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Rising Salience of Sales Tax with Its Rate.

세율에 따라 증가하는 판매세의 현저성

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Abstract

Rising Salience of Sales Tax with Its Rate.

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Recent studies report that consumers respond less to a sales tax which is not included in a posted price than an excise tax included in it. What is not yet clear is whether a level of a sales tax rate affects the degree of salience defined as ratio of the demand-sales tax elasticity to the demand-price elasticity. This is important because if the salience depends on the sales tax rate, the likelihood of achieving the first-best outcome is reduced. The purpose of this paper is to test the hypothesis that a higher level of a sales tax rate derives higher salience using a health-related survey data which contains daily cigarette consumption combined with an annual tax burden data on tobacco during 1984-2000. Empirical results show that the absolute value of the demand-sales tax elasticity becomes greater in states with a high level of the sales tax rate. At a low level, consumers still less respond to the sales tax than the excise tax, but at the higher level they react with no statistical difference. These results imply that the marginal excess burden of the sales tax, thought to be smaller, is actually greater than that of the excise tax above a certain rate.

Keywords: Commodity tax, Cigarette, Salience, Excise tax, Sales Tax
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1. Introduction

If it is possible to levy a proportional tax on all goods, the taxation system will have the same effect as imposing a lump-sum tax which does not distort behaviors, so that the first best outcome can be obtained. However, assuming a restriction of taxing only on explicit purchases, any tax systems inevitably generate excess burden by distorting behaviors. Consequently, discussions as to how the optimal taxation system will achieve second best outcomes are beginning to occur. From Ramsey (1927) providing the basis for an optimal taxation structure, various fundamental principles of taxation system have been proposed.[1] All these propositions involve discussions on how to minimize the excess burden under specific structures and assumptions.

Recent research, Chetty, Looney and Kroft (henceforth CLK (2009)) suggests a new direction to minimize excess burden using a concept of "Salience" [2] that agents react differently to an excise tax included in a posted price and a sales tax not included in a posted price and computed at the register. Since a sales tax is less salient, consumers tend to be inattentive to compute the total price of goods, and thus, an optimization error occurs. This generates two different effects on social welfare. On the one hand, a low salient tax increases social welfare by reducing an excess burden because consumers behave as if they are under a lower tax rate, so that distortion generated by the tax is lessened. Considering this aspect of consumers' behavior, it is possible for the government to achieve the first best outcome by appropriately combining the proportion of a high salient tax and a low salient tax[3]. On the other hand, social welfare decreases by making consumers excessively purchase the goods under the less salient tax and misallocate their income on the other consumption goods.

So far, the salience of the low salient tax, measured by the ratio of elasticities between low salient tax and high salient tax is assumed to be fixed and there has been a

[1] See Ramsey (1927), Corlett and Hague (1953-1954), Mirrlees (1971) Diamond (1975), Atkinson and Stiglitz (1976), and Chamley (1986) for details of second-best outcomes in various taxation area. See Piketty and Saez (2013) for a survey literature in optimal labor income taxation area.

[2] Salience is defined as the relative visibility between tax and price, and calculated as the ratio of a demand-sales tax elasticity to a demand-price tax elasticity. When a tax is included in a posted price, the change of the tax can be perceived through the change of price and this kind of tax is referred fully salient tax. However, in case of the sales tax, it is not perceived by consumers well and it is referred low salient tax.

[3] Using two good model and assumption that agents do not respond to low salient tax at all only levied on good 1, the lump-sum tax allocation can be achieved by reducing consumption of good 2 through low salient tax after matching the consumption of good 1 with the allocation of lump-sum tax through high salient tax. See Goldin(2015) for more details.

little evidence that a salience varies with its level of a tax rates. There are several reasons why testing this hypothesis is necessary. Although combination of a high and a low salience tax can generate the first best welfare state as if it is under the lump-sum tax, existence of endogenous tax's salience with its size makes this result difficult to be feasible.[4]

This paper presents evidence that sales tax does not affect consumers' behavior at the low level likewise results of previous salience literature, but at the relatively high level of sales tax rates, consumers respond to the sales tax as same as the excise tax. In other words, a gradient of the sales tax-demand curve is steeper than that of the price-demand curve at the lower rates, but it became flattered as the sales tax increases and then the two curves finally become equal. When the slope of the sales tax-demand curve is lower than that of the excise tax-demand curve, the marginal excess burden of the sales tax is higher than that of the excise tax, but the total excess burden of the sales tax is still less than that of the excise tax. After the equalization of two curves, both the marginal excess burden and the total excess burden of the sales tax and price also become equal. This justifies the traditional assumption in public economics above a certain level of the tax rate that a change of a tax has an identical effect on consumption as a change of a price.

The structure of the paper is organized as follows. Chapter 2 provides backgrounds focusing on discussions about taxation with salience and explains how this field has evolved. Description of data about cigarettes consumption and changes of the excise and the sales tax is introduced in Chapter 3. Chapter 4 presents an identification strategy of the existence of the salience effects in cigarettes consumption, and tests the primary hypothesis, rising salience as increase of the level of sales tax, and the results are shown. Chapter 5 concludes.

[4] Goldin (2015) proposes that the first best outcome is more likely to be achieved when less revenue comes from the taxed goods, the more income elastic are the taxed goods and the slower the salience increases to its tax rate.

2. Backgrounds

Harberger (1964) provides formulas of the excess burden under partial-equilibrium environment using a derivative of a consumption with respect to a tax and the tax rate assuming that reaction to the price and tax is identical. The formula in this paper is a starting point of analysis for salience and taxation.[5]

CLK (2009) is a seminal paper presenting theoretical grounds and empirical evidence of commodity taxation with the salience effects. In the theoretical part, they show a modification of formulas of tax incidence and excess burden considering concept of the salience. They find that tax incidence on consumers increases with respect to a decline of salience because producers feel less pressure to include sales tax in producers' price and excess burden decreases with the presence of low salient tax when there is no income effect on a taxed good.[6] To confirm the differences of responsiveness between the price and the sales tax two empirical research are conducted first by visualizing the sales tax on the posted price to make it fully salient in a grocery store. This laboratory experiment using difference in difference and triple difference approach confirm that consumers react more to the demand elasticity of visualized sales tax than that of non-visualized sales tax. In the next experiments using observational data, they compare the variation of the sales tax and the excise tax, which is considered as price because it includes the excise tax. The result also shows the disparity of elasticities between the excise tax and the sales tax.

To explicate salience effects, Chetty Looney and Kroft (2007), proposes a bounded rationality model adding a term describing a cognitive cost in the consumer optimization problem. The cognitive cost contains any obstacles that obstruct calculation of sales tax originating from the complexity of price system, and inability of computation. Consumers are inattentive when an amount of a sales tax they have to pay is too small to surpass the cognitive cost. In this context, consumers may respond more above a certain levels of sales tax when surpassing the cognitive cost.

One of the subsequent literature dealing with how the presence of salience effect influences on the economic phenomenon, Finkelstein (2009) shows that declining visibility

[5] $EB(t) = -(1/2)t^2(\partial x/\partial t^s)$ assuming that $(\partial x/\partial t^s) = (\partial x/\partial p)$.

[6] In CLK (2009), modified formulas of excess burden and tax incidence with salience effect are represented as follows: $EB(t^s) = -(1/2)(t^s)^2\theta(\partial x/\partial t^s)$, where $\theta = (\partial \log x/\partial \log(1+t^s))/(\partial\, logx/\partial logp)$ and $\mathrm{dq/dt^s} = \{(q/p)\varepsilon_{s,p} + (1-\theta)\varepsilon_{d,q|p}\}/(\mathrm{q/p})\varepsilon_{s,p} + \varepsilon_{d,q|p}$, where q is consumer price, $\varepsilon_{s,p}$ is the price elasticity of supply and $\varepsilon_{d,q|p}$ is the price elasticity of demand induced by change of excise tax.

of toll collection by the introduction of electronic toll collection (ETC) makes price elasticity less and consequently derives an increase of toll rates. This paper implies that keeping taxes visible plays an essential role in electorates even with the presence of compliance costs.

Until then, a representative agent is considered in an economic model. However, Goldin (2013) finds that salience of tax varies for income level by presenting low-income individuals to respond more to the change of a sales tax than high-income people. He suggests that exchanging from the excise tax to the sales tax can lessen the regressivity of commodity taxation. Although not perfect, the government can control salience by changing the design of tax structure. In this context, Goldin (2015) shows theoretically that first-best outcome can be achieved by combining low salience tax with high salience tax. However, when the tax's salience is endogenous with its level of the tax rate, it becomes more difficult to be feasible.

Reck (2015) suggests what to consider when calculating excess burden under salience effects. Which goods to buy first in a two-goods model, in which one is under a tax and the other is not, budget constraint rule is one of the significant factors in determining the excess burden. Moreover, due to debiasing, which means consumers respond the sales tax as same as the price above a certain level of a tax rate, the marginal excess burden of sales tax becomes more substantial than the marginal excess burden of the excise tax. The empirical evidence of endogenous tax's salience with its size is inconclusive. Conducting a laboratory experiment, Feldman, Goldin, and Homonoff (2017) suggests that there is no evidence of ascending salience as the sales tax increases, instead consumers are more attentive at the lower level of tax. It has several limitations that subjects, undergraduate students at Princeton University, might not represent characteristics of the general population and might behave differently in repeated way when purchasing goods through the Internet. As far as I know, this is the first paper using observational data and evaluates the presence of endogeneity of tax's salience with its size.

This paper is also related to discussions in health economics; how eating behaviors such as soda vary concerning a change of a tax.[7] While it infers that sales tax is not a useful instrument for controlling consumption, the contradictory results in this paper indicate that a sales tax is somewhat effective as an excise tax in the specific condition.

[7] Xiu Chen et al (2015) finds differences of consumers' eating behaviors with respect to inclusive and exclusive taxes based on a laboratory experiment. Jason et al (2015) tests how size of a soda tax affects health improvement through consumption change.

3.Data

Data of cigarette consumption and individual demographics comes from the Behavioral Risk Factor Surveillance System(henceforth, BRFSS) supported by the Centers for Disease Control and Prevention, which conducts a monthly survey of individual health-related risk behaviors and health conditions.[8] The survey is repeated cross-sectional data starting from 1984 with 15 states and 11,684 observations to 2017 with all US territories and 450,016 records. However, a question item asking daily consumption of cigarette only exists during 1984-2000, and thus, periods from 2001 is not considered in this paper. Because it is not the purpose to see heterogeneity, individual-level data is aggregated to state-level data considering sampling weights.[9]

Combining with BRFSS data, tax data comes from Tax Burden on Tobacco 2014 exhibiting changes of federal excise taxes, state excise taxes, retail prices per pack, and sales taxes by states from 1954 to 2014. Since the excise tax is a unit tax of which value is added directly to a pretax price of cigarettes and sales tax is an ad-valorem tax of which value is multiplied on a base price of goods, these two taxes should be made comparable. Following CLK (2009), "excise tax rate" is computed by dividing the excise tax in the year 2000 dollars with an average national retail price of cigarette in 2000 because states retail price is endogenous. Furthermore, Hawaii and West Virginia are dropped out from the dataset because sales tax is included in a posted price in the former and the correlation between sales tax and tax revenue is nearly zero so that this can lower sales tax elasticity.[10]

Since the sales tax is correlated with business cycle, monthly state unemployment rates, and annual state real per capita personal income is considered. This data comes from the Economic Research Federal Reserve Bank of ST. Louis.

Figure 1 shows trends of daily cigarette consumption and cigarette smoking rate. Daily cigarette consumption is calculated using only smokers' records while cigarette consumption rate is computed using all observations.[11] Although there was a slight

[8] Demographics includes age, sex, education, marital status, and employment status.
[9] Goldin (2013) use this individual level data to see heterogeneity between the low income and the high income. He finds that low income people more responds to sales tax rate so that the intrinsic property of commodity taxation, the regressivity, can be relaxed by converting the excise tax to the sales tax.
[10] See Appendix of CLK (2009)
[11] Many people do not answer the questionnaire asking whether smoke or not to smoke. If smoking

increase in the consumption in 1994 and the smoking rate in 1996, both show a steady decline from 1984 to 2000, the period in which data appear.

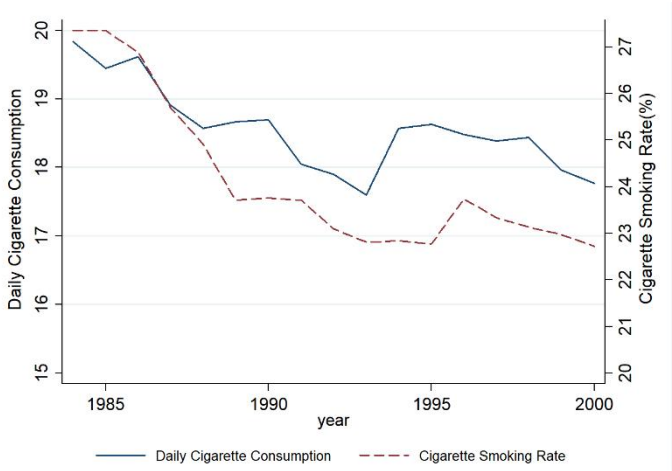

Figure 1. Daily Cigarette Consumption and Smoking Rate

Notes: Daily Cigarette Consumption is calculated for people who report that they smoke one or more cigarettes a day. When Cigarette Smoking Rate is computed, people who do not state whether they smoke or not is regarded as they are non-smokers.

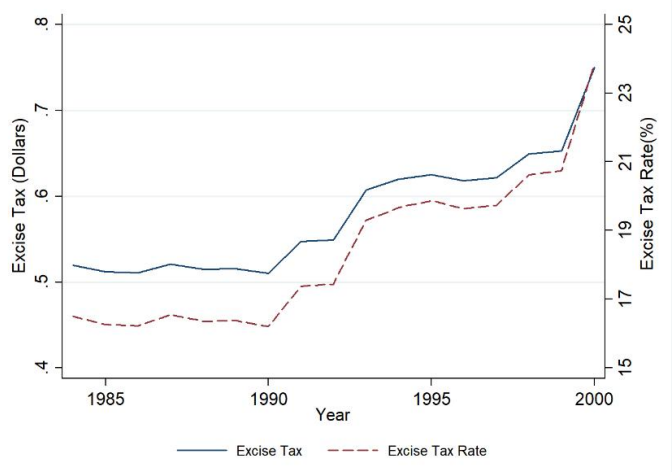

Figure 2. Excise Tax and Excise Tax Rate

Notes: To make excise tax comparable to the sales tax, the excise tax rate is calculated by dividing excise tax converted to dollars in the year 2000 to the average retail price of cigarettes in the year 2000. The excise tax is levied on a per pack.

Excise tax per pack shown in figure 2 presents real values taking inflation into

rate is calculated only considering people who answer this questionnaire, the value exhibits almost 50% which is very different from the reality. Thus, people who do not answer the questionnaire are regarded as non-smoker following Goldin (2013) facing same problem

account. In 1984, the average amount of the real excise tax imposed on cigarettes was slightly over 50 cents, and it had increased to around 75 cents, an increase of about 50%. This dramatic change is attributed to the government's intention to reduce cigarette consumption for health promotion. The converted excise tax rate showed a similar pattern to the excise tax from about 16% in 1984 to about 24% in 2000.

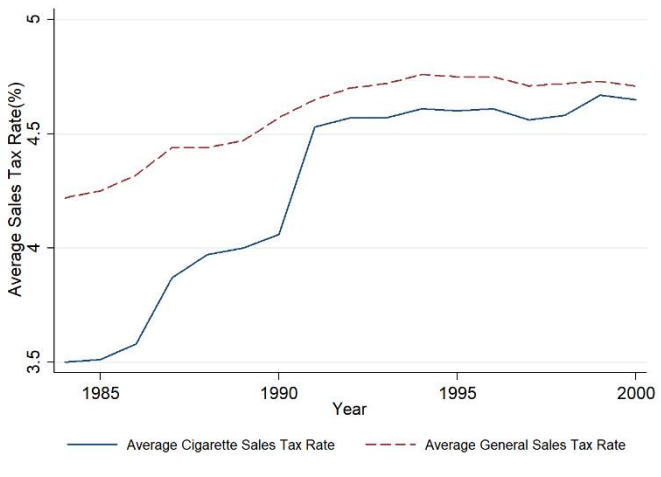

Figure 3. Cigarette Sales Tax Rate and General Sales Tax Rate

Notes: A few states do not impose sales tax on cigarettes but do on other general goods. "Cigarette Sales Tax" indicates how much sales tax is applied to the price of cigarettes while "General Sales Tax" is an indicator that is not affected by whether state governments levy sales tax on cigarettes or not.

Figure 3 displays currents of cigarette sales tax under which the actual price of cigarettes is computed, and general sales tax which applies to most of the goods. To clearly illustrate the difference between these two taxes, for example, Colorado levied 3% of sales tax on most of the goods except cigarettes in 1999. In this paper, the cigarette sales tax rate is 0%, and the general sales tax rate is 3%. This is the reason why the trend-line of the general sales tax is higher than that of the cigarette sales tax. Both had increased in sample periods, but the slope is not steep.

A brief inference about differences between a relationship of consumption with the sales tax, and consumption with the excise tax can be obtained by analyzing panel A with linear fitted values and panel B with quadratic fitted values in Figure 4. In panel A, the linear prediction plot of the sales tax is almost flat so that it seems that consumption is not correlated with the sales tax rate while consumption clearly decreases as excise tax increases. However, the quadratic prediction plot informs that consumption tends to rise slightly when the sales tax increases at the very low levels, while consumption tends to decline at the relatively higher levels of the sales tax. The tendency of the excise tax is

almost similar both in Panel A and B. This provides a rough evidence that consumers do not react at the very low level of sales tax because it may be negligible, but it became a burden as sales tax rises.[12]

Panel A. Linear Fitted Value

Panel B. Quadratic Fitted Value

Figure 4. Distribution, Plots, and Fitted Values of Sales Tax and Excise Tax

Notes: These figures plot state annual cigarette consumption against each tax rate. The distribution of sales tax is narrowly distributed in the lower section while that of the excise tax is relatively widely distributed in the higher section. To show a correlation between cigarette consumption and each tax rate linear fitted values are presented in Panel A, and quadratic fitted values are expressed in Panel B. Range of cigarette consumption are narrowed in the figure because of clarity, but this does not mean restricting observations.

[12] CLK (2007) constructs bounded rationality model of taxation which explains that existence of small cognitive cost induces misoptimizing behaviors. If the cognitive cost is smaller than sales tax, then consumers debias their behavior.

4. Identification Strategy and Results

Assume an economy with two goods that x is under sales tax t^s so that a demand of x depends on its tax included price $p(1+t^s)$; $x = x(p(1+t^s))$. Numeraire y is not under the tax and income is denoted m. It is assumed that there is no income effect[13] and the tax-inclusive price is the only factor that determines demand of x. Within the discussion of this paper, the excise tax is considered the same as the posted price p because the excise tax is included in the price and it is almost fully shifted to the price meaning that the price is fixed so that the supply curve is flat.[14] In this demand function, consumers respond equally to sales tax and excise tax. However, the equation becomes $x = x(p, 1+t^s)$ if consumers respond differently to the sales taxes excluded from the posted price. Following CLK (2009), utility function and a budget constraint are described as follows.

$$U(x,y) = a\frac{x^{1-b}}{1-b} + y$$
$$s.t.\ p(1+t^s) + y = m$$

where, b denotes inverse price elasticity of demand x and the price of y is normalized to 1.

For fully optimizing agents, the demand function appears as $x^* = (\frac{p(1+t^s)}{a})^{-\frac{1}{b}}$, while agent ignoring the sales tax at all have different demand function displaying $x^p = (\frac{p}{a})^{-\frac{1}{b}}$. Let θ denotes fraction of agents who take account the sales tax. Then aggregate demand function is denoted as $\hat{x} = \theta x^* + (1-\theta)x^p$. Using first order Taylor approximation and taking a log, the result is $log\hat{x} = \alpha + \beta logp + \theta\beta log(1+t^s)$ where $\alpha = \frac{1}{b}loga$ and $\beta = -\frac{1}{b}$. Finally, following equation can be derived by changing the price to the converted excise tax rate $1+t^e$ to make it comparable to the sales tax..

$$log\hat{x} = \alpha + \beta log(1+t^e) + \theta\beta log(1+t^s)$$

θ is now defined as the ratio of the demand sales tax elasticity to the demand

[13] By assuming that the demand of x does not depend on income, formula of excess burden becomes much simpler.

[14] To figure it out, regression analysis of how the consumer price changes when the excise tax increases is conducted. Using the data Tax Burden on Tobacco 2014, the coefficient of cigarette excise tax on cigarette retail price is about 1.1, implying the excise tax is slightly over-shifted to the consumer prices. See Appendix.

excise tax elasticity;

$$\theta = \frac{\varepsilon_{x,t^s}}{\varepsilon_{x,t^e}} = \{\frac{\frac{dx}{x}}{\frac{d(1+t^s)}{(1+t^s)}}\}/\{\frac{\frac{dx}{x}}{\frac{d(1+t^e)}{(1+t^e)}}\}$$

.

If $\theta = 1$, then t^s has a same effect on demand on x as t^e, meaning the sales tax is fully salient. On the other hand, $\theta < 1$ if consumers responds less to the sales tax because it is not presented on posted price and computed at the register, so consumers tend to be inattentive to it. In sum, hypothesis of how salience affects consumption can be tested by identifying the magnitude of θ. Then rising salience of t^s with its rates will be tested by comparing the demand sales tax elasticity in low sales tax states and that in relatively high sales tax states.

To control observed omitted variables demographics such as age, sex, race, education, and employment status are added on an econometric model. Since state governments tend to increase the sales tax when the economy is bad, the sales tax is correlated with economic fluctuations such economic growth rates, unemployment rate, net exports, interest rates, and per capita personal income and so on. Among these, monthly state unemployment rates and annual per capita personal income are used as control variables.

Unobserved omitted variables can be controlled using fixed effect model in the econometric equation. Since the entity of this data is state, considering the region effect is the same as panel analysis. Considering this, it is possible to eliminate the effect of unobserved omitted variables that differ across states but are constant over time such as culture, climate and law. Moreover, time fixed effects are used to control for variables that are constant across states but vary over time such as the perception of the health effects of smoking. Two kinds of time fixed effect, year fixed effect and month fixed effect are considered. In sum, an econometric model to test existence of salience is obtained as following:

$$(1)\quad logx_{sym} = \alpha + \beta_1 log(1+t^e)_{sym} + \beta_2 log(1+t^s)_{sym} + \gamma \mathcal{Z}_{sym} + \delta \mathcal{W}_{sym} + \eta_s + \sigma_y + \varphi_m + \varepsilon_{sym}$$

β_1 indicates the demand-excise tax elasticity of cigarettes regarded as the demand price elasticity, while β_2 indicates demand-sales tax elasticity and it is hypothesized that the values of these two coefficients differ because of the distinction of salience. $\mathcal{Z}$ stands for demographics and $\mathcal{W}$ controls business cycle. Region effects

denote η, and Time effects denote σ and φ.

Table 1. Effect of Excise Tax and Sales Tax on Cigarette Consumption

	(1)	(2)	(3)	(4)
Dependent Variable : Cigarette Consumption				
ln(1+excise tax rate)	-0.5490***	-0.3870***	-0.4434***	-0.4422***
	(0.0769)	(0.0927)	(0.0786)	(0.0797)
ln(1+sales tax rate)	-0.7304**	-0.1686	-0.2056	-0.0746
	(0.3545)	(0.3192)	(0.2782)	(0.2732)
Average Unemployment Rate (%)		-0.0087***		-0.0053**
		(0.0025)		(0.0025)
Per Capita Personal Income ($1000)		-0.0035***		0.0008
		(0.0008)		(0.0029)
Age			0.0039***	0.0037***
			(0.0012)	(0.0013)
White			0.2438***	0.2530***
			(0.0533)	(0.0537)
College			0.0015	-0.0033
			(0.0422)	(0.0415)
Married			-0.0015	-0.0018
			(0.0426)	(0.0425)
Male			0.0875*	0.0886*
			(0.0464)	(0.0464)
Employed			0.0462	0.0352
			(0.0463)	(0.0462)
Region Effects	X	X	X	X
Time Effects			X	X
N	8139	8128	8127	8116
R2	0.27	0.28	0.31	0.32
F-test for equality of tax elasticities(prob>F)	0.62	0.53	0.44	0.23

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

Notes: Standard errors in parentheses. Sampling weights are considered because the sample data come from survey data. F-test is for equality of excise tax rate and sales tax rate.

Table 1 exhibits results of the regression analysis of econometric model (1), which indicates that consumers are less respond to sales tax. Column 1 includes two tax rates and region effects. Column 2 adds variables that control business cycle while Column 3 includes demographics and time effects on top of Column 1. The specification in column 4 includes all available variables. In Column 1, the sales tax has a greater effect on cigarette

consumption than the excise tax, but as the control variables are added, the coefficient of the sales tax reduced and is statistically zero implying that consumers are inattentive to computing the sales tax as shown in Panel A of Figure 4. On the other hand, the coefficient of the excise tax continues to be around -0.4 meaning that a 1% increase of the excise tax results in a -0.4% reduction in consumption. It can be seen that consumers only respond to the excise tax and very little to the sales tax.

However, the existence of salience is inconclusive because a test for the equality of the excise tax and the sales tax rejects that they have different coefficient.[15] This is because, as shown in Panel B of Figure 4, the fact that agents reacts differently to the sales tax rates according to the level of the sales tax rates is obscured when fixed demand sales tax elasticity is assumed.

Knowing that consumers respond differently depending on the level of sales tax rate is essential in several respects. By confirming that people are less responsive at a lower level than a higher sales tax rate, it can be seen that demand sales tax elasticity and demand excise tax elasticity are statistically different. At a very low level, the government can achieve the first best outcome by combining the proportion of the sales tax and the excise tax. However, achieving the first best result becomes infeasible by raising the sales tax rates at a relatively high tax rates. In other words, the government's intention to increase social welfare by combining the excise tax and the sales tax fails because consumers face higher marginal excess burden than that generated by the excise tax at a somewhat higher sales tax rate.

Following econometric model shows how different are the elasticity of demand with respect to the low level of the sales tax and the high level of the sales tax.

$$(2)\quad log x_{sym} = \alpha + \beta_1 log(1 + t^{e}_{sym}) + \beta_2 \log(1 + t^{s}_{sym}) + \phi \log(1 + t^{s}_{sym}) \cdot H_{sym} + \pi H_{sym} + \gamma Z_{sym} + \delta W_{sym} + \eta_s + \sigma_y + \varphi_m + \varepsilon_{sym}$$

To analyze rising salience, the sales tax rate for each year is divided into two sections, so that the binary variable H indicates 0 when a state has low value of the sales tax, and 1 when it is relatively high. In the above equation, β_2 shows the value of demand sales tax elasticity at a lower level while ϕ exhibits difference between the sales tax elasticities of demand at the low and the high rates. The other remaining variables match the previous econometric equation.

[15] Given this point, Goldin (2013) shows consumers react differently to the sales tax depending on the individual income level.

Table 2 shows the result of the econometric model (2). Column 1 through 4 include controlled variables as in the table 1. When referring to the value of F-test 3 in column 4, indicating the equality of elasticities between the low level of the sales tax and the high level of the sales tax, consumers responds more to the high level of the sales tax. The coefficient β_2 is remained statistically zero and that of the excise tax is almost unchanged comparing to the coefficients in table 1. Assuming that the excise tax elasticity of demand is fixed, it can be seen that salience rises with the sales tax rate.

Table 2. Rising Salience of Sales Tax with Its Rate

	(1)	(2)	(3)	(4)
Dependent Variable : Cigarette Consumption				
ln(1+excise tax rate)	-0.5315***	-0.3830***	-0.4431***	-0.4302***
	(0.0720)	(0.0937)	(0.0773)	(0.0800)
ln(1+sales tax)	-0.3076	0.1609	-0.0103	0.1138
	(0.3218)	(0.3367)	(0.2750)	(0.2920)
High*ln(1+sales tax)	-2.5191*	-1.9175	-1.8425*	-1.7543*
	(1.4553)	(1.4489)	(0.9532)	(0.9597)
High	0.1581*	0.1151	0.1198**	0.1101**
	(0.0845)	(0.0831)	(0.0545)	(0.0543)
Region Effects	X	X	X	X
Business Cycle		X		X
Demographics			X	X
Time Effects			X	X
N	8139	8128	8127	8116
R2	0.2760	0.2807	0.3156	0.3163
F-test (1) (prob>F)	0.17	0.20	0.08	0.08
F-test (2) (prob>F)	0.52	0.13	0.15	0.08
F-test (3) (prob>F)	0.17	0.29	0.15	0.17

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

Notes: Standard errors in parentheses. Sampling weights are considered because the sample data come from survey data. According to the sales tax rate, sales tax level is classified as high and low: "high" includes the sixth quintile to the tenth quintile and first to the fifth quintile is categorized as "low." Because more than 25% of samples of sales tax have a value of 5%, more detailed division is inappropriate. F-test (1) is for equality of low sales tax rate and high sales tax rate. F-test (2) is for equality of low sales tax rate and excise tax rate. F-test (3) is for equality of high sales tax rate and excise tax rate.

Noteworthy is that the sales tax, which is deemed as a low salient tax, seems to be

more salient than the excise tax in the high level segment. Focusing only the value of the coefficients in Column 4, salience of the low level of the sales tax is 1/4 while it denotes 4 at high level tax rates as an absolute value. This result is in contradiction to the previous findings that θ is always smaller than one. In this case above a certain level of sales tax rates, the marginal excess burden of the sales tax is greater than that of the excise tax. Furthermore, if the demand curve of sales tax is located below the that of the excise tax, then not only the marginal excess burden, but the amount of total excess burden of the sales tax is greater than the that of the excise tax.

Considering F-test 2 and 3, a more accurate interpretation becomes possible. The equality test of elasticities between the low level of sales tax and the excise tax, F-test 2, indicates that they are quite different supporting results of previous salience literature. However, the coefficients of the high level of sales tax and the excise tax is not statistically different referring to the values in F-test 3 because the significance of the high level of the sales tax is not strong. Taken these all together, consumers do not care when the sales tax rate is low, but at a somewhat higher level they consider the sales tax the same as the excise tax. This result implies that the marginal excess burden of the sales tax is greater than that of the excise tax but the total excess burden of the sales tax is still smaller than that of the excise tax.

Robustness Check

-IV estimation-

The pre-tax price, which is expected to have a significant effect on cigarette consumption, has not been included in the above econometric equations. It can solve the omitted variable bias on the one hand, but cause simultaneous bias problems on the other hand. Simply analyzing OLS regression with pre-tax price has simultaneous causality error that the causality runs both from the price to the consumption and the opposite way. Therefore, IV estimation method is an appropriate method to solve these problems. In this regression analysis, the excise tax is instrumental variables for the posted price p.[16]

[16] Valid instrument require two condition; Instrument relevance condition $corr(p, t^e) = 0$ and Instrument exogeneity condition $corr(t^e, \varepsilon) = 0$. F-statistics of 1st stage in Table 3 confirms that first condition is satisfied. Second condition can be justified when referring to a previous literature. See CLK (2009) and Goldin (2013).

$$(3)\quad log x_{sym} = \alpha + \beta_1 log\, p_{sym} + \beta_2 log(1 + t^{s}_{sym}) + \phi \log(1 + t^{s}_{sym}) \cdot H_{sym} + \pi H_{sym} + \gamma Z_{sym} + \delta W_{sym} + \eta_s + \sigma_y + \varphi_m + \varepsilon_{sym}$$

Table 3 exhibits results of OLS regression, 1st stage of IV estimation, and 2nd stage of IV estimation. Column 1 through 3 include demographics, region effects and time effects while Column 4 through 6 add business cycle variables on top of that. In OLS regression, the coefficient of the posted price is reduced to around -0.1 and it is significant while that of the sales tax is equal or smaller and insignificant. Interaction term of High and sales tax rate is slightly larger than previous results. The interpretation of the equality tests is contrary to the previous results in that the coefficients between the price and the low level of the sales tax are not statistically different while those between the price and the high level of the sales tax are statistically different. However, as mentioned earlier simultaneous bias may disturb to obtain unbiased consistent estimator.

Table 3. Instrumenting for Retail Price with Excise Tax

Dependent Variable -OLS: ln(Cigar Consumption) -1st stage: ln(retail price) -IV: ln(Cigar Consumption)	Instrument Variable: Excise Tax					
	(1) OLS	(2) 1st stage	(3) IV	(4) OLS	(5) 1st stage	(6) IV
ln(retail price)	-0.1319***		-0.3117***	-0.1097***		-0.2988***
	(0.0386)		(0.0630)	(0.0381)		(0.0643)
ln(1+excise tax rate)		1.4158***			1.4398***	
		(0.0946)			(0.1002)	
ln(1+sales tax rate)	-0.0591	0.8478***	0.2547	0.1140	0.7758***	0.3456
	(0.2709)	(0.2230)	(0.2855)	(0.3000)	(0.2409)	(0.3003)
High	-2.0769**	-0.3842	-1.9779*	-2.3317**	-0.8082	-1.9958*
*ln(1+sales tax rate)	(1.0414)	(1.1014)	(1.0679)	(1.0752)	(1.1285)	(1.0772)
High	0.1298**	0.0256	0.1286**	0.1375**	0.0521	0.1257**
	(0.0598)	(0.0643)	(0.0615)	(0.0614)	(0.0649)	(0.0616)
N	8116	8116	8116	8116	8116	8116
r2	0.3107	0.9763	0.3064	0.3117	0.9765	0.3073
F statistics on 1st stage		224.15			206.44	
F-test (1) (prob>F)	0.07			0.04	0.20	
F-test (2) (prob>F)	0.80			0.47		
F-test (3) (prob>F)	0.06			0.04		
x^2-test (1) (prob>x^2)			0.06			0.05
x^2-test (2) (prob>x^2)			0.07			0.05
x^2-test (3) (prob>x^2)			0.12			0.12

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

Notes: Standard errors in parentheses. Columns 1 to 3 include region effects, time effects, and demographics. On top of that, business cycle variables are included in columns 4 to 6. F-test (1) is for equality of low sales tax rate and high sales tax rate. F-test (2) is for equality of low sales tax rate and excise tax rate. F-test (3) is for equality of high sales tax rate and excise tax rate. The chi-square test follws same meaning as the F-test in the same orders.

Instrument variable estimation can solve this problem by employing the excise tax as an instrument for the posted price.[17] First stage indicates that the increase in the excise tax has a greater effect on the increase in the retail price than the increase in the sales tax. In the second stage of IV estimation, the coefficient of price is around -0.3 slightly less than previous results of the econometric model (2) in the absolute value. On the other hand, the value of the low and high level of the sales tax are slightly greater. The chi-square results are the same as the results in Table 2 above implying rising salience and the equality of the elasticities between high level of sales tax and the price.

-Indirect effect-

In the empirical analysis so far, it is assumed two good models that only a good x is under the sales tax and other goods y are not under the sales tax, but in reality there are numerous products where the sales tax is imposed. In other words, the increase in the sales tax has impacts not only on the cigarette consumption but on other products. Therefore, the effects of the sales tax on cigarette consumption can be divided into direct effect, increase of the sales tax only on cigarette price, and indirect effect, increase of the sales tax on other prices of products except cigarette. Each effect constitutes substitution effect and income effect respectively. Thus, it is possible that reduction in cigarette consumption in states with high level of the sales tax might be not caused by the direct effect, but by the indirect effects because of decline of purchasing power and high proportion of cigarettes' complements among other products.

To estimate the direct effects of the sales tax on cigarette consumption, data on states charging sales tax only on cigarettes is required, but no states have such taxation system. As an alternative, I would like to investigate the indirect effect by determining how cigarette consumption responds when the sales tax increase in states where it is not imposed on cigarettes. Following regression shows influence of indirect effects.

[17] See CLK(2009), Goldin(2013)

$$(4)\quad log x_{sym} = \alpha + \beta_1 log(1 + t^{e}{}_{sym}) + \beta_2 H_{sym} \cdot \log(1 + t^{e}{}_{sym}) + \phi_1 \log(1 + t^{gs}{}_{sym}) \cdot (1 - E) + \phi_2 H_{sym} \cdot \log(1 + t^{gs}{}_{sym}) \cdot (1 - E) + \phi_3 log(1 + t^{gs}{}_{sym}) \cdot E + \phi_4 H_{sym} \cdot \log(1 + t^{gs}{}_{sym}) \cdot E + \nu H_{sym} + \xi E + \pi H_{sym} \cdot E + \gamma Z_{sym} + \delta \mathcal{W}_{sym} + \eta_s + \sigma_y + \varphi_m + \varepsilon_{sym}$$

In this specification, E indicates whether state governments exempt sales tax on cigarette or not. It denotes 1 if state government does not impose the sales tax on cigarettes but does impose on other products while 0 indicates non-exemption states. Therefore, ϕ_2 indicates how elasticity of high level of the sales tax is different from that of low level of sales tax in non-exemption states and ϕ_4 shows how differ of those two elasticities in exemption states. Indirect effect can be seen by looking at the value of ϕ_4. Results are shown in Table 4 and controlled variables are added as same as in the Table 1. In column 4, ϕ_2 has the value -2.2 implying that consumers in non-exemption states responds greatly to the sales tax with relatively high rates, not much different from previous results, but it is inconclusive because of insignificance. Note that the value of ϕ_4 is above 3. In other words, when the sales tax is imposed except on cigarettes, then consumption of cigarettes increases meaning that a substitution effect of indirect effect outweighs an income effect although this values is not statistically significant.[18]

Table 4. Indirect Effects of Sales Tax on Cigarette Consumption

	(1)	(2)	(3)	(4)
Dependent Variable : Cigarette Consumption				
ln(1+excise tax)	-0.3846***	-0.1641*	-0.1882*	-0.1593*
	(0.0878)	(0.0961)	(0.0964)	(0.0967)
High*ln(1+excise tax)	-0.2527**	-0.3402***	-0.3873***	-0.4065***
	(0.1210)	(0.1198)	(0.1181)	(0.1175)
ln(1+general sales tax)*non exempt	2.6863**	2.6260**	1.5121	1.1131
	(1.1022)	(1.0843)	(1.0680)	(1.0862)
High*ln(1+general sales tax) *non exempt	-5.1564*** (1.4760)	-3.8373*** (1.4150)	-2.8887** (1.4084)	-2.2161 (1.3570)
ln(1+general sales tax)*exempt	4.9301	2.7867	4.1354	3.2406
	(4.2139)	(4.2604)	(4.2530)	(4.2923)
High*ln(1+general sales tax) *exempt	-1.9020 (5.7815)	3.1458 (5.9156)	0.5742 (5.9319)	3.0983 (6.1330)

[18] Insignificance of estimation may have been derived from lack of data. There are only 8 non-exemption states in 1984 and 1 in 2000.

N	8139	8128	8127	8116
r2	0.2775	0.2828	0.3178	0.3187
F-test for equality of low and high general sales tax elasticities in non-exemption states (prob>F)	0.00	0.01	0.06	0.15

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Notes: Standard errors in parentheses. Region effects are included in Column 1, 2, 3, and 4. Business cycle variables are contained in Column 2 and 4, and Demographics and Time effects are included in Column 3 and 4. Indirect effect of sales tax on cigarette consumption can be seen by looking at how cigarette consumption respond when the sales tax changes where state government do not impose it on cigarette.

In sum, although it is inconclusive in the sense that both ϕ_2 and ϕ_4 are insignificant, it is inferable that the direct effect of the sales tax have greater impact on cigarette consumption. In other words, the indirect effect is a factor that reduced the absolute value of the coefficient of the sales tax.

5. Conclusion

Recent literature suggests that consumers respond less to the low salient tax because of inattentiveness in computation of total tax-inclusive price. Accordingly, it seems that a traditional assumption in public economics should be modified; consumers react differently to the fully salient excise tax and the low salient sales tax. However, a question has been raised about the endogeneity of tax's salience with its rate requiring an evidence whether consumers reacts more to the change of high level of sales tax than its counterparts. Recent laboratory experiment rejects prior hypothesis and it finds no reliable evidence that tax's salience rises with its rate but it has a few limitations.[19]

In this paper using observational data, daily consumption of cigarettes, demographics, development of taxes and business cycle variables, regression analysis are conducted and the results proved the hypothesis: consumers respond more to the relatively high level of the sales tax. At the low level of the sales tax, the conclusion of the salience literature is still reasonable, but the responsiveness to the sales tax and the excise tax are not statistically different at the relatively high sales tax rate.

This paper also has several limitations. Above all, since the sales tax rates are narrowly distributed and concentrated at a specific rate at the low level, the significance of the coefficients are low.[20] It is necessary to analyze how the sales tax elasticity of demand changes as the sales tax rate increases by dividing it into more detailed section. Given that the average sales tax rate has increased to 5.2% and the tax rate is further diversified in 2014, it is required to analyze using recent consumption data combined with tax data. Moreover, it is essential to look at how demand-sales tax elasticity varies in other markets such as alcohol where both the excise tax and the sales tax are imposed.

While most of states levy sales tax on the base value including excise tax, in some states they impose sales tax on excise-tax-exclusive-price[21]. In these states, the value of sales tax is lower if the rates and the price are same. Therefore, the measurement error needs to be considered.

F-test confirms that the elasticities between high level of the sales tax and the excise tax are not statistically different, but this is because the variance of demand-sales tax elasticity is very large. Only focusing the value of two elasticities there is a huge difference

[19] See Feldman, Goldin and Homonoff (2018)
[20] 12% of the observations of the sales tax rate have a value of 4%, 26% have a value of 5%, and 17% have a value of 6%.
[21] 7 states levy sales tax on top of excise-tax-exclusive-price in 1984 and 3 states in 2000.

so that the fact that $\theta > 1$ is more probable. In that case, not only marginal excess burden but also total excess burden of the sales tax is greater than that of the excise tax. Therefore, it is required to establish the economic model which can explain what determinants make consumers respond more to the sales tax than the excise tax.

Although with these limitations, this paper provides empirical evidence supporting traditional assumption in public economics in a particular condition: consumers respond equally to the change of the excise tax and the sales tax above a certain level of the sales tax rate. Thus, when the government tries to achieve a first-best outcome using the sales tax, policy makers should consider that the sales tax elasticity of demand varies according to its tax rates.

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Appendix

-Data description-

Table 5. Summary Statistics for Control Variables

Year	1984	2000
Retail Price (¢)	95.41	314.76
Age	42.56	45.22
White	0.91	0.85
College	0.41	0.56
Employed	0.59	0.65
Married	0.67	0.60
Male	0.47	0.48
Average Unemployment Rate (%)	7.36	3.87
Per Capita Personal Income ($)	12729.83	29550.46

Notes: Statistics reported are means in each year and observations are by state. The denominator of "Employed" includes homemaker, student, retired and unable to work. Income level is described as follows, for example, if annual income is less than $10,000 then it will be denoted as 1, and if one earns more than $10,000 and less than $15,000 then it will be denoted as 2. See Appendix for more details of the sample definition.

Demographic variables extracted from BRFSS data contains age, race, education level, employment status, marital status, and sex. For race, it includes various races such as white, black, Asian, Indians, Indians and others. For simplicity, the binary variable "white" indicates that the person who answered white is 1 and 0 for the others. Likewise, the binary variable "college" denotes whether the respondent enter college or not. It shows 1 if the person enter college and 0 for the others. When dealing with the binary variable "Employed" denominator contains not only working age population, but also the population above 64, and Numerator includes employee and self-employed.

-Tax incidence-

To derive the econometric equation from the economic model used in Chapter. 4, the assumption that the price of cigarette p is fixed should be justified. A fixed price means that the price increases as the same amount the tax is imposed. Incidence of tax depends on the price elasticity of demand and supply so that if the price elasticity of supply is perfectly elastic, the excise tax will be fully shifted to consumers regardless of who is taxed legally. Table 6 shows how much excise tax shift to the retail price. Dependent variable is cigarette retail price and explanatory variable is excise tax. Control variables are added as same as in the Table 1. First of all, the value of R-Square closed to 1 in Column4 indicates that most of the variation of retail price is explained by independent variables. In Column1, increase in 1¢ of excise tax brings about increase in 2.9¢ retail price; over-shifting occurs. However, as control variables are added, the coefficient of the excise tax becomes closed to 1 meaning that when 1¢ of the excise tax is imposed on cigarette then, retail price also increases in 1¢.

Table 6. The incidence of Excise Tax on Retail Price

	(1)	(2)	(3)	(4)
Dependent variable: Retail Price				
Excise tax (¢)	2.8866***	1.0668***	1.1073***	1.0657***
	(0.0876)	(0.1627)	(0.0328)	(0.0352)
Average Unemployment Rate (%)		-0.6426		1.1546***
		(1.1675)		(0.4097)
Per Capita Personal Income ($1000)		8.6577***		1.5187**
		(0.6794)		(0.5916)
S	X	X	X	X
D			X	X
Y			X	X
N	8128	8128	8116	8116
r2	0.7498	0.8854	0.9927	0.9930
F	41.6087	194.3053	44274.7899	13042.2799

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

국문초록

최근 연구에서 소비자들이 가격표에 포함되어 있는 물품세에 비하여, 가격표에 포함되어 있지 않지만 계산대에서 합산되는 판매세에 대하여 덜 반응한다고 밝혀냈다. 정부가 이 조세를 적절히 조합하면 최선의 상태를 달성할 수 있지만, 이는 수요-판매세 탄력성과 수요-물품세 탄력성의 비율로 정의되는 현저성이 판매세의 세율에 따라 어떻게 변하는지에 달려있다. 본 연구는 미국의 건강 관련 데이터와 담배 조세에 관한 보고서를 결합하여 판매세의 세율이 증가함에 따라 현저성이 증가한다는 가설을 검정하였다. 그 결과, 높은 수준의 판매세에서 수요-판매세 탄력성의 절대값이, 낮은 수준에서의 수요-판매세 탄력성의 절대값보다 크게 나타났다. 또한 낮은 수준에서의 수요-판매세 탄력성은 여전히 수요-물품세 탄력성보다 절대값이 낮게 나타났고, 높은 수준에서의 수요-판매세 탄력성은 수요-물품세 탄력성과 통계적으로 다르지 않은 값을 가진다. 이는 판매세의 세율이 증가함에 따라 판매세의 한계초과부담이 물품세의 한계초과부담보다 큰 값을 가진다는 것을 의미한다.

주요어: 상품세, 담배, 현저성, 물품세, 판매세

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