Homework 3

Economics 7103

Spring semester 2023

1

The proof can be shown by simple log rules manipulation:

Given:

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

Taking natural log on both side:

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

Expanding further:

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

We know that the natural log of Euler's number is 1

Thus:

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

Hence Proved.

2

δ is the coefficient to the binary variable that indicates the treatment/control group. In the control group, when $d_i = 0$ then δ does not exist. But when it is 1, δ gives us the multiplier effect for energy consumption of being in the treated group.

3

The change in y_i with respect to change in d_i tells us the amount of electricity saved due to being in the treatment group.

$$\frac{\Delta y_i}{\Delta d_i} = y_1 - y_0 \tag{1}$$

$$= e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i} - e^{\alpha} z_i^{\gamma} e^{\eta_i} \tag{2}$$

$$= (\delta - 1) e^{\alpha} z_i^{\gamma} e^{\eta_i} \tag{3}$$

Multiplying both sides with y_i:

$$= (\delta - 1) e^{\alpha} z_i^{\gamma} e^{\eta_i} * \frac{e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i}}{e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i}} \tag{4}$$

This gives us:

$$= \frac{\delta - 1}{\delta^{d_i}} y_i \tag{5}$$

Hence Proved.

4

The partial derivative tells us the effect of one unit change in z_i, the size of home in square feet, on electricity consumption y_i.

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

$$= e^{\alpha}\delta^{d_i} e^{\eta_i} * \gamma * z^{\gamma_i - 1} \tag{2}$$

Multiplying both sides by z_i:

$$= \frac{\gamma}{z_i} * e^{\alpha}\delta^{d_i} z_i^{\gamma} e^{\eta_i} \tag{3}$$

This is the same as y_i

$$= \gamma \frac{y_i}{z_i} \tag{4}$$

Hence proved.

5

The table gives us the Coefficients for log regressions as well as the marginal effects (dy/dx).

	Coefficient b/ci95	Marginal Effects b/ci95
ls	0.89***	
	0.88,0.91	
retrofit	-0.10***	-109.67***
	-0.11,-0.09	-125.26,-94.07
lt	0.28*	
	0.03,0.53	
sqft		0.62***
		0.60,0.63
temp		3.26
		-0.52,7.03
Constant	-0.77	-83.60
	-1.89,0.35	-386.51,219.30
Observations	1000	1000

Table 1: Regression estimates (ls: ln(sqrt), lt: ln(temp))

6

See below.

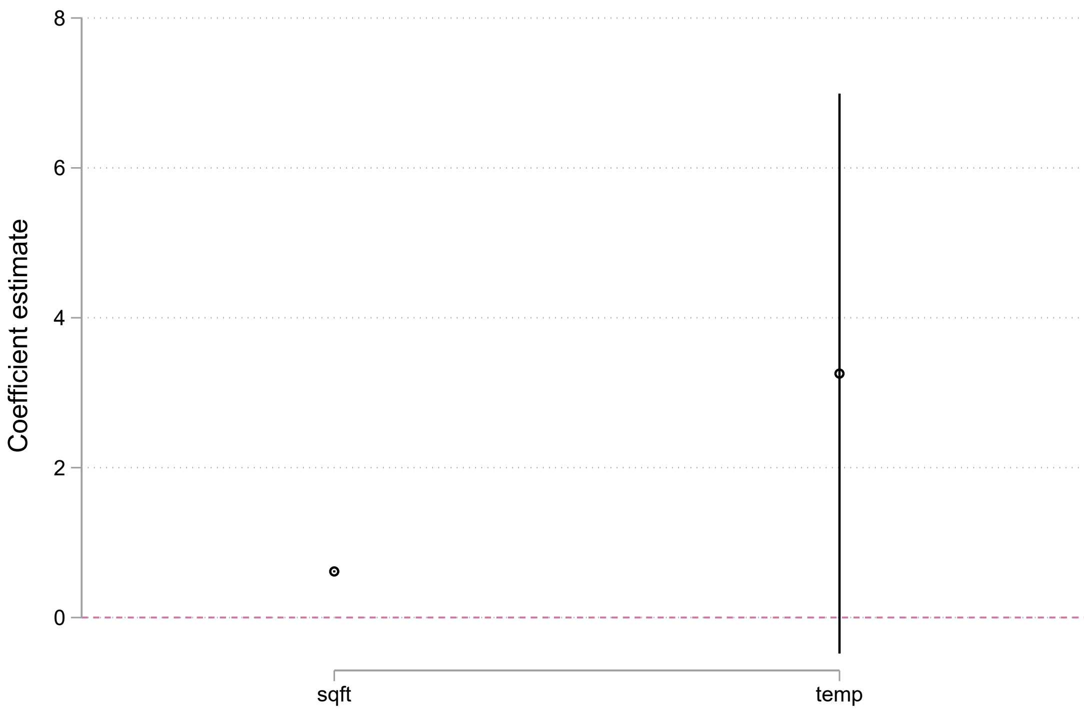

Figure 1: Marginal effects with bootstrapped CI