Aplicación 2.2. Discriminación de precios en la industria farmacéutica

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En esta aplicación se estima un modelo de demanda (inversa) para contrastar la hipótesis de que las empresas farmacéuticas discriminan internacionalmente los precios de sus productos.

## 1. Lectura de datos y análisis exploratorio básico

library(readr)  
PREC\_FARMA <- read\_csv("PREC\_FARMA.csv")

## Parsed with column specification:  
## cols(  
## CVN = col\_double(),  
## DPC = col\_double(),  
## GDPN = col\_double(),  
## IPC = col\_double(),  
## P = col\_double(),  
## PP = col\_double()  
## )

summary(PREC\_FARMA)

## CVN DPC GDPN IPC   
## Min. : 0.60 Min. :0.000 Min. : 4.90 Min. :0.0000   
## 1st Qu.: 11.07 1st Qu.:0.000 1st Qu.: 18.82 1st Qu.:0.0000   
## Median : 28.55 Median :0.000 Median : 38.65 Median :0.0000   
## Mean : 33.95 Mean :0.375 Mean : 42.81 Mean :0.2812   
## 3rd Qu.: 48.52 3rd Qu.:1.000 3rd Qu.: 68.70 3rd Qu.:1.0000   
## Max. :101.80 Max. :1.000 Max. :100.00 Max. :1.0000   
## P PP   
## Min. : 15.22 Min. :0.0   
## 1st Qu.: 50.03 1st Qu.:0.0   
## Median : 69.34 Median :0.5   
## Mean : 74.00 Mean :0.5   
## 3rd Qu.: 92.81 3rd Qu.:1.0   
## Max. :157.56 Max. :1.0

## 2. Análisis econométrico

library(car)

## Loading required package: carData

library(sfsmisc)  
#  
mod\_lin <- lm(P ~ GDPN + CVN, data=PREC\_FARMA)  
S(mod\_lin)

## Call: lm(formula = P ~ GDPN + CVN, data = PREC\_FARMA)  
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 32.6049 6.3103 5.167 1.59e-05 \*\*\*  
## GDPN 1.6641 0.2433 6.839 1.64e-07 \*\*\*  
## CVN -0.8791 0.2492 -3.528 0.00142 \*\*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard deviation: 19.54 on 29 degrees of freedom  
## Multiple R-squared: 0.7041  
## F-statistic: 34.5 on 2 and 29 DF, p-value: 2.147e-08   
## AIC BIC   
## 285.91 291.78

cis <- confint(mod\_lin)  
cis

## 2.5 % 97.5 %  
## (Intercept) 19.698866 45.5109587  
## GDPN 1.166427 2.1617053  
## CVN -1.388735 -0.3694798

#  
mod\_log <- lm(log(P) ~ log(GDPN) + log(CVN), data=PREC\_FARMA)  
S(mod\_log)

## Call: lm(formula = log(P) ~ log(GDPN) + log(CVN), data = PREC\_FARMA)  
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.26043 0.23468 9.632 1.53e-10 \*\*\*  
## log(GDPN) 0.95096 0.13058 7.283 5.08e-08 \*\*\*  
## log(CVN) -0.44518 0.09231 -4.822 4.16e-05 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard deviation: 0.2725 on 29 degrees of freedom  
## Multiple R-squared: 0.71  
## F-statistic: 35.51 on 2 and 29 DF, p-value: 1.599e-08   
## AIC BIC   
## 12.45 18.31

cis <- confint(mod\_log)  
cis

## 2.5 % 97.5 %  
## (Intercept) 1.7804586 2.7404075  
## log(GDPN) 0.6838963 1.2180319  
## log(CVN) -0.6339811 -0.2563714

H\_0 <- c("log(GDPN) = 1")  
linearHypothesis(mod\_log,H\_0,test="F")

## Linear hypothesis test  
##   
## Hypothesis:  
## log(GDPN) = 1  
##   
## Model 1: restricted model  
## Model 2: log(P) ~ log(GDPN) + log(CVN)  
##   
## Res.Df RSS Df Sum of Sq F Pr(>F)  
## 1 30 2.1636   
## 2 29 2.1532 1 0.01047 0.141 0.71

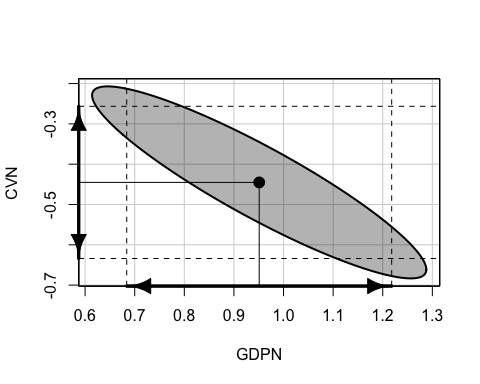
H\_0 <- c("log(CVN) = -1")  
linearHypothesis(mod\_log,H\_0,test="F")

## Linear hypothesis test  
##   
## Hypothesis:  
## log(CVN) = - 1  
##   
## Model 1: restricted model  
## Model 2: log(P) ~ log(GDPN) + log(CVN)  
##   
## Res.Df RSS Df Sum of Sq F Pr(>F)   
## 1 30 4.8351   
## 2 29 2.1532 1 2.6819 36.122 1.549e-06 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#  
b <- coef(mod\_log)  
confidenceEllipse(mod\_log, segments=500, levels=c(0.95), col="black",   
 fill=TRUE,   
 axes=TRUE, ann=TRUE, xlab="GDPN", ylab="CVN", grid=TRUE)

## Warning in plot.xy(xy.coords(x, y), type = type, ...): "axes" is not a graphical  
## parameter

box()  
usr <- par("usr")  
abline(v=cis[2, ], h=cis[3, ], lty=2)  
lines(x=c(usr[1], b[2]), y=c(b[3], b[3]))  
lines(x=c(b[2], b[2]), y=c(usr[3], b[3]))  
par <- par("xpd"=TRUE)  
p.arrows(cis[2, 1], usr[3], cis[2, 2], usr[3], lwd=3, fill="black",   
 xpd=TRUE, size=1.25)  
p.arrows(cis[2, 2], usr[3], cis[2, 1], usr[3], lwd=3, fill="black",   
 xpd=TRUE, size=1.25)  
p.arrows(usr[1], cis[3, 1], usr[1], cis[3, 2], lwd=3, fill="black",   
 xpd=TRUE, size=1.25)  
p.arrows(usr[1], cis[3, 2], usr[1], cis[3, 1], lwd=3, fill="black",   
 xpd=TRUE, size=1.25)



par(par)   
#  
mod\_log\_fact <- lm(log(P) ~ log(GDPN) + log(CVN) + PP + IPC + DPC, data=PREC\_FARMA)  
S(mod\_log\_fact)

## Call: lm(formula = log(P) ~ log(GDPN) + log(CVN) + PP + IPC + DPC, data =  
## PREC\_FARMA)  
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.50237 0.24935 10.036 1.97e-10 \*\*\*  
## log(GDPN) 0.79470 0.15652 5.077 2.74e-05 \*\*\*  
## log(CVN) -0.31792 0.11612 -2.738 0.011 \*   
## PP 0.02791 0.10735 0.260 0.797   
## IPC -0.19133 0.11501 -1.664 0.108   
## DPC -0.12626 0.11306 -1.117 0.274   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard deviation: 0.2619 on 26 degrees of freedom  
## Multiple R-squared: 0.7599  
## F-statistic: 16.46 on 5 and 26 DF, p-value: 2.442e-07   
## AIC BIC   
## 12.41 22.67

#  
anova(mod\_log,mod\_log\_fact)

## Analysis of Variance Table  
##   
## Model 1: log(P) ~ log(GDPN) + log(CVN)  
## Model 2: log(P) ~ log(GDPN) + log(CVN) + PP + IPC + DPC  
## Res.Df RSS Df Sum of Sq F Pr(>F)  
## 1 29 2.1532   
## 2 26 1.7830 3 0.3702 1.7995 0.1721

#  
H\_0 <- c("PP = 0", "IPC = 0", "DPC = 0")  
linearHypothesis(mod\_log\_fact,H\_0,test="F")

## Linear hypothesis test  
##   
## Hypothesis:  
## PP = 0  
## IPC = 0  
## DPC = 0  
##   
## Model 1: restricted model  
## Model 2: log(P) ~ log(GDPN) + log(CVN) + PP + IPC + DPC  
##   
## Res.Df RSS Df Sum of Sq F Pr(>F)  
## 1 29 2.1532   
## 2 26 1.7830 3 0.3702 1.7995 0.1721