

# Homework 3

ECON 470, Spring 2025

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Here is a link to my repository: {[https://github.com/mollyjc02/Homework\\_3.git](https://github.com/mollyjc02/Homework_3.git)}

1. Present a bar graph showing the proportion of states with a change in their cigarette tax in each year from 1970 to 1985.

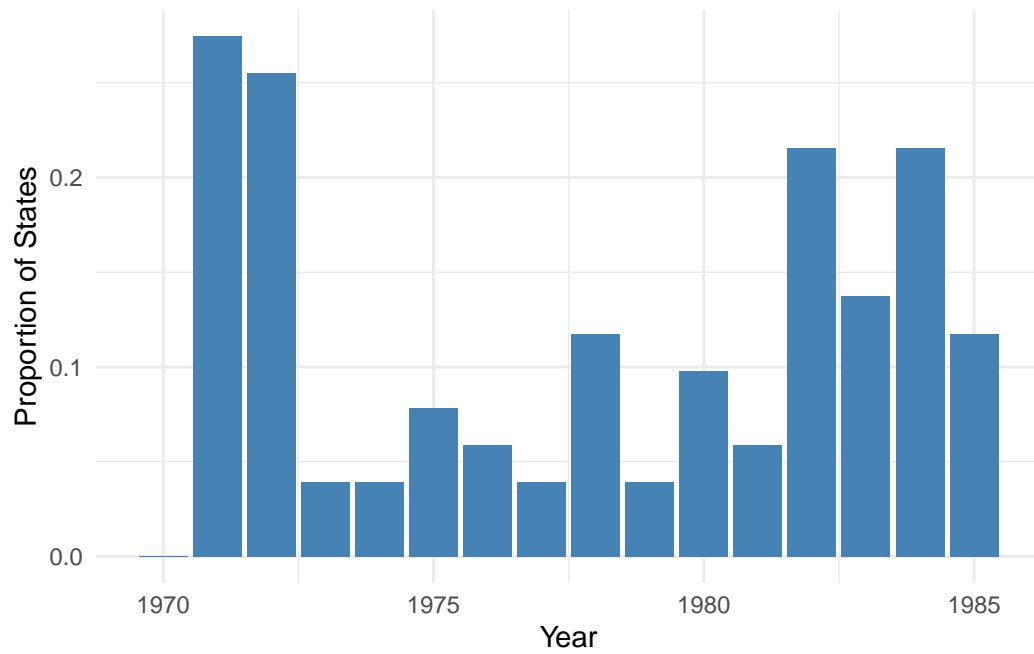


Figure 1: Proportion of States with Cigarette Tax Changes

2. Plot on a single graph the average tax (in 2012 dollars) on cigarettes and the average price of a pack of cigarettes from 1970 to 2018.

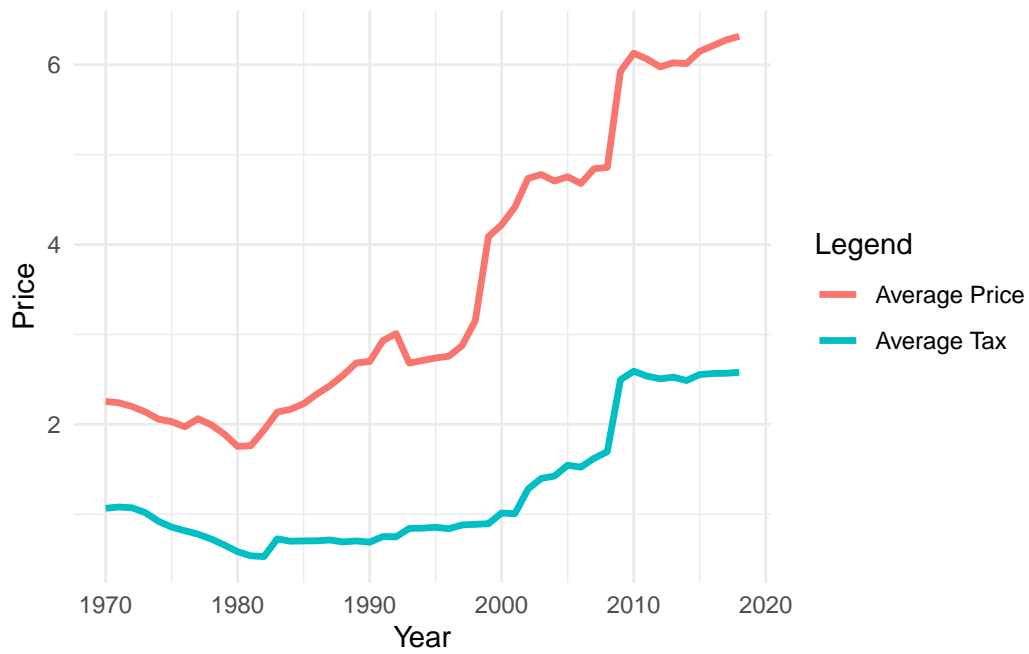
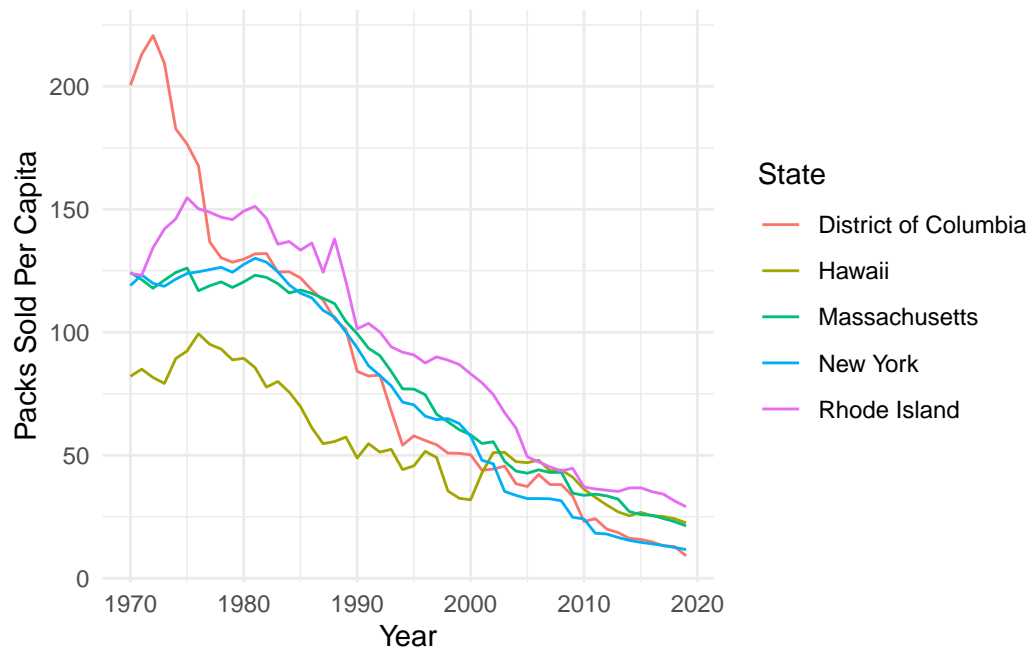


Figure 2: Average Tax and Price of Cigarettes (in 2012 dollars)

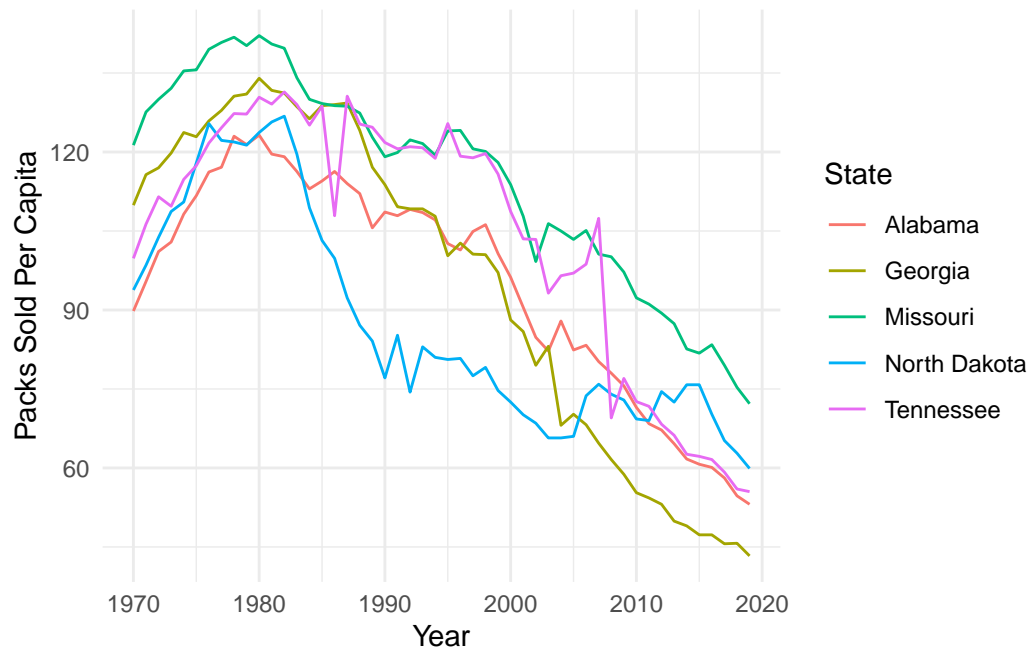
3. Identify the 5 states with the highest increases in cigarette prices (in dollars) over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.



(a) 5 States with Highest Increase in Cigarette Prices

Figure 3: Cigarette Sales Per Capita

4. Identify the 5 states with the lowest increases in cigarette prices over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.

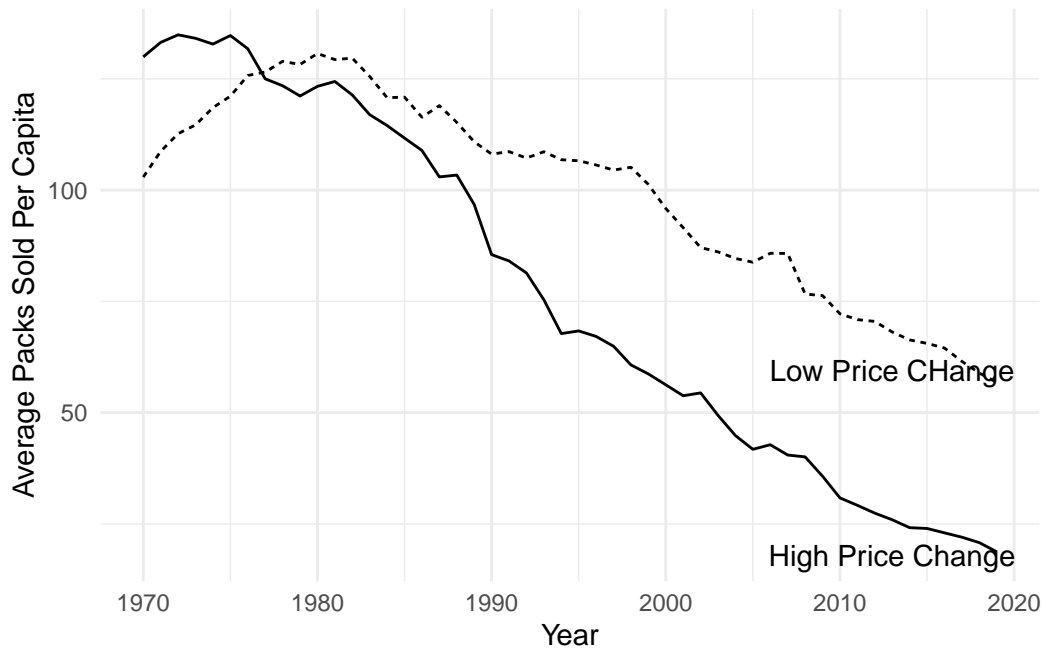


(a) 5 States with Lowest Increase in Cigarette Prices

Figure 4: Cigarette Sales Per Capita

**5. Compare the trends in sales from the 5 states with the highest price increases to those with the lowest price increases.**

As seen in Figure 5, there is a much larger decrease in cigarette sales, as measured by average packs sold per year per capita, among the top 5 states with the highest price increases compared to the 5 states with the lowest price increases.



(a) For States with Highest vs. Lowest Increases in Cigarette Prices

Figure 5: Comparison of Cigarette Sales

## 1970-1990

**6a. Focusing only on the time period from 1970 to 1990, regress log sales on log prices to estimate the price elasticity of demand over that period. Interpret your results.**

```
(Intercept)  log_price
      5.4288116    -0.8094384
```

The coefficient of -0.809 implies relatively inelastic demand. Essentially, consumers are less responsive to changes in price, which is logical considering that cigarettes are addictive goods.

**7a. Regress log sales on log prices using the total (federal and state) cigarette tax (in dollars) as an instrument for log prices. Interpret your results and compare your estimates to those without an instrument. Are they different? If so, why?**

```
(Intercept) fit_log_price  
5.4182024    -0.7955235
```

Using an instrumental variable, the coefficient on log price is similar but of lesser magnitude (-0.809 vs -0.796). This difference is likely due to a correction for endogeneity. By using the tax as an instrument, this regression addresses reverse causality and omitted variable bias, both of which could have inflated the OLS estimate.



**8a. Show the first stage and reduced-form results from the instrument.**

```
(Intercept) log_total_tax  
0.8409533      0.2600601
```

```
(Intercept) log_total_tax  
4.7492043     -0.2068839
```

## 1991-2015 (question 9)

6b.

```
(Intercept)    log_price  
    5.6617168    -0.9968136
```

The coefficient of -1 implies that the demand for cigarettes is unitary elastic. Essentially, for every 1% change in price, there is an associated 1% change in quantity demanded. In comparison to the 1970-1990 period, this relative increase in price elasticity may reflect a growing awareness among consumers about the negative health effects of smoking, making them more responsive to price changes.

**7b.**

(Intercept)	fit_log_price
5.881894	-1.150084

Using an instrumental variable, the coefficient on log price is similar but of greater magnitude (-1.000 vs -1.150). This difference suggests that the OLS estimate may have underestimated price elasticity due to endogeneity. By using the tax as an instrument, the IV regression addresses potential issues like reverse causality and omitted variable bias, which may have caused the OLS estimate to be biased toward zero. The IV estimate provides a more accurate measure of price elasticity by isolating the exogenous variation in price.

**8b.**

```
(Intercept) log_total_tax  
1.3159326      0.5135503
```

```
(Intercept) log_total_tax  
4.3684616     -0.5906258
```

**10. Compare your elasticity estimates from 1970-1990 versus those from 1991-2015. Are they different? If so, why?**

Table 1: Elasticity Estimates from OLS and IV

	1970-1990		1991-2015	
	OLS	IV	OLS	IV
<i>Estimates</i>				
Log Price	-0.809 (0.038)	-0.796 (0.071)	-0.997 (0.025)	-1.150 (0.028)
N	1,071	1,071	1,275	1,275
R2	0.294	0.294	0.561	0.548
<i>Reduced Form</i>				
Log Tax		-0.207 (0.021)		-0.591 (0.013)
N		1,071		1,275
R2		0.082		0.607
<i>First Stage</i>				
Log Tax		0.260 (0.012)		0.514 (0.007)
N		1,071		1,275
R2		0.290		0.812