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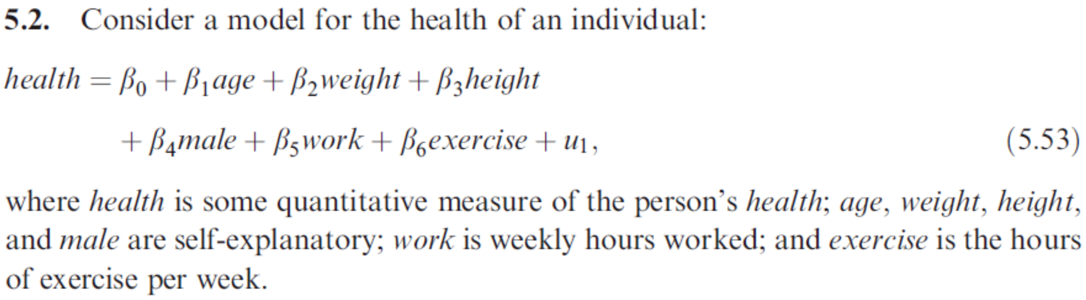
Homework 9



5.2. Consider a model for the health of an individual:

$$health = \beta_0 + \beta_1 age + \beta_2 weight + \beta_3 height + \beta_4 male + \beta_5 work + \beta_6 exercise + u_1, \quad (5.53)$$

where *health* is some quantitative measure of the person's *health*; *age*, *weight*, *height*, and *male* are self-explanatory; *work* is weekly hours worked; and *exercise* is the hours of exercise per week.

a. Why might you be concerned about exercise being correlated with the error term?

The error term involves unobserved factors that might be correlated with the variable *exercise* and also determine the health of an individual. For example, income is likely to be correlated with exercise. People with higher income can afford exercise-related activities such as getting gym membership or hiring a personal trainer. Therefore, higher income might induce higher frequency of exercise. Also, people with higher income are more aware of their health status because of more access to health providers so higher income is likely to promote better health.

b. Discuss whether *disthome* and *distwork* are likely to be uncorrelated with the error term.

If the sample selection follows a randomized setting, meaning that people do not systematically choose the location of their homes and jobs relative to health clubs, it is reasonable to believe that these two factors are uncorrelated with each other. However, the location of health clubs might depend on the location of residential areas or the location of nearby companies. Therefore, the location of health clubs may not be exogenous.

c. Write down the reduced variables in equation 5.53 with the exception of *exercise*. Write down the reduced form of exercise, and state the conditions under which the parameters of equation are identified.

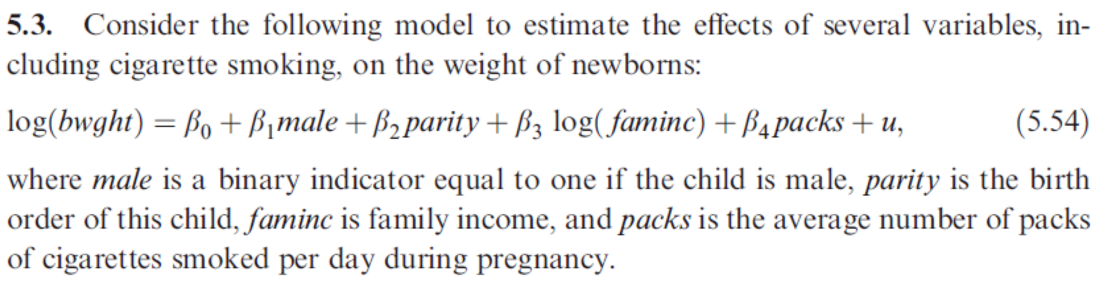
The reduced form for *exercise* is

$$exercise = b_0 + b_1 age + b_2 weight + b_3 height + b_4 male + b_5 work + b_6 dishome + b_7 distwork + u_1$$

We need at least one of b_6 or b_7 to be different from zero for the parameters of equation are identified.

d. How can the identification assumption in part c be tested?

We can do an F test with $H_0: b_6 = 0, b_7 = 0$. Ideally, we want to reject the null so that the parameters of equations are identified.



5.3. Consider the following model to estimate the effects of several variables, including cigarette smoking, on the weight of newborns:

$$\log(bwght) = \beta_0 + \beta_1 male + \beta_2 parity + \beta_3 \log(faminc) + \beta_4 packs + u, \qquad (5.54)$$

where *male* is a binary indicator equal to one if the child is male, *parity* is the birth order of this child, *faminc* is family income, and *packs* is the average number of packs of cigarettes smoked per day during pregnancy.

a. Why might you expect packs to be correlated with u?

There are unobserved factors in u that might be correlated with the number of packs of cigarette smoked and also determine the weight of newborns. For example, diet can be one of the unobserved factors because women who smoke more during pregnancy are likely to follow an unhealthy diet that may have an effect on the weight of newborns.

b. Discuss whether average cigarette price is likely to satisfy the properties of a good instrumental variable for packs.

In order for average cigarette price to be a good instrumental variable. It has to satisfy two conditions: relevance and exogeneity. Average cigarette price is relevant to *packs* since a higher average price is likely to reduce the number of packs smoked. However, average cigarette price might fail the exogeneity condition because

c. Use OLS, then 2SLS.

OLS output

```
lm(formula = log(bwght) ~ male + parity + log(faminc) + packs, 
    data = mydata)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.63729 -0.08845  0.02034  0.12271  0.84409 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)  4.675618   0.021881 213.681  < 2e-16 ***
male         0.026241   0.010089   2.601  0.00940 ** 
parity       0.014729   0.005665   2.600  0.00942 ** 
log(faminc)  0.018050   0.005584   3.233  0.00126 ** 
packs       -0.083728   0.017121  -4.890 1.12e-06 ***
```

2SLS output

```
ivreg(formula = log(bwght) ~ male + parity + log(faminc) + packs | 
    . - packs + cigprice, data = mydata)

Residuals:
     Min       1Q   Median       3Q      Max 
-2.19538 -0.06910  0.07829  0.19077  0.89686 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)  4.467861   0.258829  17.262   <2e-16 ***
male         0.029821   0.017779   1.677   0.0937 .  
parity      -0.001239   0.021932  -0.056   0.9550    
log(faminc)  0.063646   0.057013   1.116   0.2645    
packs        0.797106   1.086275   0.734   0.4632    
```

There seems to be a huge difference between OLS and 2SLS in the estimated effect of *packs* on *bwght*. With OLS, one more pack of cigarettes will reduce bwght by about 8.4%, holding other constant and the t-test is statistically significant on the coefficient. The 2SLS estimate on the coefficient of *packs* is not significant and it has opposite sign.

d. Estimate the reduced form for *packs*.

```
lm(formula = packs ~ male + parity + log(faminc) + cigprice,
    data = mydata)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.36386 -0.11365 -0.08285 -0.04761  2.36602 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.1374075  0.1040005   1.321   0.1866    
male        -0.0047261  0.0158539  -0.298   0.7657    
parity       0.0181491  0.0088802   2.044   0.0412 *  
log(faminc) -0.0526374  0.0086991  -6.051 1.85e-09 ***
cigprice     0.0007770  0.0007763   1.001   0.3171    
```

Now that *cigprice* is not statistically significant and the coefficient shows that *cigprice* has a positive effect on *packs* which is not expected. Therefore, it is reasonable to say that *cigprice* fails as an IV for *packs* because its correlation with *packs* is not statistically significant and it does not have an expected sign with regards to *packs*.