

EDS 241 Assignment 4

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Introduction

We plan to estimate the price elasticity of demand for fresh sardines across 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 $\log(\text{volume_sold_kg})$ on $\log(\text{price euro_kg})$. 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 = 3)

#linearHypothesis(mdl, c("volume_log=-1"), white.adjust = "hc2")
```

The price elasticity of demand, or the slope of the demand curve, for sardines is approximately -0.068.

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

Table 1: Sardine volume significantly impacts price in Europe

<i>Dependent variable:</i>	
	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 $\log(\text{price euro_kg})$. To begin, estimate the first-stage regression relating $\log(\text{price euro_kg})$ 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)
wind_coef <- round(fs1$coefficients[[2]], digits = 3)
```

The coefficient on wind speed is approximately 0.067. In other words, on average, when wind speed increases by 1 m/sec, the log price of sardines per kg increases by 0.067 in Euros.

Table 2 shows the results of a first-stage regression of wind speed (m/s) and log-transformed price per kg of fresh sardines across 56 ports in 4 European countries from 2013 - 2019.

Table 2: Wind speed significantly impacts sardine price in Europe

<i>Dependent variable:</i>	
	Log(Price)
Wind Speed (m/s)	0.067*** (0.006)
Observations	3,988
R ²	0.038

Note: *p<0.1; **p<0.05; ***p<0.01

(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 regression

```
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 that 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***           0.067***           -1.088*** 
##                               (0.003)          (0.006)          (0.372)
## 
## wind_m_s                     0.067***           -0.305***           7.755*** 
##                               (0.006)          (0.027)          (0.043)
## 
## price_log                   -1.088***           0.532***           -0.305*** 
##                               (0.372)          (0.025)          (0.027)
## 
## Constant                      7.755***           0.532***           -0.305*** 
##                               (0.043)          (0.025)          (0.027)
## 
```

```

## -----
## 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.

```

tsls2 <- ivreg(volume_log ~ price_log + as.factor(country) + as.factor(year) + as.factor(month) | wind_m_s)
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 <0.000000000000002 ***
## 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

```