that all impose a tax structure that are subject to EU requirements on minimum tax floor and tax burden, and a dummy for India, Canada and the US where states or provinces have jurisdictions on cigarette excise taxes, or cigarettes can be sold without excise taxes on First Nations/Indian reservations. The other controls are year fixed effects (Y_t), which to some extent account for the unobserved global trend of tobacco market activities such as the availability of counterfeit cigarettes and overall improvement of tax administration over years. Also, for all the analyses in this paper, SEs are clustered at the country level to adjust for potential correlation between observations

from the same country. According to previous evidence and economic theory, we hypothesize that tax structures other than a uniform specific excise system will be associated with greater price variation and therefore expect these estimates to be positive.

Likewise in a second model, the effects of the share of specific component among total excise taxes are estimated as an alternative tax structure measure. The equation is similar to Model (1) and in the following forms:

$$Variability_{it}=\delta_0+\delta_1\%Specific_{it}+\delta_2 Tiered_i+\delta_3 Y_t+\delta_4 C_i+\nu_{it} \quad (2)$$

In Model (2), except for tax structure variables, other covariates are the same as those specified in Model (1). The only difference between these two models is that tax structure in Model (2) is measured using an indicator of the tiered structure and the share of the specific component among total excises. This specification allows us to detect how a gradual increase in the specific (a decrease in ad valorem) component may affect price variability. The hypothesis is that a larger share of specific component would lead to lower price variability and that a tiered tax structure would lead to greater price variability.

Furthermore, we conducted several sensitivity analyses to see whether our results are sensitive to the assignment of years and tax structure measures. First, for both models, we randomly assigned years to those waves that were surveyed across two years. Second, for both models, we categorized tax structure using tobacco excise structure instead of cigarette excise structure (by categorizing Thailand into a mixed uniform structure and India into a mixed tiered structure).

Results

In table 2 we report the descriptive summary statistics after adjusting for intertemporal correlations in the data. The mean statistics show that price variability measures range from 0.3 to 1.7, with larger values when variability is measured using values closer to the tails of price distribution. On average, 43.6% of the study sample (34 out of 78 country-waves) has a specific uniform tax structure, 2.8% (2/78) has a specific tiered tax structure, 9.2% (8/78) has an ad valorem uniform tax structure, 4.2% (2/78) has an ad valorem tiered structure, 32.6% (28/78) has a mixed uniform structure and 7.8% (4/78) has a mixed tiered structure. In addition, 19.9% (8/78) of the sample has a tiered tax structure. The share of specific component among total excise taxes is 63.48 (thus ad valorem share is 36.52) in percentage points. EU countries constitute 25.6% (20/78) of the sample. India, Canada, and the US together comprise 21.8% (17/78) of the sample.

In table 3, we show the association between tax structure and price variability estimated using model (1). Estimates of marginal effects and corresponding elasticity are presented. The results show that, compared with the specific uniform structure, tiered (specific, mixed and ad valorem) and mixed uniform structures are positively associated with price variability ($P \leq 0.01$ for at least one variability measure). The elasticity estimates show that the mixed uniform structure is associated with 40–75% greater price variability; the specific tiered structure is associated with 85– 128% greater price variability; the ad valorem tiered

structure is associated with 106–289% greater price variability; and the mixed tiered structure is associated with 64–250% greater price variability.

Next, we report the estimated associations between the share of the specific component among total excises and price variability estimated using model (2) in table 4. The elasticity estimates indicate that a 10% increase in the share of specific taxes among total excises is associated with a 4.3% decrease in the IQR-to-median ratio ($p \leq 0.1$), and with a 2.8–3.6% decrease in other price variability measures ($p \leq 0.05$ or 0.1). In addition, after keeping the share of specific taxes constant, a tiered tax structure is associated with a 147% increase in the IQR-to-median ratio ($p \leq 0.01$), and with a 61–139% increase in other price variability measures ($p \leq 0.01$ or 0.05). Sensitivity analyses were conducted for both models (1) and (2) and show that most results are robust to different year assignments of ITC waves (see online supplementary appendix table S1) and to categorising Thailand into a mixed uniform structure and India into a mixed tiered structure (see online supplementary appendix table S2).

Conclusion and Discussion

Our study provides a comprehensive analysis of the association between tax structure and price variability. Using data taken from 17 ITC countries during 2002–2013, we explicitly estimated how tax structures, including specific uniform, specific tiered, mixed uniform, mixed tiered, ad valorem uniform and ad valorem tiered structures, are associated with price variability measured by price ratios derived from the price distribution. We found that complicated tax structures that depart from a specific uniform structure are associated with greater price variability ($p \leq 0.01$). We also estimated that a 10% increase in the share of specific components in total excises is associated with 2.8–4.3% lower price variability($p \leq 0.05$). In addition, a tiered tax structure is associated with a 61–147% increase in price variability ($p \leq 0.01$) over that of a uniform tax structure.

Our findings suggest that switching to a simpler tax structure would significantly reduce price variability and thus reduce opportunities for tax avoidance. They provide compelling evidence that a specific uniform tax system is the most effective tax structure in reducing price variability and likely the most effective in reducing tobacco use and its consequences. These findings are consistent with the prediction of economic theory and other existing empirical evidence.

There are several limitations in this study. First, there are very few observations for several tax structures (ad valorem tiered/uniform, specific tiered and mixed tiered structure) in our sample. Therefore, the estimates pertaining to these tax structures from model (1) may be sensitive to country-specific unobserved factors. Second, ideally, we would like to control for the market structures (e.g. market shares of tobacco companies) that are potentially related to cigarette prices and tax structure. However, the limited sample size and co-linearity between country specific factors and tax structures prohibits controlling for these attributes. Moreover, this is a limitation that is not likely to be overcome, simply because surveys carried out in many countries over a long period are expensive and scarce. Finally, during the study period, very few countries have changed their tax structure, and therefore

our analysis largely depends on between-country comparison instead of within-country comparison (the same country in different years). If more countries follow the guidance of WHO [2] to increase their reliance on specific and uniform excises, future research will be able to overcome this limitation by including more countries with changing tax structures in the analysis.

Despite the above limitations, this study assesses empirically the association between tax structure and price variability using regression analysis. Our results add to the literature supporting the long existing economic theory that a simple tax structure—a specific uniform structure—is best for increasing cigarette prices and decreasing price variability. Accordingly, countries that follow the principles of the WHO Technical Manual on Tobacco Tax to impose a specific uniform tax strucure may improve the effectiveness of increasing taxes as a tobacco control method. In addition, increasing the reliance on specific excise taxes and switching from tiered to uniform tax rates could also improve the effectiveness of increased taxes and prices as a tobacco control measure. This is particularly relevant to LMICs that impose tiered structures and EU countries where mixed tax structures have to be imposed by law. Our analysis also suggests that more opportunities for tax avoidance exist in a tax system other than specific uniform. Future research on how tax structure would ultimately impact smoking behaviours such as smoking participation, cigarette consumption and quitting is warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

We would like to thank three reviewers and the editor for invaluable comments, and Anne Chiew Kin Quah, Nachum Gabler and Adam Jentleson for support in presentations. We would also like to thank William Ridgeway, Nahleen Zahra and Penglei Yang who provided excellent research assistance.

Funding statement:

The data collection for the ITC Project is supported by grants R01 CA 100362 and P50 CA111236 (Roswell Park Transdisciplinary Tobacco Use Research Center, and P01 CA138389, R01 CA090955) from the National Cancer Institute of the United States, Robert Wood Johnson Foundation (045734), Canadian Institutes of Health Research (57897, 79551, and 115016), Commonwealth Department of Health and Aging, Canadian Tobacco Control Research Initiative (014578), National Health and Medical Research Council of Australia (265903), the International Development Research Centre (104831-002), the International Development Research Centre (African Tobacco Situational Analysis), New Zealand Health Research Council (06/453), New Zealand Ministry of Health, Mexican Consejo Nacional de Ciencia y Tecnologia (Salud-2007-C01-70032), Bloomberg Global Initiative —International Union Against Tuberculosis and Lung Disease, the Chinese Center for Disease Control and Prevention, the French Institute for Health Promotion and Health Education (INPES), the French National Cancer Institute (INCa), Observatoire français des drogues et toxicomanies (OFDT), the Netherlands Organisation for Health Research and Development (ZonMw) (the Netherlands), German Federal Ministry of Health, Dieter Mennekes-Umweltstiftung and Germany Cancer Research Center (DKFZ), Cancer Research UK (C312/A6465), NHS Health Scotland (RE065), Flight Attendants' Medical Research Institute (FAMRI), Glaxo-Smith Kline (3516601), Pfizer (Ireland), the Korean Ministry of Health and Welfare, the Malaysian Ministry of Health, and Thai Health Promotion Foundation. A Senior Investigator Award from the Ontario Institute for Cancer Research and a Prevention Scientist Award from the Canadian Cancer Society Research Institute for the third author and the SILNE Project is funded by the European Commission through FP7 HEALTH-F3-2011-278273.

References

1. Tob Control, Volume 14: Effectiveness of Tax and Price Policies in Tobacco Control. Lyon, France: 2011. International Agency for Research on Cancer (2011). IARC Handbooks of Cancer Prevention.
2. World Health Organization. WHO Technical Manual on Tobacco Tax Administration. WHO; 2010.
3. Chaloupka FJ, Peck R, Tauras JA, et al. Cigarette excise taxation: the impact of tax structure on prices, revenues , and cigarette smoking. Nati Bur Econ Res. 2010 http://www.nber.org/papers/w16287.
4. Chaloupka FJ, Yurekli A, Fong GT. Tobacco taxes as a tobacco control strategy. Tob Control. 2012; 21:172–180. [PubMed: 22345242]
5. Chaloupka FJ, Kostova D, Shang C. on behalf of the GATS Collaborative Group. Cigarette excise tax structure and cigarette prices: evidence from the Global Adult Tobacco Survey and the U.S. National Adult Tobacco Survey. Nicotine Tob Res. 2014 Jan 16; 1(Supp l):S3–S9. [PubMed: 23935181]
6. Shang C, Chaloupka FJ, Zahra N, et al. The distribution of cigarette prices under different tax structures: findings from the ITC Project. Tob Control. 2014; 23:i23–i29. [PubMed: 23792324]
7. Liber AC, Ross H, Ratanachena S, et al. Cigarette price level and variation in five Southeast Asian countries. Tob Control. 2014
8. Blecher E, Ross H, Stoklosa M. Lessons learned from cigarette tax harmonisation in the European Union. Tob Control. 2014; 23:e12–e14. [PubMed: 23407111]
9. Blecher E, Ross H, Leon ME. Cigarette affordability in Europe. Tob Control. 2013; 22:e6. [PubMed: 23092885]
10. WHO. [accessed 9/Jan/2014] WHO Report on The Global Tobacco Epidemic. 2013. ISBN 978 92 4 069160 5 (PDF). http://apps.who.int/iris/bitstream/10665/85380/1/9789241505871_eng.pdf?ua=1
11. WHO. [accessed 9/Jan/2014] Relationship between tax and price and global evidence. http://www.who.int/tobacco/economics/2_3relationshipbetweentaxprice.pdf
12. Fong GT, Cummings KM, Borland R, et al. The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. Tob Control. 2006; 15(Suppl 3):iii3–iii11. [PubMed: 16754944]
13. Orzechowski and Walker, Tax burden on Tobacco, Historical Compilation. 2011; 46
14. Waters, H.; Sáenz de Miera, B.; Ross, H., et al. The Economics of Tobacco and Tobacco Taxation in Mexico. Paris: International Union Against Tuberculosis and Lung Disease; 2010. http://www.worldlungfoundation.org/ht/a/GetDocumentAction/i/10975
15. Bernardi, L.; Barreix, A.; Marenzi, A., et al. Routledge International Studies in Money and Banking. Vol. 45. Psychology Press; 2008. Systems and Tax Reforms in Latin America.
16. Hu T, Mao Z, Shi J, et al. The Role of Taxation in Tobacco Control and Its Potential Economic Impact in China. Tob Control. 2010; 19:58–64. [PubMed: 20008158]
17. Li Q, Hu T, Mao Z, et al. When a Tax Increase Fails as a Tobacco Control Policy: the ITC China Project Evaluation of the 2009 Cigarette Tax Increase in China. Tob Control. 2012; 21:381. [PubMed: 22199012]
18. Jha P, Guindon E, Joseph RA, et al. A Rational Taxation System of Bidis and Cigarettes to Reduce Smoking Deaths in India. Economic & Political Weekly. 2011:xlvi.42.
19. Saenz-de-Miera B, Thrasher JF, Chaloupka FJ, et al. Self-reported price of Cigarettes, Consumption and Compensatory Behaviours in a Cohort of Mexican Smokers Before and After a Cigarette Tax Increase. Tob Control. 2010; 19:481–487. [PubMed: 20870740]
20. Siahpush M, Thrasher JF, Yong HH, et al. Cigarette Prices, Cigarette Expenditure and Smoking-induced Deprivation: Findings from the International Tobacco Control Mexico survey. Tob Control. 2013; 22:223–226. [PubMed: 22923478]
21. Southeast Asia Initiative on Tobacco Tax (SITT) Resource Center of the Southeast Asia Tobacco Control Alliance (SEATCA). ASEAN Tobacco Tax Report Card. Feb.2012

22. World Health Organization. Regional Office for South-East Asia. Tax policies on tobacco products in Thailand: is there a loop hole?.

23. ITC Project. Findings from Wave 1 to 4 Surveys (2005–2009). Waterloo, Ontario, Canada: University of Waterloo; Pulau Pinang, Malaysia: Universiti Sains Malaysia; Putrajaya, Malaysia: Ministry of Health; Mar. 2012 ITC Malaysia National Report.

24. Zegar SL, Liang KY, Albert PS. Models for longitudinal data: A generalized estimating equation approach. Biometrics. 1988; 44:1049–1060. [PubMed: 3233245]

25. Thompson ME, Fong GT, Hammond D. Methods of the International Tobacco Control (ITC) Four Country Survey. Tob Control. 2006; 15(Suppl 3):iii12–iii18. [PubMed: 16754941]

What this paper adds

- This paper provides important evidence of the association between tax structure and price variability of cigarettes using regression analysis.
- Complicated tax structures that depart from a specific uniform structure are associated with greater price variability of cigarettes.
- Countries that impose a specific uniform tax structure, that increase their reliance on specific excise taxes, and/or switch from tiered to uniform tax rates, will reduce price variability.
- These results support the proposition that specific uniform tax structure is the most effective tax structure for reducing tobacco consumption and prevalence.

Table 1

Tax Structure by Country

Country	Tax Base	Tax Rates
US	Specific	Uniform
Canada		
Uruguay		
Australia		
Mauritius		
Republic of Korea		
India		Tiered
Thailand	Ad Valorem	Uniform
Bangladesh		Tiered
China	Mixed (specific + ad valorem)	Uniform
Malaysia		
EU		
Mexico	Switched from ad valorem to mixed in 2009	
Brazil	Switched from specific to mixed in 2012	Tiered

EU, European Union

Table 2

Summary Statistics of Price Variability measures, Tax Structure and Other Covariates, 17 ITC countries

N=78	Description	Mean	S.E.
Price variability measured using $\frac{price\ \ difference}{median\ \ price}$			
(75%–25%)/50%	The difference between 75 and 25 percentiles of the price distribution divided by the median price.	0.293	0.049
(90%–10%)/50%	The difference between 90 and 10 percentiles of the price distribution divided by the median price.	0.686	0.078
(95%–5%)/50%	The difference between 95 and 5 percentiles of the price distribution divided by the median price.	0.996	0.138
(99%–1%)/50%	The difference between 99 and 1 percentiles of the price distribution divided by the median price.	1.673	0.264
Indicators			
Specific Uniform	Indicator equals 1 if the country applies purely specific excises in a uniform rate, 0 otherwise	0.436	0.141
Specific Tiered	Indicator equals 1 if the country applies purely specific excises in differential rates, 0 otherwise	0.028	0.021
Ad valorem uniform	Indicator equals 1 if the country applies purely ad valorem excises in a uniform rate, 0 otherwise	0.092	0.066
Ad valorem Tiered	Indicator equals 1 if the country applies purely ad valorem excises in different rates, 0 otherwise	0.042	0.043
Mixed Uniform	Indicator equals 1 if the country applies specific & ad valorem excises in a uniform rate, 0 otherwise	0.326	0.113
Mixed Tiered	Indicator equals 1 if the country applies specific & ad valorem excises with differential rates, 0 otherwise	0.078	0.059
EU	Indicator equals 1 if EU members, 0 otherwise	0.256	0.123
Tiered	Indicator equals 1 if the country applies excises with differential rates, 0 otherwise	0.199	0.095
Sub-national taxes	Indicator equals 1 if India, Canada or the US, 0 otherwise	0.218	0.128
Continuous Controls			
Per cent specific	The share or percentage of specific component among total excise taxes, and rescaled to percentage points by multiplying 100.	63.48	9.902

All statistics are adjusted for correlation within the same country over years. “sub-national taxes” is a dummy for India, Canada, the US where states or provinces have jurisdiction on cigarette excise taxes and cigarettes can be sold without excise taxes in First Nations/Indian reservations

EU, European Union; ITC, International Tobacco Control Policy Evaluation.

Table 3

The Association between Tax Structure (categorical variables) and Price Variability, 17 ITC Countries

Price Variability	**(75%–25%)/50%**	**(90%–10%)/50%**	**(95%–5%)/50%**	**(99%–1%)/50%**
	(1)	**(2)**	**(3)**	**(4)**
Specific Uniform	**Omitted**			
Specific Tiered	0.192***	0.598**	1.027***	1.374***
	(0.054)	(0.301)	(0.382)	(0.452)
	[0.853]	[1.007]	[1.276]	[1.005]
Ad Valorem Uniform	0.027	0.008	0.280	0.358
	(0.044)	(0.151)	(0.230)	(0.410)
	[0.120]	[0.013]	[0.348]	[0.262]
Ad Valorem Tiered	0.653***	0.669***	1.494***	1.446***
	(0.026)	(0.108)	(0.149)	(0.181)
	[2.894]	[1.128]	[1.857]	[1.058]
Mixed Uniform	0.089***	0.447**	0.361*	0.601**
	(0.020)	(0.197)	(0.192)	(0.289)
	[0.395]	[0.753]	[0.449]	[0.439]
Mixed Tiered	0.387*	0.381	0.850	3.426***
	(0.208)	(0.482)	(0.656)	(1.000)
	[1.714]	[0.642]	[1.057]	[2.506]
N	78	78	78	78

* $p \leq 0.1$,

** $p \leq 0.05$,

*** $p \leq 0.01$.

Marginal effects or coefficients are reported. SEs clustered at the country level are reported in parentheses and corresponding elasticity estimates are reported in square brackets. Stata module “margins, eydx” was used to obtain elasticity estimates. Price variability is measured using differences between upper and lower 25, 10, 5, and 1 percentiles divided by the median price. All regressions are estimated using GEE. Controls include year fixed effects, a dummy for EU countries that are subject to EU tax floor and burden, and a dummy for India, Canada, the US where states or provinces have jurisdiction on cigarette excise taxes and cigarettes can be sold without excise taxes in First Nations/Indian reservations.

EU, European Union; GEE, Generalised Estimating Equation; ITC, International Tobacco Control Policy Evaluation.

Table 4

The Association between Tax Structure (the Proportion of Specific Tax among Total Excises; an Indicator for Tiered Tax Structure) and Price Variability, 17 ITC Countries

Price variability	**(75%–25%)/50%**	**(90%–10%)/50%**	**(95%–5%)/50%**	**(99%–1%)/50%**
	(1)	**(2)**	**(3)**	**(4)**
Per cent Specific among total Excises in percentage points	−0.001*	−0.002**	−0.004**	−0.006*
	(0.001)	(0.001)	(0.002)	(0.004)
	[−0.431]	[−0.282]	[−0.356]	[−0.329]
Tiered(specific/mixed/ad valorem)	0.325***	0.365**	0.827***	1.884**
	(0.125)	(0.179)	(0.239)	(0.782)
	[1.469]	[0.607]	[1.038]	[1.385]
N	78	78	78	78

Note:

* $p \leq 0.1$,

** $p \leq 0.05$,

*** $p \leq 0.01$.

Marginal effects or coefficients are reported. SEs clustered at the country level are reported in parentheses and corresponding elasticity estimates are reported in square brackets. Stata module “margins, eydx” was used to obtain elasticity estimates for the tiered structure and “margins, eyex” was used for the share of specific among total excise taxes. Price variability is measured using differences between upper and lower 25, 10, 5, and 1 percentiles divided by the median price. All regressions are estimated using GEE. Controls include year fixed effects, a dummy for EU countries that are subject to EU tax floor and burden, and a dummy for India, Canada, the US where states or provinces have jurisdiction on cigarette excise taxes and cigarettes can be sold without excise taxes in First Nations/Indian reservations.

EU, European Union; GEE, Generalised Estimating Equation; ITC, International Tobacco Control Policy Evaluation.