

Instrumental Variables: Demand for Cigarettes

Dr. Patrick Toche

Textbook:

James H. Stock and Mark W. Watson, *Introduction to Econometrics*, 4th Edition, Pearson.

Other references:

Joshua D. Angrist and Jörn-Steffen Pischke, *Mostly Harmless Econometrics: An Empiricist's Companion*, 1st Edition, Princeton University Press.

Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, 7th Edition, Cengage Learning.

The textbook comes with online resources and study guides. Other references will be given from time to time.

TABLE 12.1 Two Stage Least Squares Estimates of the Demand for Cigarettes Using Panel Data for 48 U.S. States

Dependent variable: $\ln(Q_{i,1995}^{\text{cigarettes}}) - \ln(Q_{i,1985}^{\text{cigarettes}})$

Regressor	(1)	(2)	(3)
$\ln(P_{i,1995}^{\text{cigarettes}}) - \ln(P_{i,1985}^{\text{cigarettes}})$	-0.94 (0.21) [-1.36, -0.52]	-1.34 (0.23) [-1.80, -0.88]	-1.20 (0.20) [-1.60, -0.81]
$\ln(Inc_{i,1995}) - \ln(Inc_{i,1985})$	0.53 (0.34) [-0.16, 1.21]	0.43 (0.30) [-0.16, 1.02]	0.46 (0.31) [-0.16, 1.09]
Intercept	-0.12 (0.07)	-0.02 (0.07)	-0.05 (0.06)
Instrumental variable(s)	Sales tax	Cigarette-specific tax	Both sales tax and cigarette-specific tax
First-stage F -statistic	33.7	107.2	88.6
Overidentifying restrictions J -test and p -value	—	—	4.93 (0.026)

These regressions were estimated using data for 48 U.S. states (48 observations on the 10-year differences). The data are described in Appendix 12.1. The J -test of overidentifying restrictions is described in Key Concept 12.6 (its p -value is given in parentheses), and the first-stage F -statistic is described in Key Concept 12.5. Heteroskedasticity-robust standard errors are given in parentheses beneath coefficients, and 95% confidence intervals are given in brackets.

Problems and Applications

Stock & Watson, Introduction (4th), Chapter 12, Exercise 1.

This question refers to the panel data IV regressions summarized in Table 12.1.

- a. Suppose the federal government is considering a new tax on cigarettes that is estimated to increase the retail price by \$0.50 per pack. If the current price per pack is \$7.50, use the IV regression in column (1) to predict the change in demand. Construct a 95% confidence interval for the change in demand.
- b. Suppose the United States enters a recession and income falls by 2%. Use the IV regression in column (1) to predict the change in demand.
- c. Suppose the recession lasts less than one year. Do you think that the IV regression in column (1) will provide a reliable answer to the question in (b)? Why or why not?
- d. Suppose the F -statistic in column (1) were 3.7 instead of 33.7. Would the IV regression provide a reliable answer to the question posed in (a)? Why or why not?

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The change in the log-price difference if the price rises from \$7.50 to \$8.00 is:

$$\ln(P_{t,1995}^{\text{cigarettes}}) - \ln(P_{t,1985}^{\text{cigarettes}}) = \ln(8.00) - \ln(7.50) \approx 0.0645$$

The expected change in cigarette demand is about 6% per year:

$$-0.94 \cdot 0.0645 \approx -6.07\%$$

This effect may seem large, but it is a long-run estimate of the elasticity over a ten-year period.

The 95% confidence interval for the change in demand is:

$$0.0645 \cdot (-0.94 \pm 1.96 \cdot 0.21) \approx [-8.72\%, -3.41\%]$$

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- b. Suppose the United States enters a recession and income falls by 2%. Use the IV regression in column (1) to predict the change in demand.

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Problems and Applications

- c. Suppose the recession lasts less than one year. Do you think that the IV regression in column (1) will provide a reliable answer to the question in (b)? Why or why not?

The estimated regression uses changes in log-prices over a ten-year period, between 1995 and 1985, to identify the elasticity parameter. The regression therefore yields an estimate of the long-run elasticity of cigarette demand.

The price elasticity of demand for most goods is larger in the long run than in the short run, because it takes time for consumers to change their purchasing habits, particularly for changes that may not be immediately noticeable. The force of habits is particularly strong for addictive goods like cigarettes.

The IV regression in column (1) will not provide a reliable answer to the question in (b) when recessions last less than one year. And since recessions are typically expected to last between two and four quarters, it is conceivable that the change in cigarette demand induced by a two-year recession would not be much larger than the change induced by a very short recession, as even price-conscious consumers may hope to "ride out" the recession without reducing their smoking habits.

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- d. Suppose the F -statistic in column (1) were 3.7 instead of 33.7. Would the IV regression provide a reliable answer to the question posed in (a)? Why or why not?

The “rule of thumb” is that if $F < 10$, the instrument is deemed to be weak.

If the F -statistic in column (1) was 3.7 instead of 33.7, it would suggest a weak instrument, violating the “relevant instrument” condition. Statistical inference with weak instruments is imprecise. Thus the IV regression would not provide a reliable answer to question (a).

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