EDS 241 Assignment 4

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3/11/2022

Introduction

We plan to estimate the price elasticity of demand for fresh sardines acros 56 points in 4 European countries. We will use monthly data from 2013 - 2019.

Data description

Variables include:

- `country`
- `port`: where the fish is landed and sold
- `year`
- `month`
- `price_euro_kg`: price per kg in Euros
- `volume_sold_kg`: quantity of sardines sold in kg
- `wind_m_s`

Set up

Read in the data

```
data <- read_csv(here("data", "EU_sardines.csv"))

data_clean <- data %>%
  clean_names() %>%
  mutate(year = as.factor(year),
         month = as.factor(month),
         price_euro_kg = as.numeric(price_euro_kg),
         volume_sold_kg = as.numeric(volume_sold_kg),
         wind_m_s = as.numeric(wind_m_s)
  )
```

(a) Estimate a bivariate regression of log(volume_sold_kg) on log(price euro_kg). What is the price elasticity of demand for sardines? Test the null hypothesis that the price elasticity is equal to -1.

```
data_log <- data_clean %>%
  mutate(volume_log = log(volume_sold_kg),
         price_log = log(price_euro_kg))

mdl <- lm_robust(price_log ~ volume_log, data = data_log)
price_elasticity <- round(mdl$coefficients[[2]], digits = 2)
```

The price elasticity of demand for sardines is approximately -0.07.

Table 1 shows the results of a bivariate regression of log-transformed volume sold and log-transformed price per kg of freshs ardines across 56 ports in 4 European contries from 2013 - 2019.

Table 1: Sardine volume significantly impacts price in Europe

	Dependent variable:
	Log(Price)
Log(Volume)	-0.068^{***}
	(0.003)
Observations	3,988
R^2	0.104
Note:	*p<0.1; **p<0.05; ***p<0.01

(b) Like in Lecture 8 (see the IV.R script), we will use wind_m_s as an instrument for log(price_euro_kg). To begin, estimate the first-stage regression relating log(price_euro_kg) to wind_m_s. Interpret the estimated coefficient on wind speed. Does it have the expected sign?

First-stage regression

```
fs1 <- lm(formula = price_log ~ wind_m_s, data=data_log)
summary(fs1)
```

```
##
## Call:
## lm(formula = price_log ~ wind_m_s, data = data_log)
##
## Residuals:
```

```
##     Min      1Q  Median      3Q     Max
## -4.4705 -0.3871 -0.0095  0.4060  3.7839
##
## Coefficients:
##              Estimate Std. Error t value            Pr(>|t|)
## (Intercept) -0.304888   0.026660  -11.44 <0.0000000000000002 ***
## wind_m_s     0.067346   0.005374   12.53 <0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.5884 on 3986 degrees of freedom
## Multiple R-squared:  0.0379, Adjusted R-squared:  0.03766
## F-statistic:   157 on 1 and 3986 DF,  p-value: < 0.00000000000000022
```

```
wind_coef <- round(fs1$coefficients[[2]], digits = 2)

#F > 10 BUT it is testing all parameters including the constant
```

The coefficient on wind speed is approximately 0.07. In other words, on average, when wind speed increases by 1 m/sec, the log price of of sardines per kg increases by 0.07 in Euros.

Table

(b) Also test for the relevance of the instrument and whether it is a "weak" instrument by reporting the proper F-statistic.

F-test for non-weak and relevant instruments

```
f <- linearHypothesis(fs1, c("wind_m_s=0"), white.adjust = "hc2")
f_coef <- round(f$F[2], digits = 2)
```

Wind speed is not a weak instrument because the F-test value of 144.65 is above our threshold of 10.

(c) Estimate the TSLS estimator of the price elasticity of demand for sardines using wind_m_s as an instrument for log(price_euro_kg). What is the estimated price elasticity of demand for sardines?

Two-stage least square regresion

```
tsls1 <- ivreg(volume_log ~ price_log | wind_m_s, data = data_log)
price_elasticity2 <- round(tsls1$coefficients[[2]], digits = 2)

summary(tsls1)
```

```
##
## Call:
## ivreg(formula = volume_log ~ price_log | wind_m_s, data = data_log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.8626 -1.9790 -0.2333  2.0950  6.2354
##
## Coefficients:
##             Estimate Std. Error t value            Pr(>|t|)
## (Intercept)  7.75534    0.04331  179.08 <0.0000000000000002 ***
## price_log   -1.08802    0.37003   -2.94              0.0033 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.728 on 3986 degrees of freedom
## Multiple R-Squared: 0.09529, Adjusted R-squared: 0.09506
## Wald test: 8.646 on 1 and 3986 DF,  p-value: 0.003297
```

```
#takes cares of 1st and 2nd stage regression
#our elasticity of demand = B1 = -1.3744
#we estimate the demand elasticity (slope of the demand curve) using only the variation of log price th
# 1 demand curve with multiple supply curves moving around (windspeed only affects supply, not demand)
#accounting for endogeneity bias can significantly impact our estimate of B1
```

Calculate robust standard errors

- use `starprep()`to calculate OLS SEs
- use `coeftest()` to calculate TSLS SEs
- present SEs using `stargazer()`

```
se_ols_fs1 <- starprep(mdl2,fs1, stat = c("std.error"), se_type = "HC2", alpha = 0.05)

se_tsls1 <- coeftest(tsls1, vcov = vcovHC(tsls1, type = "HC2"))[, "Std. Error"]

se_models <- append(se_ols_fs1,list(se_tsls1))
stargazer(mdl2, fs1, tsls1, se = se_models, type="text")
```

```
##
## ===============================================================
##                                       Dependent variable:
##                                   ----------------------------
##                                         price_log    volume_log
##                                            OLS       instrumental
##                                                        variable
##                                      (1)        (2)       (3)
## ---------------------------------------------------------------
## volume_log                          -0.068***
##                                      (0.003)
##
## wind_m_s                                        0.067***
##                                                 (0.006)
```

```
##
## price_log                                              -1.088***
##                                                         (0.372)
##
## Constant                          0.532***  -0.305***    7.755***
##                                   (0.025)    (0.027)     (0.043)
##
## ------------------------------------------------------------------
## Observations                       3,988      3,988       3,988
## R2                                 0.104      0.038       0.095
## Adjusted R2                        0.104      0.038       0.095
## Residual Std. Error (df = 3986)    0.568      0.588       2.728
## F Statistic (df = 1; 3986)      464.828*** 157.041***
## ==================================================================
## Note:                                  *p<0.1; **p<0.05; ***p<0.01
```

The estimated price elasticity of demand for sardines is approximately -1.09.

(d) Repeat the exercise in (c), but include fixed effects for each year, month, and country. [Hint: you can use the command "as.factor(country) + as.factor(year) +as.factor(month)" to the ivreg function in R]. Report the estimated price elasticity of demand and the F-statistic testing for relevant and non-weak instruments.

```r
tsls2 <- ivreg(volume_log ~ price_log + as.factor(country) + as.factor(year) + as.factor(month) | wind_r
price_elasticity2 <- round(tsls1$coefficients[[2]], digits = 2)

summary(tsls2)
```

```
##
## Call:
## ivreg(formula = volume_log ~ price_log + as.factor(country) +
##     as.factor(year) + as.factor(month) | wind_m_s, data = data_log)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -8.8626 -1.9790 -0.2333  2.0950  6.2354
##
## Coefficients:
##             Estimate Std. Error t value            Pr(>|t|)
## (Intercept)  7.75534    0.04331  179.08 <0.0000000000000002 ***
## price_log   -1.08802    0.37003   -2.94              0.0033 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
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## Residual standard error: 2.728 on 3986 degrees of freedom
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