Projekt SAP

Tema 2 - Uloga izvoza i uvoza u gospodarstvu

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Učitavanje podataka i deskriptivna analiza

Na početku učitavamo podatke i analiziramo kako izgledaju podaci.

```
export.data = read.csv("Export_data.csv", fileEncoding="UTF-8-BOM")
# head(export.data)

import.data = read.csv("Import_data.csv", fileEncoding="UTF-8-BOM")
# head(import.data)

gdp.data = read.csv("GDP_data.csv", fileEncoding="UTF-8-BOM")
# head(gdp.data)

gdp.pc.data = read.csv("GDPpercapita_data.csv", fileEncoding="UTF-8-BOM")
# head(gdp.pc.data)
```

Sljedeći blok koda generira dataframe sa brojem upisanih podataka te brojem procjena među upisanim podacima.

```
export.loc.cnt = export.data %>% group_by(LOCATION) %>%
    summarise(exp_n = n(), exp_est = sum(Flag.Codes == 'E')) %>%
    arrange(desc(exp_n), exp_est)
import.loc.cnt = import.data %>% group_by(LOCATION) %>%
    summarise(imp_n = n(), imp_est = sum(Flag.Codes == 'E')) %>%
    arrange(desc(imp_n), imp_est)
gdp.loc.cnt = gdp.data %>% group_by(LOCATION) %>%
    summarise(gdp_n = n(), gdp_est = sum(Flag.Codes == 'E')) %>%
    arrange(desc(gdp_n), gdp_est)
gdp.pc.loc.cnt = gdp.pc.data %>% group_by(LOCATION) %>%
    summarise(gdp_pc_n = n(), gdp_pc_est = sum(Flag.Codes == 'E')) %>%
    arrange(desc(gdp_pc_n), gdp_pc_est)
loc.cnt = merge(merge(export.loc.cnt, import.loc.cnt), merge(gdp.loc.cnt, gdp.pc.loc.cnt))
knitr::kable(
  head(arrange(loc.cnt,
               desc(loc.cnt[,2]), desc(loc.cnt[,4]), desc(loc.cnt[,6]), desc(loc.cnt[,8]),
               loc.cnt[,3], loc.cnt[,5], loc.cnt[,7], loc.cnt[,9]), 20),
  caption = "Broj podataka za pojedinu državu"
)
```

Table 1: Broj podataka za pojedinu državu

LOCATION	exp_n	exp_est	imp_n	imp_est	gdp_n	gdp_est	gdp_pc_n	gdp_pc_est
CAN	41	0	41	0	41	0	41	0

LOCATION	exp_n	exp_est	imp_n	imp_est	gdp_n	gdp_est	gdp_pc_n	gdp_pc_est
DNK	41	0	41	0	41	0	41	0
FRA	41	0	41	0	41	0	41	0
CHE	41	1	41	1	41	1	41	1
FIN	41	1	41	1	41	1	41	1
DEU	41	12	41	12	41	12	41	12
SWE	41	14	41	14	41	14	41	14
GBR	41	16	41	16	41	0	41	0
AUT	41	16	41	16	41	16	41	16
BEL	41	16	41	16	41	16	41	16
ESP	41	16	41	16	41	16	41	16
GRC	41	16	41	16	41	16	41	16
IRL	41	16	41	16	41	16	41	16
ITA	41	16	41	16	41	16	41	16
NLD	41	16	41	16	41	16	41	16
ISL	41	16	41	16	41	16	41	17
PRT	41	17	41	17	41	17	41	17
AUS	40	0	40	0	40	0	40	0
NOR	40	0	40	0	40	0	40	0
USA	40	0	40	0	40	0	40	0

{{r, include=FALSE} remove(export.loc.cnt, import.loc.cnt, gdp.loc.cnt, gdp.pc.loc.cnt, loc.cnt)

Odabrane drzave

Odabrali smo USA, Njemačku(DEU) i Grčku(GRC) za analizu.

Deskriptivna statistika

```
time = 1979:2019
usa = data.frame(export.mln_usd = export.data$Value[export.data$LOCATION == "USA"],
                 import.mln_usd = import.data$Value[import.data$LOCATION == "USA"],
                 gdp.mln_usd = gdp.data$Value[gdp.data$LOCATION == "USA"],
                 gdp.pc.usd_cap = gdp.pc.data$Value[gdp.pc.data$LOCATION == "USA"])
usa$net.trade = usa$export.mln_usd - usa$import.mln_usd
deu = data.frame(export.mln_usd = export.data$Value[export.data$LOCATION == "DEU"],
                 import.mln_usd = import.data$Value[import.data$LOCATION == "DEU"],
                 gdp.mln_usd = gdp.data$Value[gdp.data$LOCATION == "DEU"],
                 gdp.pc.usd_cap = gdp.pc.data$Value[gdp.pc.data$LOCATION == "DEU"])
deu$net.trade = deu$export.mln_usd - deu$import.mln_usd
grc = data.frame(export.mln_usd = export.data$Value[export.data$LOCATION == "GRC"],
                 import.mln_usd = import.data$Value[import.data$LOCATION == "GRC"],
                 gdp.mln_usd = gdp.data$Value[gdp.data$LOCATION == "GRC"],
                 gdp.pc.usd_cap = gdp.pc.data$Value[gdp.pc.data$LOCATION == "GRC"])
grc$net.trade = grc$export.mln_usd - grc$import.mln_usd
```

```
usa = usa %>% mutate(import.mln_usd,
                     import.growth = import.mln_usd - lag(import.mln_usd),
                     import.growth.percentage = import.growth / lag(import.mln_usd) * 100)
deu = deu %>% mutate(import.mln_usd,
```

```
                      import.growth = import.mln_usd - lag(import.mln_usd),
                      import.growth.percentage = import.growth / lag(import.mln_usd) * 100)
grc = grc %>% mutate(import.mln_usd,
                      import.growth = import.mln_usd - lag(import.mln_usd),
                      import.growth.percentage = import.growth / lag(import.mln_usd) * 100)
```

```
interpolate.usa = data.frame(t(rep(NA, length(names(usa)))))
names(interpolate.usa) = names(usa)
interpolate.usa$import.growth.percentage = mean(usa$import.growth.percentage
                                                [time >= 2013 & time < 2019])
interpolate.usa$import.mln_usd = usa$import.mln_usd[nrow(usa)] *
                                 (1 + interpolate.usa$import.growth.percentage / 100)
interpolate.usa$import.growth = interpolate.usa$import.mln_usd - usa$import.mln_usd[nrow(usa)]
usa = rbind(usa, interpolate.usa)
```

```
summary(usa)
```

```
##  export.mln_usd    import.mln_usd     gdp.mln_usd       gdp.pc.usd_cap
##  Min.   : 347872   Min.   : 366207   Min.   : 2627334   Min.   :11672
##  1st Qu.: 591516   1st Qu.: 690188   1st Qu.: 5540294   1st Qu.:22445
##  Median :1185694   Median :1538060   Median : 9346740   Median :33648
##  Mean   :1206334   Mean   :1545274   Mean   :10103023   Mean   :34815
##  3rd Qu.:1762818   3rd Qu.:2326964   3rd Qu.:14517106   3rd Qu.:48004
##  Max.   :2416053   Max.   :3224342   Max.   :20580223   Max.   :62853
##  NA's   :1                           NA's   :1          NA's   :1
##    net.trade       import.growth     import.growth.percentage
##  Min.   :-722881   Min.   :-304448   Min.   :-13.084
##  1st Qu.:-497748   1st Qu.:  32563   1st Qu.:  2.683
##  Median :-274298   Median :  65733   Median :  5.143
##  Mean   :-296964   Mean   :  70801   Mean   :  5.592
##  3rd Qu.: -77556   3rd Qu.: 130815   3rd Qu.:  8.659
##  Max.   :  19122   Max.   : 265511   Max.   : 24.343
##  NA's   :1         NA's   :1         NA's   :1
```

```
summary(deu)
```

```
##  export.mln_usd    import.mln_usd     gdp.mln_usd       gdp.pc.usd_cap
##  Min.   : 277599   Min.   : 303002   Min.   : 736116   Min.   : 9425
##  1st Qu.: 439432   1st Qu.: 421397   1st Qu.:1413237   1st Qu.:17963
##  Median : 789414   Median : 780127   Median :2158516   Median :26510
##  Mean   : 961808   Mean   : 851788   Mean   :2344231   Mean   :28963
##  3rd Qu.:1466601   3rd Qu.:1237522   3rd Qu.:3103958   3rd Qu.:38432
##  Max.   :2019336   Max.   :1773266   Max.   :4632060   Max.   :55737
##
##    net.trade       import.growth     import.growth.percentage
##  Min.   :-27681   Min.   :-119972   Min.   :-9.695
##  1st Qu.: 12702   1st Qu.:  12657   1st Qu.: 2.694
##  Median : 38067   Median :  36879   Median : 4.881
##  Mean   :110020   Mean   :  36700   Mean   : 4.605
##  3rd Qu.:235195   3rd Qu.:  62129   3rd Qu.: 7.926
##  Max.   :294551   Max.   : 143844   Max.   :12.871
##                   NA's   :1         NA's   :1
```

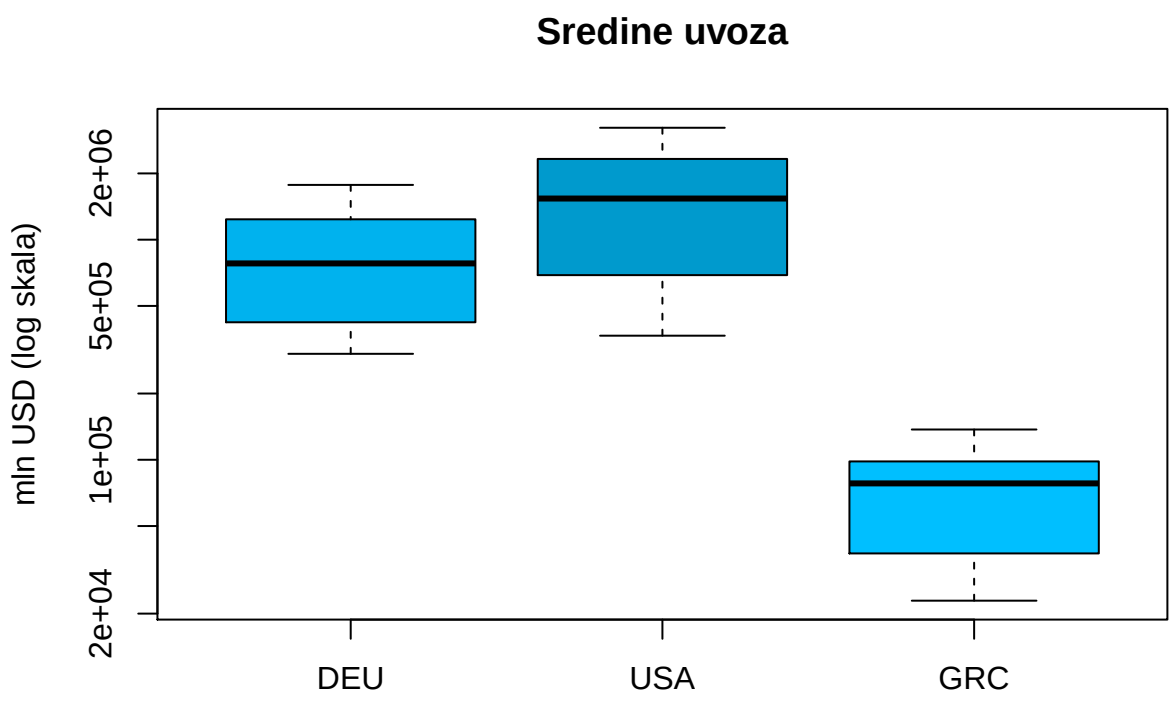
```
summary(grc)
```

```
##  export.mln_usd   import.mln_usd    gdp.mln_usd      gdp.pc.usd_cap
```

```
##  Min.   : 20482   Min.   : 22900   Min.   : 76529   Min.   : 7933
##  1st Qu.: 28580   1st Qu.: 37540   1st Qu.:130598   1st Qu.:12811
##  Median : 56743   Median : 78096   Median :198712   Median :18465
##  Mean   : 56376   Mean   : 70093   Mean   :210316   Mean   :19609
##  3rd Qu.: 81461   3rd Qu.: 98300   3rd Qu.:291109   3rd Qu.:26839
##  Max.   :109674   Max.   :137267   Max.   :341818   Max.   :31172
##
##    net.trade      import.growth      import.growth.percentage
##  Min.   :-44429   Min.   :-27939.2   Min.   :-20.3539
##  1st Qu.:-24525   1st Qu.:   345.2   1st Qu.:  0.5721
##  Median :-11914   Median :  1963.6   Median :  4.2862
##  Mean   :-13717   Mean   :  2054.5   Mean   :  4.1784
##  3rd Qu.: -3016   3rd Qu.:  4379.9   3rd Qu.:  8.5646
##  Max.   :  4592   Max.   : 18180.4   Max.   : 20.1801
##                   NA's   :1          NA's   :1
```

Uvoz

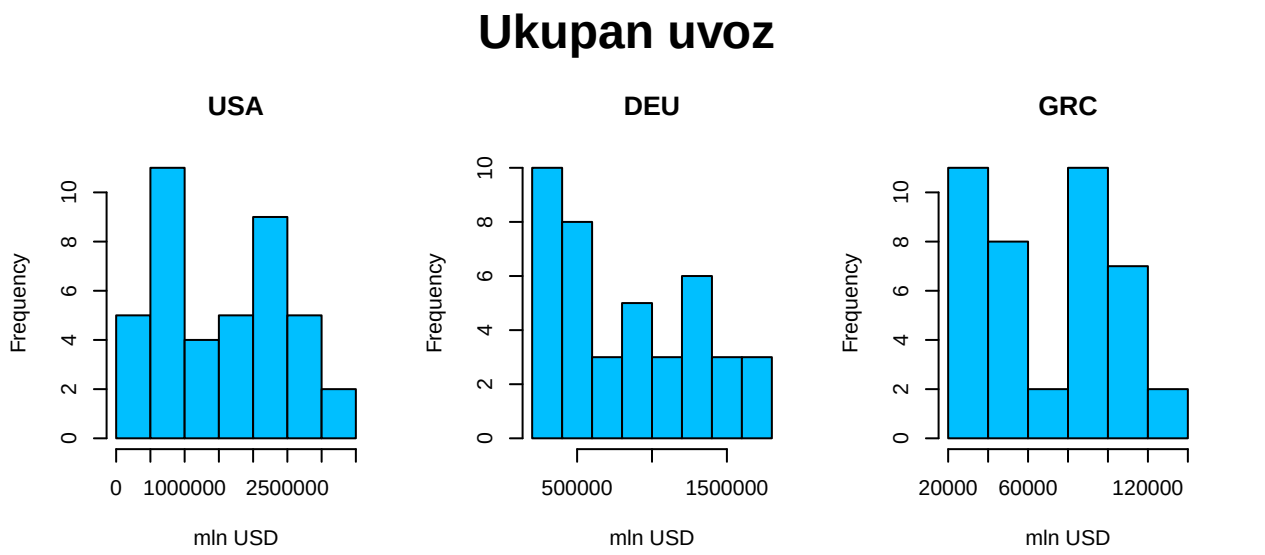
```
boxplot(deu$import.mln_usd,
        usa$import.mln_usd,
        grc$import.mln_usd,
        names = c("DEU", "USA", "GRC"), main = "Sredine uvoza",
        col = c("deepskyblue2", "deepskyblue3", "deepskyblue"),
        ylab = "mln USD (log skala)",
        log = "y")
```



Vidimo da im se čisti uvoz u mil. USD razlikuje jako čak i na logaritamskoj skali.

```
par(mfrow = c(1, 3), oma = c(0, 0, 2, 0))
hist(usa$import.mln_usd, main="USA", xlab="mln USD", col="deepskyblue")
hist(deu$import.mln_usd, main="DEU", xlab="mln USD", col="deepskyblue")
```

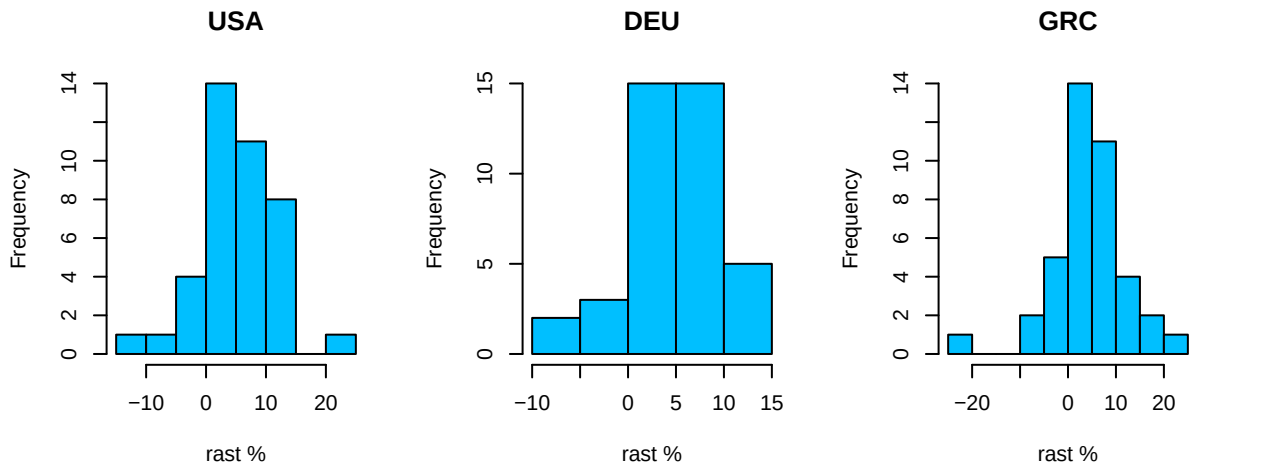
```
hist(grc$import.mln_usd, main="GRC", xlab="mln USD", col="deepskyblue")
mtext("Ukupan uvoz", outer = T, cex = 1.5, font = 2)
```

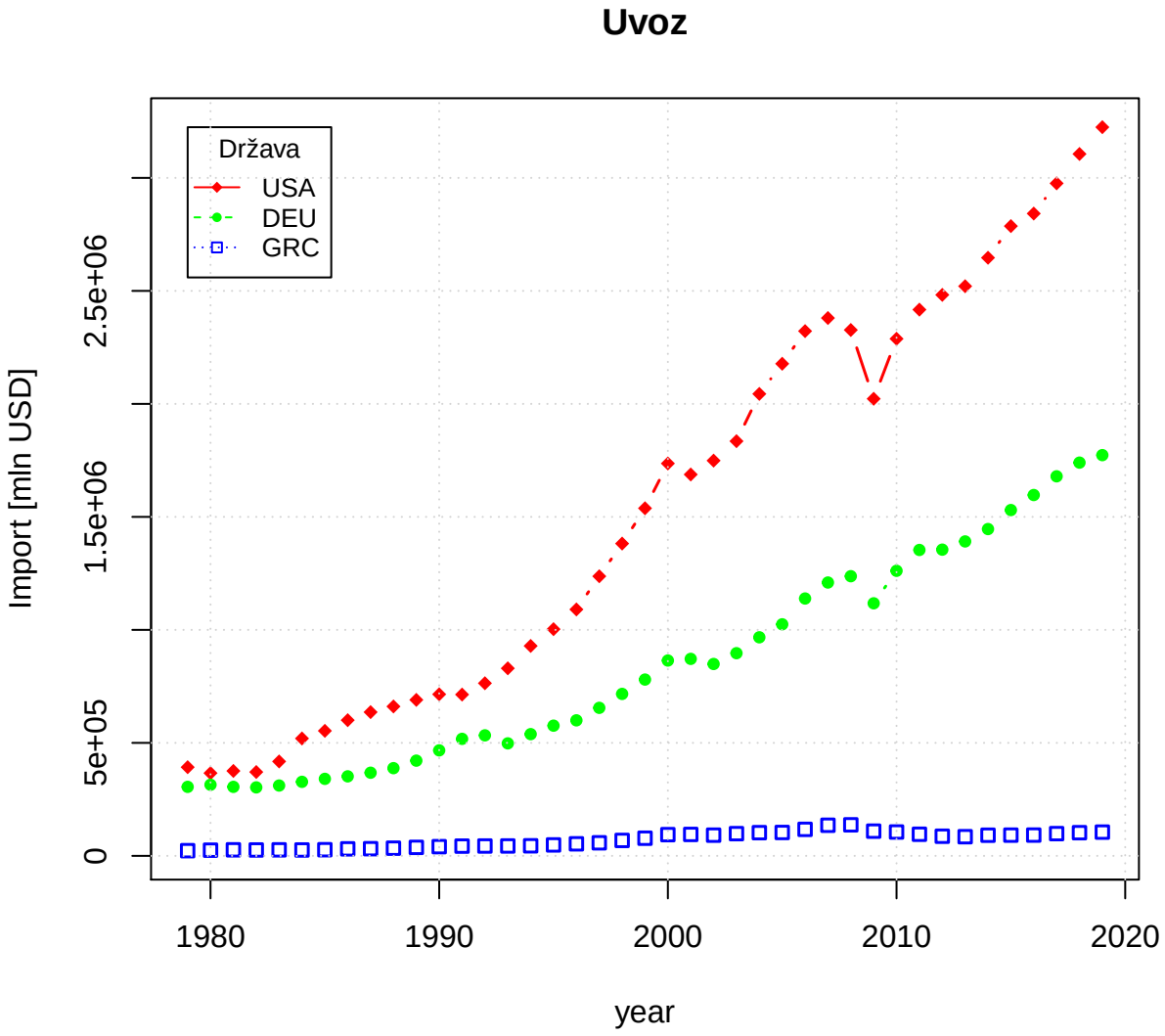


Za distribucije ukupnog uvoza ne možemo pretpostaviti normalnost, pa nema smisla raditi parametarske testove.

Usporedimo sada postotnu promjenu uvoza.

```
par(mfrow = c(1, 3), oma = c(0, 0, 2, 0))
hist(usa$import.growth.percentage, main="USA", xlab="rast %", col="deepskyblue")
hist(deu$import.growth.percentage, main="DEU", xlab="rast %", col="deepskyblue")
hist(grc$import.growth.percentage, main="GRC", xlab="rast %", col="deepskyblue")
mtext("Postotni rast uvoza", outer = T, cex = 1.5, font = 2)
```

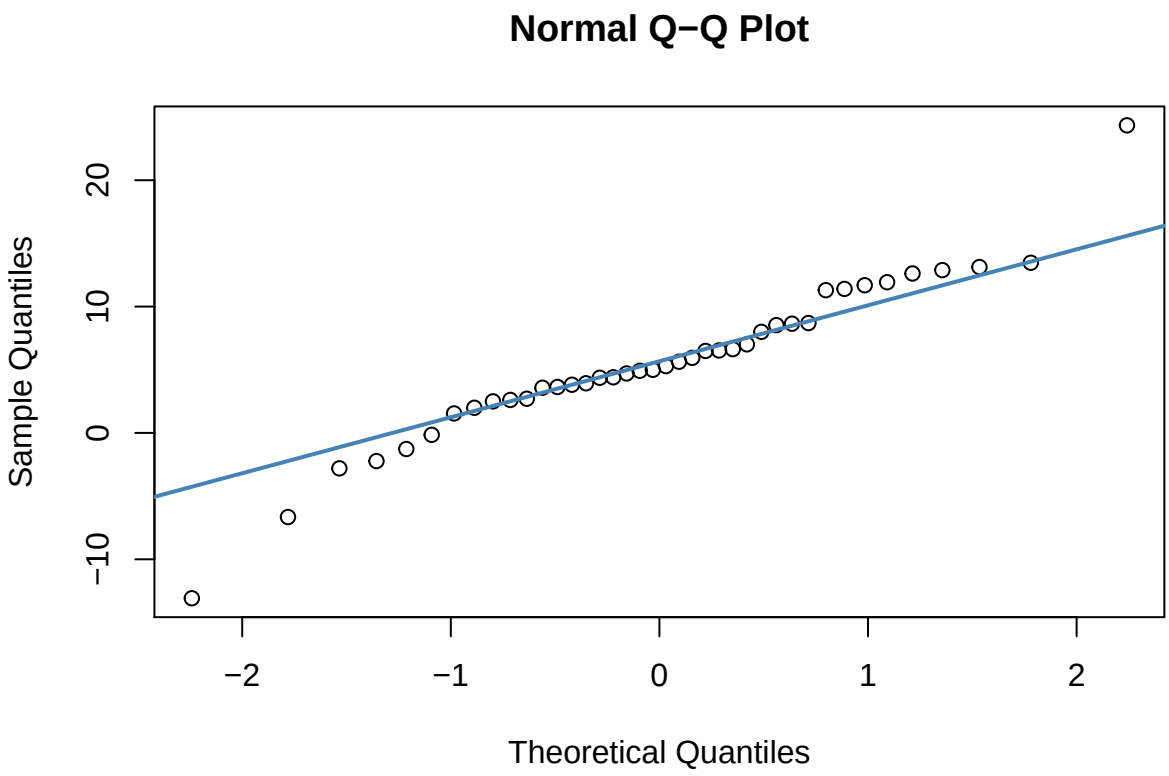




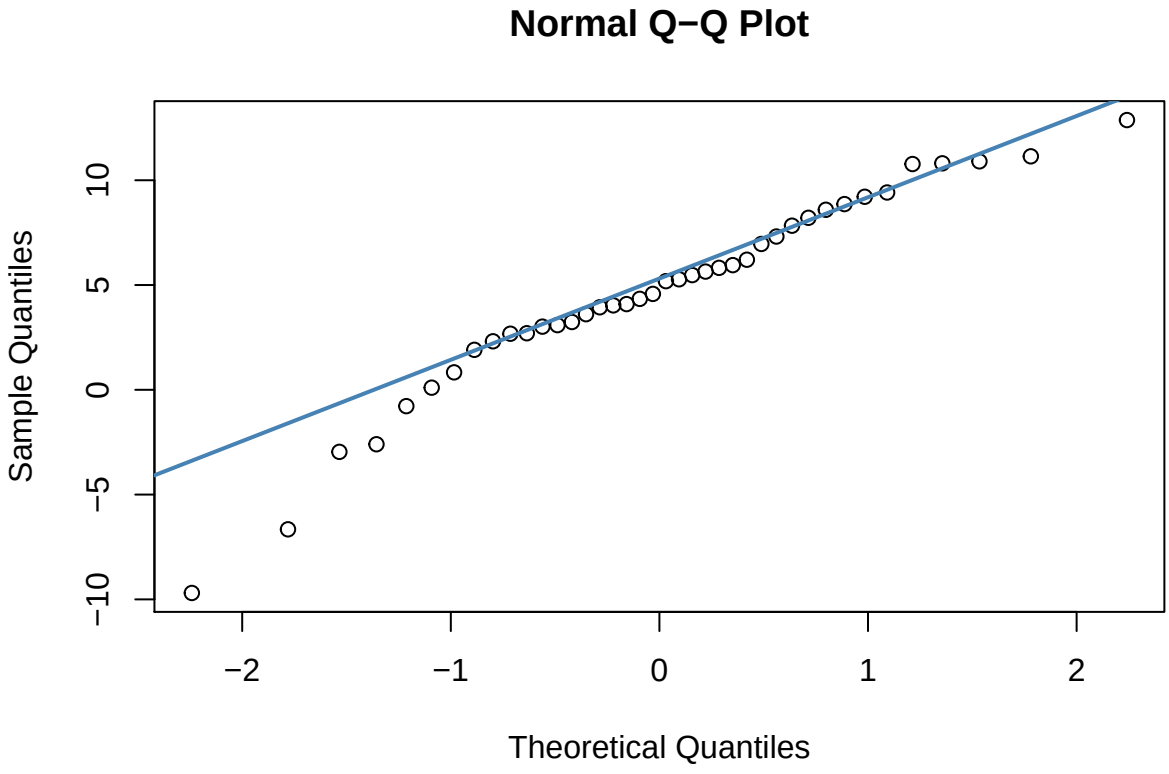
Distribucije nisu previše zakrivljene i imamo dovoljno podataka da možemo pretpostaviti normalnost distribucije.

Taj zaključak potvrđuju i qq plotovi.

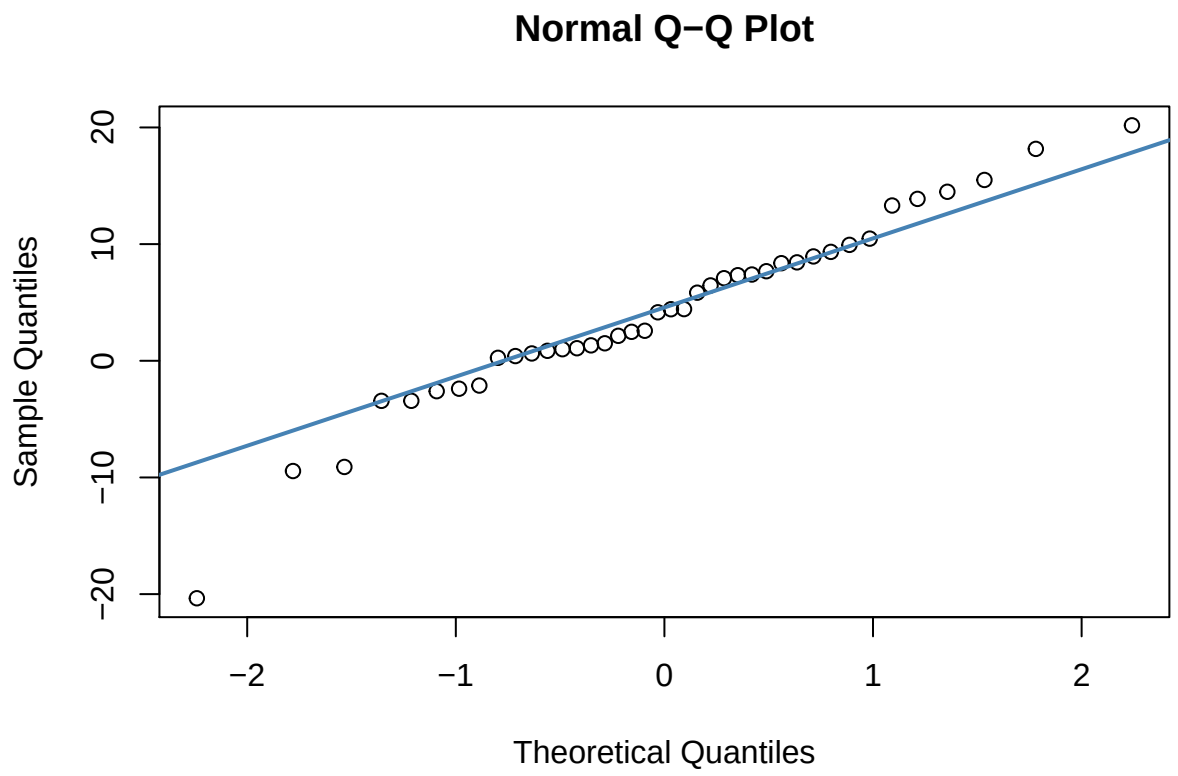
```
qqnorm(usa$import.growth.percentage)
qqline(usa$import.growth.percentage, col = "steelblue", lwd = 2)
```



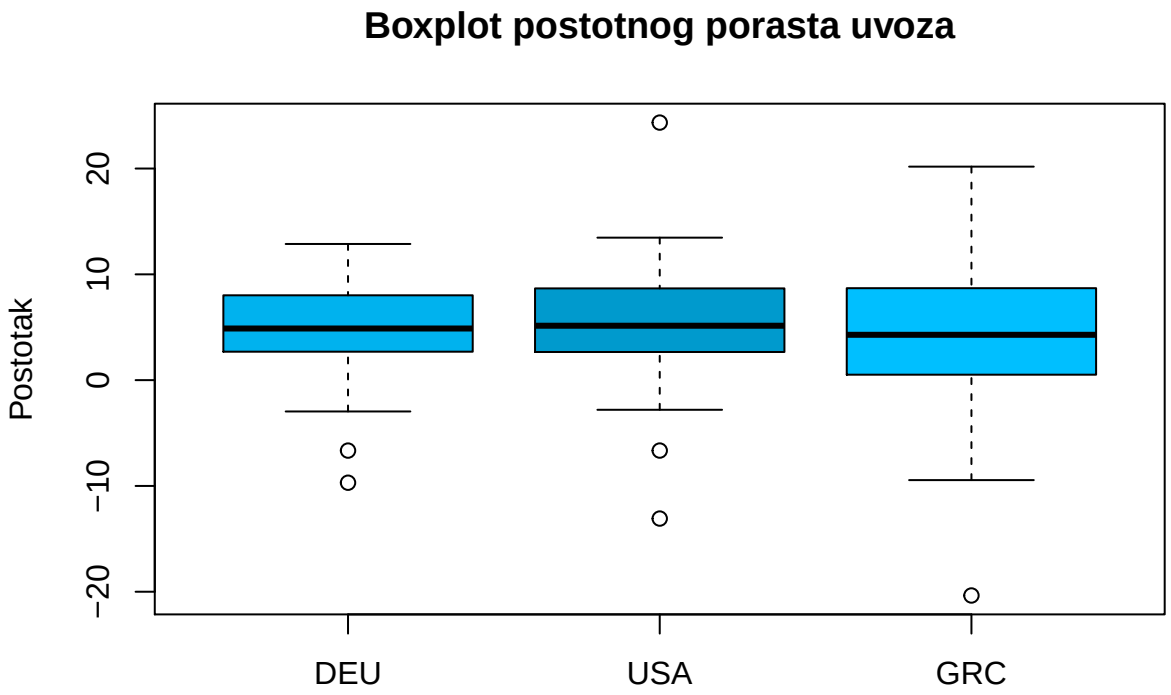

```r
qqnorm(deu$import.growth.percentage)
qqline(deu$import.growth.percentage, col = "steelblue", lwd = 2)
```




```r
qqnorm(grc$import.growth.percentage)
qqline(grc$import.growth.percentage, col = "steelblue", lwd = 2)
```




```
boxplot(deu$import.growth.percentage,
        usa$import.growth.percentage,
        grc$import.growth.percentage,
        names = c("DEU", "USA", "GRC"), main = "Boxplot postotnog porasta uvoza",
        col = c("deepskyblue2", "deepskyblue3", "deepskyblue"),
        ylab = "Postotak")
```

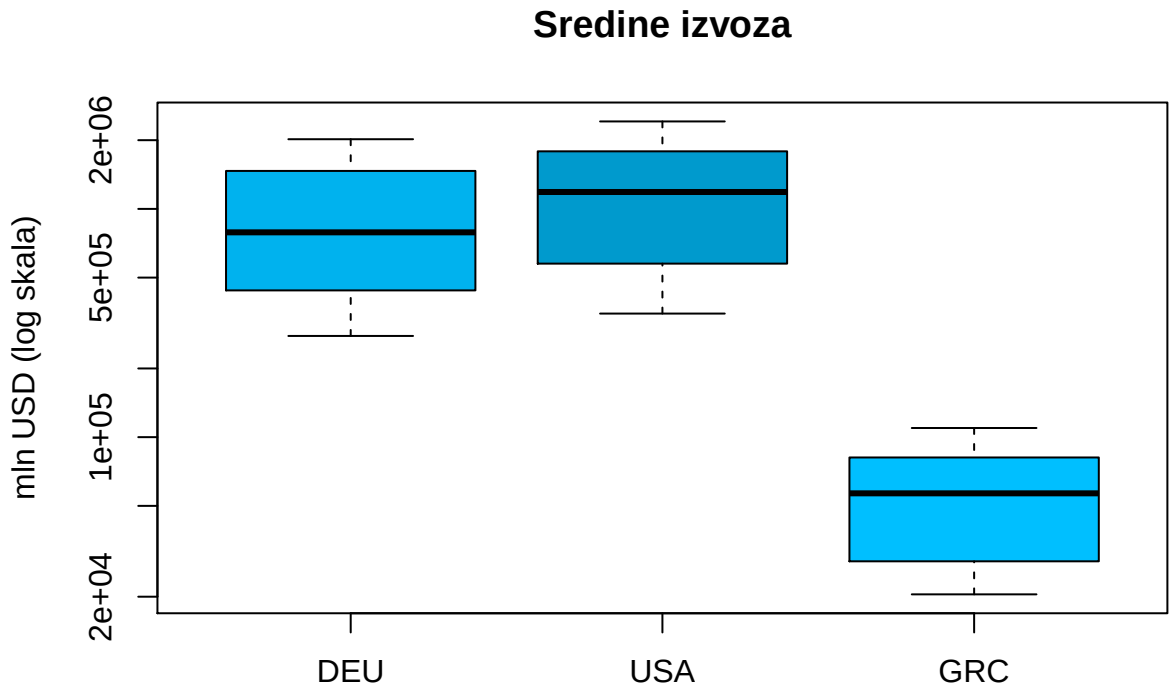


Ovaj plot pokazuje da bi varijable USA i DEU mogle imati istu sredinu. To ćemo provjeriti t testom u idućem

poglavlju.

Izvoz

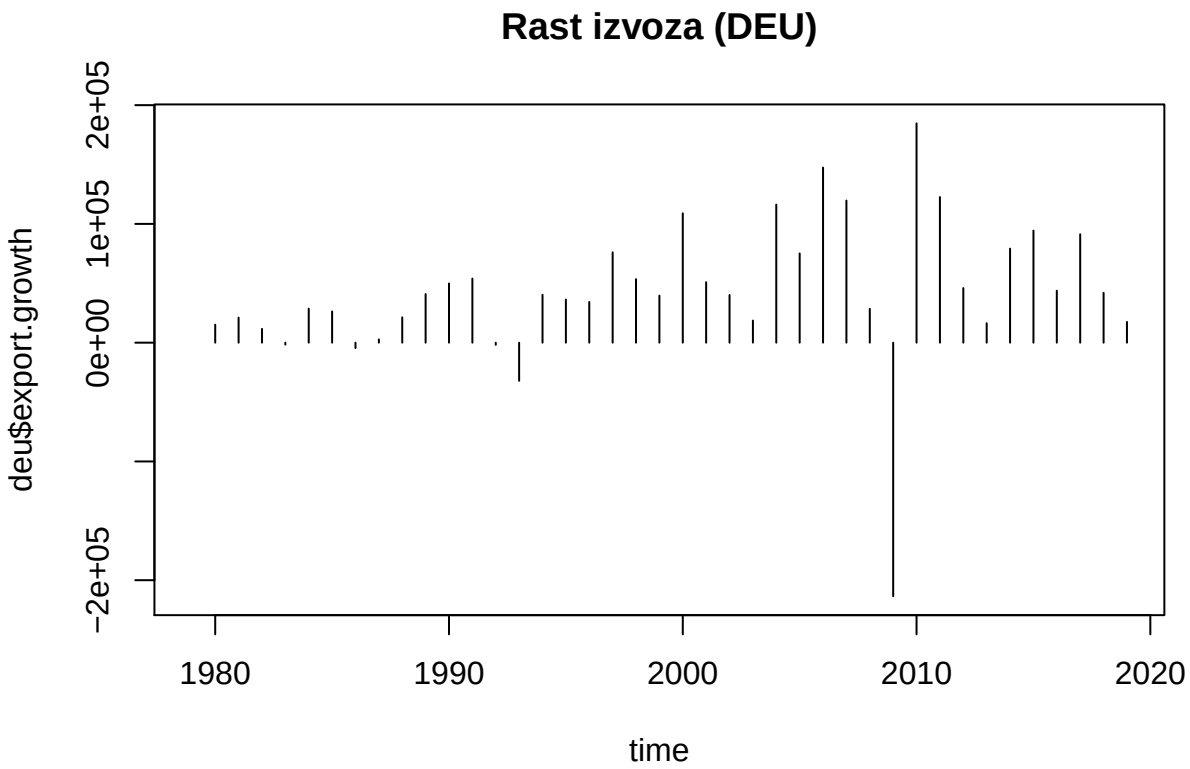
```
boxplot(deu$export.mln_usd,
        usa$export.mln_usd,
        grc$export.mln_usd,
        names = c("DEU", "USA", "GRC"), main = "Sredine izvoza",
        col = c("deepskyblue2", "deepskyblue3", "deepskyblue"),
        ylab = "mln USD (log skala)",
        log = "y")
```



Podaci su slični kao i kod uvoza, SAD prednjači i u izvozu u odnosu na Njemačku i Grčku.

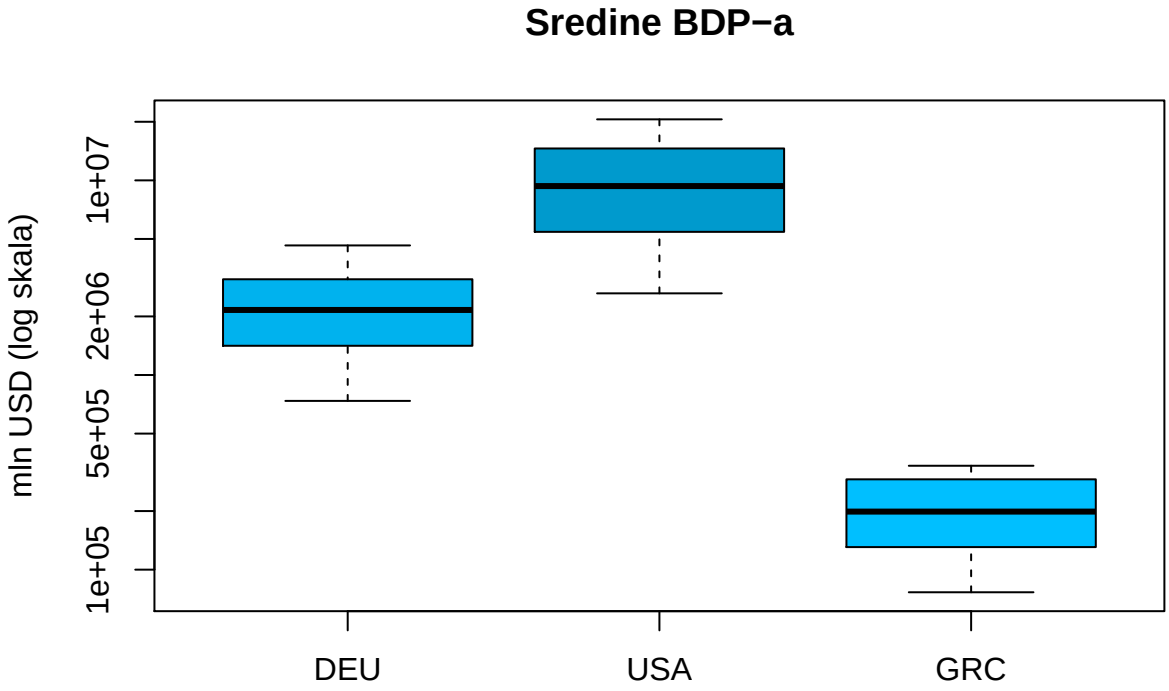
```
usa = usa %>% mutate(export.mln_usd, export.growth = export.mln_usd - lag(export.mln_usd))
deu = deu %>% mutate(export.mln_usd, export.growth = export.mln_usd - lag(export.mln_usd))
grc = grc %>% mutate(export.mln_usd, export.growth = export.mln_usd - lag(export.mln_usd))
```

```
time = 1979:2019
plot(time, deu$export.growth, type = "h", main = "Rast izvoza (DEU)")
```



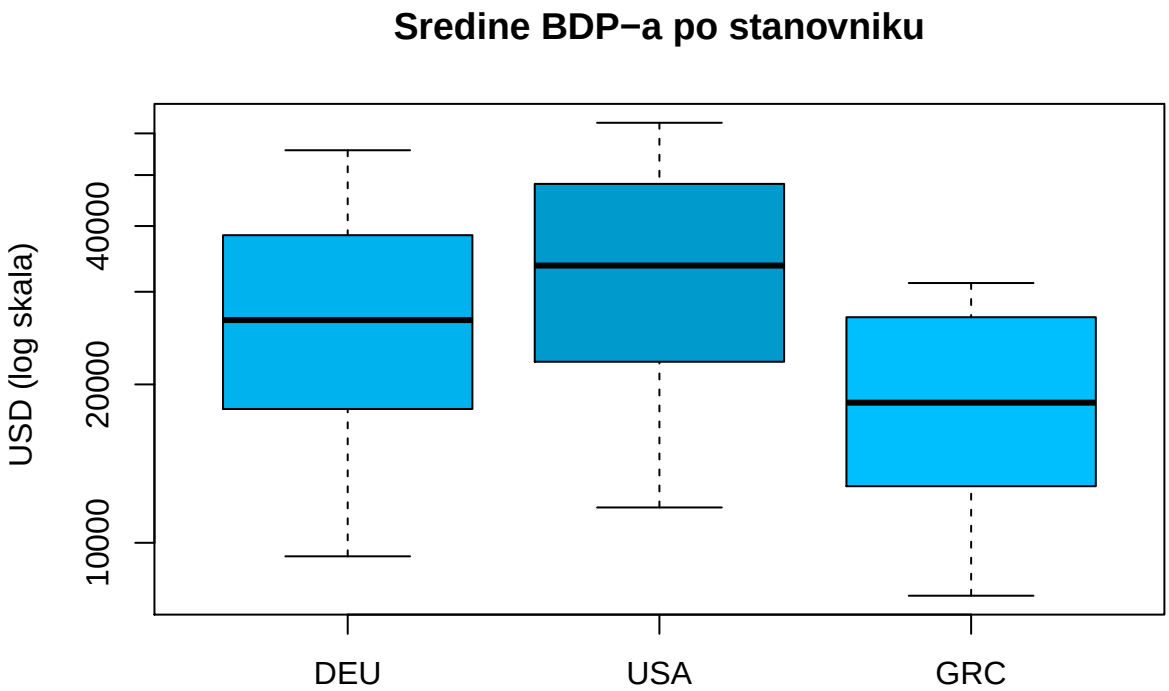
Za razliku od uvoza koji linearno raste, izvoz više "osjeća" promjene na tržištu (veće fluktuacije), npr. značajan pad izvoza 2009. godine zbog tadašnje svjetske gospodarske krize.

```
boxplot(deu$gdp.mln_usd,
        usa$gdp.mln_usd,
        grc$gdp.mln_usd,
        names = c("DEU", "USA", "GRC"), main = "Sredine BDP-a",
        col = c("deepskyblue2", "deepskyblue3", "deepskyblue"),
        ylab = "mln USD (log skala)",
        log = "y")
```



Kao i kod uvoza i izvoza, po čistom BDP-u SAD značajno prednjači, dok je razlika između Njemačke i Grčke veća od one između SAD-a i Njemačke. No, ovaj prikaz možda nije mjerodavan što se tiče razvijenosti. Treba pogledati BDP po stanovniku:

```
boxplot(deu$gdp.pc.usd_cap,
        usa$gdp.pc.usd_cap,
        grc$gdp.pc.usd_cap,
        names = c("DEU", "USA", "GRC"), main = "Sredine BDP-a po stanovniku",
        col = c("deepskyblue2", "deepskyblue3", "deepskyblue"),
        ylab = " USD (log skala)",
        log = "y")
```

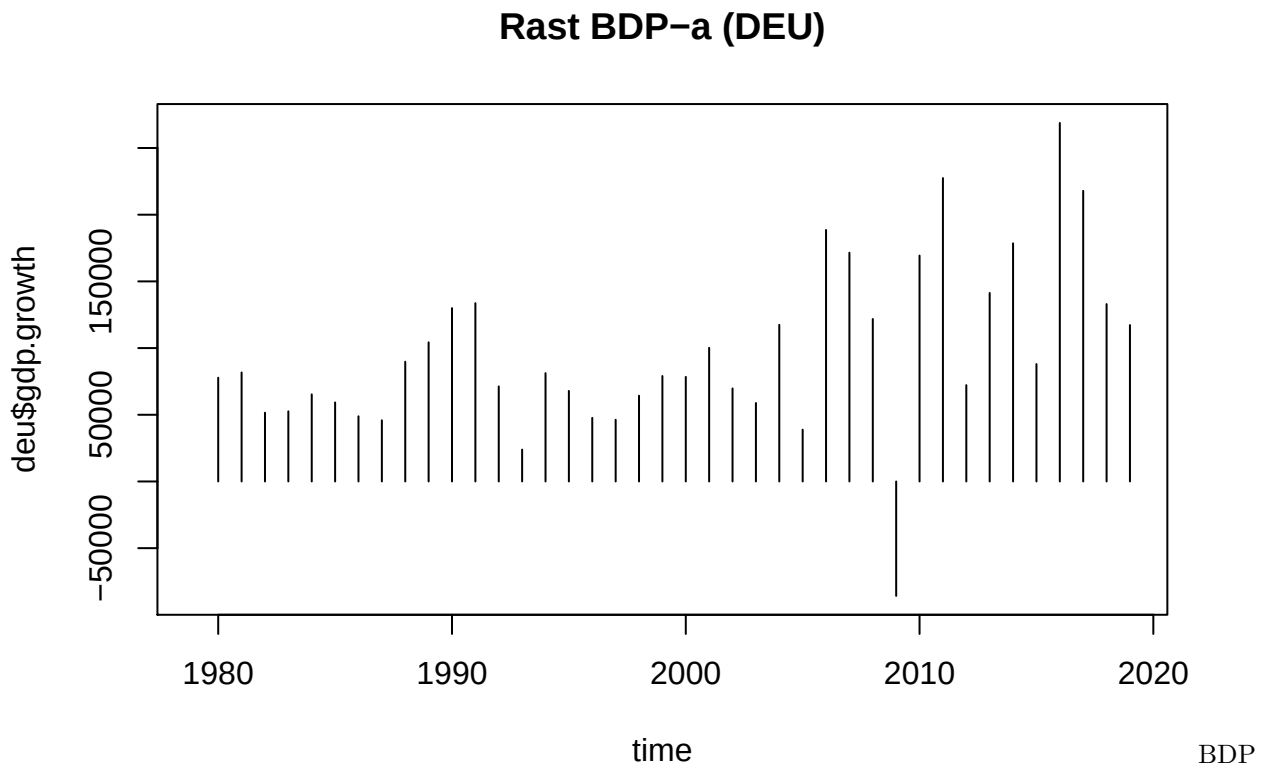


Na

prikazu BDP-a po stanovniku podaci su normaliziralni brojem stanovnika, razlike nisu toliko značajne, no SAD i dalje prednjači.

```
usa = usa %>% mutate(gdp.mln_usd, gdp.growth = gdp.mln_usd - lag(gdp.mln_usd))
deu = deu %>% mutate(gdp.mln_usd, gdp.growth = gdp.mln_usd - lag(gdp.mln_usd))
grc = grc %>% mutate(gdp.mln_usd, gdp.growth = gdp.mln_usd - lag(gdp.mln_usd))
```

```
time = 1979:2019
plot(time, deu$gdp.growth, type = "h", main = "Rast BDP-a (DEU)")
```



BDP

Njemačke je u stalnom porastu uz fluktuacije, a jedini pad BDP-a koji primjećujemo vezan je uz gospodarsku krizu 2009. godine, kada primjećujemo i značajne padove u uvozu i izvozu. Rast BDP-a po stanovniku bit će proporcionalan.

Testiranje hipoteza

Hipoteza 0: USA i DEU imaju jednaku sredinu postotne promjene uvoza

Alternativna hipoteza: USA ima veću postotnu promjenu uvoza.

```
t.test(usa$import.growth.percentage[-c(1)], deu$import.growth.percentage[-c(1)],
       alternative = "g")
```

```
##
##  Welch Two Sample t-test
##
## data:  usa$import.growth.percentage[-c(1)] and deu$import.growth.percentage[-c(1)]
## t = 0.79157, df = 72.659, p-value = 0.2156
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  -1.089884       Inf
## sample estimates:
```

```
## mean of x mean of y
##  5.591600  4.605104
```

Test pokazuje da odbacujemo $H0$ i priklanjamo se hipotezi $H1$. USA ima veće fluktuacije u rastu uvoza.