Exchange Rates

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(2.2)

We consider four economies with their currencies: Euro area with the euro, China with the renminbi, Japan with the yen, and the United States with the US dollar.

(a)

Download (or copy to your Excel file) the annual nominal exchange rates for the US dollar (**E,** i.e. units of foreign currencies for 1 US dollar) vs. other three currencies from the OECD homepage (https://data.oecd.org/conversion/exchange-rates.htm) from 2000 until 2022.

```
ex_rate <- read.csv("https://raw.githubusercontent.com/MarkusStefan/Economics/main/exchange_rate.csv")
```

Exchange rates are defined as the price of one country's' currency in relation to another country's currency. This indicator is measured in terms of national currency per US dollar.

"Total, National currency units/US dollar, 2000 – 2022"

```
# filtering for each country/region
EA <- ex_rate %>% subset(LOCATION == "EU27_2020") %>%
  as.data.frame() %>% select(Value)
colnames(EA) <- "€euro"
EA
```

```
##         €euro
## 1333 1.082705
## 1334 1.116533
## 1335 1.057559
## 1336 0.884048
## 1337 0.803922
## 1338 0.803800
## 1339 0.796433
## 1340 0.729672
## 1341 0.679923
## 1342 0.716958
## 1343 0.754309
## 1344 0.718414
## 1345 0.778338
## 1346 0.752945
## 1347 0.752728
## 1348 0.901296
## 1349 0.903421
## 1350 0.885206
## 1351 0.846773
## 1352 0.893276
## 1353 0.875506
## 1354 0.845494
## 1355 0.949624
```

```
USA <- ex_rate %>% subset(LOCATION == "USA") %>%
  as.data.frame() %>% select(Value)
colnames(USA) <- "$dollar"
USA
```

```
##     $dollar
## 667       1
## 668       1
## 669       1
## 670       1
## 671       1
## 672       1
## 673       1
## 674       1
## 675       1
## 676       1
## 677       1
## 678       1
## 679       1
## 680       1
## 681       1
## 682       1
## 683       1
## 684       1
## 685       1
## 686       1
## 687       1
## 688       1
## 689       1
```

```
CHN <- ex_rate %>% subset(LOCATION == "CHN") %>%
  as.data.frame() %>% select(Value) #%>% rename(Value='CHN')
colnames(CHN) <- "¥renminbi"
CHN
```

```
##     ¥renminbi
## 736  8.278504
## 737  8.277068
## 738  8.276958
## 739  8.277037
## 740  8.276801
## 741  8.194317
## 742  7.973438
## 743  7.607532
## 744  6.948655
## 745  6.831416
## 746  6.770269
## 747  6.461461
## 748  6.312333
## 749  6.195758
## 750  6.143434
## 751  6.227489
## 752  6.644478
## 753  6.758755
## 754  6.615957
## 755  6.908385
## 756  6.900767
## 757  6.448975
## 758  6.737158
```

```
JPN <- ex_rate %>% subset(LOCATION == "JPN") %>%
  as.data.frame() %>% select(Value)
colnames(JPN) <- "¥Yen"
JPN
```

```
##          ¥Yen
## 323 107.76550
## 324 121.52895
## 325 125.38802
## 326 115.93346
## 327 108.19257
## 328 110.21821
## 329 116.29931
## 330 117.75353
## 331 103.35949
## 332  93.57009
## 333  87.77988
## 334  79.80702
## 335  79.79045
## 336  97.59566
## 337 105.94478
## 338 121.04403
## 339 108.79290
## 340 112.16614
## 341 110.42318
## 342 109.00967
## 343 106.77458
## 344 109.75432
## 345 131.49814
```

(b)

Calculate the exchange rates for other three currencies using your data from (a), i.e. exchange rates for the euro vs. remaining three currencies, exchange rates for the renminbi vs. other three currencies and so on.

Exchange rates are given in:

$$\frac{E^*}{E^\$}$$

Exchange rates in terms of dollar:

```
regions <- list(USA, EA, CHN, JPN)

for (r1 in regions){
  for (r2 in regions){
    if (colnames(r1)==colnames(r2)){
      next
    }
    else {
      er <- r1/r2
      colnames(er) <- paste0(colnames(r1),"/", colnames(r2))
      print(er)
    }
  }
  }
```

```
##     $dollar/€euro
## 667     0.9236126
## 668     0.8956296
## 669     0.9455737
## 670     1.1311603
## 671     1.2439018
## 672     1.2440906
## 673     1.2555984
## 674     1.3704788
## 675     1.4707548
## 676     1.3947818
## 677     1.3257166
## 678     1.3919551
## 679     1.2847889
## 680     1.3281183
## 681     1.3285011
## 682     1.1095134
## 683     1.1069036
## 684     1.1296805
## 685     1.1809540
## 686     1.1194748
## 687     1.1421966
## 688     1.1827405
## 689     1.0530484
##     $dollar/¥renminbi
## 667         0.1207948
## 668         0.1208157
## 669         0.1208173
## 670         0.1208162
## 671         0.1208196
## 672         0.1220358
## 673         0.1254164
## 674         0.1314487
## 675         0.1439127
## 676         0.1463825
## 677         0.1477046
## 678         0.1547638
## 679         0.1584200
## 680         0.1614008
## 681         0.1627754
## 682         0.1605784
## 683         0.1505009
## 684         0.1479562
## 685         0.1511497
## 686         0.1447516
## 687         0.1449114
## 688         0.1550634
## 689         0.1484305
##     $dollar/¥Yen
## 667  0.009279408
## 668  0.008228492
## 669  0.007975244
## 670  0.008625637
## 671  0.009242779
## 672  0.009072911
## 673  0.008598503
## 674  0.008492314
## 675  0.009674970
## 676  0.010687176
## 677  0.011392133
## 678  0.012530226
## 679  0.012532827
## 680  0.010246357
## 681  0.009438879
## 682  0.008261457
## 683  0.009191776
## 684  0.008915346
## 685  0.009056070
## 686  0.009173498
## 687  0.009365525
## 688  0.009111258
## 689  0.007604670
##      €euro/$dollar
## 1333      1.082705
## 1334      1.116533
## 1335      1.057559
## 1336      0.884048
## 1337      0.803922
## 1338      0.803800
## 1339      0.796433
## 1340      0.729672
## 1341      0.679923
## 1342      0.716958
## 1343      0.754309
## 1344      0.718414
## 1345      0.778338
## 1346      0.752945
## 1347      0.752728
## 1348      0.901296
## 1349      0.903421
## 1350      0.885206
## 1351      0.846773
```

```
## 1352      0.893276
## 1353      0.875506
## 1354      0.845494
## 1355      0.949624
##      €euro/¥renminbi
## 1333      0.13078510
## 1334      0.13489475
## 1335      0.12777146
## 1336      0.10680730
## 1337      0.09712956
## 1338      0.09809237
## 1339      0.09988577
## 1340      0.09591442
## 1341      0.09784958
## 1342      0.10495013
## 1343      0.11141492
## 1344      0.11118445
## 1345      0.12330433
## 1346      0.12152589
## 1347      0.12252561
## 1348      0.14472864
## 1349      0.13596568
## 1350      0.13097175
## 1351      0.12798950
## 1352      0.12930316
## 1353      0.12687082
## 1354      0.13110518
## 1355      0.14095320
##       €euro/¥Yen
## 1333 0.010046861
## 1334 0.009187383
## 1335 0.008434291
## 1336 0.007625477
## 1337 0.007430473
## 1338 0.007292806
## 1339 0.006848132
## 1340 0.006196604
## 1341 0.006578235
## 1342 0.007662256
## 1343 0.008593188
## 1344 0.009001890
## 1345 0.009754776
## 1346 0.007714944
## 1347 0.007104909
## 1348 0.007446018
## 1349 0.008304044
## 1350 0.007891918
## 1351 0.007668435
## 1352 0.008194466
## 1353 0.008199573
## 1354 0.007703514
## 1355 0.007221577
##     ¥renminbi/$dollar
## 736          8.278504
## 737          8.277068
## 738          8.276958
## 739          8.277037
## 740          8.276801
## 741          8.194317
## 742          7.973438
## 743          7.607532
## 744          6.948655
## 745          6.831416
## 746          6.770269
## 747          6.461461
## 748          6.312333
## 749          6.195758
## 750          6.143434
## 751          6.227489
## 752          6.644478
## 753          6.758755
## 754          6.615957
## 755          6.908385
## 756          6.900767
## 757          6.448975
## 758          6.737158
##     ¥renminbi/€euro
## 736        7.646131
## 737        7.413187
## 738        7.826474
## 739        9.362656
## 740       10.295527
## 741       10.194473
## 742       10.011436
## 743       10.425961
## 744       10.219768
## 745        9.528335
## 746        8.975458
## 747        8.994063
## 748        8.110015
## 749        8.228699
## 750        8.161559
## 751        6.909483
```

```
## 752        7.354797
## 753        7.635234
## 754        7.813141
## 755        7.733763
## 756        7.882033
## 757        7.627464
## 758        7.094553
##     ¥renminbi/¥Yen
## 736     0.07681961
## 737     0.06810779
## 738     0.06601076
## 739     0.07139472
## 740     0.07650064
## 741     0.07434631
## 742     0.06855963
## 743     0.06460555
## 744     0.06722803
## 745     0.07300854
## 746     0.07712780
## 747     0.08096357
## 748     0.07911138
## 749     0.06348395
## 750     0.05798713
## 751     0.05144813
## 752     0.06107456
## 753     0.06025664
## 754     0.05991457
## 755     0.06337406
## 756     0.06462930
## 757     0.05875828
## 758     0.05123387
##     ¥Yen/$dollar
## 323    107.76550
## 324    121.52895
## 325    125.38802
## 326    115.93346
## 327    108.19257
## 328    110.21821
## 329    116.29931
## 330    117.75353
## 331    103.35949
## 332     93.57009
## 333     87.77988
## 334     79.80702
## 335     79.79045
## 336     97.59566
## 337    105.94478
## 338    121.04403
## 339    108.79290
## 340    112.16614
## 341    110.42318
## 342    109.00967
## 343    106.77458
## 344    109.75432
## 345    131.49814
##     ¥Yen/€euro
## 323   99.53357
## 324  108.84492
## 325  118.56362
## 326  131.13933
## 327  134.58093
## 328  137.12144
## 329  146.02523
## 330  161.37871
## 331  152.01647
## 332  130.50986
## 333  116.37124
## 334  111.08779
## 335  102.51389
## 336  129.61858
## 337  140.74776
## 338  134.29997
## 339  120.42326
## 340  126.71191
## 341  130.40470
## 342  122.03358
## 343  121.95757
## 344  129.81088
## 345  138.47390
##     ¥Yen/¥renminbi
## 323       13.01751
## 324       14.68261
## 325       15.14905
## 326       14.00664
## 327       13.07179
## 328       13.45057
## 329       14.58584
## 330       15.47855
## 331       14.87475
## 332       13.69703
## 333       12.96549
## 334       12.35123
## 335       12.64041
```

```
## 336       15.75201
## 337       17.24521
## 338       19.43705
## 339       16.37343
## 340       16.59568
## 341       16.69043
## 342       15.77933
## 343       15.47286
## 344       17.01888
## 345       19.51834
```

(c)

Consider two goods in two time periods (2010 and 2020): a ski set produced in Euro area (producer price is 300 euros) and a Bluetooth headset produced in Japan (producer price is 3000 yen). The producer prices are assumed to be constant. Exchange rates are given from (a-b). Calculate the prices for these two goods between 2010 and 2020 in all economies in domestic currency. Discuss the effects of appreciation/depreciation of the domestic currency regarding the price of domestic/foreign goods.

Function that automatically calculates, how the price in foreign regions changes, taking into account exchange rates of currencies:

```
ex_price_diff <- function(price, in_terms_of, list_of_exrates){
  for (i in list_of_exrates){
    er10 <- i[11,]/in_terms_of[11,] # exchange rate in 2010
    price10 <- price * er10
    er20 <- i[21,]/in_terms_of[21,] # exchange rate in 2020
    price20 <- price * er20
    cat("price in 2010:\t", price10, colnames(i), "\n")
    cat("price in 2020:\t", price20, colnames(i), "\n\n")
    }
}
```

Prices for the ski set outside Euro Area:

```
regions <- list(USA, CHN, JPN)
ski_price <- 300 # Euro

ex_price_diff(ski_price, EA, regions)
```

```
## price in 2010:    397.715 $dollar
## price in 2020:    342.659 $dollar
##
## price in 2010:    2692.638 ¥renminbi
## price in 2020:    2364.61 ¥renminbi
##
## price in 2010:    34911.37 ¥Yen
## price in 2020:    36587.27 ¥Yen
```

The dollar and the renminbi appreciated, and the yen depreciated in terms of euro. Therefore, US and Chinese customers are better off purchasing the ski set in 2020, whereas Japanese customers would have been better of buying in 2010, disregarding other factors.

Prices for the Bluetooth headset outside Japan:

```
regions <- list(USA, CHN, EA)
headset_price <- 3000 # Yen

ex_price_diff(headset_price, JPN, regions)
```

```
## price in 2010:    34.1764 $dollar
## price in 2020:    28.09657 $dollar
##
## price in 2010:    231.3834 ¥renminbi
## price in 2020:    193.8879 ¥renminbi
##
## price in 2010:    25.77957 €euro
## price in 2020:    24.59872 €euro
```

The Japanese yen depreciated relative to all other currencies; hence, foreign customers are better off when buying the headset in 2020.

- Appreciation of domestic currency leads to lower prices of foreign goods in domestic currency, and higher prices of domestic goods in foreign currency. Cheaper to import more expensive to export.
- Depreciation of domestic currency leads to higher prices of foreign goods in domestic currency, and lower prices of domestic goods in foreign currency. More expensive to import, cheaper to exports.