ECON3140HW6

Nick Gembs

4/21/2022

```
library(haven)

data <- read_dta("C:/Users/Nick/Downloads/JEC.dta")

# 3.1
# This model is created to estimate the overall elasticity of demand in the
market. Elasticity is represented in the form of percent change, and since
this model is likely skewed and not entirely linear, a log-log model would
best respresent this model by regressing a percent change in y (Qi) on a
percent change in x (Pi). ICE is included because it will clearly have an
effect on quantity shipped, as icy roads will lower quntity. However, this
regressor is not logged because it is binary.

# 3.2

lm.fit <- lm(data$quantity ~ log(data$price) + data$ice + data$seas1 +
data$seas2 + data$seas3 + data$seas4 + data$seas5 + data$seas6 + data$seas7 +
data$seas8 + data$seas9 + data$seas10 + data$seas11 + data$seas12)

summary(lm.fit)

##
## Call:
## lm(formula = data$quantity ~ log(data$price) + data$ice + data$seas1 +
##     data$seas2 + data$seas3 + data$seas4 + data$seas5 + data$seas6 +
##     data$seas7 + data$seas8 + data$seas9 + data$seas10 + data$seas11 +
##     data$seas12)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -28520  -6705   -164   5565  33087
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)      -8049.3     4174.5  -1.928  0.05474 .
## log(data$price) -16233.3     2007.1  -8.088 1.35e-14 ***
## data$ice         13326.4     2913.7   4.574 6.91e-06 ***
## data$seas1       -2768.0     2703.1  -1.024  0.30662
## data$seas2        2479.8     2711.3   0.915  0.36109
## data$seas3        3284.8     2711.6   1.211  0.22665
## data$seas4        8581.9     2697.8   3.181  0.00161 **
## data$seas5        7356.7     3164.9   2.324  0.02074 *
```

```
## data$seas6        5391.2     3887.9   1.387  0.16653
## data$seas7        8190.2     3898.8   2.101  0.03647 *
## data$seas8        -461.2     3894.3  -0.118  0.90580
## data$seas9        3251.9     3898.3   0.834  0.40482
## data$seas10       6984.2     3929.3   1.777  0.07646 .
## data$seas11       7912.3     3900.1   2.029  0.04333 *
## data$seas12       7599.3     3876.7   1.960  0.05085 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9678 on 313 degrees of freedom
## Multiple R-squared:  0.3375, Adjusted R-squared:  0.3079
## F-statistic: 11.39 on 14 and 313 DF,  p-value: < 2.2e-16

# 3.3

# This estimate is not entirely credible because some of the covariates may
be correlated with the error term. log(price) likely has a nonzero
corrleation with other regressors and the error term as many factors effect
price, including the navigatibility of the Great Lakes and the season. Cartel
would be a plausible IV as it is not correlated with the other terms.

# 3.4

firststage = lm(log(data$price) ~ data$cartel)
summary(firststage)

##
## Call:
## lm(formula = log(data$price) ~ data$cartel)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.59597 -0.23180 -0.08515  0.09717  0.61550
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.66532    0.02047  -81.37   <2e-16 ***
## data$cartel  0.36418    0.02601   14.00   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2288 on 326 degrees of freedom
## Multiple R-squared:  0.3755, Adjusted R-squared:  0.3735
## F-statistic:   196 on 1 and 326 DF,  p-value: < 2.2e-16

firststage = lm((data$ice) ~ data$cartel)
summary(firststage)

##
## Call:
```

```
## lm(formula = (data$ice) ~ data$cartel)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.4384 -0.4384 -0.4080  0.5616  0.5920
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.40800    0.04436   9.198   <2e-16 ***
## data$cartel  0.03042    0.05638   0.540     0.59
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.4959 on 326 degrees of freedom
## Multiple R-squared:  0.0008924,  Adjusted R-squared:  -0.002172
## F-statistic: 0.2912 on 1 and 326 DF,  p-value: 0.5898
```

 # Based on the P values and F statistics, cartel appears to be a weak instrumental variable for ice, however a strong instrumental variable for price. Cartel could instead be an instrumental variable for price as price will likely go up if the great lakes are not navigable. Price is also likely correlated with the error term as many factors effect the price. Carteli is not correlated witht the other covariates like price is.

 # 3.5

```
second = lm( data$quantity ~ firststage$fitted.values + data$ice + data$seas1
+ data$seas2 + data$seas3 + data$seas4 + data$seas5 + data$seas6 + data$seas7
+ data$seas8 + data$seas9 + data$seas10 + data$seas11 + data$seas12 )
summary(second)
```

```
##
## Call:
## lm(formula = data$quantity ~ firststage$fitted.values + data$ice +
##     data$seas1 + data$seas2 + data$seas3 + data$seas4 + data$seas5 +
##     data$seas6 + data$seas7 + data$seas8 + data$seas9 + data$seas10 +
##     data$seas11 + data$seas12)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -25009  -6334  -1752   6347  36365
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 117529.43   17636.33   6.664 1.20e-10 ***
## firststage$fitted.values -236334.28   38904.42  -6.075 3.60e-09 ***
## data$ice                    12202.81    3058.82   3.989 8.25e-05 ***
## data$seas1                  -3514.65    2812.82  -1.250   0.2124
## data$seas2                    149.39    2812.82   0.053   0.9577
## data$seas3                    -99.27    2823.96  -0.035   0.9720
```

```
## data$seas4                   6734.06    2825.80   2.383   0.0178 *
## data$seas5                   6386.45    3326.25   1.920   0.0558 .
## data$seas6                   5012.46    4071.77   1.231   0.2192
## data$seas7                   8483.21    4071.77   2.083   0.0380 *
## data$seas8                   -733.63    4080.34  -0.180   0.8574
## data$seas9                   2318.94    4109.47   0.564   0.5730
## data$seas10                  7584.27    4109.47   1.846   0.0659 .
## data$seas11                  8581.47    4063.79   2.112   0.0355 *
## data$seas12                  6670.39    4063.79   1.641   0.1017
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10060 on 313 degrees of freedom
## Multiple R-squared:  0.2835, Adjusted R-squared:  0.2514
## F-statistic: 8.846 on 14 and 313 DF,  p-value: 2.934e-16

EstimatedElasticity = second$coefficients[2]
EstimatedElasticity

## firststage$fitted.values
##                -236334.3

# Price Elasticity of Demand is very negative, suggesting a heavily elastic
demand

# 3.6

# This IV regression shows that the elasticity of demand is significantly
less than negative 1, suggesting heavy elasticity. This means that the firm
is not operating at a profit maximizing price.
```