

Endogenous Tax's Salience with Its Rate

Evidence from US Cigarette Sales Tax

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Table of contents

1. Introduction
2. Data Description
3. Identification Strategy and Results
4. Conclusion

Introduction

* Structure of Commodity Taxation in US

- Consumer Price = Pretax Price + Excise Tax + Sales Tax
= Posted price + Sales Tax

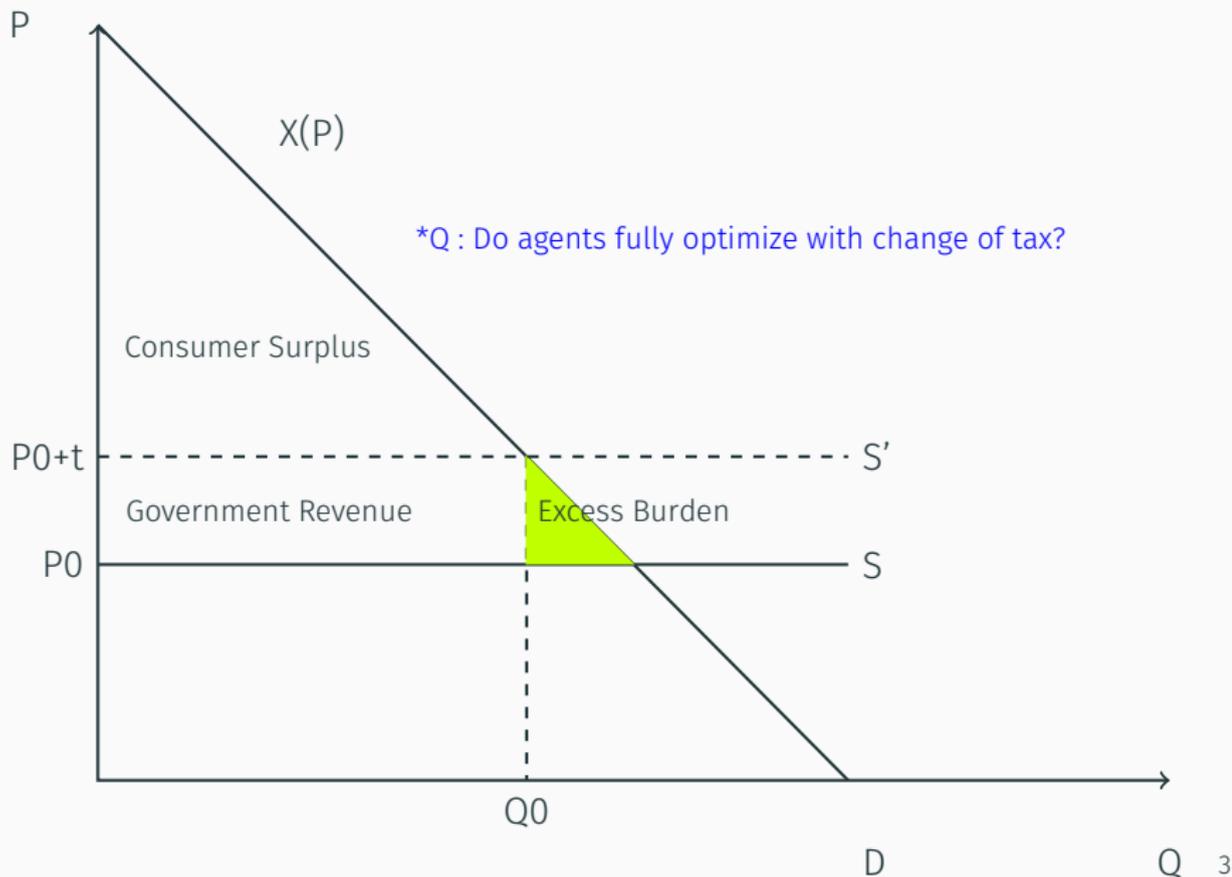
* Salience Effect

- Customers know what is taxed, but focus on the posted price when shopping (Chetty, Looney and Kroft 2009)

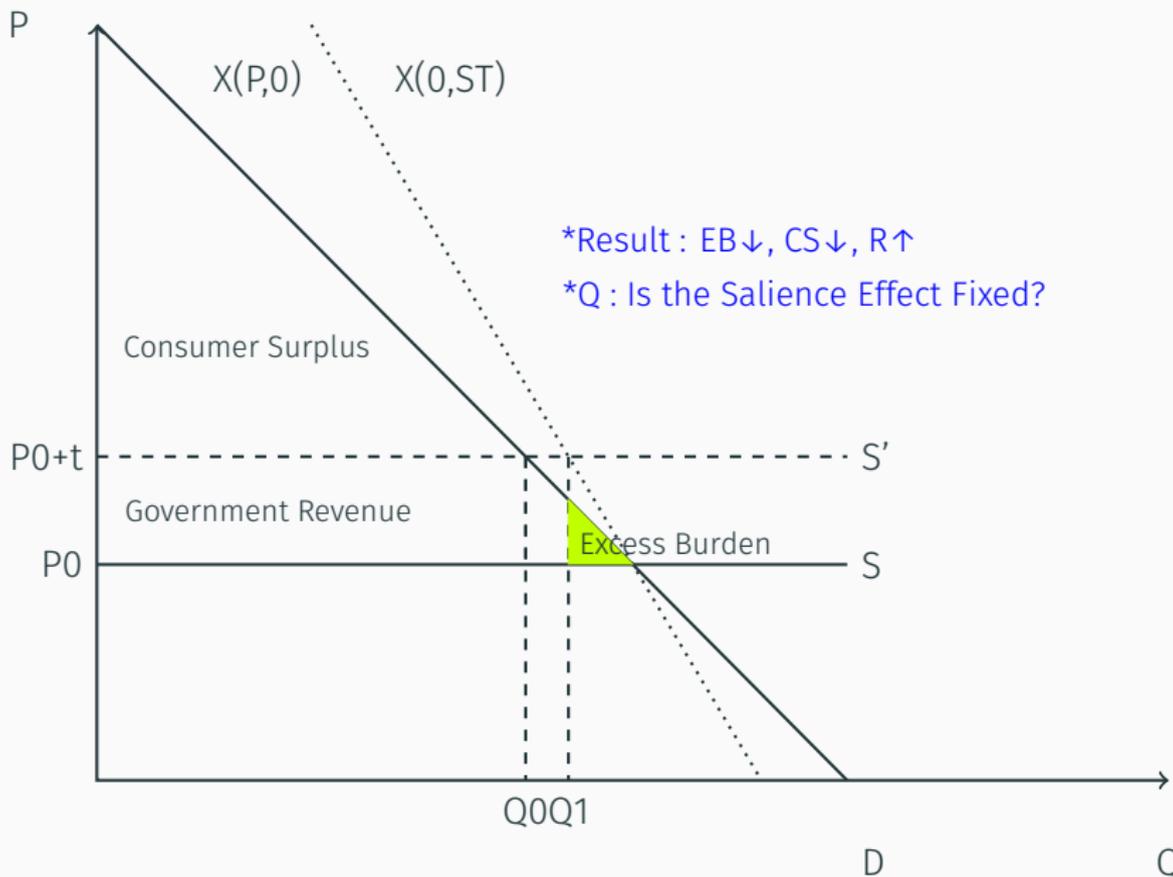
* Imperfect optimization

- $x(p, t_s) = x((1 + t_s)p)$: full-optimization model
- $x(p, t_s) = x((1 + t_s), p)$: Salience effect

Introduction - Traditional Commodity Taxation



Introduction - Commodity Taxation with Saliency Effect



* Previous Literature

- Harberger (1964) - The measurement of waste
- Gary Becker and Kevin Murphy(1988) - A theory of rational addiction
- Chetty, Looney and Kroft (2009) - Salience and Taxation: Theory and evidence
- Goldin and Homonoff (2013) - Smoke gets in your eyes: Cigarette tax salience and regressivity

- * **Differentiating models of decision making**
 - Bounded rationality vs Confirmation bias
- * **Limited attainability of first best outcome**
 - understanding how salience varies is crucial for assessing the benefits of employing such taxes
- * **Sales tax can be more salient than excise tax above certain level of rate**
- * **A state government can control cigarette consumption effectively by imposing high level of sales tax on cigarette**

Data Description

* Cigarette consumption and Demographics

- Annual cross sectional survey from Behavioral Risk Factor Surveillance System (BRFSS)
- Using survey year from 1984 to 2000

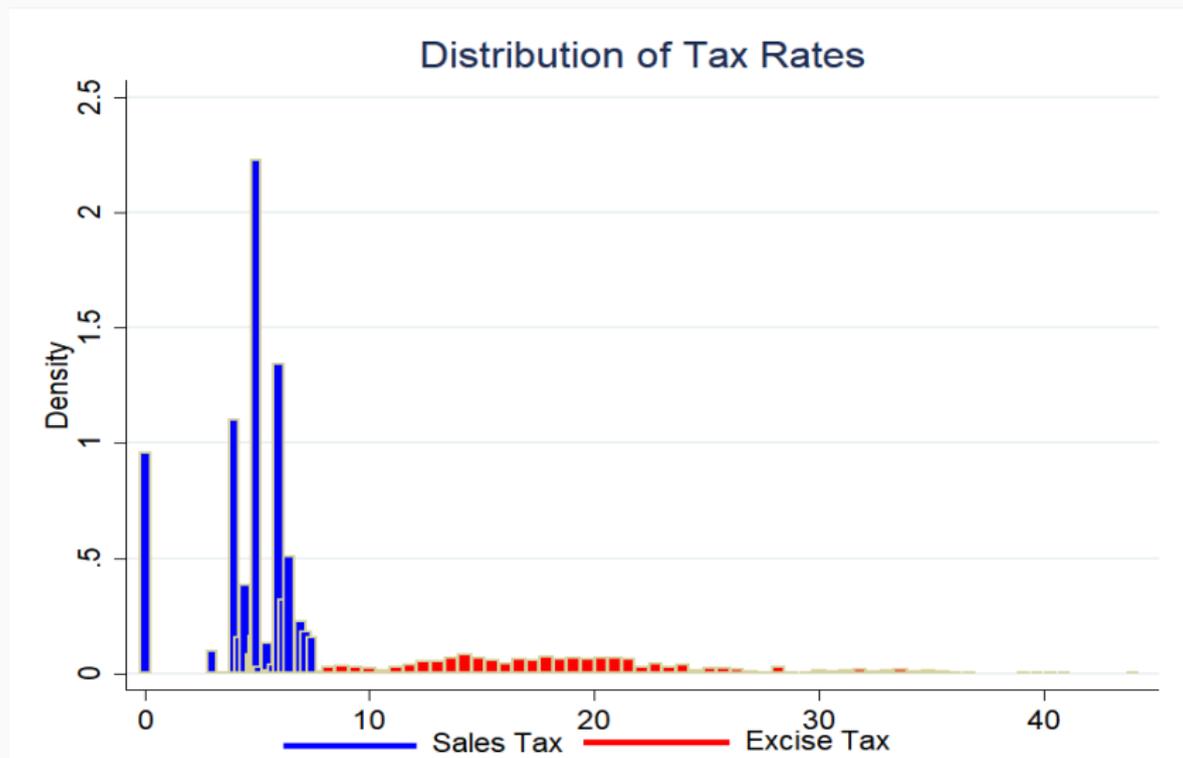
* Change of Tax

- Data comes from Tax Burden on Tobacco 2014
- To make excise tax and sales tax comparable, excise tax rate is computed by dividing excise tax with average national retail price in 2000 because states' retail price is endogenous with excise tax

Data - Description

Year	Stats	AVG daily Cigar Consumption	Excise Tax	Sales Tax
1984	min	18.98	9.11	0
	mean	20.04	14.83	4.27
	max	21.74	20.74	6
2000	min	13.74	11.15	0
	mean	18.16	23.13	4.79
	max	21.20	44.27	7.5

Data - Tax rate distribution



Identification Strategy and Results

* 1. Identification of Salience

log-linearize $x(p, t_s) = x((1 + t_s)p)$

$$\log x(p, t_s) = \alpha + \beta \log p + \theta \beta \log t_s$$

$$\theta = \epsilon_{x, t_s} / \epsilon_{x, p}$$

If consumers optimize fully, then $\theta = 1$

If $\theta < 1$, then sales tax is not fully salient

1. Identification of Salience

* Econometric model 1

$$C_{ismy} = \alpha + \beta_1 \text{Excisetax}_{sm y} + \beta_2 \text{Salestax}_{sm y} \\ + \gamma X_{ismy} + \delta P_{sm y} + \zeta_s + \epsilon_m + \omega_y + \mu_{ismy}$$

* C : Individual Daily Cigarette consumption

X : Demographics

P : real pre-tax price, previous and following real retail price

* (1) Intensive margin : Log-log model

(2) Extensive margin : Logit

(3) Combined effect : Log-log model

Result 1-(1) Log-log

1- (1) Identifying Tax's Salience : Intensive margin margin – OLS, log-log model				
	(1)	(2)	(3)	(4)
	Base	Unemployment	Pre-tax price	Rational addctio
Log excise tax	-0.4606*** (0.0914)	-0.4536*** (0.0913)	-0.4944*** (0.0917)	-0.3627*** (0.1085)
Log sales tax	-0.2798 (0.3464)	-0.2904 (0.3462)	-0.3752 (0.3484)	-0.4705 (0.3565)
white	0.4115*** (0.0076)	0.4120*** (0.0076)	0.4118*** (0.0076)	0.4121*** (0.0076)
male	0.1768*** (0.0046)	0.1785*** (0.0045)	0.1786*** (0.0045)	0.1786*** (0.0045)
education	-0.0299*** (0.0018)	-0.0298*** (0.0018)	-0.0298*** (0.0018)	-0.0298*** (0.0018)
marital	-0.0236*** (0.0050)	-0.0239*** (0.0050)	-0.0239*** (0.0050)	-0.0239*** (0.0050)
age	0.0393*** (0.0035)	0.0402*** (0.0035)	0.0403*** (0.0035)	0.0403*** (0.0035)
exercise	-0.1032*** (0.0053)	-0.1030*** (0.0052)	-0.1030*** (0.0052)	-0.1029*** (0.0052)
unemployed		0.0154*** (0.0019)	0.0154*** (0.0019)	0.0154*** (0.0019)
Log real pre-tax price			0.1998*** (0.0706)	0.2285*** (0.0747)
Log real retail price last year				0.0568*** (0.0186)
Log real retail price next year				-0.1383** (0.0595)
N	276063	276062	276062	276062
r2	0.1130	0.1135	0.1136	0.1138
F	0.23	0.19	0.10	0.08
P>F	0.6322	0.6655	0.7529	0.7793

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald test-Log excise tax = Log sales tax

Result 1-(2)) Logit

1- (3) Identifying Tax's Salienc : Extensive margin – Logit, Marginal effect at mean				
	(1)	(2)	(3)	(4)
	Base	Unemployment	Pre-tax price	Rational addictio
Excise tax	-0.0021*** (0.0004)	-0.0021*** (0.0004)	-0.0021*** (0.0004)	-0.0019*** (0.0004)
Sales tax	-0.0011 (0.0017)	-0.0011 (0.0017)	-0.0011 (0.0017)	-0.0011 (0.0018)
N	634782	634781	634781	634781
F	0.08	0.28	0.28	0.29
P>F	0.7819	0.5967	0.5993	0.5919

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test CET=CST

Result 1-(3) Log-log

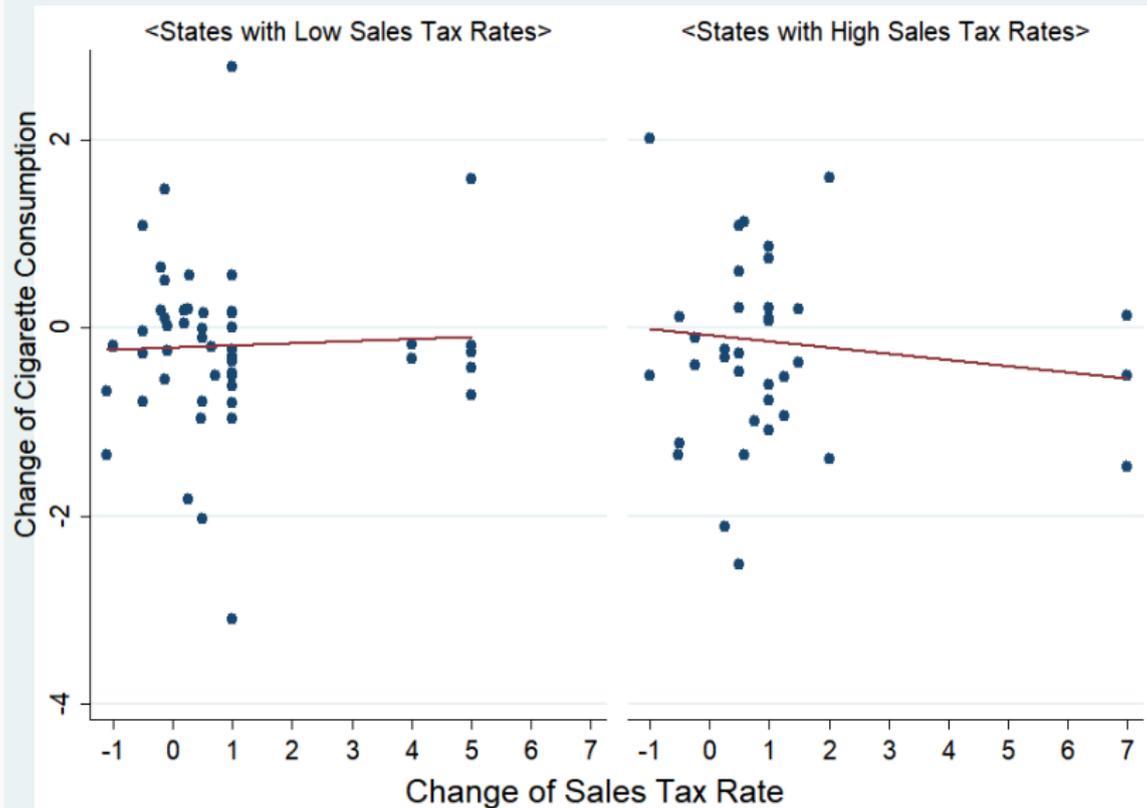
1- (4) Identifying Tax's Salience : Combined effect – OLS, log-log				
	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addictive
Log excise tax	-0.9079*** (0.1130)	-0.9006*** (0.1130)	-0.9337*** (0.1135)	-0.8839*** (0.1302)
Log sales tax	-0.4895 (0.4612)	-0.4899 (0.4612)	-0.5649 (0.4625)	-0.6113 (0.4707)
White	0.1726*** (0.0094)	0.1731*** (0.0094)	0.1731*** (0.0094)	0.1732*** (0.0094)
Male	-0.0077 (0.0059)	-0.0059 (0.0059)	-0.0059 (0.0059)	-0.0059 (0.0059)
Education	-0.1073*** (0.0022)	-0.1073*** (0.0022)	-0.1073*** (0.0022)	-0.1073*** (0.0022)
Marital	-0.3313*** (0.0066)	-0.3318*** (0.0066)	-0.3318*** (0.0066)	-0.3318*** (0.0066)
Age	0.0708*** (0.0037)	0.0719*** (0.0038)	0.0719*** (0.0038)	0.0719*** (0.0038)
Exercise	-0.3029*** (0.0072)	-0.3025*** (0.0072)	-0.3026*** (0.0072)	-0.3026*** (0.0072)
Unemployed		0.0148*** (0.0029)	0.0148*** (0.0029)	0.0148*** (0.0029)
Log real pre-tax price			0.1833** (0.0890)	0.1888** (0.0928)
Log real retail price last year				0.0275 (0.0243)
Log real retail price next year				-0.0512 (0.0731)
N	596482	596481	596481	596481
r2	0.1270	0.1271	0.1271	0.1271
F	0.71	0.69	0.55	0.29
P>F	0.3979	0.4066	0.4567	0.5884

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test: Log excise tax = Log sales tax

Endogenous Tax's Salience with Its Rate



Endogenous Tax's Salience with Its Rate

* Econometric model 2

$$C_{ismy} = \alpha + \beta_1 \text{Excisetax}_{sm y} + \beta_2 \text{Salestax}_{sm y} + \rho \text{HIGH}_{sm y} * \text{Salestax}_{sm y} \\ + \delta \text{HIGH}_{sm y} + \gamma X_{ismy} + \delta P_{sm y} + \zeta_s + \epsilon_m + \omega_y + \mu_{ismy}$$

- * HIGH : Binary variable indicating whether a state imposes relatively high level of sales tax on cigarettes
- * ρ indicates responsiveness to sales tax in states with relatively high sales tax rate

Result2-(1)

2- (1) Endogenous Tax's Saliency with Its Rate: Intensive margin – OLS, Log-log

	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addict
Log excise tax	-0.4314*** (0.0908)	-0.4229*** (0.0907)	-0.4628*** (0.0910)	-0.3331*** (0.1089)
Log sales tax	-0.0732 (0.3754)	-0.0603 (0.3754)	-0.1522 (0.3776)	-0.2271 (0.3840)
HIGH*Log sales tax	-3.1538* (1.6820)	-3.2995** (1.6758)	-3.0815* (1.6802)	-2.1444 (1.7537)
HIGH	0.1893* (0.0966)	0.1968** (0.0963)	0.1836* (0.0966)	0.1223 (0.1015)
unemployed		0.0155*** (0.0019)	0.0155*** (0.0019)	0.0155*** (0.0019)
Log real pre-tax price			0.1862*** (0.0708)	0.2250*** (0.0748)
Log real retail price last year				0.0457** (0.0195)
Log real retail price next year				-0.1420** (0.0597)
N	276063	276062	276062	276062
r2	0.1131	0.1136	0.1137	0.1138
F	2.60	2.92	2.41	1.05
P>F	0.1069	0.0872	0.1207	0.3062

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test: Log excise tax = HIGH*Log sales tax

2- (3) Endogenous Tax's Salience with Its Rate: Extensive margin – Logit, Marginal effect

	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addictio
Excise tax	-0.0020*** (0.0003)	-0.0020*** (0.0003)	-0.0020*** (0.0004)	-0.0018*** (0.0004)
Sales tax	-0.0008 (0.0019)	-0.0008 (0.0019)	-0.0007 (0.0019)	-0.0003 (0.0019)
HIGH *Sales tax	-0.0134* (0.0073)	-0.0135* (0.0073)	-0.0137* (0.0074)	-0.0162** (0.0078)
N	634782	634781	634781	634781
F	2.40	2.43	2.51	3.40
P>F	0.1217	0.1189	0.1133	0.0652

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

F-test Excise tax=Sales tax

Result2-(3)

2- (4) Endogenous Tax's Salience with Its Rate: Combined effect – OLS, Log-log

	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addict
Log excise tax	-0.8578*** (0.1122)	-0.8499*** (0.1122)	-0.8790*** (0.1127)	-0.8100*** (0.1313)
Log sales tax	-0.2458 (0.5082)	-0.2313 (0.5083)	-0.3071 (0.5099)	-0.2479 (0.5190)
HIGH*Log sales tax	-5.7286*** (1.9382)	-5.7868*** (1.9364)	-5.5790*** (1.9469)	-5.9387*** (2.0599)
HIGH	0.3572*** (0.1113)	0.3598*** (0.1112)	0.3473*** (0.1118)	0.3690*** (0.1192)
unemployed		0.0148*** (0.0029)	0.0148*** (0.0029)	0.0148*** (0.0029)
Log real pre-tax price			0.1512* (0.0896)	0.1762* (0.0929)
Log real retail price last year				-0.0125 (0.0258)
Log real retail price next year				-0.0611 (0.0735)
N	596482	596481	596481	596481
r2	0.1271	0.1272	0.1272	0.1272
F	6.27	6.45	5.78	6.06
P>F	0.0123	0.0111	0.0162	0.0138

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test** Log excise tax= HIGH*Log sales tax

- * Increase of sales tax has impact on prices of other goods
 - Differences in sales tax elasticity of demand between two groups may stem from differences in indirect effect rather than differences in salience

- * Fixed Effect Model (3)

$$\begin{aligned}C_{ismy} = & \alpha + \beta_1 \text{Excisetax}_{sm y} + \beta_2 EX * GST_{sm y} + \beta_3 GST \\ & + \gamma_1 HIGH * \text{Excisetax} + \gamma_2 EX * HIGH * GST + \gamma_3 HIGH * GST \\ & + \delta_1 HIGH_{sm y} + \delta_2 EX + \delta_3 EX * HIGH + \rho_1 X_{ismy} + \rho_2 P_{sm y} \\ & + \zeta_s + \epsilon_m + \omega_y + \mu_{ismy}\end{aligned}$$

- * γ_2 indicates indirect effect in states with high general sales tax rate

Result3-(1)

4- (1) Identifying indirect effect of sales tax on cigarette: Intensive margin – OLS estimation

	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addict
Log excise tax	-0.1611 (0.1247)	-0.1582 (0.1246)	-0.2254* (0.1262)	-0.0905 (0.1433)
Exempt*Log GST	0.2369 (0.2179)	0.2203 (0.2177)	0.2180 (0.2179)	0.2782 (0.2190)
Log GST	0.0863** (0.0426)	0.0863** (0.0426)	0.0707 (0.0432)	0.0747* (0.0432)
HIGH*Log excise tax	-0.4342*** (0.1425)	-0.4249*** (0.1424)	-0.3751*** (0.1436)	-0.3454** (0.1402)
Exempt*HIGH *Log GST	-0.0441 (0.3446)	-0.0283 (0.3446)	-0.1112 (0.3480)	-0.1468 (0.3484)
HIGH*Log GST	-3.5026** (1.7609)	-3.6664** (1.7543)	-3.4550** (1.7600)	-2.8966 (1.8039)
N	253258	253257	253257	253257
r2	0.1138	0.1144	0.1144	0.1146
F	3.79	4.23	3.53	2.36
P>F	0.0514	0.0397	0.0602	0.1241

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test: Exempt*HIGH*Log GST = HIGH*Log GST

4- (3) Identifying indirect effect of sales tax on cigarette: Extensive margin – Logit, Marginal effect				
	(1)	(2)	(3)	(4)
	Base	Unemployment	Pre-tax price	Rational addicti
Excise tax	-0.0014*** (0.0005)	-0.0014*** (0.0005)	-0.0013** (0.0005)	-0.0009 (0.0006)
Exempt*GST	-0.0009 (0.0222)	-0.0011 (0.0222)	-0.0009 (0.0222)	-0.0036 (0.0225)
GST	0.0111* (0.0062)	0.0111* (0.0062)	0.0120* (0.0063)	0.0129** (0.0063)
HIGH* Excise tax	-0.0011* (0.0006)	-0.0011* (0.0006)	-0.0011* (0.0006)	-0.0014** (0.0006)
Exempt*HIGH*GST	-0.0200 (0.0315)	-0.0197 (0.0315)	-0.0170 (0.0318)	-0.0143 (0.0319)
HIGH*GST	-0.0145** (0.0073)	-0.0146** (0.0073)	-0.0154** (0.0074)	-0.0170** (0.0074)
N	580110	580109	580109	580109
F	0.03	0.02	0.00	0.01
P=F	0.8730	0.8799	0.9631	0.9385

Marginal effects; Standard errors in parentheses

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test: Exempt*HIGH*GST=HIGH*GST

Result3-(3)

4- (4) Identifying indirect effect of sales tax on cigarette: Combined effect – OLS, Log-log

	(1) Base	(2) Unemployment	(3) Pre-tax price	(4) Rational addiction
Log excise tax	-0.1608 (0.1247)	-0.1579 (0.1246)	-0.2253* (0.1262)	-0.0898 (0.1433)
Exempt*Log GST	0.2352 (0.2179)	0.2187 (0.2177)	0.2163 (0.2179)	0.2767 (0.2191)
Log GST	0.0863** (0.0426)	0.0862** (0.0426)	0.0707 (0.0432)	0.0746* (0.0432)
HIGH*Log excise tax	-0.4338*** (0.1425)	-0.4244*** (0.1424)	-0.3745*** (0.1436)	-0.3449** (0.1402)
Exempt*HIGH *Log GST	-0.0425 (0.3446)	-0.0267 (0.3446)	-0.1098 (0.3480)	-0.1455 (0.3484)
HIGH*Log GST	-3.4926** (1.7609)	-3.6563** (1.7543)	-3.4443* (1.7601)	-2.8862 (1.8039)
N	253254	253253	253253	253253
r2	0.1138	0.1144	0.1144	0.1146
F	3.78	4.21	3.51	2.26
P>F	0.0520	0.0402	0.0609	0.1331

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Adjusted wald-test: Exempt*HIGH*Log GST = HIGH*Log GST

Conclusion

- * Supporting Bounded Rationality
- * Limited attainability of first best outcome
 - understanding how salience varies is crucial for assessing the benefits of employing such taxes
- * Sales tax can be more salient than excise tax above certain level of rate
- * A state government can control cigarette consumption effectively by imposing high level of sales tax on cigarette

- * Deriving excess burden formula considering health improvement
- * Imperfect optimization in social insurance market

Thank you