The Impact of Tax Structure on Cigarette Prices and Price Variability: Findings from the International Tobacco Control Policy Evaluation (ITC) Project



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## MOTIVATION

- Economic theory has indicated that more opportunities exist for tax avoidance/ brand switching when tax structure departs from a uniform specific structure.
- Lack of empirical evidence very few studies.
  Chaloupka et al. 2010, 2013; Shang et al. 2013.
- First empirical study estimating the impact of tax structure on cigarette prices and price variability, with comparisons across countries with various tax structures.

## DATA

- Uses data from 17 countries in the International Tobacco Control Policy (ITC) Evaluation Project.
- ITC Project consists of parallel longitudinal surveys, of smokers and other users, 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 Project includes countries with different cigarette excise tax structures, which allows comparisons of various tax structures.

### WORLD TOBACCO TAX STUCTURES



### TAX STRUCTURES IN ITC COUNTRIES

Country	Type of Tax	Tax Structure	
US		Uniform	
Canada			
India		Tiered	
Republic of Korea	Specific		
Brazil	Specific		
Uruguay			
Australia		Uniform	
Mauritius			
Thailand	AdValaram	Uniform	
Bangladesh	Auvulorem	Tiorod	
China		hered	
Malaysia	Mixed (specific + ad valorem)		
EU		Uniform	
Mexico	Switched from ad valorem to mixed in 2009		

## METHODOLOGY

- Self-reported price of a pack of 20 cigarettes in constant 2010 international \$ is derived and aggregated into country-year measures of price and price gap.
- Price measure: Prices at 1<sup>st</sup>, 5<sup>th</sup>, 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup> (median), 75<sup>th</sup>, 90<sup>th</sup>, 95<sup>th</sup>, and 99<sup>th</sup> percentiles of the price distribution for each country and year.
- Price gap measure: Difference between the median prices below the lower and above the upper 50<sup>th</sup>, 25<sup>th</sup>, 10<sup>th</sup>, 5<sup>th</sup>, and 1<sup>st</sup> percentiles of the price distribution.

# METHODOLOGY (cont'd.)

- Tax structures are measured using indicators for specific uniform, specific tiered, ad valorem specific, ad valorem tiered, mixed uniform, and mixed tiered; as well as the share of ad valorem component to total excises (%).
- The associations of tax structure with price and price gap are estimated using Generalized Estimating Equation (GEE) model (with robust standard errors).
- The total number of observations is 72 (constructed from 17 countries).

### ANALYSIS & RESULTS Summary Statistics

Percentiles	1 <sup>st</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	99 <sup>th</sup>
Price									
(mean)	0.786	1.394	2.298	3.186	3.638	4.083	4.466	4.760	5.783
S.E.	0.198	0.363	0.507	0.755	0.828	0.925	0.988	1.017	1.225
	≥50 <sup>th</sup>	<sup>n</sup> ≥75 <sup>th</sup>		≥90 <sup>th</sup>		≥95 <sup>th</sup>		≥99 <sup>th</sup>	
Cutoffs	-<50 <sup>th</sup>	-≤	25 <sup>th</sup>	-≤	10 <sup>th</sup>	— <u></u>	5 <sup>th</sup>	<u> </u>	1 <sup>th</sup>
Price Gap									
(mean)	1.211	2.2	235	3.2	217	4.2	213	6.5	37
S.E.	0.087	0.2	268	0.3	339	0.3	93	0.6	551

#### Summary Statistics (cont'd.)

(N=72)	Mean	S.E.
Specific Uniform	0.348	0.147
Specific Tiered	0.130	0.076
Ad valorem Uniform	0.099	0.070
Ad valorem Tiered	0.045	0.045
Mixed Uniform	0.320	0.113
Mixed Tiered	0.058	0.058
% specific	63.10	10.14
% ad valorem	36.90	10.14
\$ Specific	2.013	0.415
\$ Ad valorem	0.746	0.237

# ANALYSIS & RESULTS (cont'd.)

### The Effect of Tax Structure on Price Gap

- Hypothesis 1: Tax Structures other than the specific uniform system are associated with a greater price gap.
- Equation 1: Tax Structures are measured by indicators
- $Gap_{it} = \alpha_0 + \alpha_1 Specific Tiered_{it} + \alpha_2 Advalorem Uniform_{it} + \alpha_3 Advalorem Tiered_{it} + \alpha_4 Mix Uniform_{it} + \alpha_5 Mix Tiered_{it} + \alpha_6 X_{it} + \alpha_7 Y_t + \alpha_8 C_i + \varepsilon_{it}$
- Specific uniform tax structure is the omitted category, the estimates of other tax structures are expected to be positive.

### ANALYSIS & RESULTS (cont'd.)

Price Gap	≥ <b>50</b> <sup>th</sup> -<5 <b>0</b> <sup>th</sup>	≥7 <b>5</b> <sup>th</sup> -≤25 <sup>th</sup>	≥90 <sup>th</sup> -≤10 <sup>th</sup>	≥95 <sup>th</sup> -≤5 <sup>th</sup>	≥99 <sup>th</sup> -≤1 <sup>th</sup>	
Specific	-0.060	0.030	0.698+	1.060+	0.493	
Tiered	(0.074)	(0.219)	(0.443)	(0.689)	(0.953)	
Ad Valorem	0.026	0.165	1.841***	1.552***	2.158***	
Uniform	(0.080)	80) (0.363) (0.233) (0.407		(0.407)	(0.789)	
Ad Valorem	0.006	0.184	0.563*	0.888+	0.822	
Tiered	(0.162)	(0.389)	(0.312)	(0.620)	(1.341)	
Mixed	0.393**	1.234***	2.073***	2.512***	1.963**	
Uniform	(0.175)	(0.410)	(0.199)	(0.389)	(0.768)	
Mixed	0.500***	1.052***	3.463***	4.999***	11.12***	
Tiered	(0.124)	(0.409)	(0.296)	(0.485)	(0.963)	

\*0.05

+, one side test \*0.05

### ANALYSIS & RESULTS (cont'd.)

### The Effect of Tax Structure on Price Gap.

- Hypothesis 2: Countries with a greater share of *ad valorem* tax among total excises are associated with a greater price gap.
- Equation 2: Tax Structures are measured using the share of *ad valorem* tax among total excises (range: 0%–100%)
  - **E2(1):** Gap<sub>it</sub> =  $\alpha_0 + \alpha_1 \%$  Advalorem<sub>it</sub> +  $\alpha_2 X_{it} + \alpha_3 Y_t + \alpha_4 C_i + \varepsilon_{it}$
  - **E2(2):** Gap<sub>it</sub> =  $\alpha_0 + \alpha_1 \%$  Advalorem<sub>it</sub> +  $\alpha_2$  Tiered<sub>i</sub> +  $\alpha_3 X_{it} + \alpha_4 Y_t + \alpha_5 C_i + \varepsilon_{it}$

# ANALYSIS & RESULTS (contd.)

Equation 2(1)

Price Gap	≥ <b>50</b> <sup>th</sup> -<5 <b>0</b> <sup>th</sup>	≥7 <b>5</b> <sup>th</sup> -≤25 <sup>th</sup>	≥90 <sup>th</sup> -≤10 <sup>th</sup>	≥95 <sup>th</sup> -≤5 <sup>th</sup>	≥99 <sup>th</sup> -≤1 <sup>th</sup>
% Ad	0.00133	0.00499*	0.0141***	0.0101+	0.0171*
valorem	(0.00115)	(0.00267)	(0.00482)	(0.00627)	(0.0099)

#### Equation 2(2)

Price Gap	≥ <b>50</b> <sup>th</sup> -<5 <b>0</b> <sup>th</sup>	≥7 <b>5</b> <sup>th</sup> -≤25 <sup>th</sup>	≥90 <sup>th</sup> -≤10 <sup>th</sup>	≥95 <sup>th</sup> -≤5 <sup>th</sup>	$\geq 99^{\text{th}} \leq 1^{\text{th}}$
% Ad	0.00193+	0.00613*	0.0171***	0.0164*	0.0266+
valorem	(0.00124)	(0.00368)	(0.00627)	(0.00849)	(0.0166)
Tiered	0.124	0.241	0.615	1.314+	2.314
(Specific/mixed/ ad valorem)	(0.138)	(0.317)	(0.721)	(0.987)	(1.927)

# ANALYSIS & RESULTS (contd.)

### The Effect of Tax Structure on Prices.

Hypothesis 3: *Ad valorem* taxes compared with specific taxes may allow for more opportunities for pricing strategy.

Equation 3:

Price <sub>it</sub> =  $\beta_0 + \beta_1$ \$specific<sub>it</sub> +  $\beta_2$ \$advalorem<sub>it</sub> +  $\beta_3$ Tiered<sub>i</sub> + $\beta_4 X_{it} + \beta_5 Y_t + \beta_6 C_i + \varepsilon_{it}$ 

## ANALYSIS & RESULTS (contd.)

	1 <sup>st</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	99 <sup>th</sup>
\$ Specific	0.082	0.304 **	0.480 ***	0.717 ***	0.626 ***	0.557 ***	0.536 ***	0.725 ***	1.375 ***
	(0.086)	(0.124)	(0.123)	(0.078)	(0.114)	(0.159)	(0.162)	(0.131)	(0.246)
\$Ad valorem	0.225	0.124	0.320+	0.798 ***	0.675 **	0.859 **	1.157 **	0.868 **	1.610 ***
	(0.186)	(0.267)	(0.212)	(0.213)	(0.274)	(0.376)	(0.456)	(0.433)	(0.558)

## CONCLUSIONS

- Complicated tax structures that depart from a specific uniform structure are associated with greater price gaps.
- 1 percentage point increase in the share of *ad valorem* among total excises is associated with \$0.01-0.02 greater price gap.
- Only Specific (not *ad valorem*) excise taxes are significantly associated with prices lower than the first quartile of the price distribution.
- Future Research: More data is always better! Both Cross-sectional and Longitudinal.

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