Homework 3

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1 Question 1 (a)

$$y_i = e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i} \tag{1}$$

Take log on both sides

$$\ln(y_i) = \ln(e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i}) \tag{2}$$

$$\ln(y_i) = \ln(e^{\alpha}) + \ln(\delta^{d_i}) + \ln(z_i^{\gamma}) + \ln(e^{\eta_i}) \tag{3}$$

$$\ln(y_i) = \alpha \ln(e) + d_i \ln(\delta) + \gamma \ln(z_i) + \eta_i \ln(e) \tag{4}$$

We know that $\ln(e) = 1$

$$\ln(y_i) = \alpha + d_i \ln(\delta) + \gamma \ln(z_i) + \eta_i \tag{5}$$

2 Question 1 (b)

2.1 Answer:

When both the dependent and independent variables are converted into logs before the OLS estimation, that is the case of elasticity. This is known as the log-log case or double log case and provides us with direct estimates of the elasticities of the independent variables. In this case, the coefficient of estimates is variable.

That means δ gives the estimates of the elasticities of the variable 'Retrofit'. In other words, holding other control variables constant coefficient δ gives the estimates of the difference in the electricity consumption between the houses which received the retrofit program as compared to the houses which did not receive the program.

3 Question 1 (c)

$$y_i = e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i} \tag{6}$$

$$\text{When } d_i = 0 \ y_{i0} = e^{\alpha} z_i^{\gamma} e^{\eta_i} \tag{7}$$

$$\text{When } d_i = 1 \ y_{i1} = \delta e^{\alpha} z_i^{\gamma} e^{\eta_i} \tag{8}$$

$$\triangle y_i = y_{i1} - y_{i0} \tag{9}$$

$$\frac{\triangle y_i}{\triangle d_i} = (\delta_1 - 1) e^{\alpha} z_i^{\gamma} e^{\eta_i} \tag{10}$$

$$\text{From equation 6 we can get } e^{\alpha} z_i^{\gamma} e^{\eta_i} = \frac{y_i}{\delta^{d_i}} \tag{11}$$

$$\frac{\triangle y_i}{\triangle d_i} = \frac{(\delta_1 - 1)}{\delta^{d_i}} y_i \tag{12}$$

$$\tag{13}$$

4 Question 1 (d)

From equation 5 we can get

$$\ln(y_i) = \alpha + d_i \ln(\delta) + \gamma \ln(z_i) + \eta_i \tag{14}$$

Differentiate with respect to z_i

$$\frac{1}{y_i}\frac{\partial y_i}{\partial z_i} = \frac{\gamma}{z_i} \tag{15}$$

$$\frac{\partial y_i}{\partial z_i} = \gamma \frac{y_i}{z_i} \tag{16}$$

$$\tag{17}$$

5 Question 1 (e)

	Coefficient Estimates	Average Marginal Effect
Constant	-0.768728	0.000000
Sqft of home	0.894291	0.628662
Retrofit	-0.100547	-113.975304
Temperature	0.281345	3.997015
Observations	1000.000000	1000.000000

Table 1: Estimates table without bootstrapping

Table 2 bootstrap the 95% confidence intervals of the coefficient estimates and the marginal effects estimates using 1000 sampling replications. Note that each bootstrap replication perform both the regression and the second stage calculation of the marginal effect.

	Estimates	Average Marginal Effect
sqft of home	0.89	0.63
	(0.88, 0.91)	(0.62, 0.64)
Retrofit	-0.10	-113.98
	(-0.11, -0.09)	(-128.29, -99.76)
Temperature	0.28	4.00
	(0.03, 0.52)	(0.42, 7.45)
Constant	-0.77	0.00
	(-1.86, 0.38)	(0.0, 0.0)
Observations	1000	1000

Table 2: With Bootstrapping

6 Question 1 (f)

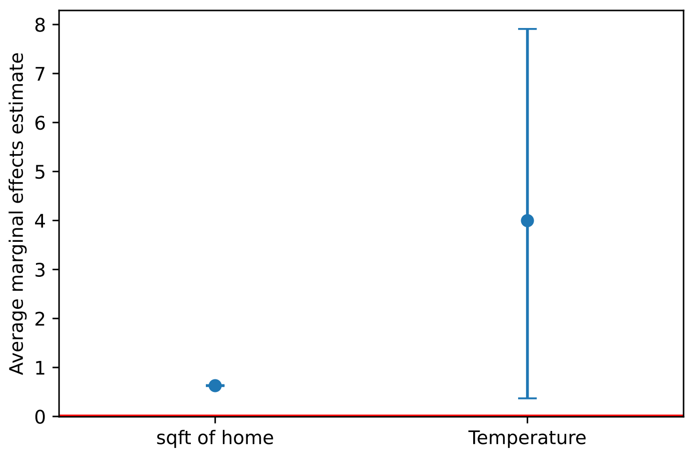

Figure 1: The average marginal effects of outdoor temperature and square feet of the home with bands for their bootstrapped confidence intervals