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Economics 471: Applied Econometrics
Problem Set 2

Due Thursday, February 16th.

An important economic policy question has been tax policy for gasoline and other petroleum based products. A crucial component of any such debate is a reliable model of consumer demand. In this problem we will explore U.S. postwar demand for gasoline and some consequences for tax policy.

A simple static model for the demand for gasoline is

$$\log\ y_t\ =\ \alpha\ +\ \beta\ \log\ x_t\ +\ \gamma\ \log\ p_t\ +\ u_t$$

y_t = per capita personal consumption on gasoline in thousands of gallons, at annual rates.
x_t = per capita personal income, at annual rates
p_t = real price/gallon of gasoline at 1982 prices = \$1/gal.
Data on these three variables are on the 471 web page. There are 201 quarterly observations, starting in 1947 through 1997.

1. Estimate the static model suggested above. Compare and contrast the results with the results reported by Madalla's Example 4.3, (p.103, *Introductory Econometrics*) based on data from 1947-69:

$$\log\ y_t\ = \underset{(2.90)}{-8.72} + \underset{(.486)}{.535} \log\ x_t\ + \underset{(.137)}{1.541} \log\ p_t$$

2. Interpret the estimated parameters. Using the last observed quarters' data as a base period, Suppose the tax on gasoline were raised by 50 cents per gallon in 1982 prices. What does the model predict about the change in quantity demanded?

3. If the initial tax rate was 30 cents per gallon in (2), how much net revenue does the model predict that the tax would raise? Now compute the revenue change for a 1 dollar and 5 dollar per gallon tax increase, do the predictions of the model seem reasonable?

4. The simple static model for the demand for gasoline has some implausible features from a policy analysis standpoint. An alternative somewhat more appealing model might be the following:

$$\log\ y_t\ =\ \beta_0\ +\ \beta_1\ \log\ x_t\ +\ \beta_2\ \log\ p_t\ +\ \beta_3\ (\log\ p_t)^2\ +\ \beta_4\ \log\ p_t\ \log x_t\ +\ u_t \quad (2)$$

In model (2) the price elasticity of demand is

$$\eta \;=\; \frac{\partial \log y}{\partial \log p} \;=\; \beta_2 \;+\; 2\beta_3 \;\log\; p_t \;+\; \beta_4 \;\log x_t$$

If, as seems to be the case in US postwar data, $\beta_2 < 0$, $\beta_3 < 0$, and $\beta_4 > 0$, the model implies that gasoline demand is: (i) more elastic as price increases, and (ii) less elastic as income increases.

(a) Do these implications seem intuitively plausible? Why, or why not?

(b) Recalling that revenue is maximized when $\eta = -1$, suppose per capita income is x_0 and give a formula for computing the price which maximizes gasoline revenue assuming model (2) is correct.

(c) Estimate model (2) and compute the revenue maximizing price level according to the estimated model and assuming per capita inome is \$15,000 per year.