Exam #2 Answer Key

Economics 435

Spring 2003

1 A few short questions

a) No. While high school grades satisfy relevance (they are correlated with university attendance), they are not exogenous (they are associated with intelligence, patience, and hard work, which are likely to impact future wages).

b) No.

c) The assumption needed is that Δu_i and $\Delta unem_i$ are uncorrelated. You will get partial credit for assuming that $unem_{i,t}$ and u_{it} are uncorrelated, but this is a stronger assumption than is necessary.

2 Mismeasurement in the CPI

a) Since $\hat{\beta}_1 = \frac{\hat{cov}(g_i, m_i)}{\hat{var}(m_i)}$,

$$\begin{aligned}
\text{plim } \hat{\beta}_1 &= \frac{cov(g_i, m_i)}{var(m_i)} \\
&= \frac{\beta_1 cov(a_i, m_i) + cov(u_i, m_i)}{var(a_i) + var(v_i) + 2cov(a_i, v_i)} \\
&= \frac{\beta_1 var(a_i) + \beta_1 cov(a_i, v_i)}{var(a_i) + var(v_i)} \\
&= \beta_1 \frac{var(a_i)}{var(a_i) + \sigma_v^2}
\end{aligned}$$

b) The estimator is biased towards zero.

c)

$$\begin{aligned}
\text{plim } \hat{\beta}_1 &= \frac{cov(g_i, m_i)}{var(m_i)} \\
&= \frac{cov(g_i, (1+\gamma)a_i)}{var((1+\gamma)a_i)} \\
&= \frac{(1+\gamma)\beta_1 var(a_i) + (1+\gamma)cov(u_i, a_i)}{(1+\gamma)^2 var(a_i)} \\
&= \beta_1/(1+\gamma)
\end{aligned}$$

d) Again, the estimator is biased towards zero.

e) Following the previously used method:

$$\begin{aligned}
\text{plim } \hat{\beta}_1 &= \frac{cov(g_i, m_i)}{var(m_i)} \\
&= \frac{cov(g_i, a_i) + \lambda(cov(g_i, h_i)}{var(a_i) + \lambda^2 var(h_i) + 2\lambda cov(a_i, h_i)} \\
&= \frac{\beta_1 var(a_i) + \beta_2 cov(a_i, h_i) + cov(a_i, u_i) + \lambda(\beta_1 cov(a_i, h_i) + \beta_2 var(h_i) + cov(u_i, h_i)}{var(a_i) + \lambda^2 var(h_i)} \\
&= \frac{\beta_1 var(a_i) + \lambda\beta_2 var(h_i)}{var(a_i) + \lambda^2 var(h_i)}
\end{aligned}$$

f) When $\beta_1 = 0$, plim $\hat{\beta}_1 > 0$, so the bias is upwards. When $\beta_2 = 0$, the bias is towards zero. When $\lambda = 0$, there is no bias.

g) There are many correct answers, the most obvious of which is initial GDP.

3 Estimating the demand for cigarettes

a) Substituting in $p_i^S + t_i$ for p_i^D, and rearranging, we get the reduced form

$$q_i = \frac{\beta_0 + \beta_1\alpha_0}{1 - \beta_1\alpha_1} + \frac{\beta_1}{1 - \beta_1\alpha_1} t_i + \frac{\beta_1 v_i + u_i}{1 - \beta_1\alpha_1}$$

Since this satisfies the conditions for consistent estimation by OLS, the coefficient on t_i will be a consistent estimate of $\frac{\beta_1}{1-\beta_1\alpha_1}$, and a consistent estimate of the price elasticity of demand β_1 if either $\alpha_1 = 0$ or $\beta_1 = 0$.

b) In order for the response to tax changes to give us the elasticity of demand it is necessary to assume that supply is perfectly elastic - firms will provide any amount at some fixed price. When that is the case, tax increases are passed directly on to consumers, so an increase in tax of t_i is the same as an increase in consumer's price of t_i.

Alternatively, if demand is perfectly inelastic ($\beta_1 = 0$), then there will be no quantity response to tax changes, and we will tend to estimate (correctly) that $\beta_1 = 0$.