

timeseries-by-decade-plots-and-lms.R

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```
library(ggplot2)

## Warning: package 'ggplot2' was built under R version 4.1.3

library(tidyverse)

## Warning: package 'tidyverse' was built under R version 4.1.2

## -- Attaching packages ----- tidyverse 1.3.1 --

## v tibble 3.1.2      v dplyr 1.0.7
## v tidyr 1.1.3      v stringr 1.4.0
## v readr 1.4.0      v forcats 0.5.1
## v purrr 0.3.4

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()

library(readxl)

## Warning: package 'readxl' was built under R version 4.1.2

pwt100=read_excel("C:\\Users\\Alexandros\\Desktop\\STAN\\pwt100.xlsx",sheet="Data")
data=pwt100

numerics=data %>% select_if(is.numeric)
df=cbind(data[1:3],numerics) %>% as_tibble

rep(1:7,times=1,each=10) %>% as.factor

## [1] 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4
## [39] 4 4 5 5 5 5 5 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7
## Levels: 1 2 3 4 5 6 7

#make decade as factor

df=df %>% group_by(country) %>% mutate(decade=as.factor(rep(1:7,times=1,each=10)))

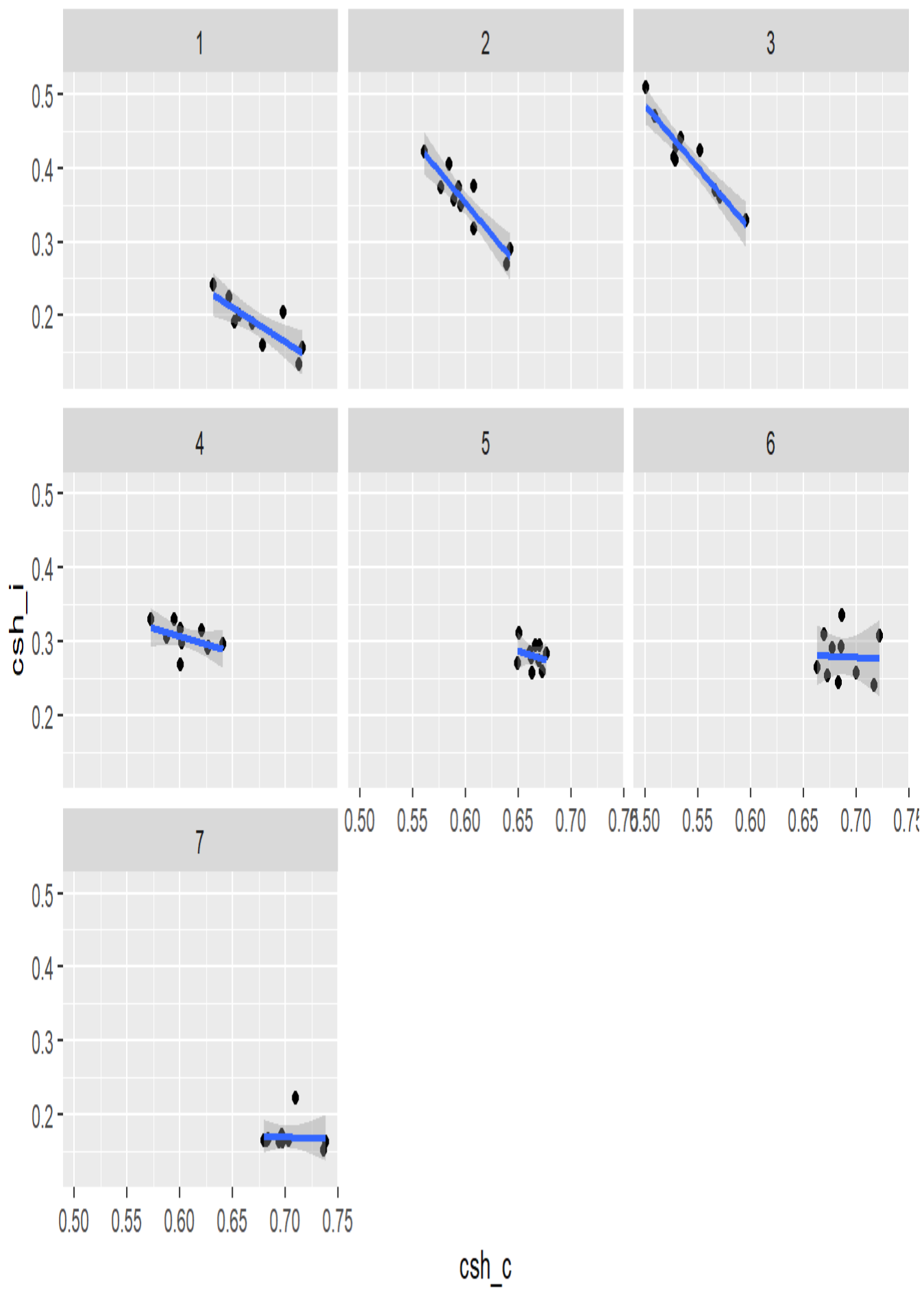
euro=df %>% filter(currency_unit=="Euro")
```

```
GR=euro %>% filter(country=="Greece")
##plot scatter by decade
ggplot(GR, aes(csh_c, csh_i)) +
  geom_point() +
  geom_smooth(method=lm)+
  facet_wrap(vars(decade))

## `geom_smooth()` using formula 'y ~ x'

## Warning: Removed 1 rows containing non-finite values (stat_smooth).

## Warning: Removed 1 rows containing missing values (geom_point).
```



```
?vars
```

```
## starting httpd help server ...
```

```
## done
```

```
GR %>% split(.$decade) %>% #split dataframe into 3 based on species
  map(~lm(csh_c~csh_i,data=.x)) %>% # run an lm regression on each split dataframe
  map(summary) %>% #Get summary for every model
  map(coef) #get coef
```

```
## $`1`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.8100461 0.03655589 22.159112 9.633418e-08
## csh_i        -0.7219423 0.19040198 -3.791674 6.788060e-03
##
## $`2`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.7700509 0.02748705 28.015045 2.845969e-09
## csh_i        -0.4814513 0.07718150 -6.237911 2.489515e-04
##
## $`3`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.7579739 0.02809703 26.977012 3.838600e-09
## csh_i        -0.5212690 0.06712635 -7.765491 5.406275e-05
##
## $`4`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.7663516 0.1043811  7.341863 8.056727e-05
## csh_i        -0.5241465 0.3431524 -1.527445 1.651695e-01
##
## $`5`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.7018296 0.05163546 13.5920091 8.253666e-07
## csh_i        -0.1333642 0.18390570 -0.7251773 4.890093e-01
##
## $`6`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.6950211 0.06114092 11.367526 3.235398e-06
## csh_i        -0.0258483 0.21767905 -0.118745 9.084049e-01
##
## $`7`
##           Estimate Std. Error   t value    Pr(>|t|)
## (Intercept)  0.70932998 0.06518045 10.8825567 4.499002e-06
## csh_i        -0.04261789 0.38247232 -0.1114274 9.140224e-01
```

```
GR %>% split(.$decade) %>% #split dataframe into 3 based on species
  map(~lm(csh_c~csh_i,data=.x)) %>% # run an lm regression on each split dataframe
  map(summary) %>% #Get summary for every model
  map("r.squared") #get rsquared
```

```
## $`1`
## [1] 0.6725421
##
## $`2`
## [1] 0.8294663
##
## $`3`
## [1] 0.8828746
##
## $`4`
## [1] 0.2257881
##
```

```

## $`5`
## [1] 0.06168066
##
## $`6`
## [1] 0.001759446
##
## $`7`
## [1] 0.001549603

#### correlations for each decade
GR %>% split(.$decade) %>% #split dataframe into 3 based on species
  map(~cor(.$csh_c, .$csh_i))

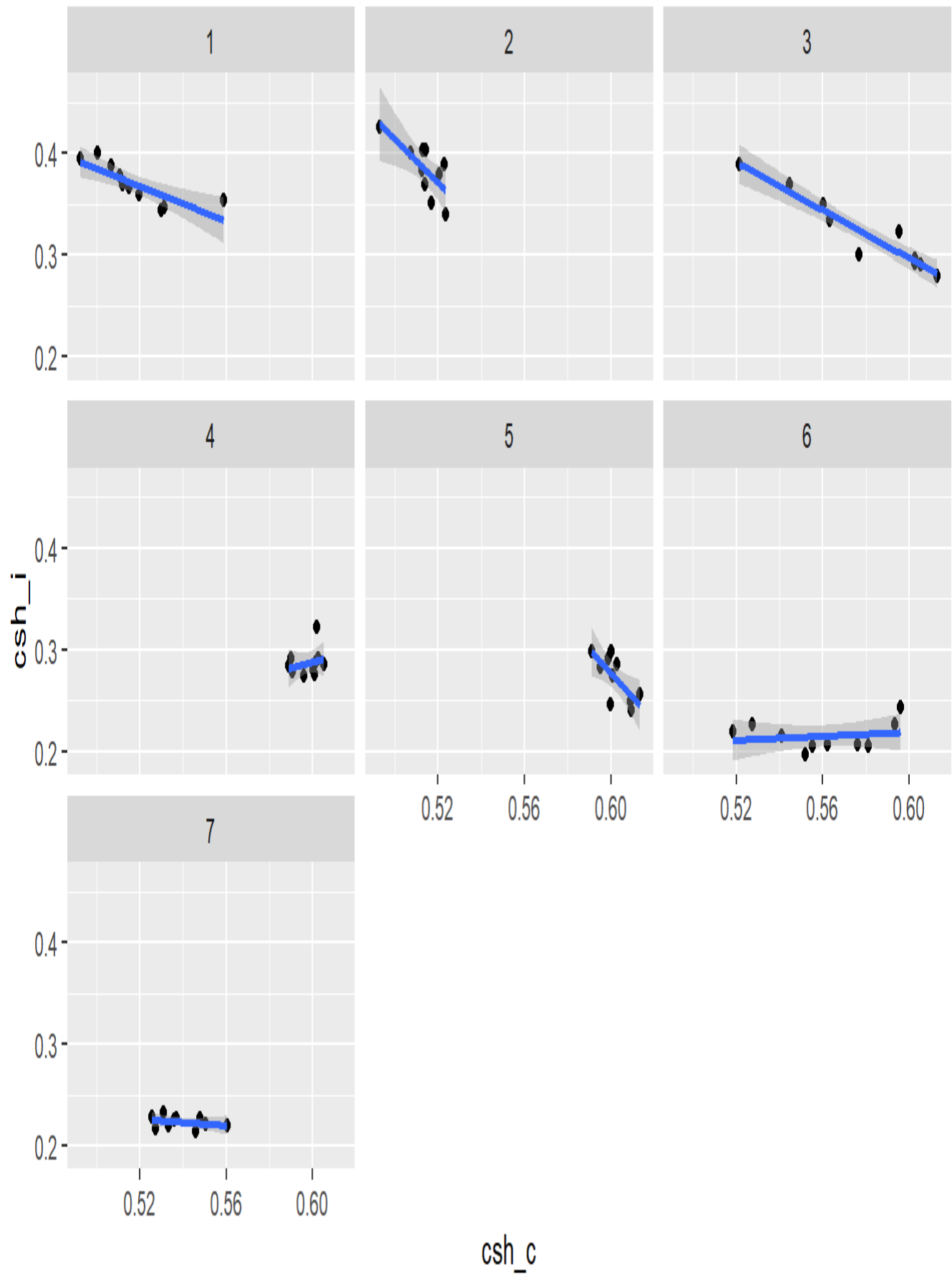
## $`1`
## [1] NA
##
## $`2`
## [1] -0.9107504
##
## $`3`
## [1] -0.9396141
##
## $`4`
## [1] -0.4751716
##
## $`5`
## [1] -0.2483559
##
## $`6`
## [1] -0.04194575
##
## $`7`
## [1] -0.039365

ggplot(df %>% filter(country=="Germany"), aes(csh_c, csh_i)) +
  geom_point() +
  geom_smooth(method=lm)+
  facet_wrap(vars(decade))+
  ggtitle("Germany")

## `geom_smooth()` using formula 'y ~ x'

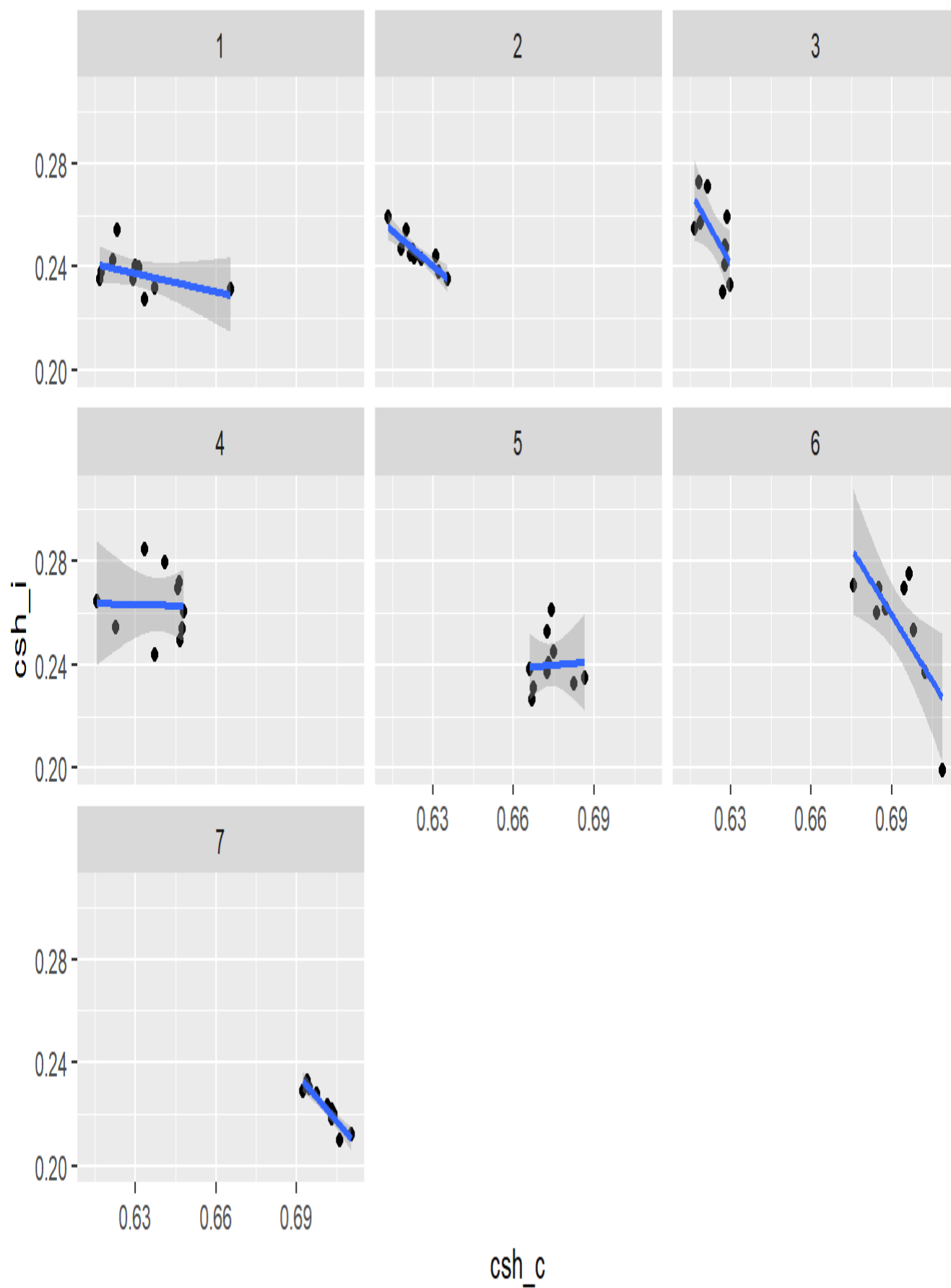
```

Germany



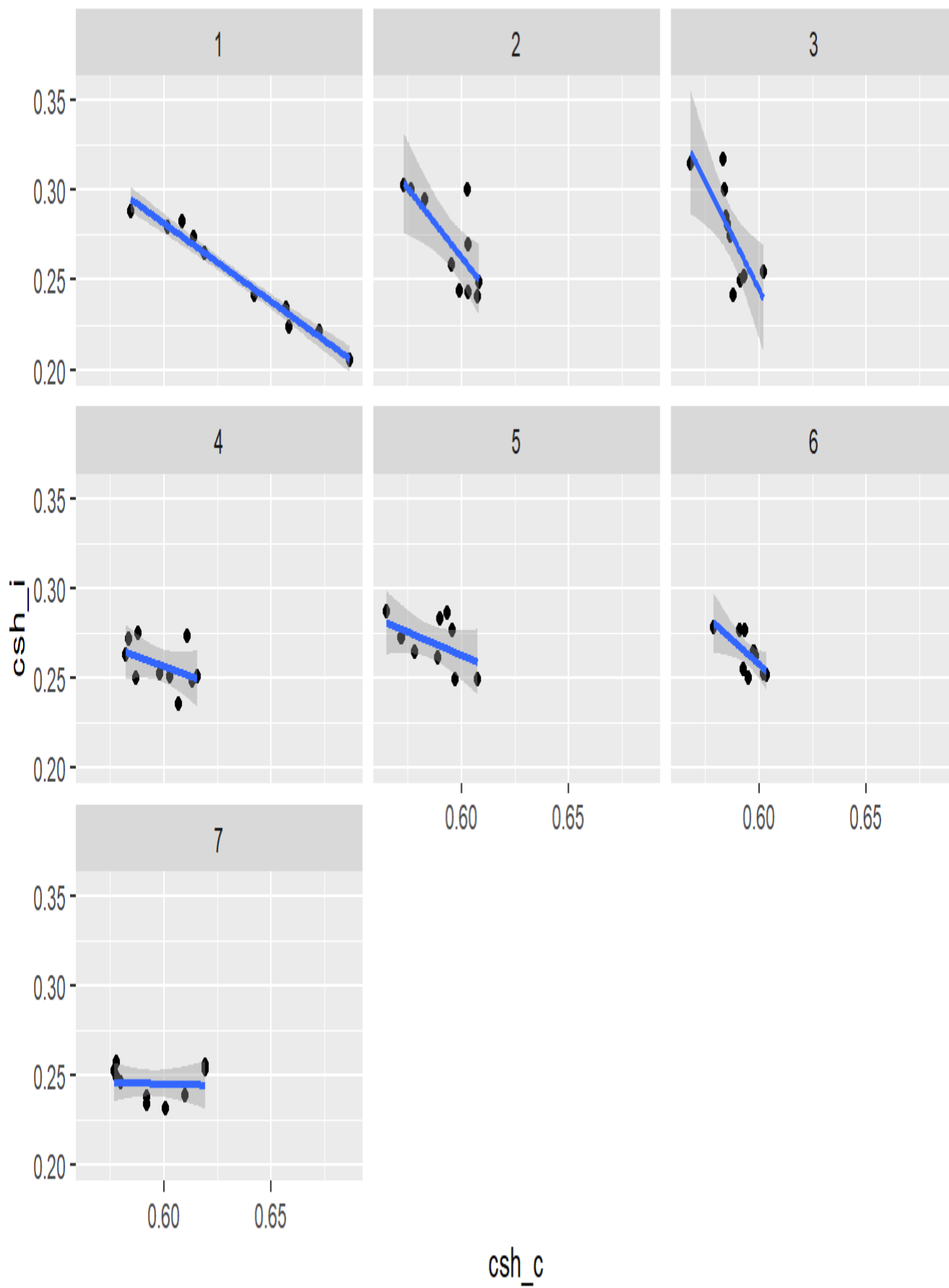
```
ggplot(df %>% filter(country=="United States"), aes(csh_c, csh_i)) +  
  geom_point() +  
  geom_smooth(method=lm)+  
  facet_wrap(vars(decade))+  
  ggtitle("United States,by decade 1950-2019")  
  
## `geom_smooth()` using formula 'y ~ x'
```

United States,by decade 1950-2019



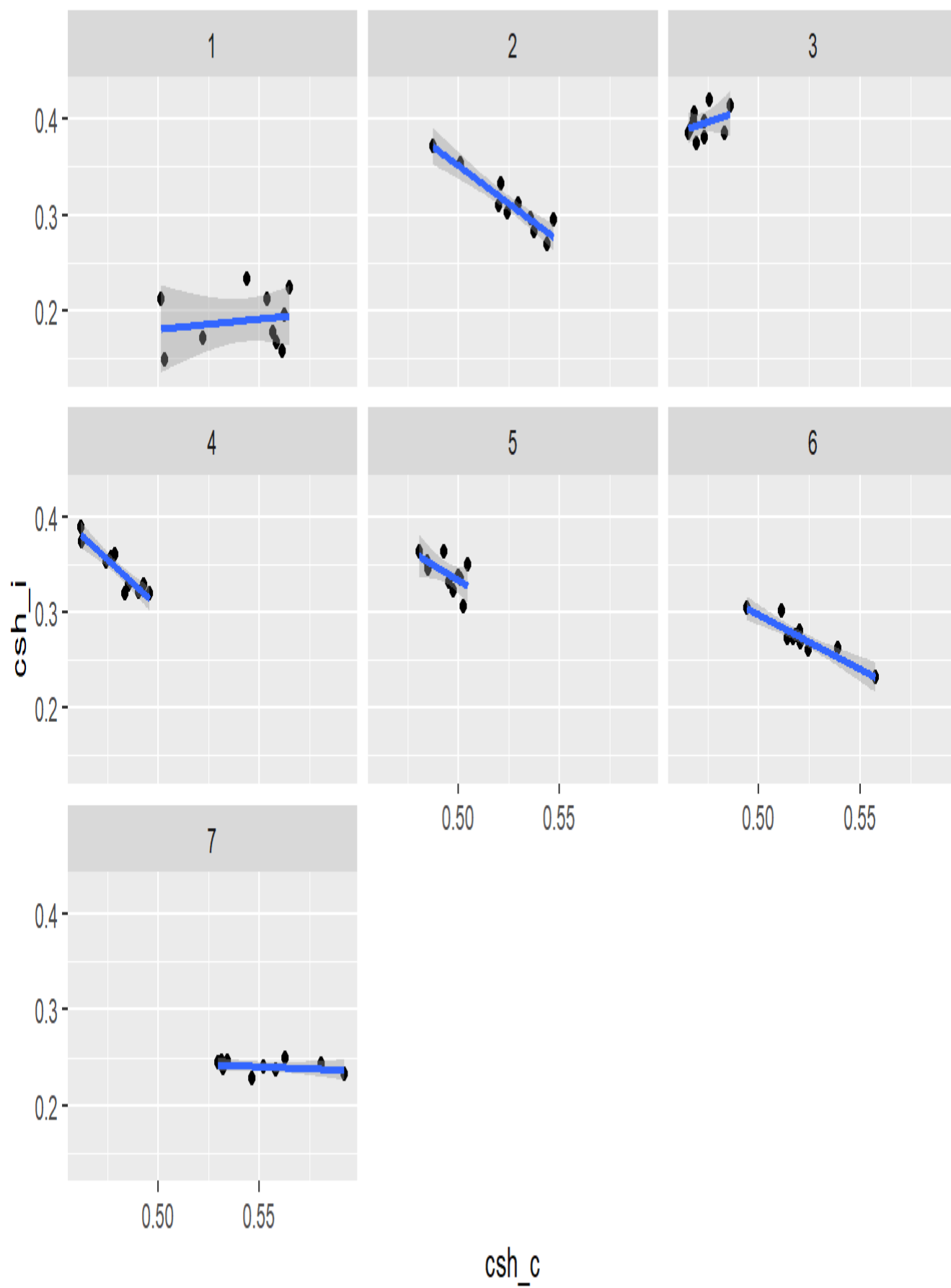

```
ggplot(df %>% filter(country=="Italy"), aes(csh_c, csh_i)) +  
  geom_point() +  
  geom_smooth(method=lm)+  
  facet_wrap(vars(decade))+  
  ggtitle("Italy")  
  
## `geom_smooth()` using formula 'y ~ x'
```

Italy

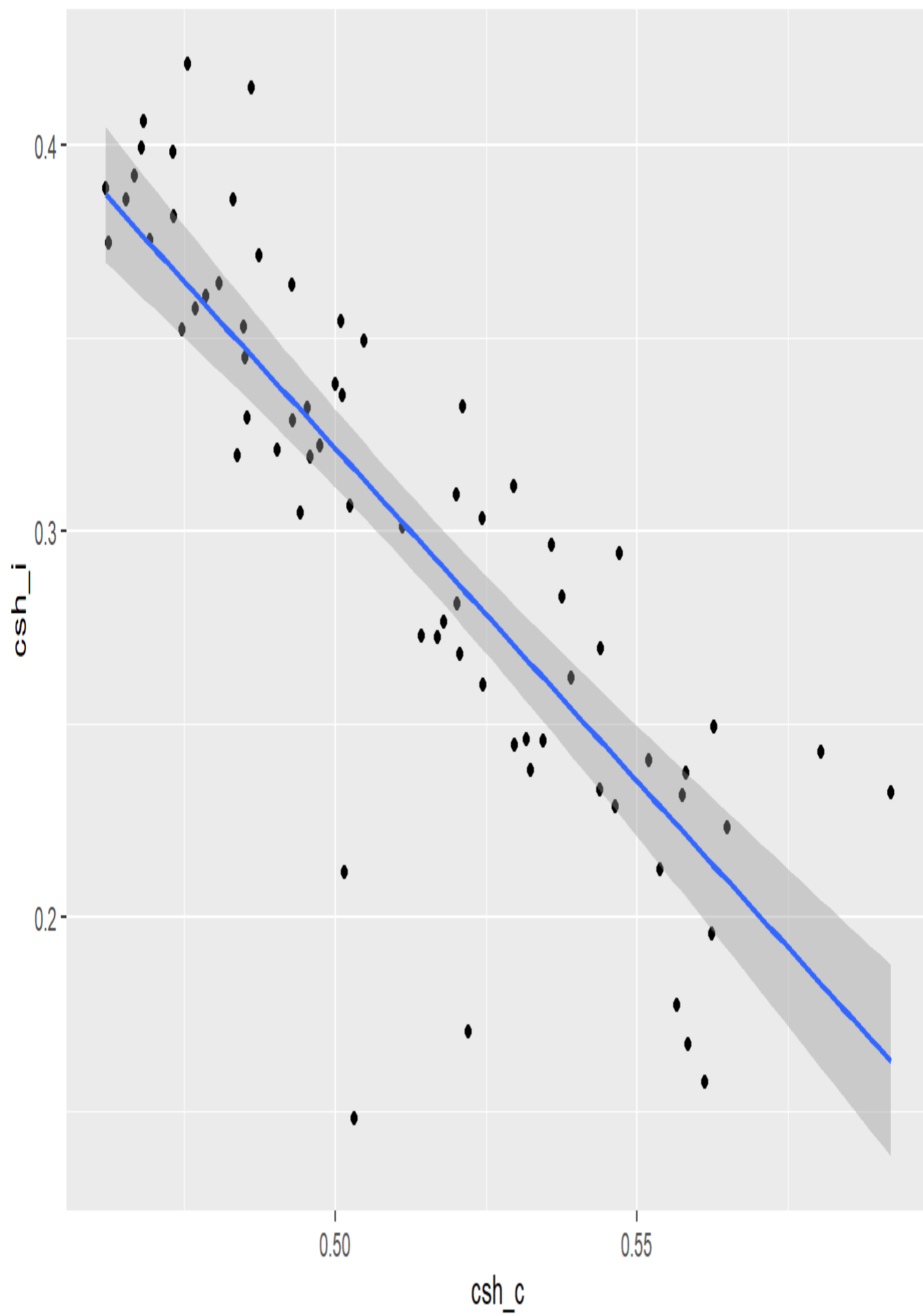


```
ggplot(df %>% filter(country=="Japan"), aes(csh_c, csh_i)) +  
  geom_point() +  
  geom_smooth(method=lm)+  
  facet_wrap(vars(decade))+  
  ggtitle("Japan")  
  
## `geom_smooth()` using formula 'y ~ x'
```

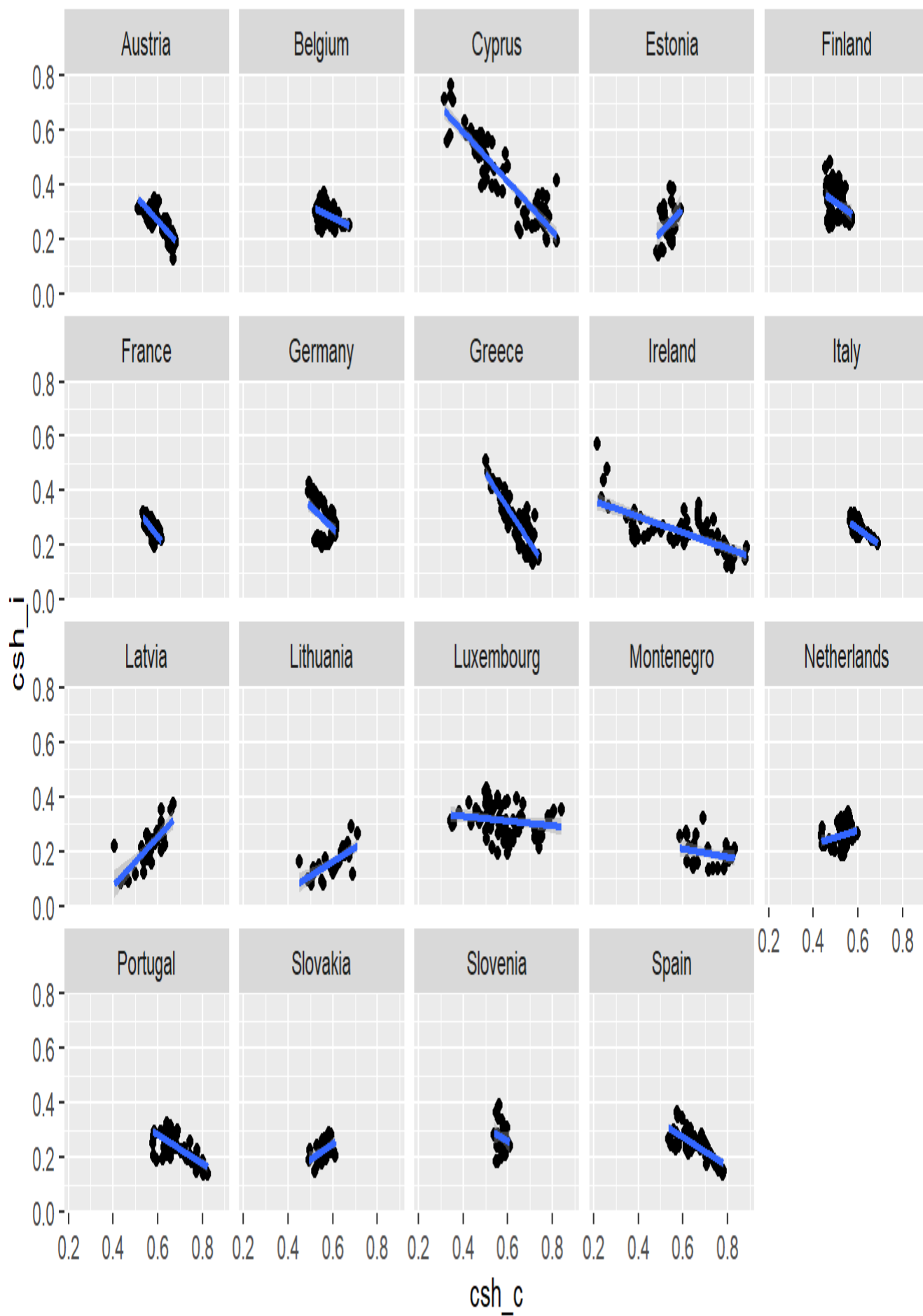
Japan



```
ggplot(df %>% filter(country=="Japan"), aes(csh_c, csh_i)) +  
  geom_point() +  
  geom_smooth(method=lm)  
  
## `geom_smooth()` using formula 'y ~ x'
```



```
ggplot(euro %>% filter(country!="Malta"), aes(csh_c, csh_i)) +  
  geom_point() +  
  geom_smooth(method=lm)+  
  facet_wrap(vars(country))  
  
## `geom_smooth()` using formula 'y ~ x'  
  
## Warning: Removed 241 rows containing non-finite values (stat_smooth).  
  
## Warning: Removed 241 rows containing missing values (geom_point).
```




```
seuro=euro %>% group_by(country) %>% mutate(scons=scale(csh_c),sinv=scale(csh_i)) %>%
ungroup
seuro
```

```
## # A tibble: 1,400 x 50
```

```
##   countrycode country currency_unit year  rgdpe  rgdpo  pop  emp  avh  hc
##   <chr>      <chr>    <chr>      <dbl>  <dbl>  <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 AUT        Austria Euro      1950 40357. 41605.  6.98  2.93 2086.  2.55
## 2 AUT        Austria Euro      1951 41846. 43706.  6.98  2.99 2083.  2.54
## 3 AUT        Austria Euro      1952 43858. 44922.  6.97  2.92 2080.  2.52
## 4 AUT        Austria Euro      1953 46027. 47309.  6.98  2.89 2078.  2.51
## 5 AUT        Austria Euro      1954 49078. 50658.  6.99  2.98 2075.  2.49
## 6 AUT        Austria Euro      1955 53920. 55542.  6.99  3.13 2072.  2.48
## 7 AUT        Austria Euro      1956 58296. 59630.  7.00  3.22 2070.  2.46
## 8 AUT        Austria Euro      1957 61308. 62760.  7.01  3.30 2067.  2.45
## 9 AUT        Austria Euro      1958 64192. 65324.  7.03  3.32 2065.  2.43
## 10 AUT       Austria Euro      1959 66692. 67548.  7.06  3.37 2062.  2.42
## # ... with 1,390 more rows, and 40 more variables: ccon <dbl>, cda <dbl>,
## #   cgdpe <dbl>, cgdpo <dbl>, cn <dbl>, ck <dbl>, ctfp <dbl>, cwtfp <dbl>,
## #   rgdpna <dbl>, rconna <dbl>, rdana <dbl>, rnna <dbl>, rkna <dbl>,
## #   rtfpna <dbl>, rwtfpna <dbl>, labsh <dbl>, irr <dbl>, delta <dbl>, xr <dbl>,
## #   pl_con <dbl>, pl_da <dbl>, pl_gdpo <dbl>, cor_exp <dbl>, statcap <dbl>,
## #   csh_c <dbl>, csh_i <dbl>, csh_g <dbl>, csh_x <dbl>, csh_m <dbl>,
## #   csh_r <dbl>, pl_c <dbl>, pl_i <dbl>, pl_g <dbl>, pl_x <dbl>, pl_m <dbl>,
## #   pl_n <dbl>, pl_k <dbl>, decade <fct>, scons <dbl[,1]>, sinv <dbl[,1]>
```

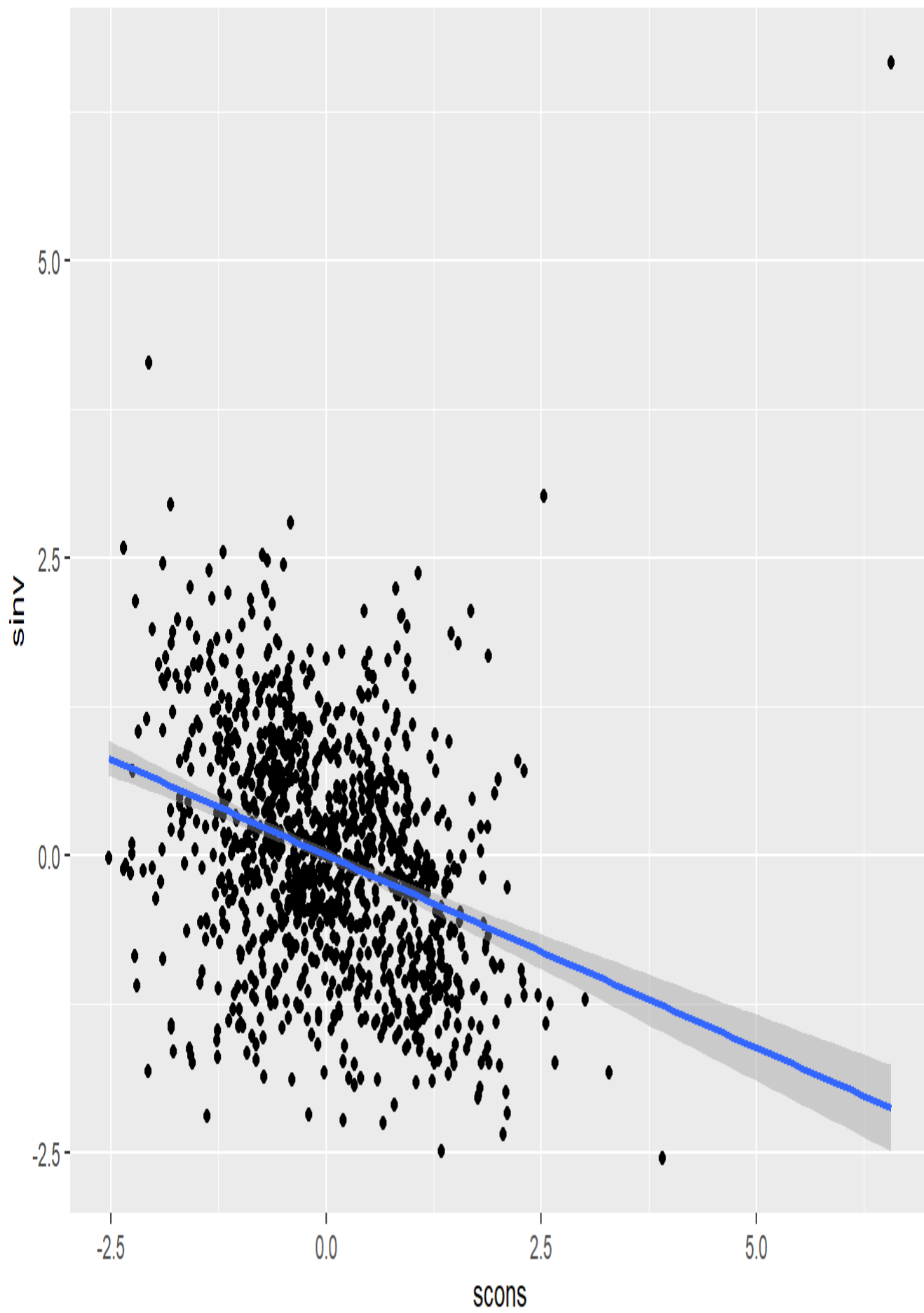
```
#scaled total scatterplot
```

```
ggplot(data=seuro, aes(scons, sinv)) +
  geom_point()+
  geom_smooth(method = lm)
```

```
## `geom_smooth()` using formula 'y ~ x'
```

```
## Warning: Removed 245 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 245 rows containing missing values (geom_point).
```



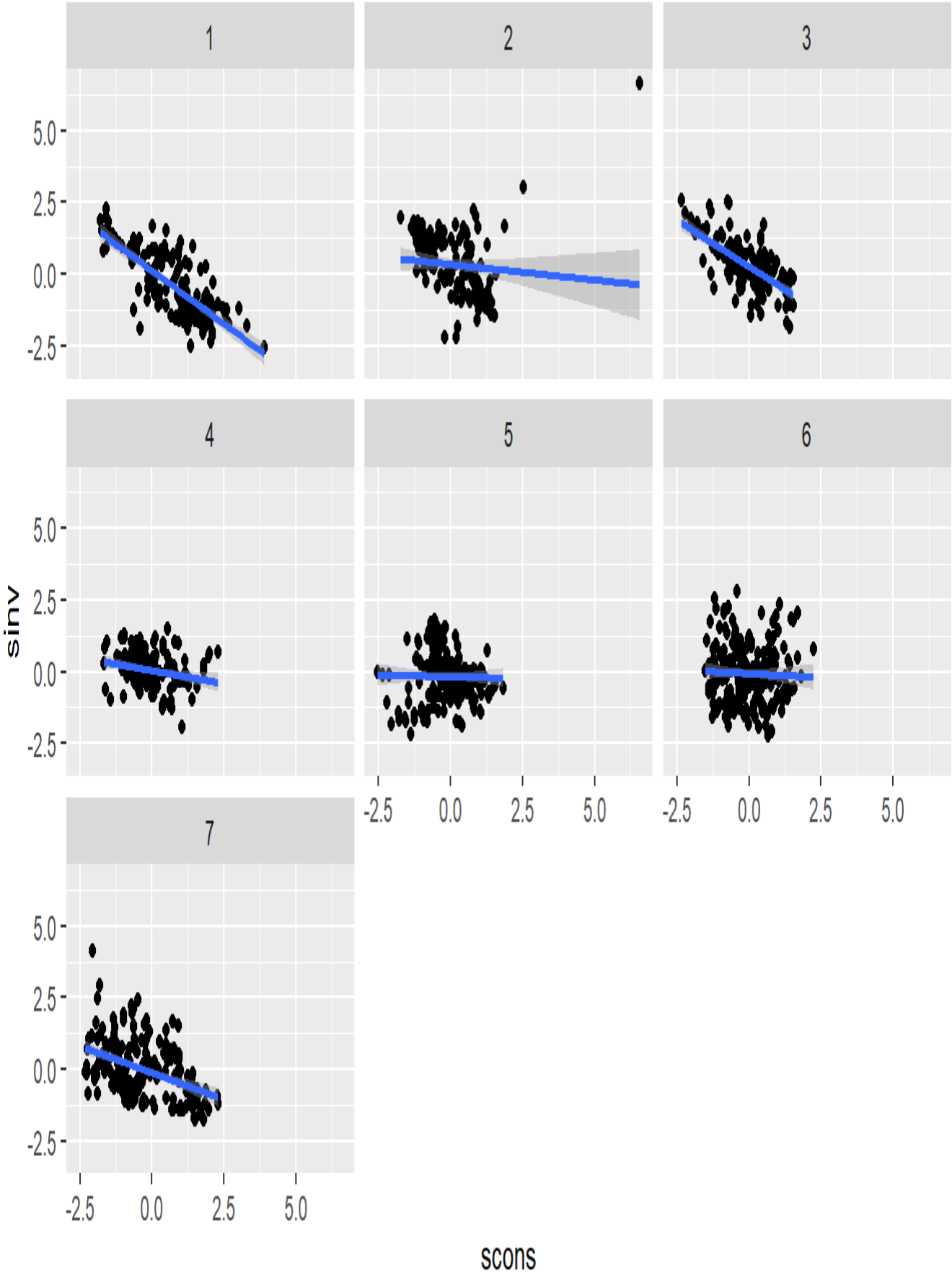
```
ggplot(data=seuro, aes(scons, sinv)) +  
  geom_point()+  
  geom_smooth(method = lm)+  
  facet_wrap(~decade)+  
  ggtitle("total scaled")
```

```
## `geom_smooth()` using formula 'y ~ x'
```

```
## Warning: Removed 245 rows containing non-finite values (stat_smooth).
```

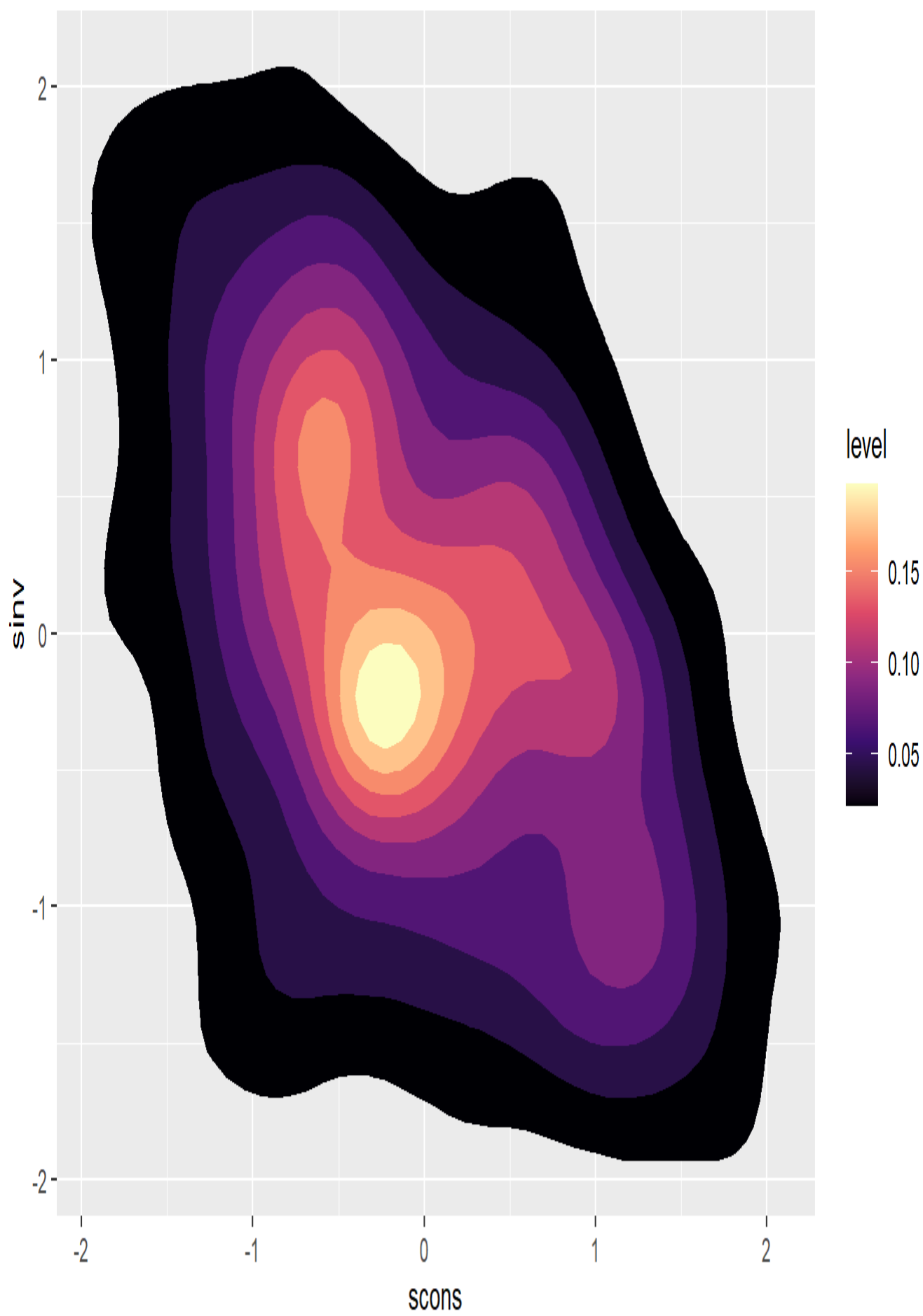
```
## Warning: Removed 245 rows containing missing values (geom_point).
```

total scaled



```
##dens plot
ggplot(seuro) +
  stat_density_2d(aes(x = scon, y = sinv, fill = ..level..),
    geom = "polygon", bins = 10, contour = TRUE)+
  #facet_wrap(~Species)+
  scale_fill_viridis_c(option = "A")

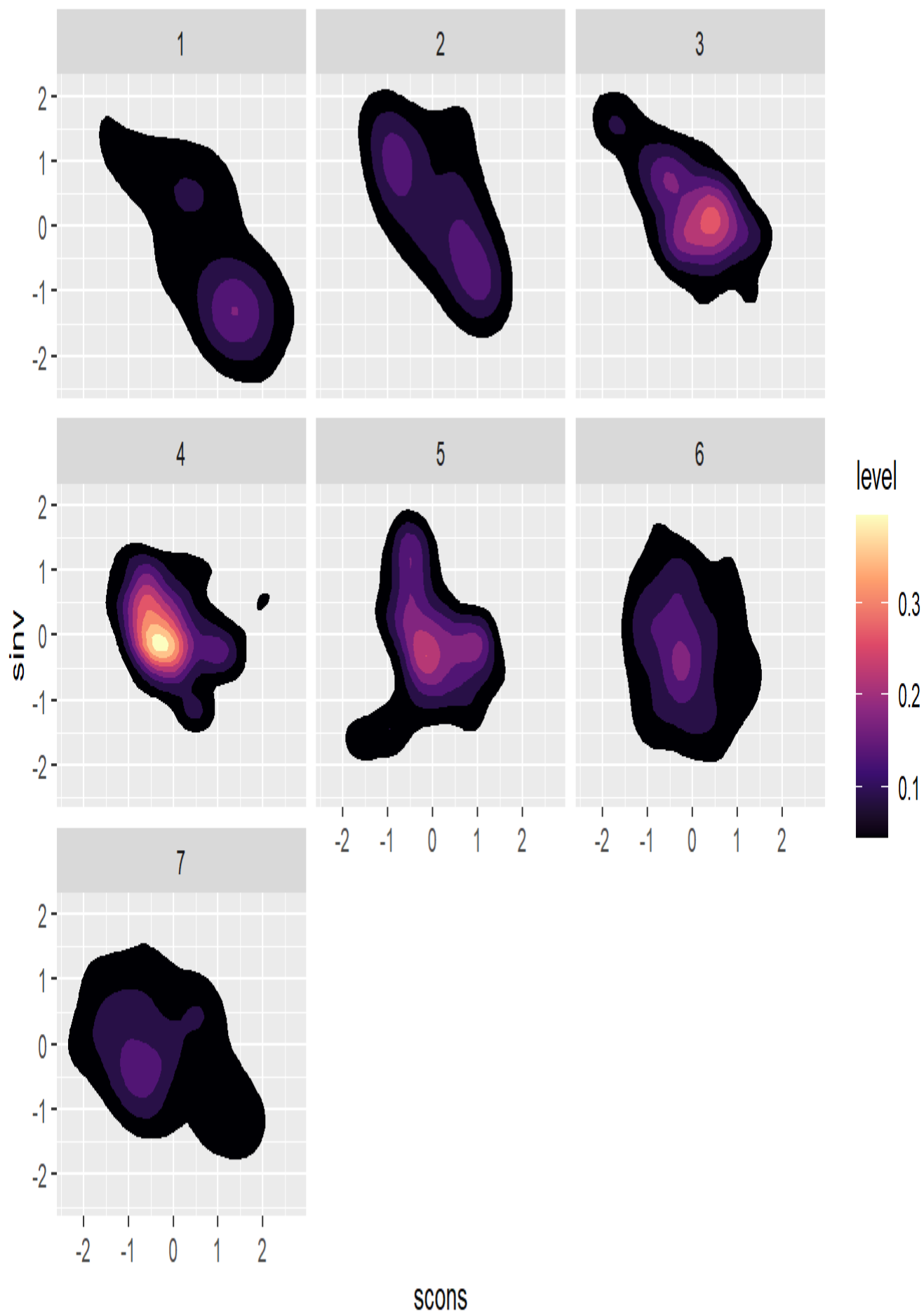
## Warning: Removed 245 rows containing non-finite values (stat_density2d).
```



```
##same by decade

ggplot(seuro) +
  stat_density_2d(aes(x = scons, y = sinv, fill = ..level..),
    geom = "polygon", bins = 10, contour = TRUE)+
  facet_wrap(~decade)+
  scale_fill_viridis_c(option = "A")

## Warning: Removed 245 rows containing non-finite values (stat_density2d).
```




```

###3d print
seuro2=seuro %>%select(scons,sinv) %>% na.omit
den3d <- MASS::kde2d(seuro2$scons, seuro2$sinv)

# the new part:
library(plotly)

## Warning: package 'plotly' was built under R version 4.1.2

##
## Attaching package: 'plotly'

## The following object is masked from 'package:ggplot2':
##
##     last_plot

## The following object is masked from 'package:stats':
##
##     filter

## The following object is masked from 'package:graphics':
##
##     layout

#plot_ly(x=den3d$x, y=den3d$y, z=den3d$z) %>% add_surface()

# Advanced na dropping -----

df2000=euro %>% filter(year>=2000)
df2000=df2000 %>% select_if(is.numeric) %>% summarize_all(mean)
### Remove columns and rows with more than 50% NA
#df2000[which(rowMeans(!is.na(dat)) > 0.5), which(colMeans(!is.na(dat)) > 0.5)]

## Remove rows with more than 50% NA
df2000[which(rowMeans(!is.na(df2000)) > 0.5), ]

## # A tibble: 20 x 45
##   country  year  rgdpe  rgdpo  pop  emp  avh  hc  ccon  cda  cgdpe
##   <chr>    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1 Austria 2010.  3.95e5 3.86e5  8.44  4.09 1691.  3.26 2.75e5 3.84e5 3.97e5
## 2 Belgium 2010.  4.73e5 4.49e5 10.9  4.48 1584.  3.08 3.26e5 4.65e5 4.75e5
## 3 Cyprus  2010.  2.74e4 2.36e4  0.797 0.321 1856.  2.72 2.13e4 2.80e4 2.76e4
## 4 Estonia 2010.  3.37e4 3.21e4  1.34  0.625 1913.  3.47 2.43e4 3.34e4 3.35e4
## 5 Finland 2010.  2.25e5 2.22e5  5.36  2.49 1641.  3.32 1.59e5 2.19e5 2.24e5
## 6 France  2010.  2.56e6 2.54e6 64.6  27.0 1526.  3.05 1.93e6 2.56e6 2.55e6
## 7 Germany 2010.  3.56e6 3.66e6 81.6  41.0 1424.  3.63 2.57e6 3.37e6 3.56e6
## 8 Greece  2010.  3.22e5 3.05e5 10.9  4.43 2071.  2.93 2.73e5 3.42e5 3.19e5
## 9 Ireland 2010.  2.57e5 2.73e5  4.40  1.95 1818.  3.02 1.24e5 2.16e5 2.60e5
## 10 Italy   2010.  2.27e6 2.24e6 59.1  24.7 1774.  2.97 1.68e6 2.26e6 2.28e6
## 11 Latvia 2010.  4.36e4 4.26e4  2.14  0.933 1925.  3.01 3.53e4 4.61e4 4.32e4
## 12 Lithuan~ 2010.  7.26e4 6.75e4  3.15  1.37 1876.  3.13 6.05e4 7.35e4 7.18e4
## 13 Luxembo~ 2010.  4.84e4 3.66e4  0.511 0.354 1538.  3.19 2.11e4 3.34e4 4.88e4
## 14 Malta   2010.  1.38e4 1.19e4  0.416 0.171 2073.  2.99 9.79e3 1.28e4 1.38e4
## 15 Montene~ 2010.  8.46e3 9.40e3  0.622 0.204  NA  NA  8.63e3 1.05e4 8.30e3
## 16 Netherl~ 2010.  8.13e5 8.33e5 16.6  8.74 1432.  3.27 5.49e5 7.39e5 8.09e5
## 17 Portugal 2010.  3.03e5 2.89e5 10.4  4.92 1885.  2.35 2.42e5 3.16e5 3.03e5
## 18 Slovakia 2010.  1.39e5 1.29e5  5.42  2.22 1762.  3.59 1.06e5 1.36e5 1.37e5

```

```
## 19 Slovenia 2010. 6.39e4 5.92e4 2.03 0.960 1672. 3.39 4.48e4 6.19e4 6.38e4
## 20 Spain 2010. 1.59e6 1.55e6 45.2 18.9 1715. 2.80 1.16e6 1.60e6 1.59e6
## # ... with 34 more variables: cgdpo <dbl>, cn <dbl>, ck <dbl>, ctfp <dbl>,
## # cwtfp <dbl>, rgdpna <dbl>, rconna <dbl>, rdana <dbl>, rnna <dbl>,
## # rkna <dbl>, rtfpna <dbl>, rwtfpna <dbl>, labsh <dbl>, irr <dbl>,
## # delta <dbl>, xr <dbl>, pl_con <dbl>, pl_da <dbl>, pl_gdpo <dbl>,
## # cor_exp <dbl>, statcap <dbl>, csh_c <dbl>, csh_i <dbl>, csh_g <dbl>,
## # csh_x <dbl>, csh_m <dbl>, csh_r <dbl>, pl_c <dbl>, pl_i <dbl>, pl_g <dbl>,
## # pl_x <dbl>, pl_m <dbl>, pl_n <dbl>, pl_k <dbl>
```

```
df2000[which(rowMeans(is.na(df2000)) > 0.5), ] #the rows that are dropped
```

```
## # A tibble: 0 x 45
## # ... with 45 variables: country <chr>, year <dbl>, rgdpe <dbl>, rgdpo <dbl>,
## # pop <dbl>, emp <dbl>, avh <dbl>, hc <dbl>, ccon <dbl>, cda <dbl>,
## # cgdpe <dbl>, cgdpo <dbl>, cn <dbl>, ck <dbl>, ctfp <dbl>, cwtfp <dbl>,
## # rgdpna <dbl>, rconna <dbl>, rdana <dbl>, rnna <dbl>, rkna <dbl>,
## # rtfpna <dbl>, rwtfpna <dbl>, labsh <dbl>, irr <dbl>, delta <dbl>, xr <dbl>,
## # pl_con <dbl>, pl_da <dbl>, pl_gdpo <dbl>, cor_exp <dbl>, statcap <dbl>,
## # csh_c <dbl>, csh_i <dbl>, csh_g <dbl>, csh_x <dbl>, csh_m <dbl>,
## # csh_r <dbl>, pl_c <dbl>, pl_i <dbl>, pl_g <dbl>, pl_x <dbl>, pl_m <dbl>,
## # pl_n <dbl>, pl_k <dbl>
```

```
#####PCA
```

```
#we want to drop columns for pca, lets say columns with more than 80% nas
```

```
df2000=df2000[,which(colMeans(!is.na(df2000)) > 0.8)]
df2000[,which(colMeans(is.na(df2000)) > 0.8)] #columns that are dropped
```

```
## # A tibble: 20 x 0
```

```
pc=prcomp(df2000 %>% ungroup %>% select(-country) %>% na.omit)
```

```
biplot(pc)
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

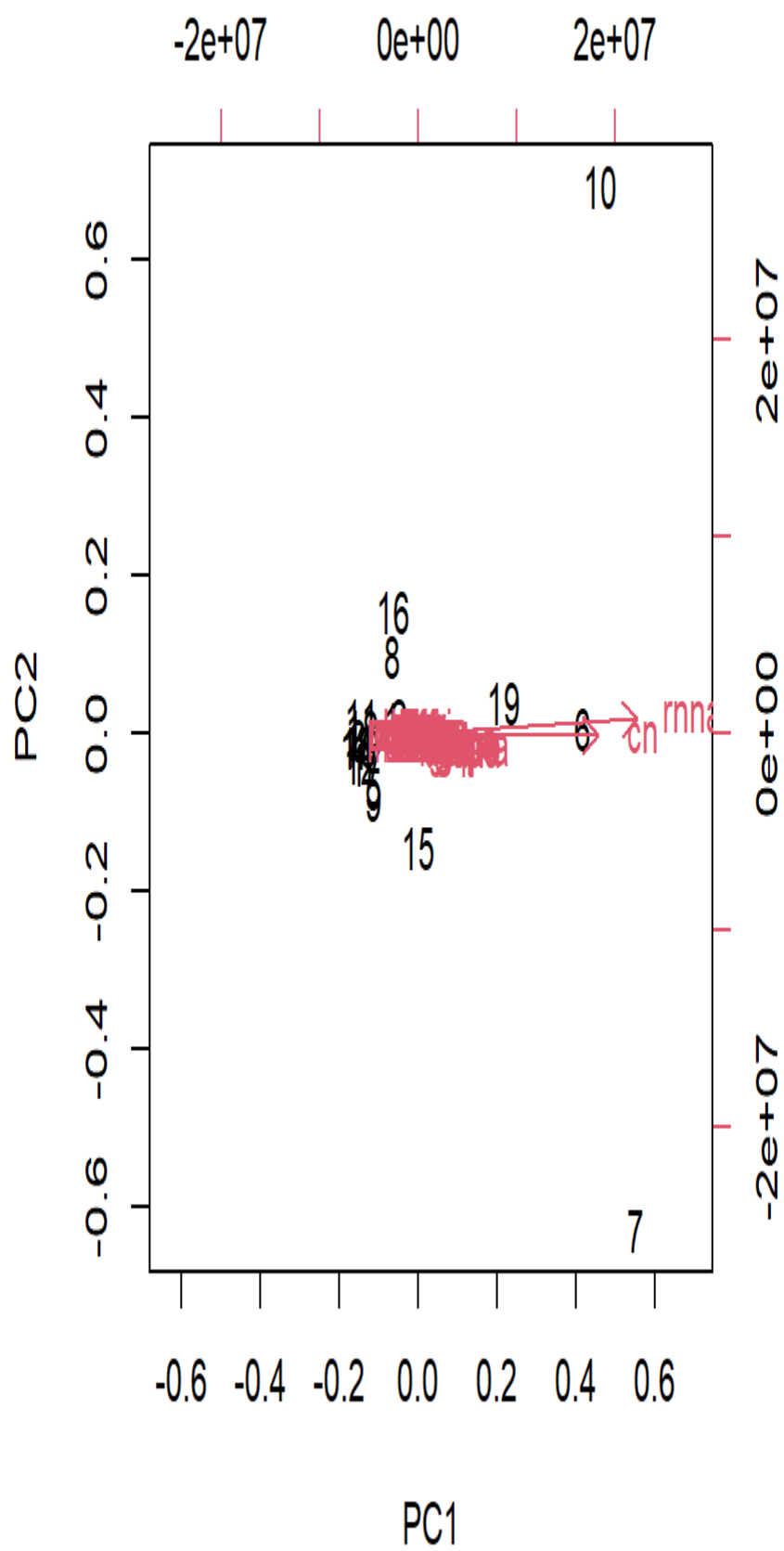
```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

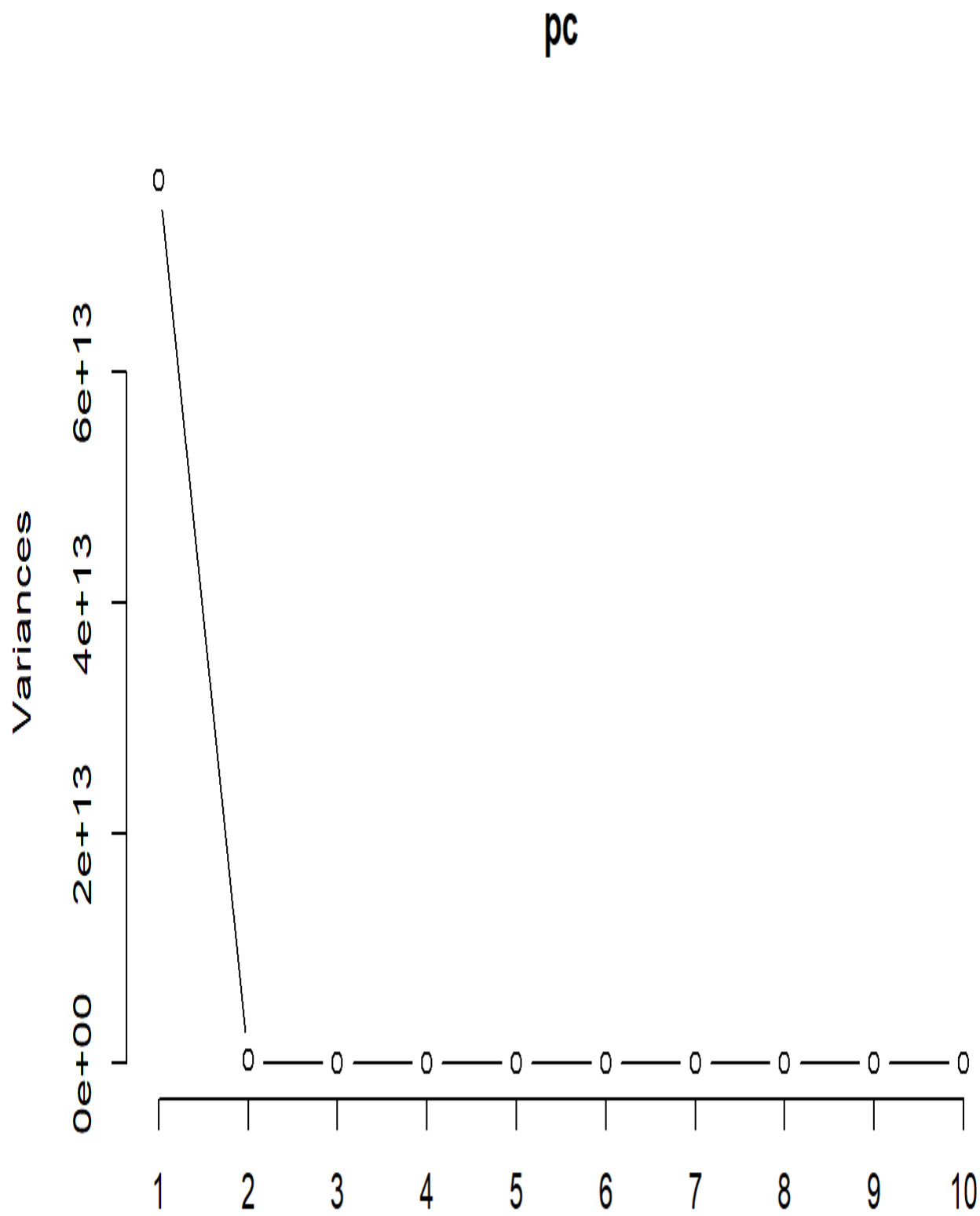
```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
```

[illegible]



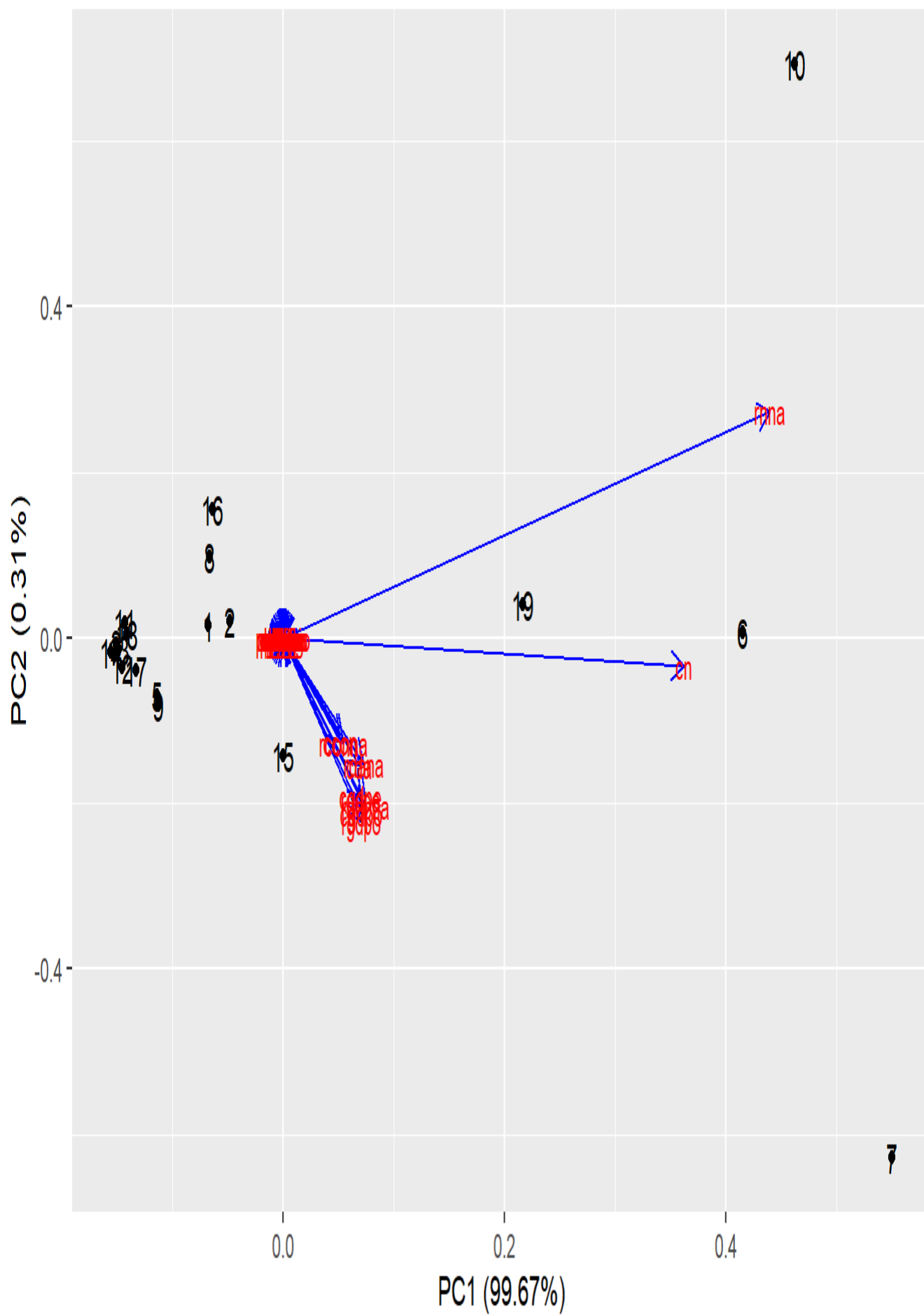
```
screeplot(pc,type="lines") ### See explained variance of PCs
```



```
library(ggfortify)

## Warning: package 'ggfortify' was built under R version 4.1.2

autoplot(pc, data = df2000 %>% na.omit,
         loadings = TRUE, loadings.colour = 'blue',
         loadings.label = TRUE, loadings.label.size = 3,label=T)
```



pc\$rotation

##		PC1	PC2	PC3	PC4	PC5
##	year	-4.366476e-16	-1.727275e-15	-2.008419e-15	-2.726751e-15	-3.899719e-14
##	rgdpe	1.163471e-01	-3.211434e-01	1.163559e-01	-1.328551e-02	1.477255e-01
##	rgdpo	1.172742e-01	-3.671515e-01	1.693539e-01	-2.770090e-01	-1.714075e-01
##	pop	2.848176e-06	-4.167688e-06	-8.327364e-06	2.629758e-05	-4.712103e-06
##	emp	1.290503e-06	-4.006313e-06	-3.029337e-06	-7.246312e-07	-2.277668e-05
##	avh	-1.038479e-05	1.512420e-04	-2.337976e-04	2.727525e-04	-3.273535e-03
##	hc	2.540704e-09	-3.072211e-07	6.990711e-07	-8.804097e-07	-2.877806e-07
##	ccon	8.573486e-02	-2.070590e-01	1.021339e-01	4.129845e-01	-4.800375e-01
##	cda	1.135044e-01	-2.559503e-01	7.243866e-02	4.975738e-01	3.289821e-01
##	cgdpe	1.164014e-01	-3.176451e-01	1.057651e-01	-4.318799e-02	1.836200e-01
##	cgdpo	1.165930e-01	-3.510540e-01	1.613542e-01	-3.272559e-01	-1.148388e-01
##	cn	5.983041e-01	-5.675991e-02	-7.927930e-01	-5.895581e-02	-4.537497e-02
##	ck	8.030604e-09	-8.466063e-09	1.138016e-08	-2.068293e-09	1.742033e-08
##	ctfp	7.066625e-09	-8.106208e-08	9.608801e-08	-8.178140e-07	5.544703e-06
##	cwtfp	4.814915e-09	-3.164508e-08	-2.366525e-08	2.216038e-07	2.839497e-06
##	rgdpna	1.234594e-01	-3.362229e-01	9.970518e-02	-3.999526e-01	6.846581e-02
##	rconna	8.979034e-02	-2.090417e-01	4.448265e-02	3.227053e-01	-5.756507e-01
##	rdana	1.206294e-01	-2.530717e-01	2.220571e-02	3.583378e-01	4.741596e-01
##	rnna	7.276740e-01	4.533587e-01	5.137575e-01	-3.050613e-03	1.639550e-02
##	rkna	3.039258e-09	3.313567e-08	-7.180455e-08	3.003133e-07	-1.823751e-06
##	rtfpna	1.902326e-09	4.359484e-08	-1.243772e-07	9.172260e-08	-4.131477e-07
##	rwtfpna	8.736138e-10	4.644850e-08	-1.750151e-07	1.809155e-08	-7.014178e-07
##	labsh	1.737037e-09	-2.884885e-08	-4.493147e-08	3.742622e-07	-3.016770e-07
##	irr	-1.095137e-09	2.677633e-09	1.840896e-08	-2.403879e-07	4.687056e-07
##	delta	-1.801489e-10	-1.588803e-09	6.007999e-09	-3.150416e-08	1.145213e-07
##	xr	-2.022422e-10	-2.799871e-09	1.492465e-08	8.516969e-08	-2.033255e-08
##	pl_con	7.267624e-09	-3.171664e-08	6.090944e-08	-9.994184e-07	4.838259e-06
##	pl_da	7.134561e-09	-4.168964e-08	8.313953e-08	-6.580461e-07	3.717463e-06
##	pl_gdpo	3.632534e-09	-2.896277e-08	6.522654e-08	-3.981774e-07	2.843473e-06
##	csch_c	-2.267930e-10	4.328989e-08	-1.088801e-07	7.376179e-07	-2.780023e-06
##	csch_i	-1.265942e-09	1.057156e-08	-3.844380e-08	-7.085273e-08	8.809432e-07
##	csch_g	-1.786176e-09	-3.878947e-09	3.956719e-08	3.846073e-07	-9.005556e-07
##	csch_x	-6.505380e-09	-1.622521e-07	4.413130e-07	-1.572436e-06	5.620327e-06
##	csch_m	1.397178e-08	1.085533e-07	-3.216351e-07	4.138747e-07	-1.738624e-06
##	csch_r	-4.187494e-09	3.716290e-09	-1.192122e-08	1.071893e-07	-1.082068e-06
##	pl_c	5.731766e-09	-2.895578e-08	2.421739e-08	-8.087134e-07	3.929812e-06
##	pl_i	5.117599e-09	-8.319329e-08	2.028472e-07	-1.026226e-07	2.208050e-06
##	pl_g	1.162451e-08	-2.993816e-08	1.906994e-07	-1.601432e-06	7.271829e-06
##	pl_x	1.117738e-09	-2.953413e-09	-2.668170e-09	4.834186e-09	1.295574e-07
##	pl_m	3.239846e-09	-1.211877e-08	1.792696e-08	-5.072617e-08	5.394507e-07
##	pl_n	7.208685e-09	-1.170217e-07	2.699284e-07	-2.356048e-07	3.063502e-06
##	pl_k	-2.064915e-09	-7.982573e-08	3.758692e-07	-2.322160e-06	6.911738e-06
##		PC6	PC7	PC8	PC9	PC10
##	year	1.478393e-14	5.801333e-14	-1.014168e-13	4.191867e-13	7.947580e-13
##	rgdpe	-3.104311e-01	3.795978e-01	-3.323682e-01	-1.445455e-02	5.312382e-02
##	rgdpo	-2.197147e-01	1.165772e-02	4.024816e-01	5.613985e-01	-4.334429e-01
##	pop	-2.285704e-06	-7.574614e-05	-1.538805e-05	3.635880e-04	4.493174e-04
##	emp	1.116407e-06	-6.637296e-07	-5.193817e-06	2.886894e-04	-1.115458e-05
##	avh	3.844990e-03	-1.417488e-02	1.248841e-02	4.916988e-02	2.679044e-02
##	hc	4.230837e-06	1.571281e-05	2.051514e-06	-1.956271e-05	1.638152e-04
##	ccon	-2.006999e-01	-3.160898e-01	-2.952356e-01	3.362153e-01	4.325317e-01
##	cda	-2.245448e-01	-4.607704e-01	3.861856e-02	-3.153807e-01	-4.429475e-01
##	cgdpe	-2.070605e-01	4.572847e-01	-2.752752e-01	-1.483276e-01	5.056309e-02
##	cgdpo	-9.839852e-02	-2.073715e-01	4.507419e-01	-4.949384e-01	4.622847e-01
##	cn	-6.531931e-02	-1.835673e-02	9.301633e-03	6.169073e-03	5.118780e-03
##	ck	-1.360741e-08	9.120535e-08	1.063213e-07	-4.784720e-07	-3.696601e-07
##	ctfp	-3.616409e-06	7.330663e-07	-7.795766e-06	-6.189053e-05	-3.116637e-06
##	cwtfp	-2.204402e-06	3.482849e-06	-5.130768e-06	-3.949264e-05	-3.707357e-06
##	rgdpna	5.525731e-01	-3.660373e-01	-4.920411e-01	3.157368e-02	-1.210721e-01
##	rconna	4.320642e-01	3.653716e-01	9.695658e-02	-3.076079e-01	-2.862780e-01
##	rdana	4.640093e-01	1.524353e-01	3.289209e-01	3.272174e-01	3.351928e-01

##	rnna	2.232495e-02	1.346090e-02	-1.806144e-03	-2.271001e-03	-6.574925e-03
##	rkna	-1.549769e-06	3.530859e-06	2.751946e-06	1.470154e-05	-1.231007e-05
##	rtfpna	-1.761111e-06	1.031309e-06	-5.760995e-06	-1.501540e-05	-1.429555e-05
##	rwtfpna	-1.767165e-06	-1.767078e-07	-6.486281e-06	-2.677903e-06	-1.148192e-06
##	labsh	-1.051763e-06	3.657174e-06	1.445844e-07	2.833355e-06	-3.249632e-05
##	irr	3.971185e-07	-1.927078e-06	-2.043561e-06	-1.217217e-05	1.767122e-05
##	delta	3.942977e-08	8.512322e-08	4.408314e-08	-1.036601e-06	2.840903e-06
##	xr	-3.660563e-07	1.586986e-06	6.841866e-07	2.583312e-06	3.420782e-05
##	pl_con	-3.705036e-06	5.396334e-06	-1.095341e-05	-1.194103e-04	-7.224782e-05
##	pl_da	-3.282417e-06	5.064697e-06	-6.742625e-06	-9.260731e-05	-6.242691e-05
##	pl_gdpo	-2.446467e-06	9.207358e-06	-2.947344e-05	-1.331784e-04	-7.471416e-05
##	cs_h_c	8.437801e-07	3.766326e-07	2.853300e-06	2.559398e-05	8.662035e-06
##	cs_h_i	5.081183e-07	9.256502e-07	-2.338592e-06	-1.420131e-05	-1.963636e-05
##	cs_h_g	1.481632e-08	1.961010e-07	3.007615e-06	1.439922e-05	1.427318e-05
##	cs_h_x	-3.754657e-06	2.548007e-05	8.754555e-06	-2.769745e-05	6.353788e-06
##	cs_h_m	1.427819e-06	-2.731608e-05	1.611695e-05	4.057127e-05	1.521558e-05
##	cs_h_r	9.601227e-07	3.376312e-07	-2.839383e-05	-3.866572e-05	-2.486821e-05
##	pl_c	-2.733546e-06	2.583878e-06	-3.707053e-06	-9.446302e-05	-5.381836e-05
##	pl_i	-1.752322e-06	3.109072e-06	-1.104501e-06	-4.428359e-05	-2.795571e-05
##	pl_g	-5.242987e-06	1.390815e-05	-3.391663e-05	-1.901431e-04	-1.209187e-04
##	pl_x	1.457665e-07	7.494887e-07	2.725898e-07	-4.877600e-06	3.318434e-06
##	pl_m	-3.999620e-07	5.741779e-07	6.835328e-07	-4.401839e-06	-4.863967e-06
##	pl_n	-2.015864e-06	4.704517e-06	-4.938414e-06	-5.109968e-05	-3.731133e-05
##	pl_k	5.900560e-07	-1.098865e-05	-2.542690e-05	-1.559986e-04	7.820883e-05
##		PC11	PC12	PC13	PC14	PC15
##	year	-2.232416e-13	-7.245130e-13	-7.378692e-10	-6.784694e-10	-9.109630e-10
##	rgdpe	6.914139e-01	-1.256064e-01	-6.285693e-04	2.300326e-04	-1.159978e-04
##	rgdpo	-4.876413e-02	2.881405e-02	2.076456e-04	-5.243844e-05	9.945479e-05
##	pop	-3.620326e-04	2.492405e-03	-8.436345e-01	3.395855e-02	1.392686e-01
##	emp	-1.952475e-04	1.550505e-03	-4.268275e-01	4.160720e-01	8.319510e-02
##	avh	-1.635986e-01	-9.847366e-01	-2.575011e-03	5.914603e-04	8.985917e-04
##	hc	3.993676e-04	5.207200e-04	2.630743e-02	-4.237564e-01	7.087923e-01
##	ccon	-9.366804e-02	4.579042e-02	5.632214e-04	1.256959e-05	-1.871440e-05
##	cda	-1.634844e-02	-1.984911e-02	-3.655185e-04	-7.928015e-05	3.342533e-05
##	cgdpe	-6.906749e-01	9.713335e-02	4.454962e-04	-2.114332e-04	9.090783e-05
##	cgdpo	4.682852e-02	-1.140110e-02	-1.050973e-04	6.917415e-05	-9.212269e-05
##	cn	5.276315e-05	8.733395e-04	1.716524e-05	-1.998995e-06	-9.972313e-07
##	ck	5.804710e-07	-2.245071e-06	7.237647e-04	-3.746515e-04	1.966801e-04
##	ctfp	-3.732539e-05	-3.498496e-04	2.899498e-02	1.484696e-01	-3.500528e-02
##	cwtfp	-5.760499e-05	-3.589816e-04	4.042854e-02	1.176802e-01	-2.039134e-01
##	rgdpna	6.099375e-03	-1.959091e-03	-2.641547e-05	-3.371396e-05	1.068677e-05
##	rconna	5.901296e-02	-3.333411e-02	-4.054518e-04	-1.341284e-05	7.494143e-06
##	rdana	3.191352e-02	2.242129e-02	3.565511e-04	7.527740e-05	-2.430485e-05
##	rnna	2.224741e-04	-5.740667e-04	-1.142674e-05	9.475977e-07	1.143710e-06
##	rkna	3.958581e-05	2.838619e-04	2.264576e-02	4.351822e-02	2.177331e-02
##	rtfpna	-1.651041e-05	4.631779e-05	4.760935e-02	6.544778e-02	6.312474e-02
##	rwtfpna	-4.615896e-05	-9.562252e-05	4.054568e-02	5.596635e-02	3.634506e-02
##	labsh	1.326228e-05	2.921181e-04	1.057138e-02	-1.630270e-02	-1.188181e-02
##	irr	-3.171449e-05	-2.273526e-04	-2.427475e-03	9.273838e-03	-1.578590e-02
##	delta	-1.306064e-06	-3.298122e-05	-2.262036e-04	-4.236057e-03	4.344536e-03
##	xr	-1.235782e-05	4.993837e-05	-1.736895e-02	1.098440e-02	4.604245e-02
##	pl_con	7.689371e-08	8.825154e-05	1.170899e-01	2.303789e-01	2.222203e-01
##	pl_da	4.831007e-05	3.946739e-05	1.039564e-01	1.929503e-01	1.835103e-01
##	pl_gdpo	-2.449873e-05	1.275889e-04	1.171847e-01	1.808561e-01	1.723421e-01
##	cs_h_c	-4.544404e-05	-4.852222e-05	2.513911e-02	4.486934e-02	-2.312690e-01
##	cs_h_i	-4.473434e-05	1.546941e-04	1.277376e-02	-1.355996e-02	4.916351e-02
##	cs_h_g	4.804300e-05	-1.321817e-04	-2.579880e-02	-6.264517e-02	-7.172860e-03
##	cs_h_x	-1.927262e-05	-4.537570e-04	-5.979722e-02	-3.403505e-01	1.867406e-01
##	cs_h_m	1.680863e-04	5.915110e-04	5.175213e-03	3.449309e-01	1.170857e-01
##	cs_h_r	-1.066783e-04	-1.117441e-04	4.250794e-02	2.675548e-02	-1.145480e-01
##	pl_c	1.210312e-05	2.790742e-05	9.138913e-02	1.819135e-01	2.062766e-01
##	pl_i	1.409502e-04	-8.999546e-05	4.719394e-02	9.240432e-02	1.470197e-01
##	pl_g	-6.068491e-05	3.152113e-04	1.919089e-01	3.716733e-01	2.708595e-01
##	pl_x	-7.976438e-06	1.732729e-05	1.627613e-03	1.322731e-02	8.431212e-03

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## pl_m      1.183799e-05  1.009929e-06  7.515154e-03  2.462417e-02  4.831505e-02
## pl_n      1.842410e-04 -1.033199e-04  6.022870e-02  1.140738e-01  1.743864e-01
## pl_k      -6.808875e-05 -1.468698e-03  4.320021e-02  2.055153e-01  1.393512e-01
##          PC16          PC17          PC18          PC19
## year      1.636274e-09  2.014296e-09 -2.350880e-09  9.997090e-01
## rgdpe     1.003535e-05 -3.089894e-06  1.406466e-05 -2.040236e-06
## rgdpo     1.484178e-04 -4.329194e-05 -6.607787e-05 -1.140832e-06
## pop       3.765376e-01  1.311890e-01 -7.795455e-02 -3.374239e-03
## emp       -5.828870e-01 -3.464330e-01  1.735264e-01  4.191066e-03
## avh       -8.875190e-05  6.373594e-04  6.800332e-04  1.222372e-05
## hc        4.713694e-02 -2.088742e-01  1.588355e-01  1.174005e-02
## ccon      -6.724879e-05 -3.578122e-05 -2.613854e-05 -1.810036e-06
## cda       2.276642e-05  2.278641e-05  2.716004e-05  2.108911e-06
## cgdpe     -2.912817e-05  6.345539e-05  1.651838e-05  3.278218e-06
## cgdpo     -1.203793e-04  2.178988e-06  4.853305e-05  1.997160e-07
## cn        -9.047980e-07 -1.443779e-06 -7.709613e-07 -3.876259e-08
## ck        -3.452713e-04  4.160996e-04  4.567109e-04 -2.117623e-05
## ctfp      -1.018331e-01 -1.876476e-01 -2.444449e-01  3.063934e-03
## rwdtfp    -4.501327e-02 -2.681237e-01  1.415862e-01  3.407149e-03
## rgdpna    -7.410202e-07  1.100951e-05 -2.089597e-06  1.701581e-07
## rconna    4.318605e-05  3.810590e-05  1.688909e-05  1.339926e-06
## rdana     -2.129868e-05 -5.005181e-05 -2.767619e-05 -2.078496e-06
## rnna      1.424200e-06  6.466405e-07  3.227674e-07  2.599490e-08
## rkna      -4.523427e-02  1.473750e-01 -3.528336e-01  4.374945e-03
## rtfpna    -9.365752e-02  1.364784e-01  2.540609e-01 -2.170661e-03
## rwtfpna   -5.162775e-02 -1.645420e-01 -4.199859e-01  8.637628e-04
## labsh     -1.298695e-01 -1.814097e-01  4.749321e-02 -3.095176e-03
## irr       1.672077e-02 -1.041785e-01 -6.460188e-02  8.814544e-05
## delta     -6.187551e-03 -4.821907e-02  1.096313e-03 -8.037652e-04
## xr        4.154493e-02 -4.821118e-02  3.512889e-01 -4.301650e-03
## pl_con    -1.276120e-03  1.567839e-02 -1.453142e-01 -2.354362e-03
## pl_da     2.867735e-03 -8.638830e-03 -9.579640e-04 -3.242954e-03
## pl_gdpo   1.744884e-01 -1.715693e-01  1.277775e-01 -5.628840e-03
## csh_c     -1.296662e-02  4.159611e-02  2.264090e-01  6.003198e-03
## csh_i     4.507514e-02 -5.458544e-02  1.501292e-01 -3.626314e-03
## csh_g     5.350314e-02 -8.586889e-03  2.732941e-02 -7.950494e-04
## csh_x     -4.852659e-01  3.796824e-02 -2.796943e-01 -1.041469e-02
## csh_m     3.205558e-02  4.468180e-01 -8.236526e-02  9.071973e-03
## csh_r     3.675986e-01 -4.632100e-01 -4.180813e-02 -2.447369e-04
## pl_c      1.465809e-02 -1.417191e-02 -1.129571e-01 -3.039920e-03
## pl_i      3.333309e-02  5.766974e-02  1.354596e-01 -3.624924e-03
## pl_g      1.799504e-02  1.325385e-01  4.268035e-02 -2.200002e-03
## pl_x      1.812344e-02 -1.050287e-01  1.095261e-01 -2.091920e-03
## pl_m      -1.104390e-02 -2.041071e-02  6.207389e-02 -1.877953e-03
## pl_n      1.268052e-02  1.241190e-01  1.947861e-01 -4.012248e-03
## pl_k      2.490620e-01 -3.131662e-01 -2.793722e-01 -1.102114e-03

```

```
pc$scale
```

```
## [1] FALSE
```

```

##### to see variable importance
varpc=factoextra::get_pca_var(pc)
varpc

```

```
## Principal Component Analysis Results for variables
```

```

## =====
##   Name      Description
## 1 "$coord"   "Coordinates for the variables"
## 2 "$cor"     "Correlations between variables and dimensions"
## 3 "$cos2"    "Cos2 for the variables"
## 4 "$contrib" "contributions of the variables"

```

varpc\$contrib

##	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
## year	1.906611e-29	2.983481e-28	4.033747e-28	7.435170e-28	1.520781e-25
## rgdpe	1.353664e+00	1.031331e+01	1.353870e+00	1.765046e-02	2.182283e+00
## rgdp	1.375324e+00	1.348002e+01	2.868075e+00	7.673396e+00	2.938054e+00
## pop	8.112105e-10	1.736962e-09	6.934500e-09	6.915628e-08	2.220392e-09
## emp	1.665399e-10	1.605054e-09	9.176885e-10	5.250903e-11	5.187770e-08
## avh	1.078438e-08	2.287415e-06	5.466133e-06	7.439395e-06	1.071603e-03
## hc	6.455176e-16	9.438480e-12	4.887004e-11	7.751212e-11	8.281766e-12
## ccon	7.350467e-01	4.287343e+00	1.043133e+00	1.705562e+01	2.304360e+01
## cda	1.288326e+00	6.551055e+00	5.247360e-01	2.475797e+01	1.082292e+01
## cgdpe	1.354928e+00	1.008984e+01	1.118626e+00	1.865202e-01	3.371632e+00
## cgdpo	1.359394e+00	1.232389e+01	2.603519e+00	1.070964e+01	1.318795e+00
## cn	3.579678e+01	3.221688e-01	6.285207e+01	3.475788e-01	2.058888e-01
## ck	6.449060e-15	7.167422e-15	1.295080e-14	4.277837e-16	3.034679e-14
## ctfp	4.993719e-15	6.571061e-13	9.232906e-13	6.688197e-11	3.074373e-09
## cwtfp	2.318341e-15	1.001411e-13	5.600441e-14	4.910825e-12	8.062742e-10
## rgdpna	1.524222e+00	1.130459e+01	9.941123e-01	1.599621e+01	4.687567e-01
## rconna	8.062305e-01	4.369844e+00	1.978706e-01	1.041387e+01	3.313738e+01
## rdana	1.455146e+00	6.404526e+00	4.930936e-02	1.284060e+01	2.248274e+01
## rna	5.295094e+01	2.055341e+01	2.639468e+01	9.306240e-04	2.688123e-02
## rkna	9.237087e-16	1.097973e-13	5.155893e-13	9.018807e-12	3.326069e-10
## rtfpna	3.618845e-16	1.900510e-13	1.546968e-12	8.413036e-13	1.706910e-11
## rwtfpna	7.632010e-17	2.157464e-13	3.063030e-12	3.273043e-14	4.919869e-11
## labsh	3.017297e-16	8.322560e-14	2.018837e-13	1.400722e-11	9.100900e-12
## irr	1.199325e-16	7.169720e-16	3.388897e-14	5.778635e-12	2.196850e-11
## delta	3.245364e-18	2.524295e-16	3.609605e-15	9.925121e-14	1.311512e-12
## xr	4.090191e-18	7.839276e-16	2.227452e-14	7.253876e-13	4.134125e-14
## pl_con	5.281836e-15	1.005945e-13	3.709959e-13	9.988371e-11	2.340875e-09
## pl_da	5.090196e-15	1.738026e-13	6.912181e-13	4.330247e-11	1.381953e-09
## pl_gdp	1.319531e-15	8.388423e-14	4.254502e-13	1.585453e-11	8.085337e-10
## csh_c	5.143504e-18	1.874014e-13	1.185487e-12	5.440802e-11	7.728529e-10
## csh_i	1.602610e-16	1.117578e-14	1.477926e-13	5.020109e-13	7.760609e-11
## csh_g	3.190424e-16	1.504623e-15	1.565563e-13	1.479227e-11	8.110003e-11
## csh_x	4.231996e-15	2.632575e-12	1.947572e-11	2.472556e-10	3.158808e-09
## csh_m	1.952107e-14	1.178382e-12	1.034492e-11	1.712922e-11	3.022813e-10
## csh_r	1.753510e-15	1.381081e-15	1.421155e-14	1.148955e-12	1.170871e-10
## pl_c	3.285314e-15	8.384375e-14	5.864818e-14	6.540174e-11	1.544342e-09
## pl_i	2.618982e-15	6.921124e-13	4.114699e-12	1.053140e-12	4.875483e-10
## pl_g	1.351293e-14	8.962934e-14	3.636628e-12	2.564583e-10	5.287949e-09
## pl_x	1.249339e-16	8.722647e-16	7.119129e-16	2.336935e-15	1.678513e-12
## pl_m	1.049660e-15	1.468647e-14	3.213760e-14	2.573144e-13	2.910071e-11
## pl_n	5.196515e-15	1.369407e-12	7.286132e-12	5.550963e-12	9.385042e-10
## pl_k	4.263875e-16	6.372148e-13	1.412777e-11	5.392429e-10	4.777213e-09
##	Dim.6	Dim.7	Dim.8	Dim.9	Dim.10
## year	2.185644e-26	3.365547e-25	1.028537e-24	1.757175e-23	6.316403e-23
## rgdpe	9.636745e+00	1.440945e+01	1.104686e+01	2.089341e-02	2.822140e-01
## rgdp	4.827457e+00	1.359024e-02	1.619914e+01	3.151683e+01	1.878728e+01
## pop	5.224442e-10	5.737477e-07	2.367921e-08	1.321962e-05	2.018861e-05
## emp	1.246365e-10	4.405370e-11	2.697574e-09	8.334159e-06	1.244247e-08
## avh	1.478394e-03	2.009274e-02	1.559604e-02	2.417677e-01	7.177274e-02
## hc	1.789998e-09	2.468923e-08	4.208709e-10	3.826995e-08	2.683543e-06
## ccon	4.028045e+00	9.991278e+00	8.716407e+00	1.130407e+01	1.870837e+01
## cda	5.042036e+00	2.123093e+01	1.491393e-01	9.946496e+00	1.962025e+01
## cgdpe	4.287405e+00	2.091093e+01	7.577644e+00	2.200108e+00	2.556626e-01
## cgdpo	9.682268e-01	4.300292e+00	2.031683e+01	2.449640e+01	2.137072e+01
## cn	4.266612e-01	3.369694e-02	8.652038e-03	3.805746e-03	2.620191e-03
## ck	1.851616e-14	8.318416e-13	1.130422e-12	2.289354e-11	1.366486e-11
## ctfp	1.307841e-09	5.373863e-11	6.077396e-09	3.830438e-07	9.713425e-10
## cwtfp	4.859388e-10	1.213024e-09	2.632478e-09	1.559668e-07	1.374449e-09
## rgdpna	3.053370e+01	1.339833e+01	2.421044e+01	9.968972e-02	1.465845e+00
## rconna	1.866795e+01	1.334964e+01	9.400578e-01	9.462263e+00	8.195511e+00
## rdana	2.153046e+01	2.323652e+00	1.081890e+01	1.070712e+01	1.123542e+01

## rnna	4.984033e-02	1.811958e-02	3.262158e-04	5.157446e-04	4.322964e-03
## rkna	2.401784e-10	1.246697e-09	7.573208e-10	2.161353e-08	1.515378e-08
## rtfpna	3.101513e-10	1.063598e-10	3.318906e-09	2.254621e-08	2.043627e-08
## rwtfpna	3.122872e-10	3.122564e-12	4.207184e-09	7.171167e-10	1.318346e-10
## labsh	1.106204e-10	1.337492e-09	2.090464e-12	8.027903e-10	1.056011e-07
## irr	1.577031e-11	3.713631e-10	4.176143e-10	1.481617e-08	3.122720e-08
## delta	1.554707e-13	7.245963e-13	1.943323e-13	1.074542e-10	8.070729e-10
## xr	1.339972e-11	2.518525e-10	4.681113e-11	6.673502e-10	1.170175e-07
## pl_con	1.372729e-09	2.912042e-09	1.199771e-08	1.425882e-06	5.219748e-07
## pl_da	1.077426e-09	2.565116e-09	4.546299e-09	8.576114e-07	3.897119e-07
## pl_gdpo	5.985200e-10	8.477545e-09	8.686837e-08	1.773649e-06	5.582205e-07
## csh_c	7.119649e-11	1.418521e-11	8.141319e-10	6.550517e-08	7.503085e-09
## csh_i	2.581842e-11	8.568283e-11	5.469013e-10	2.016771e-08	3.855868e-08
## csh_g	2.195235e-14	3.845561e-12	9.045746e-10	2.073376e-08	2.037236e-08
## csh_x	1.409745e-09	6.492339e-08	7.664223e-09	7.671489e-08	4.037062e-09
## csh_m	2.038667e-10	7.461684e-08	2.597562e-08	1.646028e-07	2.315139e-08
## csh_r	9.218356e-11	1.139948e-11	8.062096e-08	1.495038e-07	6.184281e-08
## pl_c	7.472275e-10	6.676423e-10	1.374224e-09	8.923263e-07	2.896416e-07
## pl_i	3.070632e-10	9.666330e-10	1.219923e-10	1.961036e-07	7.815219e-08
## pl_g	2.748891e-09	1.934366e-08	1.150338e-07	3.615440e-06	1.462132e-06
## pl_x	2.124787e-12	5.617333e-11	7.430521e-12	2.379098e-09	1.101200e-09
## pl_m	1.599696e-11	3.296803e-11	4.672171e-11	1.937618e-09	2.365818e-09
## pl_n	4.063709e-10	2.213248e-09	2.438793e-09	2.611178e-07	1.392135e-07
## pl_k	3.481661e-11	1.207504e-08	6.465272e-08	2.433556e-06	6.116621e-07
##	Dim.11	Dim.12	Dim.13	Dim.14	Dim.15
## year	4.983680e-24	5.249191e-23	5.444509e-17	4.603207e-17	8.298536e-17
## rgdpe	4.780531e+01	1.577696e+00	3.950994e-05	5.291497e-06	1.345550e-06
## rgdpo	2.377940e-01	8.302496e-02	4.311668e-06	2.749790e-07	9.891255e-07
## pop	1.310676e-05	6.212082e-04	7.117192e+01	1.153183e-01	1.939574e+00
## emp	3.812159e-06	2.404067e-04	1.821817e+01	1.731159e+01	6.921425e-01
## avh	2.676451e+00	9.697061e+01	6.630680e-04	3.498253e-05	8.074670e-05
## hc	1.594945e-05	2.711494e-05	6.920810e-02	1.795695e+01	5.023866e+01
## ccon	8.773701e-01	2.096763e-01	3.172183e-05	1.579946e-08	3.502288e-08
## cda	2.672714e-02	3.939872e-02	1.336038e-05	6.285343e-07	1.117253e-07
## cgdpe	4.770318e+01	9.434887e-01	1.984669e-05	4.470400e-06	8.264233e-07
## cgdpo	2.192910e-01	1.299850e-02	1.104545e-06	4.785063e-07	8.486591e-07
## cn	2.783950e-07	7.627219e-05	2.946454e-08	3.995981e-10	9.944702e-11
## ck	3.369466e-11	5.040346e-10	5.238353e-05	1.403637e-05	3.868306e-06
## ctfp	1.393185e-07	1.223947e-05	8.407089e-02	2.204322e+00	1.225370e-01
## cwtfp	3.318335e-07	1.288678e-05	1.634466e-01	1.384864e+00	4.158066e+00
## rgdpna	3.720238e-03	3.838038e-04	6.977769e-08	1.136631e-07	1.142071e-08
## rconna	3.482529e-01	1.111163e-01	1.643912e-05	1.799042e-08	5.616219e-09
## rdana	1.018473e-01	5.027143e-02	1.271287e-05	5.666687e-07	5.907255e-08
## rnna	4.949472e-06	3.295526e-05	1.305705e-08	8.979414e-11	1.308072e-10
## rkna	1.567036e-07	8.057757e-06	5.128307e-02	1.893835e-01	4.740769e-02
## rtfpna	2.725936e-08	2.145338e-07	2.266650e-01	4.283412e-01	3.984733e-01
## rwtfpna	2.130650e-07	9.143666e-07	1.643952e-01	3.132233e-01	1.320963e-01
## labsh	1.758881e-08	8.533300e-06	1.117541e-02	2.657779e-02	1.411773e-02
## irr	1.005809e-07	5.168921e-06	5.892634e-04	8.600408e-03	2.491947e-02
## delta	1.705804e-10	1.087761e-07	5.116807e-06	1.794418e-03	1.887500e-03
## xr	1.527158e-08	2.493841e-07	3.016805e-02	1.206570e-02	2.119907e-01
## pl_con	5.912643e-13	7.788335e-07	1.371004e+00	5.307442e+00	4.938184e+00
## pl_da	2.333863e-07	1.557675e-07	1.080693e+00	3.722983e+00	3.367605e+00
## pl_gdpo	6.001879e-08	1.627893e-06	1.373226e+00	3.270893e+00	2.970181e+00
## csh_c	2.065161e-07	2.354406e-07	6.319749e-02	2.013258e-01	5.348534e+00
## csh_i	2.001161e-07	2.393027e-06	1.631689e-02	1.838726e-02	2.417051e-01
## csh_g	2.308130e-07	1.747201e-06	6.655780e-02	3.924417e-01	5.144992e-03
## csh_x	3.714340e-08	2.058955e-05	3.575708e-01	1.158385e+01	3.487207e+00
## csh_m	2.825301e-06	3.498853e-05	2.678283e-03	1.189773e+01	1.370905e+00
## csh_r	1.138027e-06	1.248675e-06	1.806925e-01	7.158554e-02	1.312124e+00
## pl_c	1.464855e-08	7.788242e-08	8.351972e-01	3.309252e+00	4.255004e+00
## pl_i	1.986696e-06	8.099183e-07	2.227268e-01	8.538559e-01	2.161481e+00
## pl_g	3.682658e-07	9.935817e-06	3.682903e+00	1.381410e+01	7.336487e+00
## pl_x	6.362356e-09	3.002349e-08	2.649125e-04	1.749618e-02	7.108534e-03

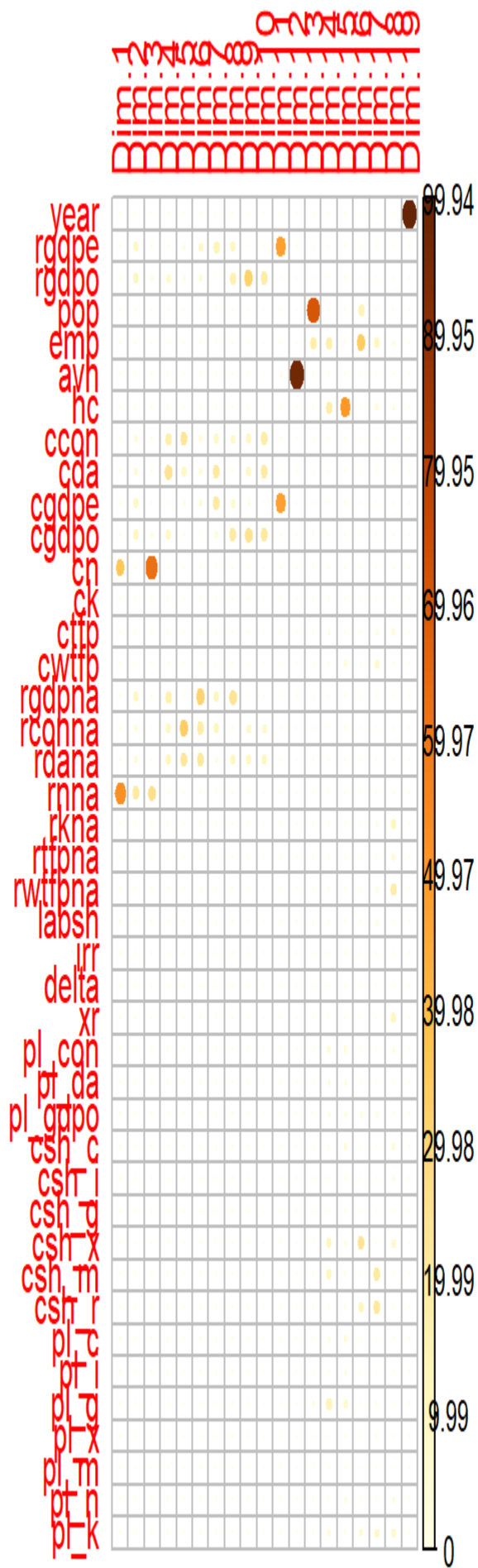
## pl_m	1.401381e-08	1.019957e-10	5.647754e-03	6.063496e-02	2.334344e-01
## pl_n	3.394474e-06	1.067500e-06	3.627497e-01	1.301283e+00	3.041061e+00
## pl_k	4.636078e-07	2.157075e-04	1.866258e-01	4.223652e+00	1.941876e+00
##	Dim.16	Dim.17	Dim.18	Dim.19	
## year	2.677391e-16	4.057387e-16	5.526635e-16	9.994181e+01	
## rgdpe	1.007083e-08	9.547445e-10	1.978148e-08	4.162564e-10	
## rgdpo	2.202783e-06	1.874192e-07	4.366285e-07	1.301497e-10	
## pop	1.417806e+01	1.721056e+00	6.076912e-01	1.138549e-03	
## emp	3.397572e+01	1.200158e+01	3.011140e+00	1.756504e-03	
## avh	7.876900e-07	4.062271e-05	4.624451e-05	1.494193e-08	
## hc	2.221891e-01	4.362845e+00	2.522871e+00	1.378287e-02	
## ccon	4.522400e-07	1.280296e-07	6.832235e-08	3.276230e-10	
## cda	5.183099e-08	5.192203e-08	7.376676e-08	4.447504e-10	
## cgdpe	8.484502e-08	4.026586e-07	2.728568e-08	1.074671e-09	
## cgdpo	1.449118e-06	4.747990e-10	2.355457e-07	3.988648e-12	
## cn	8.186594e-11	2.084499e-10	5.943813e-11	1.502539e-13	
## ck	1.192123e-05	1.731389e-05	2.085848e-05	4.484328e-08	
## ctfp	1.036999e+00	3.521161e+00	5.975331e+00	9.387689e-04	
## cwtfp	2.026194e-01	7.189033e+00	2.004666e+00	1.160866e-03	
## rgdpna	5.491110e-11	1.212092e-08	4.366416e-10	2.895379e-12	
## rconna	1.865035e-07	1.452060e-07	2.852414e-08	1.795400e-10	
## rdana	4.536338e-08	2.505184e-07	7.659714e-08	4.320144e-10	
## rnna	2.028345e-10	4.181440e-11	1.041788e-11	6.757350e-14	
## rkna	2.046139e-01	2.171939e+00	1.244915e+01	1.914015e-03	
## rtfpna	8.771732e-01	1.862637e+00	6.454695e+00	4.711770e-04	
## rwtfpna	2.665425e-01	2.707406e+00	1.763882e+01	7.460861e-05	
## labsh	1.686609e+00	3.290949e+00	2.255605e-01	9.580115e-04	
## irr	2.795842e-02	1.085315e+00	4.173403e-01	7.769619e-07	
## delta	3.828579e-03	2.325079e-01	1.201901e-04	6.460386e-05	
## xr	1.725981e-01	2.324318e-01	1.234039e+01	1.850419e-03	
## pl_con	1.628481e-04	2.458118e-02	2.111620e+00	5.543019e-04	
## pl_da	8.223905e-04	7.462939e-03	9.176951e-05	1.051675e-03	
## pl_gdpo	3.044619e+00	2.943601e+00	1.632710e+00	3.168384e-03	
## csh_c	1.681331e-02	1.730236e-01	5.126106e+00	3.603838e-03	
## csh_i	2.031768e-01	2.979570e-01	2.253877e+00	1.315015e-03	
## csh_g	2.862586e-01	7.373466e-03	7.468968e-02	6.321036e-05	
## csh_x	2.354830e+01	1.441587e-01	7.822890e+00	1.084657e-02	
## csh_m	1.027560e-01	1.996463e+01	6.784036e-01	8.230070e-03	
## csh_r	1.351288e+01	2.145635e+01	1.747920e-01	5.989613e-06	
## pl_c	2.148596e-02	2.008431e-02	1.275931e+00	9.241113e-04	
## pl_i	1.111095e-01	3.325799e-01	1.834931e+00	1.314007e-03	
## pl_g	3.238215e-02	1.756647e+00	1.821612e-01	4.840008e-04	
## pl_x	3.284591e-02	1.103103e+00	1.199597e+00	4.376130e-04	
## pl_m	1.219677e-02	4.165969e-02	3.853167e-01	3.526708e-04	
## pl_n	1.607957e-02	1.540553e+00	3.794162e+00	1.609813e-03	
## pl_k	6.203187e+00	9.807307e+00	7.804882e+00	1.214655e-04	

```
library("corrplot")
```

```
## Warning: package 'corrplot' was built under R version 4.1.2
```

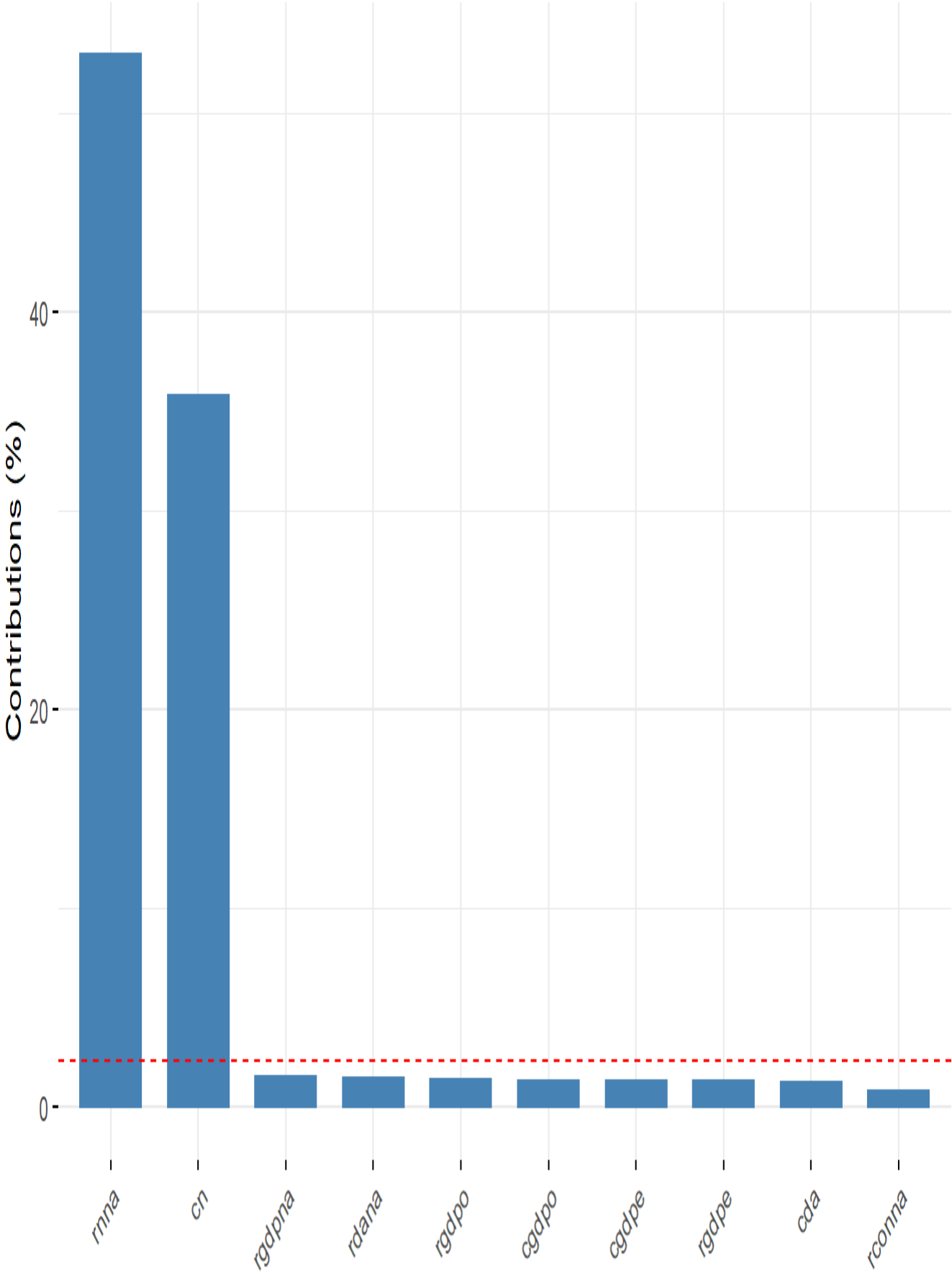
```
## corrplot 0.92 loaded
```

```
corrplot(varpc$contrib, is.corr=FALSE)
```



```
# Contributions of variables to PC1
factoextra::fviz_contrib(pc, choice = "var", axes = 1, top = 10)
```


Contribution of variables to Dim-1



```
# Contributions of variables to PC2
factoextra::fviz_contrib(pc, choice = "var", axes = 2, top = 10)
```

Contribution of variables to Dim-2

