Economics 696F, Causal Inference and Program Evaluation

Problem Set 3 Suggested Solutions

1. The m-file `hw3a.m`, listed below, implements these calculations. It calls another function `tsls.m` for 2SLS estimates and standard errors under both homoskedasticity and heteroskedasticity.

   a. The least squares estimate is

$$\hat{q} = 8.41867 - 0.54087p.$$

   We expect that -0.54087 is greater than the true demand elasticity. Setting demand equal to supply, we have

$$\alpha_0 + \alpha_1 p + \epsilon^d = \beta_0 + \beta_1 p + \beta_2 z + \epsilon^s,$$

   which gives

$$p = \frac{\beta_0 - \alpha_0 + \beta_2 z + \epsilon^s - \epsilon^d}{\alpha_1 - \beta_1}.$$

   The least squares estimator satisfies

$$\begin{aligned}
\text{plim } b &= \frac{Cov(p,q)}{Var(p)} \\
&= \frac{Cov(p, \alpha_0 + \alpha_1 p + \epsilon^d}{Var(p)} \\
&= \alpha_1 \frac{Var(p)}{Var(p)} + \frac{Cov(p, \epsilon^d)}{Var(p)} \\
&= \alpha_1 + \frac{Cov(p, \epsilon^d)}{Var(p)}.
\end{aligned}$$

   From our earlier expression for p, and the assumption that supply and demand shocks are uncorrelated, we have

$$Cov(p, \epsilon^d) = -\frac{1}{\alpha_1 - \beta_1} Var(\epsilon^d).$$

   Since we expect $\alpha_1 < \beta_1$, we expect $Cov(p, \epsilon^d) > 0$. Thus plim $b > \alpha_1$.

   (b) The reduced form regressions give

$$\begin{aligned}
\hat{p} &= -0.29033 + 0.33526z \\
\hat{q} &= 8.62805 - 0.36289z
\end{aligned}$$

   The indirect estimate of α_1 is

$$\hat{\alpha_1} = -0.36289/0.33526 = -1.0824.$$

(c) The exclusion restriction in the extended model says that the demand shock is unrelated to off-shore weather, after controlling for the variables in x. This is more plausible, since it allows for some correlation between off-shore weather and demand through variables such as cold and rainy.

(d) The 2SLS estimate of the demand elasticity is -1.222796, with a standard error of 0.51247. This is similar to the estimate in the shorter model.

(e). The standard error allowing for heteroskedasticity is 0.52444. This is only slightly larger than the SE assuming homoskedasticity.

2. The M-function `imbens_newey.m` implements the Imbens-Newey estimator, and this is called by `hw3b.m` to analyze the data set. Here are the results:

```
Results:

     x         muhat

   0.00000  -0.60812
   0.50000   1.36471
   1.00000   3.33754
   1.50000   5.31038
   2.00000   7.28321
```