BACKGROUND

As is known to all, smoking can cause multiple health problems and thus has become an important concern in the society. According to Department of Health and Human Services, tobacco use kills over 480,000 people in the United States every year, with more than 41,000 of these deaths from exposure to secondhand smoke. The cost of smoking-related diseases in the U.S. exceeds $300 billion per year, which is also a big burden to public finance.

To inhibit people from smoking from the angle of economics, federal tobacco tax appeared in the United States in mid-19th century. Additionally, U.S. state governments also began to levy a tobacco excise tax based on a certain tax rate per unit legislated by each state individually from 1921. Since then, every state and the District of Columbia have gradually set up a cigarette excise tax. As of the end of 2015, excise tax on state level ranged from $0.17 per pack in Missouri to $4.35 per pack in New York, and the tobacco tax that federal government implements is $1.01 per pack (20 cigarettes) starting from April 1, 2009. Given that federal tobacco tax applies to all states equally, the effect of cigarette tax policy largely depends on the tax rate of each state.

PROBLEM DEFINITION

Since cigarette tax rate differs among states, the goal of this project is to compare and examine the effect of excise tax rate of different states by using several comparable indicators through GIS analysis.

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The indicators used in the project are all on state basis (48 states). We exclude Alaska and Hawaii, the two states away from the American mainland, and Washington D.C, which is hard to show on the output maps under current scale. One of crucial characteristics of these indicators is that they can demonstrate either direct or indirect influence of cigarette tax on tobacco industry and people, and therefore can detect relative effectiveness of tax rate of a certain state. Specifically they are: 1. Cigarette Sales per Capita (in Quantity/Pack); 2. Smoking Prevalence, expressed by the ratio of the number of smokers to total state population; 3. Incidence Rates of Smoking-Related Illnesses (among which lung cancer is the most pertinent and serious disease), which means the number of people who get these illnesses.

**DATA SOURCES & PROCESSING**

In order to guarantee the accuracy of the comparison between different data sets, all data I collected in the analysis is as of December 31, 2015.

The statistics of excise tax rates on cigarettes of different states derived from State Tobacco Activities Tracking and Evaluation System of Centers for Disease Control and Prevention (CDC). They are expressed in dollars per pack (20 cigarettes). I also found the percentages of current cigarette use among adults and youth by states respectively from the Behavior Risk Factor Surveillance System of CDC.

For 2015 cigarette sales in quantity per capita, since there is no direct source, I just divided each state’s cigarette tax revenue published on the website of U.S. Alcohol and Tobacco Tax and Trade Bureau by their own excise tax rate per pack and population to get it.

Lung cancer incidence rates came from the calculation results of the amount of new lung cancer cases in 2015 from American Cancer Society divided by state population. Considering the readability of the map, incidence rates are eventually shown in the number of lung cancer cases this year per 100,000 people.

**RESULTS**
• **Indicator I: Cigarette Sales per Capita (in Quantity/Pack)**

From the perspective of cigarette sales (See Appendix I), we can conclude the most direct effect of levying an excise tax on state level on cigarette consumers. In 2015, most states with higher cigarette sales in quantity per capita are subject to relatively low excise tax rates on cigarette, such as Missouri, Kentucky, Virginia and North Dakota, which is consistent with common sense, since smokers do not have to be restricted by the factor of price when purchasing cigarettes in those states. This situation also illustrates that cigarette tax, as a pricing disincentive, does not exhaust all of its potential in those states, since people’s consumption of cigarettes may get effectively controlled once their cigarette tax rates are increased to a higher level.

However, sales in New Hampshire and Delaware are also at the highest level in the case that they have already implemented high cigarette tax rate. In view of the fact that there is no large room left for these two states to raise their tax rates, the two states may search for other methods combined with the tool of excise tax together to reduce residents’ consumption on tobacco within their jurisdiction.

What makes policy-makers happy is that in the states where people pay the most tax on cigarettes to state government, mainly concentrated in the northeastern part of the United States, including New York, Massachusetts, Vermont, Connecticut, every person consumes fewer cigarettes on average. Cigarette excise tax in those states plays a very good role in preventing people from using more cigarettes, which is just in line with state government’s purpose of introducing a tax on tobacco products.

• **Indicator II: Smoking Prevalence**

Although the majority of smokers having developed an addiction to tobacco can hardly quit smoking completely in a short time period due to higher prices they have to pay for a pack of cigarettes, looking at the proportion of smokers among people in each state also assists local legislators to determine state excise tax rate in the long run. Since youngsters are generally more sensitive to the change of cigarettes’ price than the elders with stable income source are, raising the price of cigarettes will
exert drastically different influence on adults and youth. In order to distinguish these two groups of population, we evaluate the level of cigarette tax through percentage of cigarette users among adults and youths respectively (See Appendix II and III).

1. Cigarette Use among Adults

If we divide the United States into two sections—the west and east—from the middle, cigarette use among adults in the west is much more comforting than that of the east (See Appendix II). Smokers occupy over one-fifth of the total adult population in many states with lower excise tax rate, under $1.18 per pack, including Kentucky, Tennessee, West Virginia, Arkansas, Mississippi and so forth. We cannot simply attribute the fact that they have such high ratio of cigarette consumers to lower tax rate, since many other states with the same low rate can meanwhile keep their smoking prevalence among adults at a comparatively low level, for instance, Virginia. Together with less tax, there must be other regional factors driving up the number of adult smokers in those states, like social beliefs, susceptibility to tobacco advertising etc. Likewise, in those states having both lower tax rate and lower percentage of smokers, while price does not become a roadblock to local smokers, their tobacco consumption behavior is probably also restricted by other factors.

However, we have to admit one fact that no matter in the west or east, states with higher tax rate always have fewer percentage of smokers among adults, with only one exception—Michigan. Undoubtedly, this phenomenon cannot be simply explained as “coincidence”. In the long term, higher retailer prices have definitely imposed some financial pressure on the adults with medium or lower income while the price may have nothing to do with the rich. People who cannot afford frequent smoking may reduce smoking or even turn to cigarette substitute in cheaper price. Especially in the states with the most expensive cigarette excise tax throughout the United States, like Washington, Minnesota, and New York, only a small part of the

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adults currently smoke.

2. Cigarette Use among Youth

For teenage smokers, it is very important for them to develop a good habit of staying away from cigarettes; otherwise, they will pay a huge cost on health for the behavior of smoking after they grow up. Looking at the states with the record of young smokers (See Appendix III), we will find the distribution of the percentage of smoking youth by states has many overlaps with that of the adults. Those states with higher proportion of adult smokers, consisting of Kentucky, West Virginia, Arkansas, Mississippi, Alabama, possess higher percentage of adolescent smokers as well. Another two states, Nebraska and Wyoming, do not have too many smoking adults, but they do own a large portion of smoking teenagers instead. There is one resemblance among all those states where smoking adolescent accounts for a large part of teenage population—relatively low cigarette tax rate compared to other states. Since pricing disincentive has been proved an effective way to keep youngsters from cigarettes\textsuperscript{9}, increasing tax rate is a good potential option for policy makers to change the situation of smoking prevalence among youth in those states.

- **Indicator III: Illness Incidence Rate**

Smokers usually have higher odds suffering from many pertinent diseases due to harmful substances in cigarettes than nonsmokers. Many studies have shown there is a highly correlated relationship between smoking and getting lung cancer\textsuperscript{10}. By observing the distribution of lung cancer incidence rate (See Appendix IV), we are able to know which states we should put our most efforts in to cut off cigarette use, one of the biggest contributors leading to lung cancer.

The distribution of incidence rate of lung cancer also shares a lot of similarities with the distribution of smoking prevalence among adults and youth due


to their correlation. The number of new cases of lung cancer in 2015 in the east is far more than that in the west relative to their population respectively, which corresponds to the situation of smoking popularity of the same year in these two sections. Higher incidence rate of lung cancer is mainly concentrated in the states with more prevalent cigarette use, including Kentucky, Tennessee, Arkansas, Mississippi, Oklahoma, Missouri, Indiana, West Virginia etc.

There are three states whose ratio of new lung cancer patients in 2015 to total population remains high in the northeast of the U.S.—Maine, Delaware, and Rhode Island. What seems contradictory is that the cigarette tax rates in these states are higher than other states with lower incidence rates. However, it does not state getting lung cancer is unrelated with smoking. Take Maine as an example. Although smokers in Maine have to pay more tax than many other states, the statistics of cigarette sales and the proportion of smokers among Maine’s residents are not that optimistic, which partially results in high incidence rate of lung cancer. Consequently, governments of these states can start with other effective approaches that indeed reduce the smoking of local residents other than excise tax in order to prevent lung cancer, even though the cases of lung cancer in these states do not merely result from smoking.

LIMITATIONS

The first and second categories of indicators chosen in the project—cigarette sales and smoking prevalence—exactly reflect whether the circumstance of smoking control is good or bad in a certain state and thus further examine the effect of cigarette tax of a state in a horizontal comparison. Nevertheless, cigarette is just one of numerous contributors to lung cancer so patients suffering from lung cancer cannot put all the blame to smoking. In this sense, it is not very accurate to regard the incidence rate of lung cancer or incidence rate of any other disease as an indicator of cigarette tax evaluation.

Moreover, disease is a very transportable attribute and may not reflect the cigarette use in that state. It can take a long time for potential lung cancer patients to be diagnosed after they consume a great quantity of cigarettes. During this period,
they can move to any other states, so states like Florida, where many people retire, may have many lung cancer cases that are not caused by the consumption of cigarettes in their jurisdiction. Overall, the incidence rate of smoking-related illness is a good, but potentially flawed indicator. The reason I eventually include it in the project is that incidence rate is the most important and ultimate change that cigarette tax can potentially make to the health of human beings.

In addition, economic tools may take a long time to change people’s consumption habits, especially for tobacco products. Sales of cigarettes can keep relatively constant whatever the change of price is in the short run because smokers are hard to reduce the quantity they consume once getting addicted to cigarettes. However, the statistics used for this project were all extracted from the same period. In this case, sales and smoking popularity may neither display the impact of the excise tax precisely if the tax rate has just been adjusted in the same year or last year.

Besides, data like cigarette use among youth is not available in some states, which also limits our analysis of tax rate evaluation of these states.

**CONCLUSION & RECOMMENDATIONS**

Taking all those indicators discussed above into consideration, we discover the states in the west of the United States generally perform better in terms of cigarette use and smoking-related diseases control. California is one of the top performers among these states. Its cigarette sales, smoking prevalence and incidence rate are all at the lowest level throughout the U.S.

For the states with poor indicators, I develop several recommendations regarding cigarette tax for them:

1. Raise excise tax rate.

This method applies to the states that have unfavorable indicators compared to other states but still implement a relatively low excise tax rate. Since there is still room for tax rate increase in these states, legislators should first consider giving full play to the power of tobacco market and price regulation. States satisfying this description are Kentucky, West Virginia, Tennessee, Arkansas, Mississippi, Alabama,
Oklahoma, Missouri, Indiana, North Carolina, North Dakota, and Wyoming. Higher price of cigarettes will force people who are sensitive to price to cut down smoking gradually, particularly young people, and therefore improve the indicators of cigarette sales in quantity and smoking prevalence. One study shows that smoking rate among adolescents will decrease by about 7% with every 10% increase in cigarettes’ price. Cigarette excise tax revenue generated by state government can be saved and exclusively used for the prevention and treatment of smoking-related diseases within the state.

2. Set up additional cigarette tax at county level.

This method can break down a statewide issue into more specific issues easily managed by local governments. To improve the overall performance of smoking control, a state can first identify which counties contribute most cigarette sales or smokers and then focus on these target areas. Besides the excise tax on state level, imposing an additional tax at local level such as county tax sometimes is also necessary to prevent current situation from further deterioration. Although smokers may also cross to another county for a purchase, the cost is very high, especially for people living in the center of a big county. For those who always buy cigarettes expediently and frequently, like getting from downstairs grocery store, a county tax can hardly force them to purchase from another county far away from current place.

3. Combine cigarette tax with other tools.

For the states whose excise tax rate is higher but indicators still need to be improved, the government should explore different policy tools rather than rely solely on tax. These states are Michigan, Maine, New Hampshire, and Delaware. Some state governments have introduced a variety of policies to protect people from cigarettes. For example, the government of California State bans students smoking on school grounds in middle and junior high schools. Assisted with other tools, cigarette excise

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tax may work better on reducing smoking prevalence and promoting people’s health.
REFERENCES


APPENDIX I

The Distribution of Cigarette Tax and Cigarette Sales on State Level, 2015

Source: Centers for Disease Control and Prevention
U.S. Alcohol and Tobacco Tax and Trade Bureau
APPENDIX II

The Distribution of Cigarette Tax and Cigarette Use among Adults on State Level, 2015

Source: Centers for Disease Control and Prevention
APPENDIX III

The Distribution of Cigarette Tax and Cigarette Use among Youth on State Level, 2015

Source: Centers for Disease Control and Prevention
APPENDIX IV

The Distribution of Cigarette Tax and Lung Cancer Incidence Rate on State Level, 2015

Source: Centers for Disease Control and Prevention, American Cancer Society
*Rates are per 100,000