

Homework 3

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Summarize the Data

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

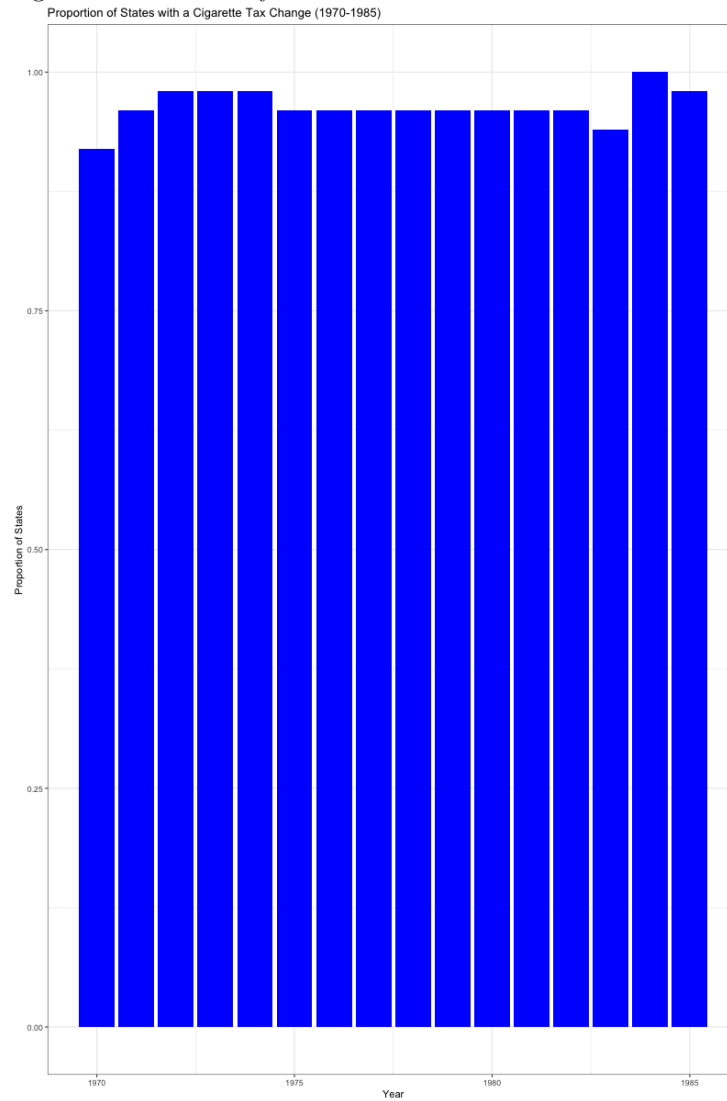


Figure 1: Proportion of states with cigarette tax changes (1970-1985).

Question 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.

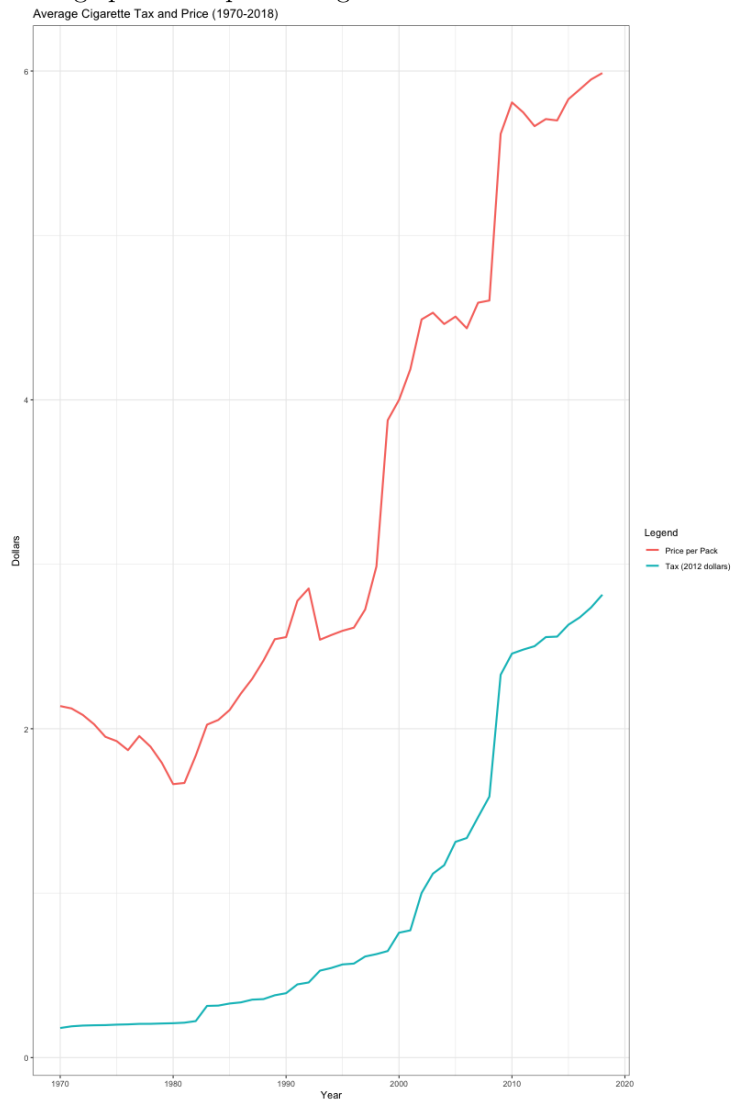


Figure 2: Average cigarette tax and price (1970-2018).

Question 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.

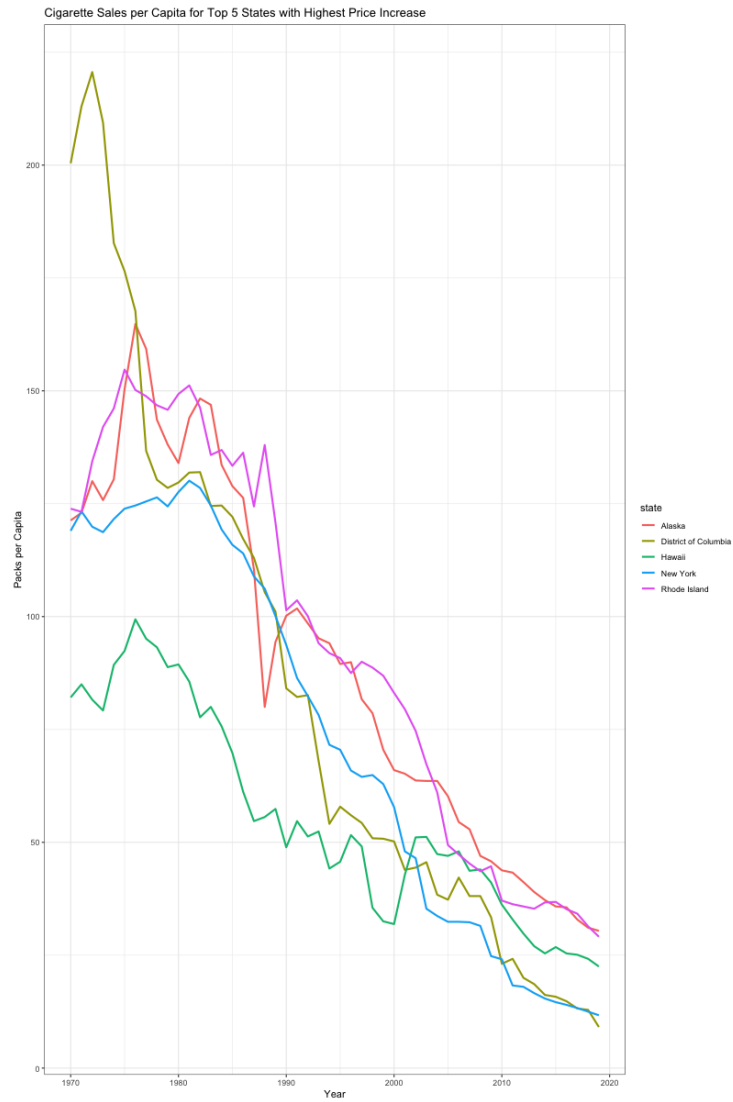


Figure 3: Cigarette sales per capita for top 5 states with highest price increases.

Question 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.

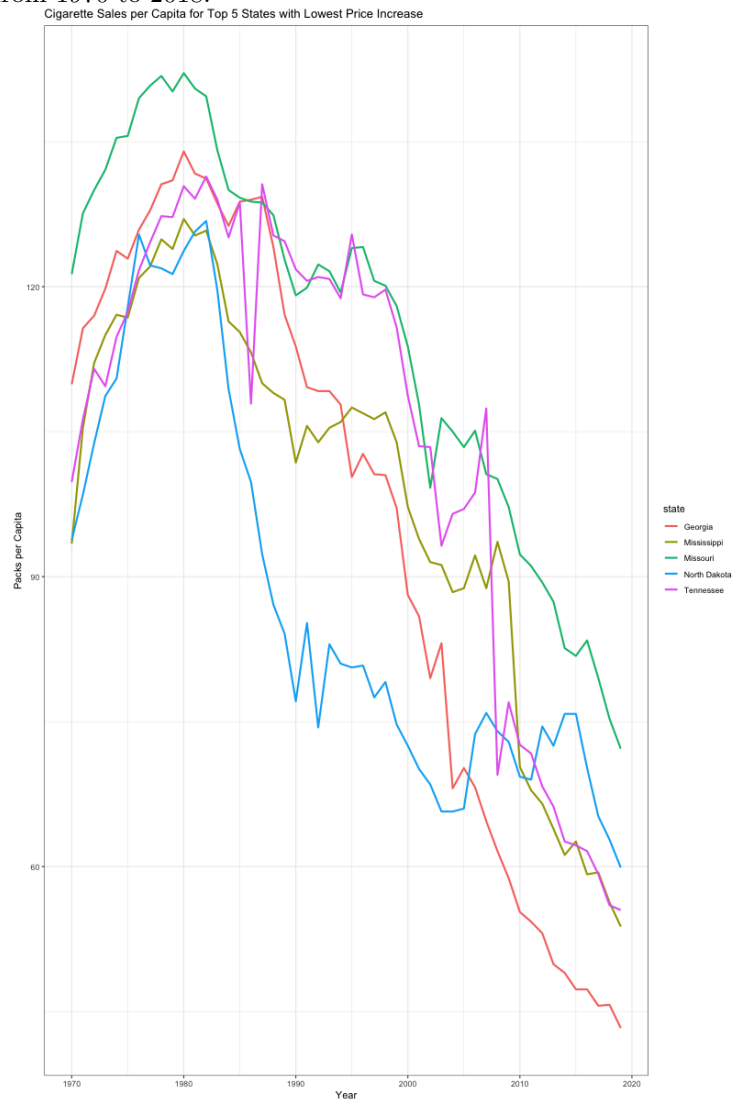


Figure 4: Cigarette sales per capita for top 5 states with lowest price increases.

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

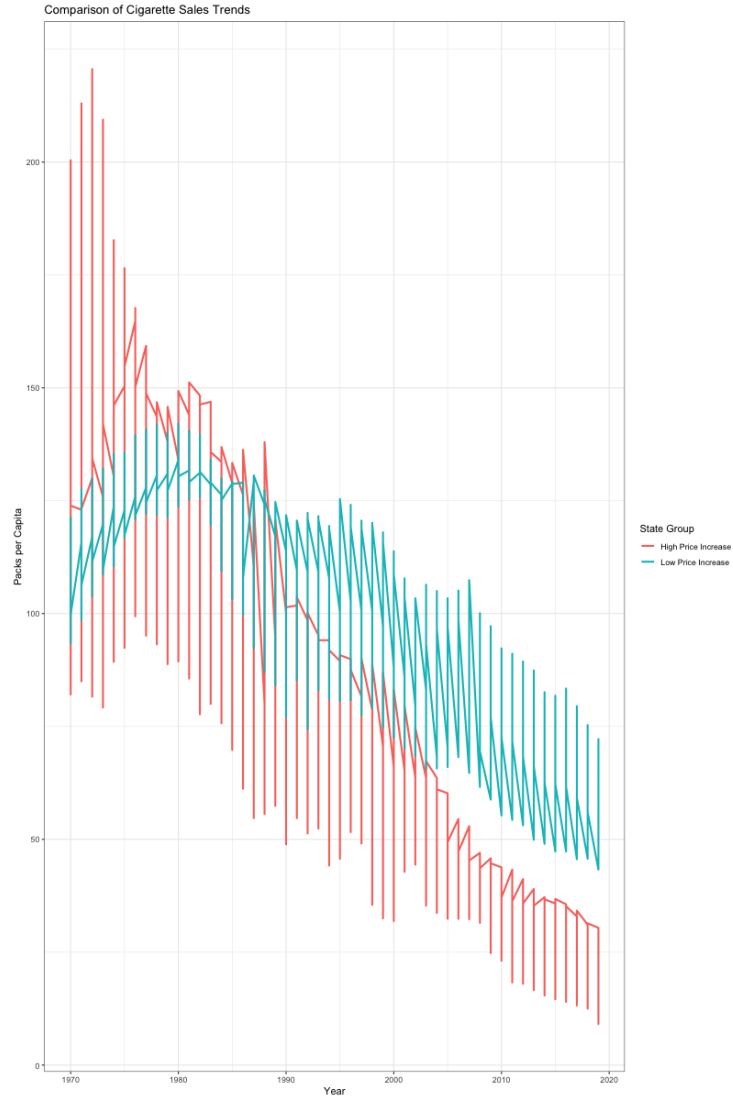


Figure 5: Comparison of cigarette sales trends: Highest vs. lowest price increases.

Estimate ATEs

Question 6: 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.

$$\log(\text{Sales per Capita}) = 5.38544 - 0.80944 \times \log(\text{Price}) \quad (1)$$

The coefficient for $\log(\text{Price})$ is -0.809, indicating that a 1% increase in cigarette prices leads to a 0.81% decrease in cigarette sales per capita. The estimate is highly significant ($p < 0.001$), confirming a strong negative relationship between price and cigarette demand.

Question 7: Again limiting to 1970 to 1990, 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?

$$\log(\text{Sales per Capita}) = 5.44402 - 0.89208 \times \log(\text{Price}) \quad (2)$$

The IV estimate of -0.892 is slightly larger in magnitude than the OLS estimate (-0.809), suggesting that OLS may have underestimated price elasticity due to endogeneity. Since cigarette sales and prices may be jointly determined, OLS estimates may be biased downward. The IV estimate corrects for this bias and provides a more accurate measure of the true effect.

Question 8: Show the first stage and reduced-form results from the instrument.

First-stage regression:

$$\log(\text{Price}) = 0.384 + 1.263 \times \text{Tax} \quad (3)$$

Reduced-form regression:

$$\log(\text{Sales per Capita}) = 5.101 - 1.127 \times \text{Tax} \quad (4)$$

Question 9: Repeat questions 1-3 focusing on the period from 1991 to 2015.

OLS regression (1991-2015):

$$\log(\text{Sales per Capita}) = 5.60830 - 0.99681 \times \log(\text{Price}) \quad (5)$$

The estimated price elasticity is -0.997, which is more elastic than the 1970-1990 estimate (-0.809), suggesting cigarette demand became more responsive to price over time.

IV regression (1991-2015):

$$\log(\text{Sales per Capita}) = 5.82616 - 1.15435 \times \log(\text{Price}) \quad (6)$$

The IV estimate (-1.154) is again larger in absolute value than the OLS estimate, reinforcing the pattern seen in the earlier period where OLS underestimates elasticity.

First-stage regression:

$$\log(\text{Price}) = 0.9952 + 0.2934 \times \text{Tax} \quad (7)$$

Reduced-form regression:

$$\log(\text{Sales per Capita}) = 4.6774 - 0.3386 \times \text{Tax} \quad (8)$$

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

Time Period	OLS Elasticity	IV Elasticity
1970-1990	-0.809	-0.892
1991-2015	-0.997	-1.154

Table 1: Comparison of Price Elasticity Estimates

- Cigarette demand became more elastic over time as seen in both OLS and IV estimates.
- The IV estimates are consistently larger in magnitude, suggesting that OLS underestimates price elasticity due to potential endogeneity.
- The demand shift may be explained by stricter regulations, increased health awareness, and availability of smoking alternatives.
- Higher taxes, smoking bans, and advertising restrictions made consumers more price-sensitive.
- Growing knowledge about smoking risks likely increased demand elasticity.
- The rise of vaping, nicotine patches, and other alternatives contributed to higher elasticity.