

Tools for Constructing Composite Indicators

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Abstract

Keywords: composite indicators, CIP, R.

1. Introduction

2. Example session

3. Data sets

3.1. CIP: The Competitive Industrial Performance Index

3.2. TAI: Technology achievement index

4. The (ten) steps for constructing a composite indicators

5. The ProcessControl class

```
> library(CItools)
> ctr <- ProcessControl()
> names(ctr)
```

```
[1] "aggregation"      "normalization"    "weights"          "missingindicator"
[5] "cleaning"         "setmax"           "setmin"
```

6. The compind class

```
> library(CItools)
> data(cip)
> head(cip)
```

	country	year	MVApc	MXpc	MHVAsh	MVAsh	MHXsh	MXsh
1	Albania	1996	93.38696	55.45967	NA	9.455400	10.025371	82.00571
2	Albania	1997	70.41306	34.48729	2.013606	7.886519	12.931489	77.68516
3	Albania	1998	91.57565	57.04980	5.119037	9.062150	4.986206	84.84187
4	Albania	1999	123.16641	103.22675	7.703302	11.045816	8.311419	90.59448
5	Albania	2000	121.73711	77.70033	7.610967	10.170708	6.559917	91.52747
6	Albania	2001	129.18137	90.44488	12.307333	10.103809	6.639842	91.51321

	ImWMVA	ImWMT
1	0.005855031	0.004294599
2	0.004185166	0.002532108
3	0.005364120	0.004132572
4	0.006926821	0.007212425
5	0.006493174	0.004934976
6	0.007011170	0.005961145

```
> index_cip = compind(country~., time="year", for.period = 2005:2010, data=cip,
+   ctr=ProcessControl(weights=c("fixed",1/6,1/6,1/12,1/12,1/12,1/12,1/6,1/6),
+   aggregation="linear"))
> class(index_cip)
```

```
[1] "compind"
```

```
> names(index_cip)
```

```
[1] "entity"          "index"           "ranking"
[4] "indicator.array" "normindicator.array" "weight.array"
[7] "call"           "ctr"             "time.length"
```

7. Visualization of composite indicators

The computed composite indices and the underlying indicators can be presented in tabular or graphical way, using the services provided by the package. The following graphical displays are possible, depending on the number of time periods for which the index was computed.

- *Bar plot*: this is the default presentation if the composite index was computed for only one time period (year). All entities can be presented, but in case that these are too many, a subset can be selected - either by listing several entities or by choosing a criterion for selection. This can be *first/last 15 percent*. If several entities are selected, there are two possibilities for displaying them: a bar plot with only these entities or a bar plot with all entities, but the selected ones are highlighted. It is possible to sort the entities in the bar plot in ascending or descending order of the index or alphabetically.

- *Line plot*: this is the default presentation if the composite index was computed for several time periods (years) or if more than one time period was selected in the call to the `plot()` function. All entities can be presented, but in case that these are too many, a subset can be selected by listing several entities. Currently it is not possible, but an option will be implemented to choose a criterion for selection (first xx percent, last xx percent, first quantil, etc).
- *Radial plot*: The radial plot can present the underlying indicators (eight in the case of the CIP index) for several entities (in case of one year index) or for one entity and several years, depending on how the index was computed.
- *World map*: The index computed (or selected) for one time period can be presented on the world map. Additional options are to show only several selected countries. The countries can be selected either as a list or by a criterion (first 15 percent, etc.).

7.1. Bar plot

The Bar plot is the default presentation if the composite index was computed for only one time period (year). All entities can be presented, but in case that these are too many, a subset can be selected - either by listing several entities or by choosing a criterion for selection. The criterion can be *first/last 15 percent*, etc. If several entities are selected, there are two possibilities for displaying them: a bar plot with only these entities or a bar plot with all entities, but the selected ones are highlighted.

It is possible to sort the entities in the bar plot in ascending or descending order of the index or alphabetically.

```
> ## compute Composite index (eight-indicators linear) for one year
> ##
> index_cip1 = compind(country~., time="year", for.period = 2010, data=cip,
+   ctr=ProcessControl(weights=c("fixed",1/6,1/6,1/12,1/12,1/12,1/12,1/6,1/6),
+   aggregation="linear"))
> ## default plot for composite indicator - bar plot for only one year
> plot(index_cip1)

> ## Bar plot for composite indicator, one year and several selected entities
> plot(index_cip1, entity=c("India", "Japan", "United Kingdom",
+   "Bulgaria", "Austria", "China"))

> ## Bar plot for composite indicator, one year and several
> ## selected entities.
> ## The option used is to highlight the selected countries
> ## on the global graph
> plot(index_cip1, which="bar2", entity=c("India", "Japan",
+   "United Kingdom", "Bulgaria", "Austria", "China"))
```

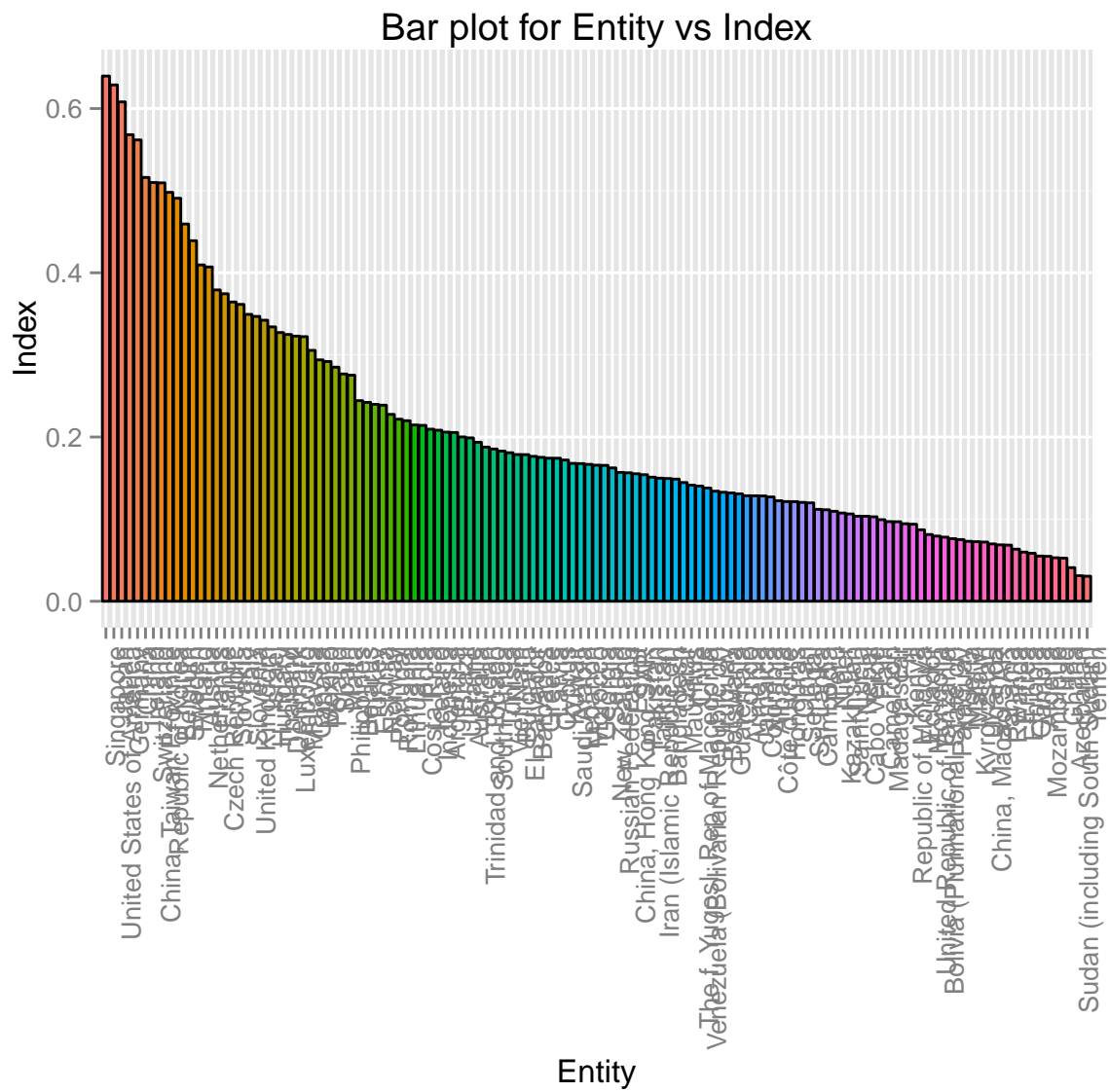


Figure 1: Bar plot for CIP index: one year and all countries.

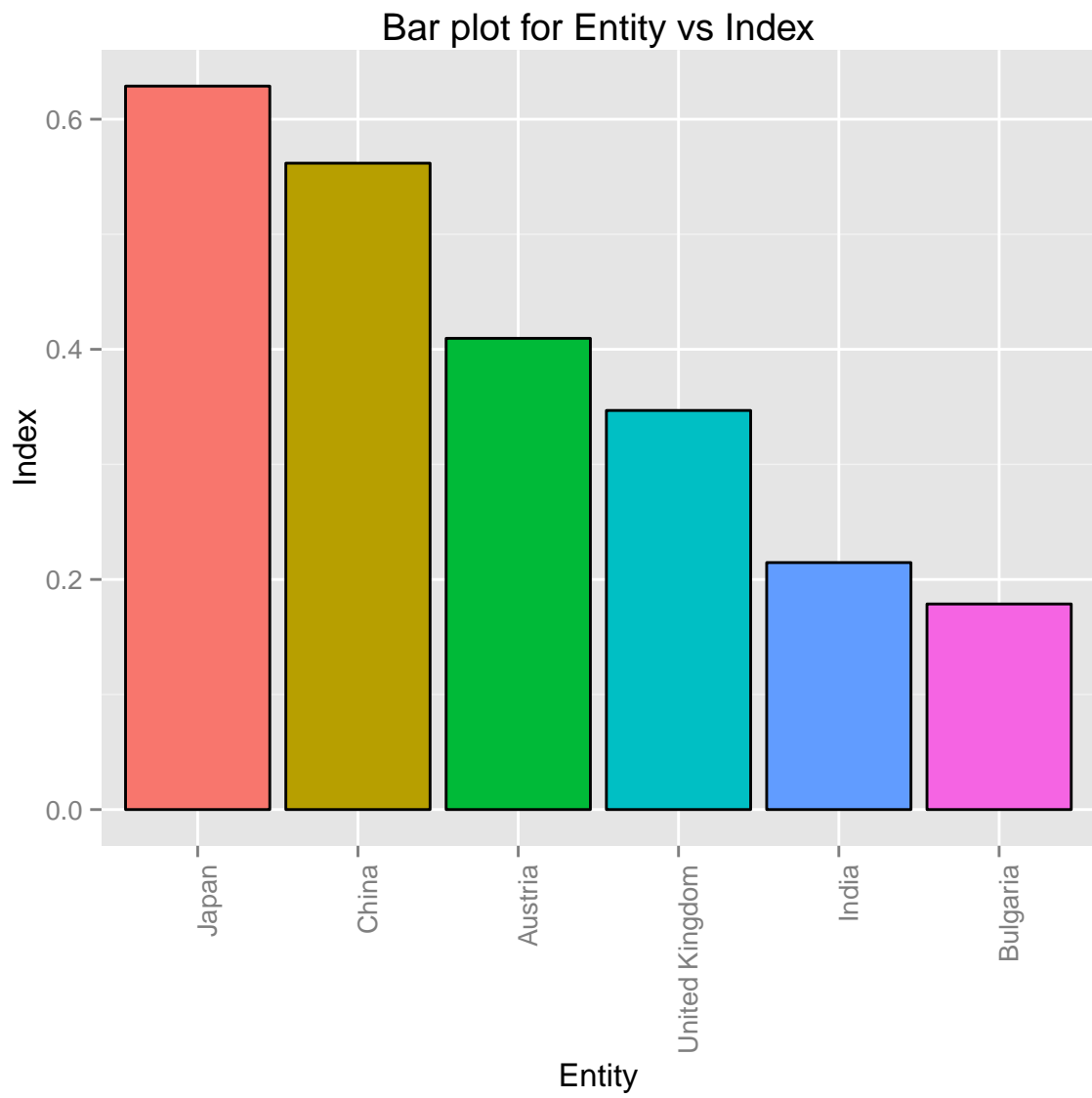


Figure 2: Bar plot for CIP index: one year and several countries.

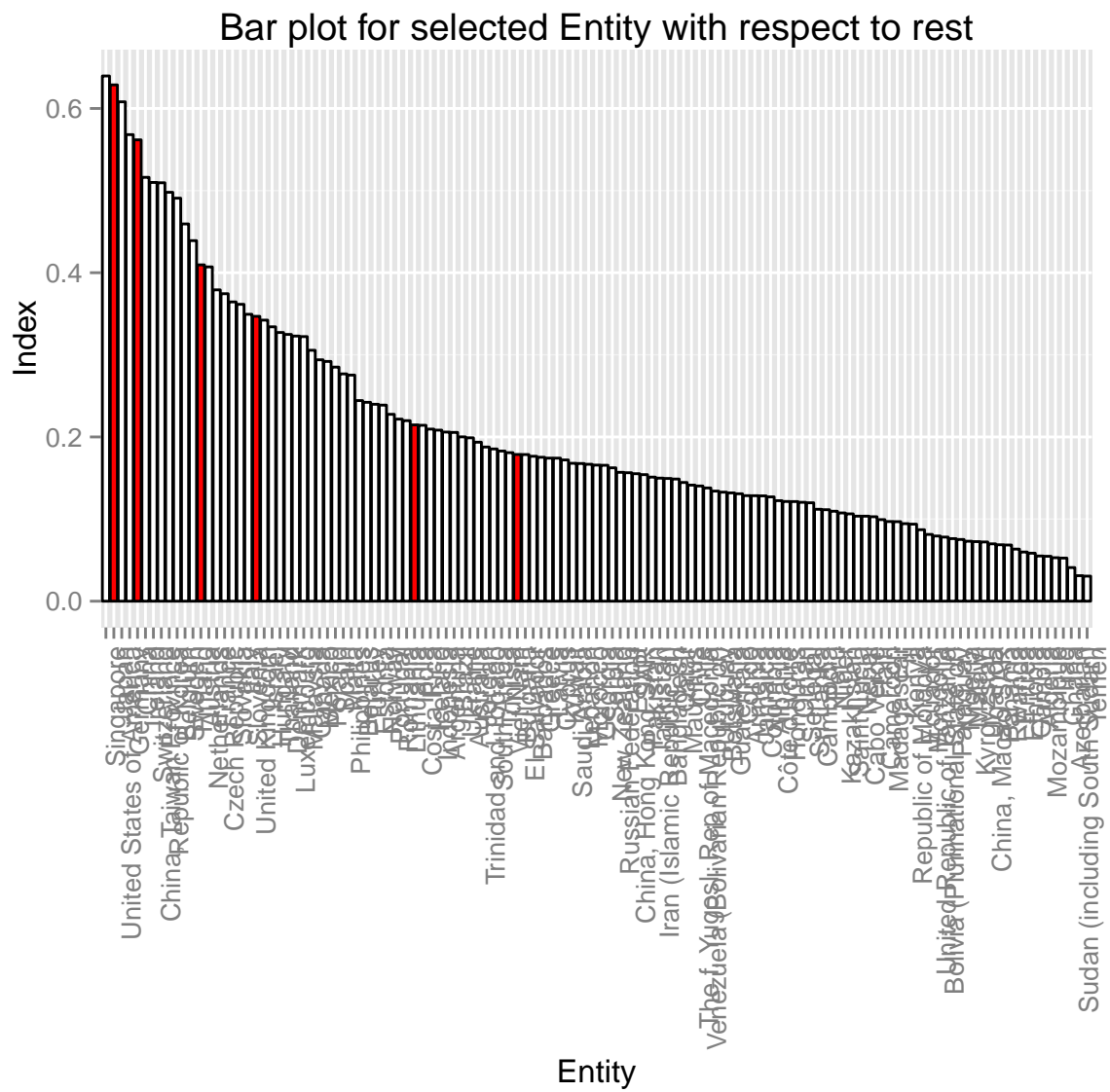


Figure 3: Bar plot for CIP index: one year and several countries highlighted on the global graph.

```
> ## Bar plot for composite indicator, one year and
> ## several selected entities
> ## A criterion (30% highly ranked countries according to CIP)
> ## is used to select the countries
> ##
> plot(index_cip1, entity.num="first 30 percent")
```

You can select the graph title, X-label, the Y-label as well as the sorting of the bars, as shown in Figure ??.

```
> ## Bar plot for composite indicator, one year and several
> ## selected entities
> ## A criterion (30% highly ranked countries according to CIP)
> ## is used to select the countries
> ## Title, X-label and Y-label are selected by the user
> ##
> plot(index_cip1, entity.num="first 30 percent", xlab="Country",
+ ylab="CIP index", title="CIP index of the 30% highly ranked countries.")
```

Similarly, we can select the last 30% ranked countries in descending order, as shown in Figure ??.

```
> ## Bar plot for composite indicator, one year and
> ## several selected entities
> ## A criterion (30% lowest ranked countries according to
> ## the CIP index, in descending order) is used to select the countries
> ## Title, X-label and Y-label are selected by the user
> ##
> plot(index_cip1, entity.num="last 30 percent", sort="descending",
+ xlab="Country", ylab="CIP index",
+ title="CIP index of the 30% lowest ranked countries.")
```

7.2. Line plot

The Line plot is the default presentation if the composite index was computed for several time periods (years). All entities can be presented, but in case that these are too many, a subset can be selected - either by listing several entities or by choosing a criterion for selection. The criterion can be *first/last 15 percent*, etc.

```
> ## default plot for composite indicator - line plot for more than one year
> plot(index_cip)

> plot(index_cip, entity=c("Austria", "India", "Bulgaria", "Oman"),
+ ylab="CIP Index", xlab="", title="CIP index 2005-2010 for the EU-15 countries")
```

Let us select a group of countries and plot for them a line plot of the CIP ranking. To select the country names of a group of country, say *EU-15*, we can use the function `getCountryGroup()`. The result is shown in Figure ??

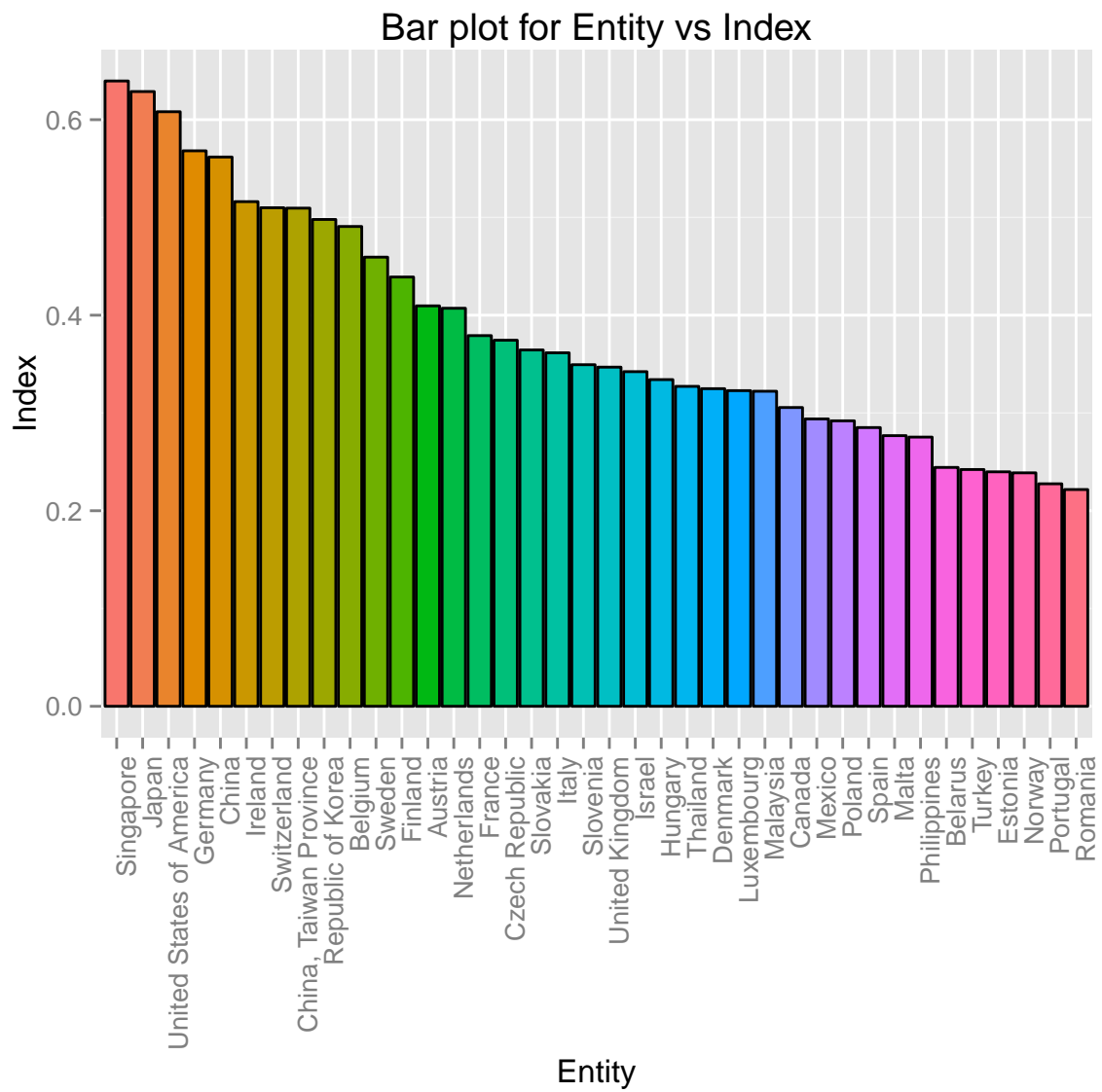


Figure 4: Bar plot for CIP index: one year and several countries selected as the 30 percent highly ranked countries.

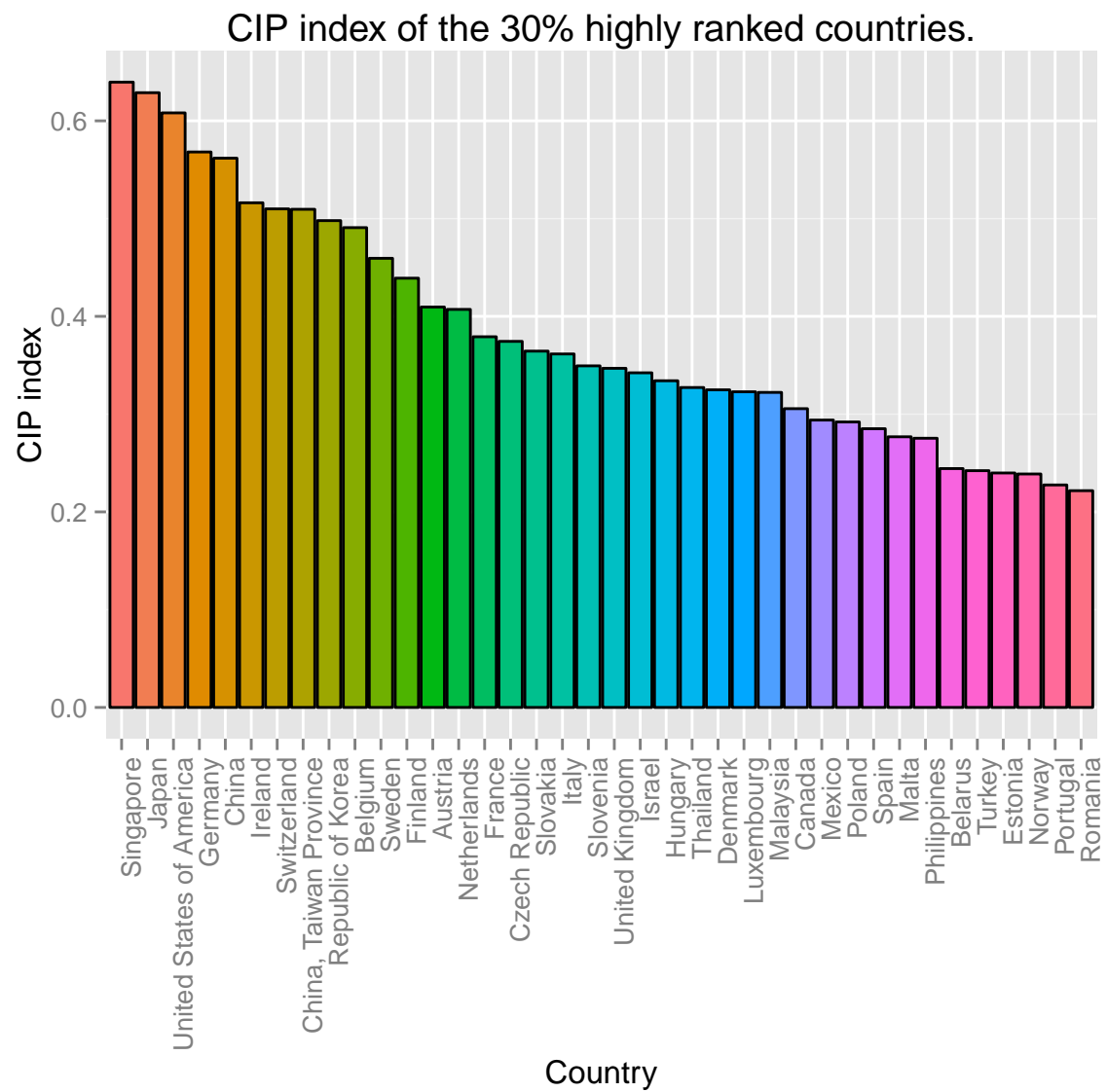


Figure 5: Bar plot for CIP index: one year and several countries selected as the 30 percent highly ranked countries. The characteristics of the graph (title, X- and Y-labels) are selected

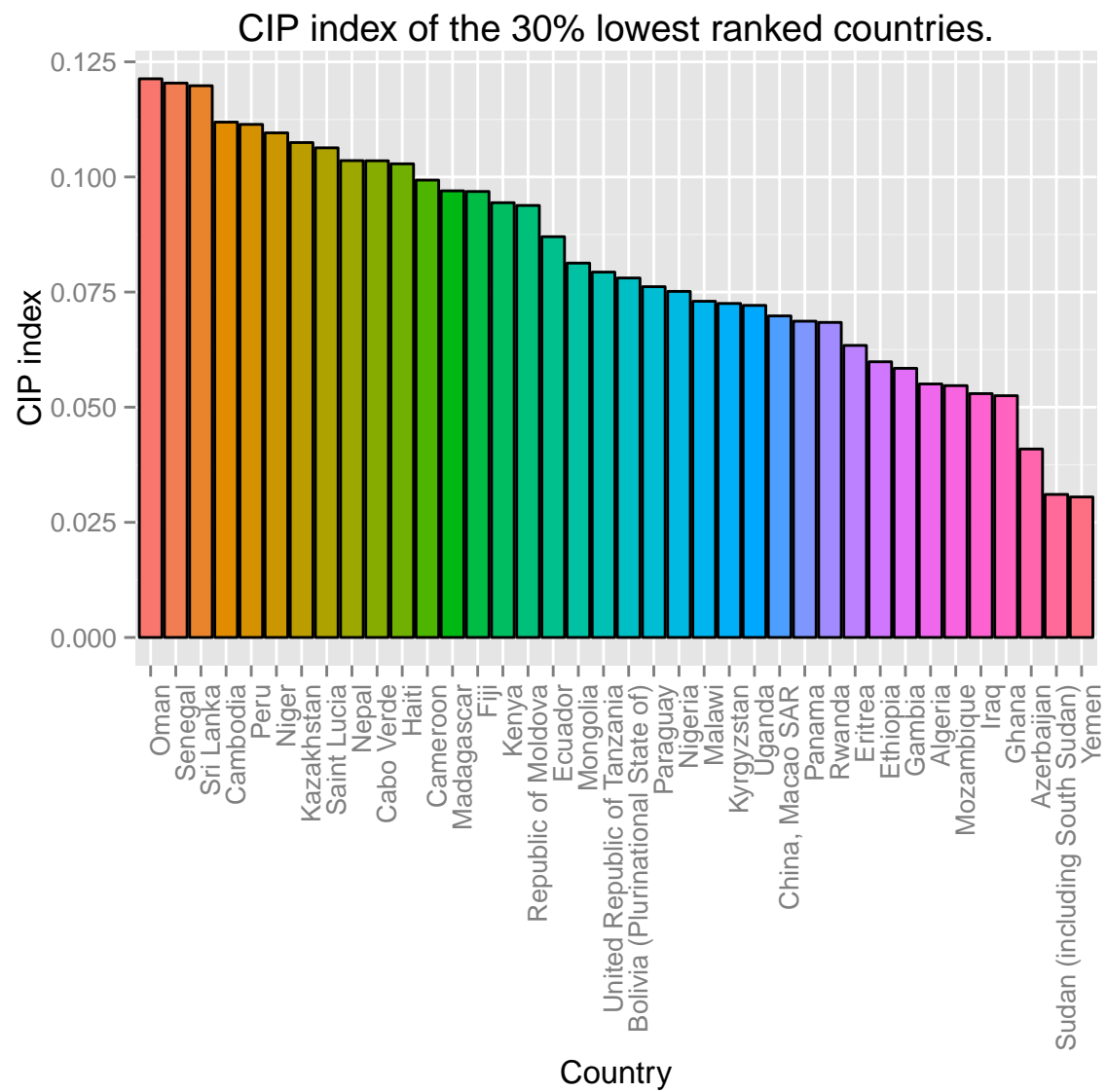


Figure 6: Bar plot for CIP index: one year and several countries selected as the 30 percent highly ranked countries. The characteristics of the graph (title, X- and Y-labels) are selected

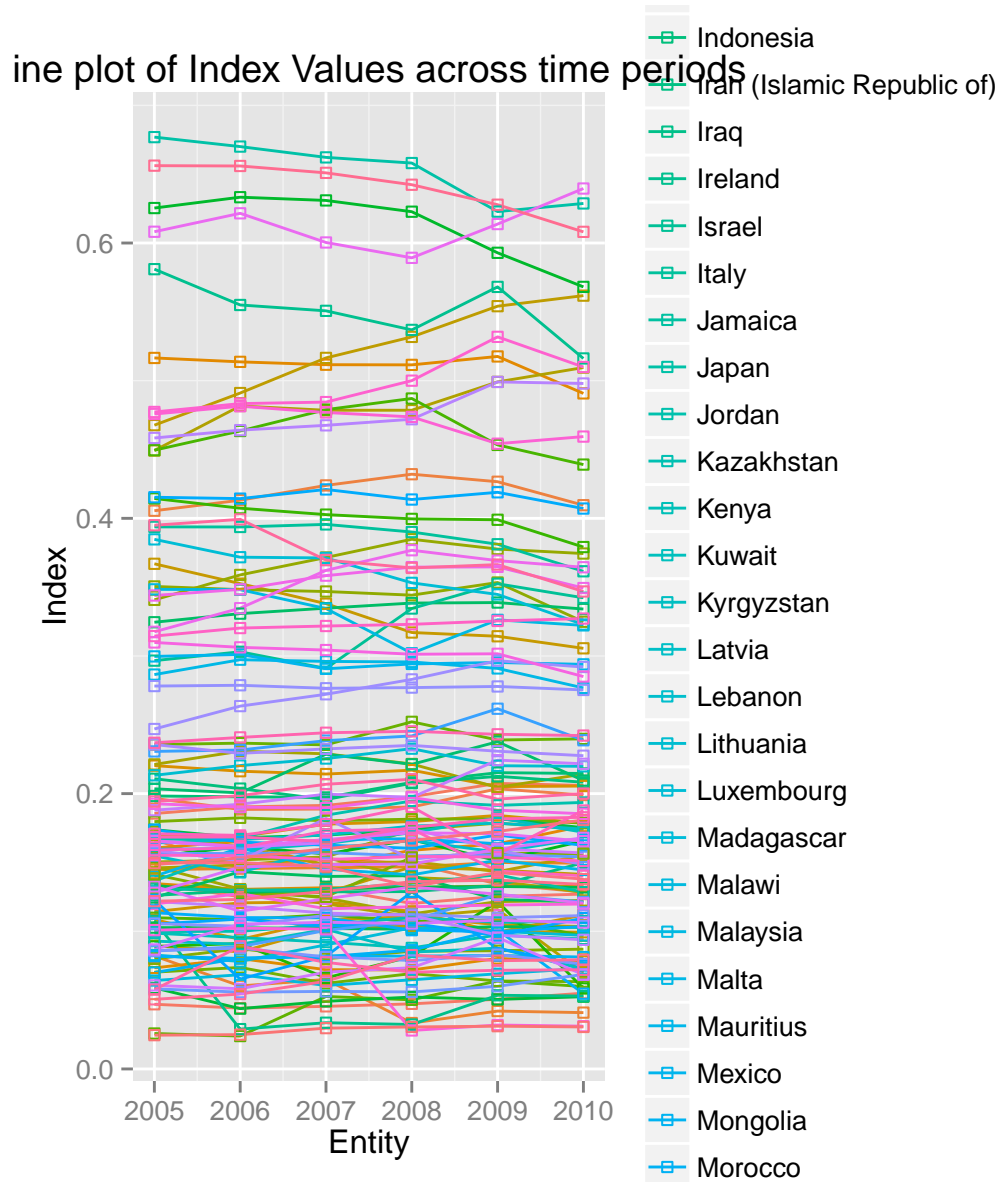


Figure 7: Line plot for CIP index: more than one year and all countries. The plot is quite unreadable, therefore it is better to select only several countries, a region or countries based on some criterion (e.g. the first 30 percent in the last year).

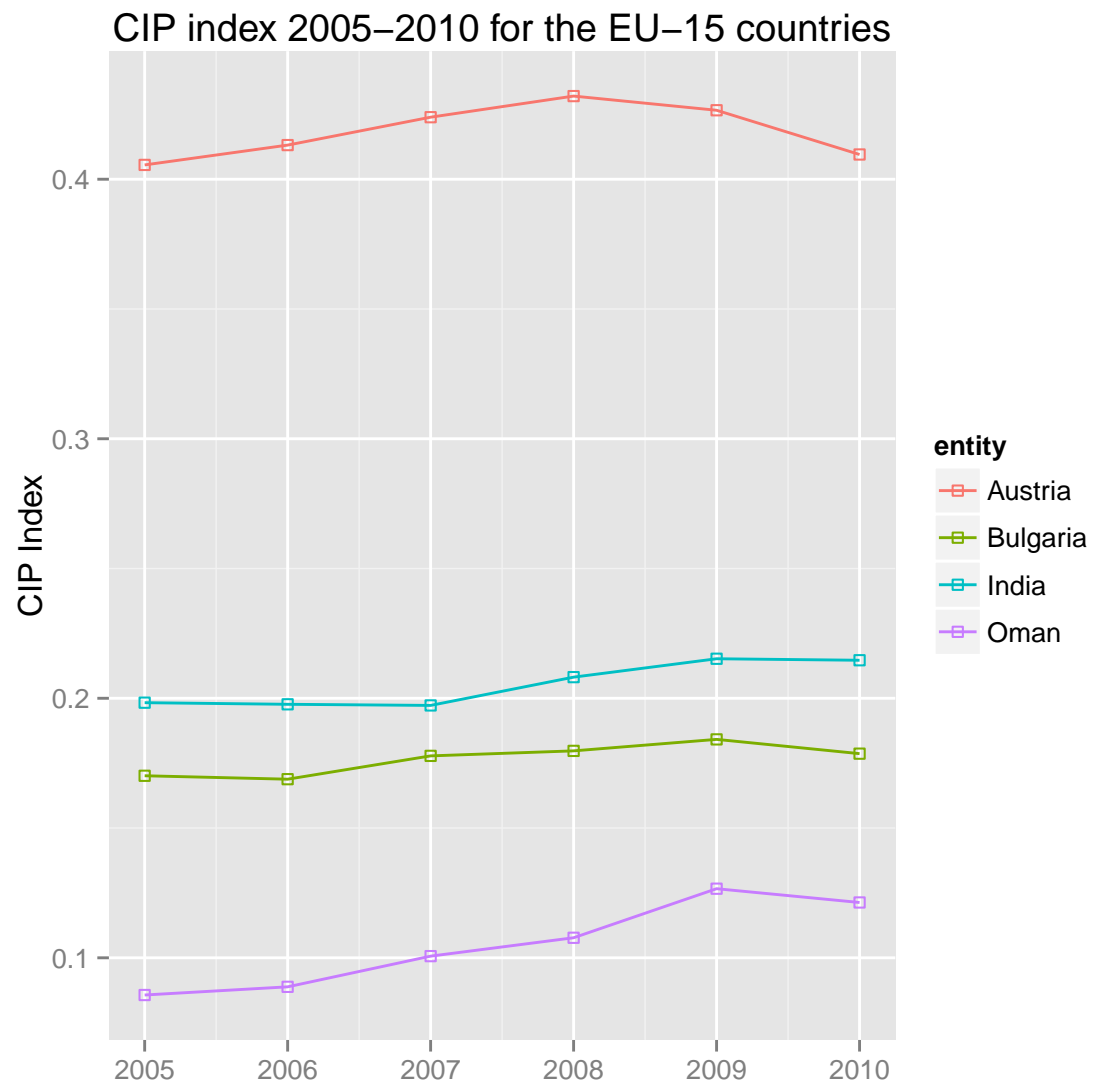


Figure 8: Line plot for CIP index: 2005-2010 for several selected countries.

```

> mycode <- getCountryCode("EU-15")           # get the code of the group EU-15
> mygroup <- getCountryGroup(mycode)          # get the list of (UN) codes of the countries in
> myct <- getCountryName(mygroup)             # get the names of the countries in the group
> myct
> plot(index_cip, entity=myct, ylab="CIP Index", xlab="",
+ title="CIP index 2005-2010 for the EU-15 countries")

```

7.3. Radial plot

First we present a radial plot of the CIP index for one year and several countries.

```

> plot(index_cip1, which = 'radial', entity=c('India', 'Japan', 'United Kingdom'))

```

Similarly, the radial plot can be produced for one country and several years.

```

> plot(index_cip, which='radial', entity = 'Japan')

```

7.4. Composite indicator on the world map

In order to present a composite indicator on the world map, we have to select the plot type as a `which="map"`. We can plot (represent in color) all countries for which an index is computed or only selected countries. There are two ways to select countries:

1. provide a list of countries: `entity=c("Austria", "Australia2", "India", "Bulgaria")` as shown in Figure ?? and
2. select the countries ranked first or last, by specifying a percentage, e.g. `entity.num="first 15 percent"`) as shown in Figure ??.

```

> plot(index_cip1, which="map")
> box()

```

```

> plot(index_cip1, which="map", entity=c("Austria", "Australia", "India", "United States o
> box()

```

```

> plot(index_cip1, which="map", entity.num="first 30 percent")
> box()

```

8. Sensitivity Analysis

9. Conclusions

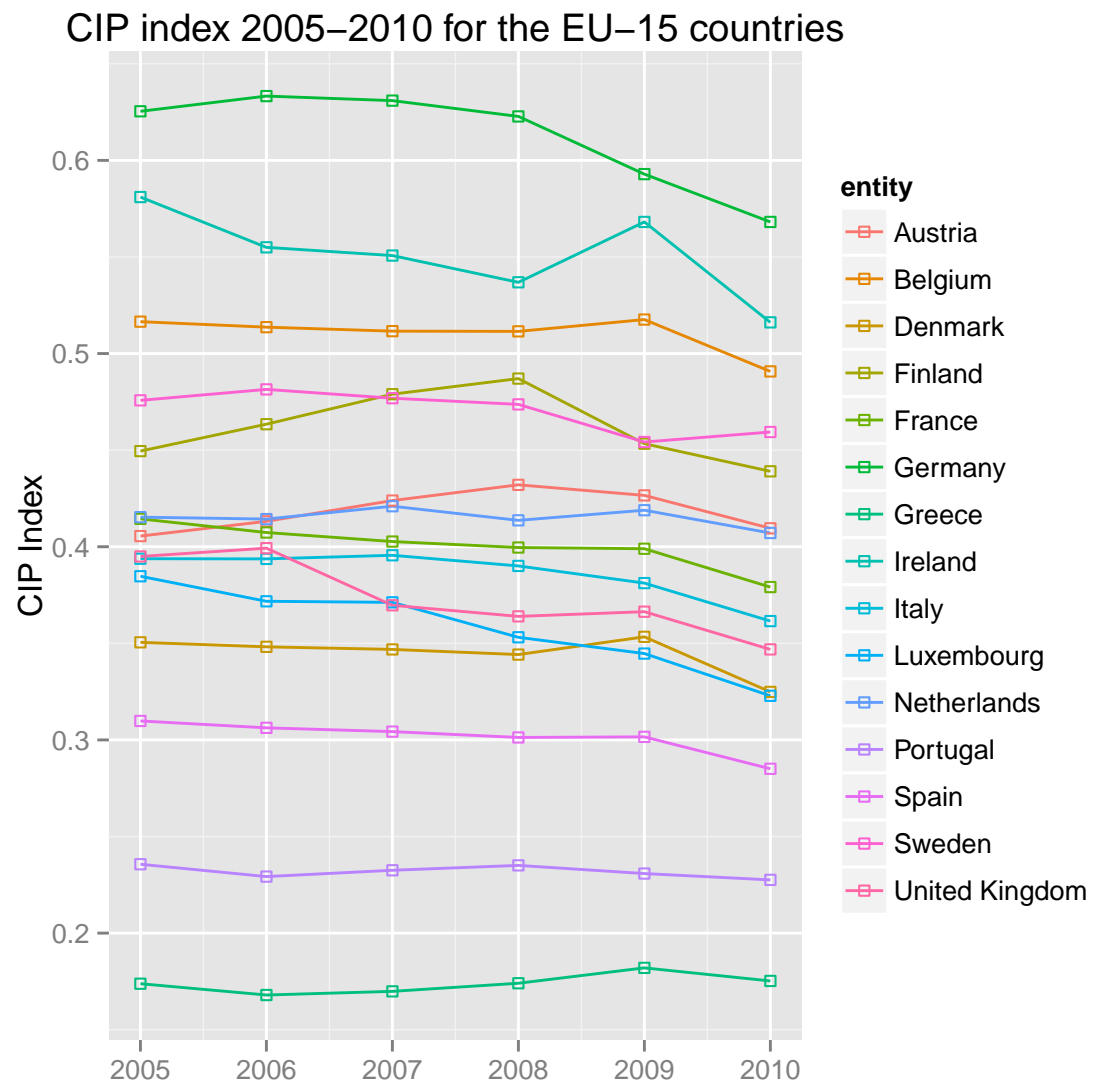


Figure 9: Line plot for CIP index: 2005–2010 for all EU-15 countries.

Radial Decomposition plot for underlying indicators for India, Japan, United Kingdom

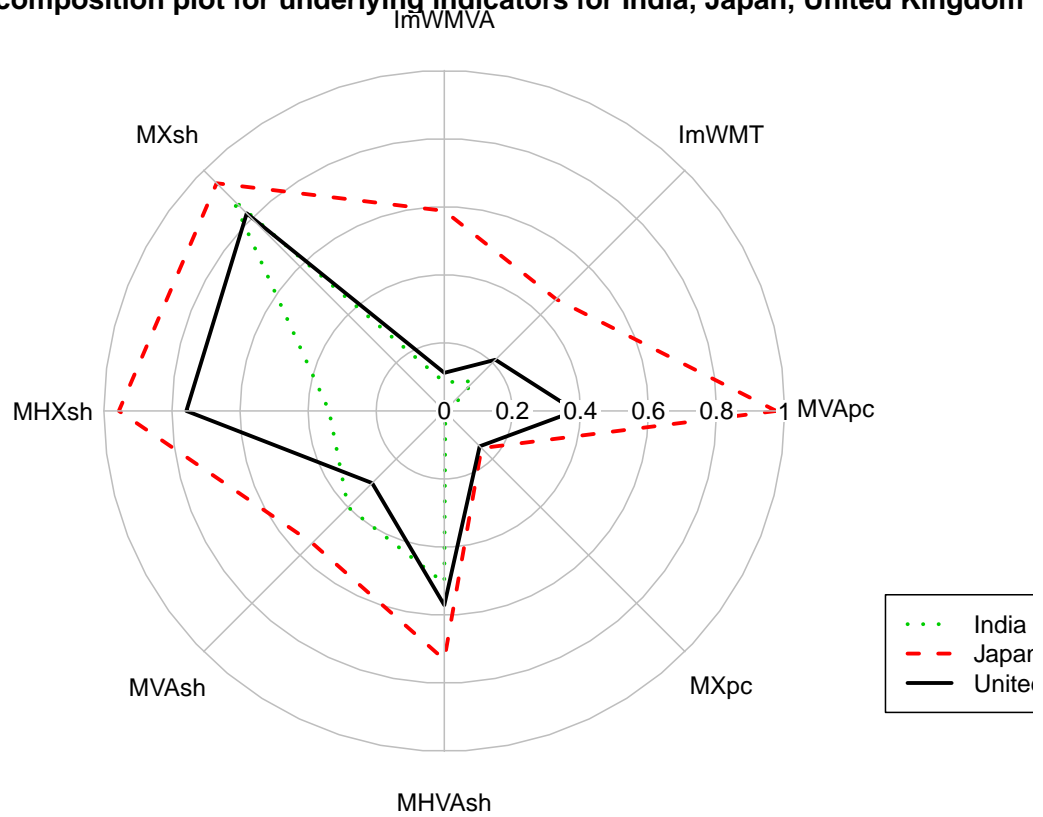


Figure 10: Radial plot for CIP index: one year and several countries.

Radial Decomposition plot for underlying indicators for Japan

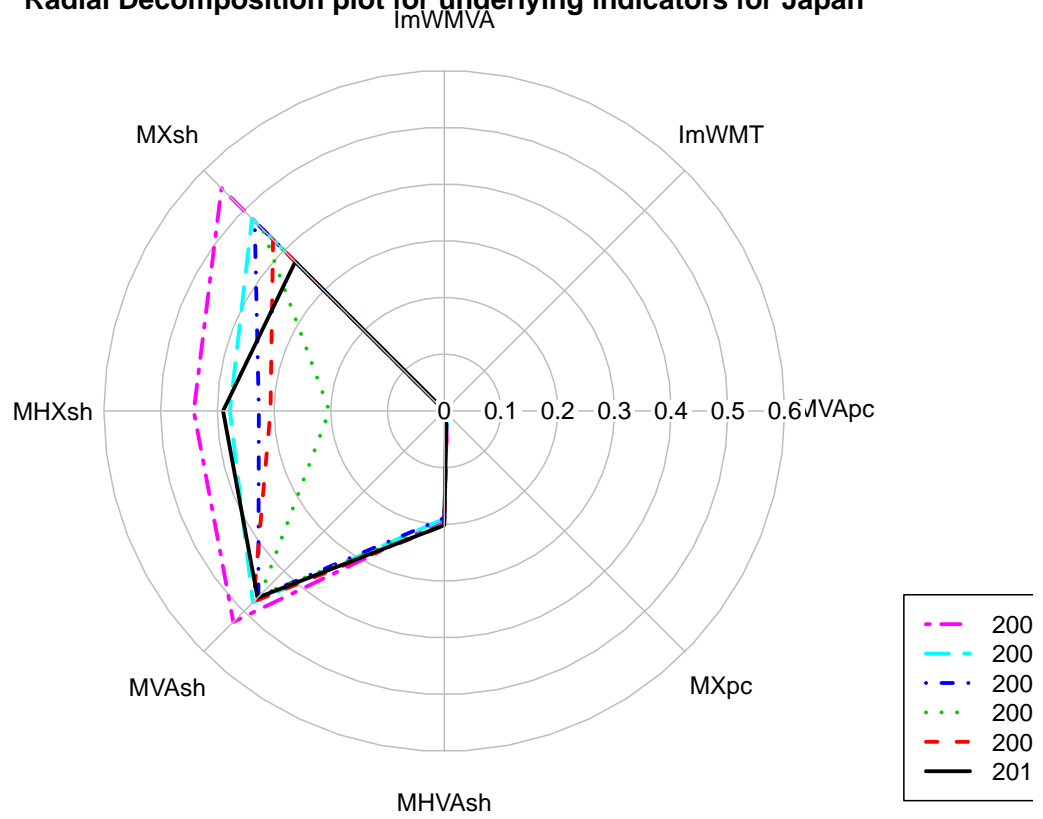


Figure 11: Radial plot for CIP index: a range of years and one country.

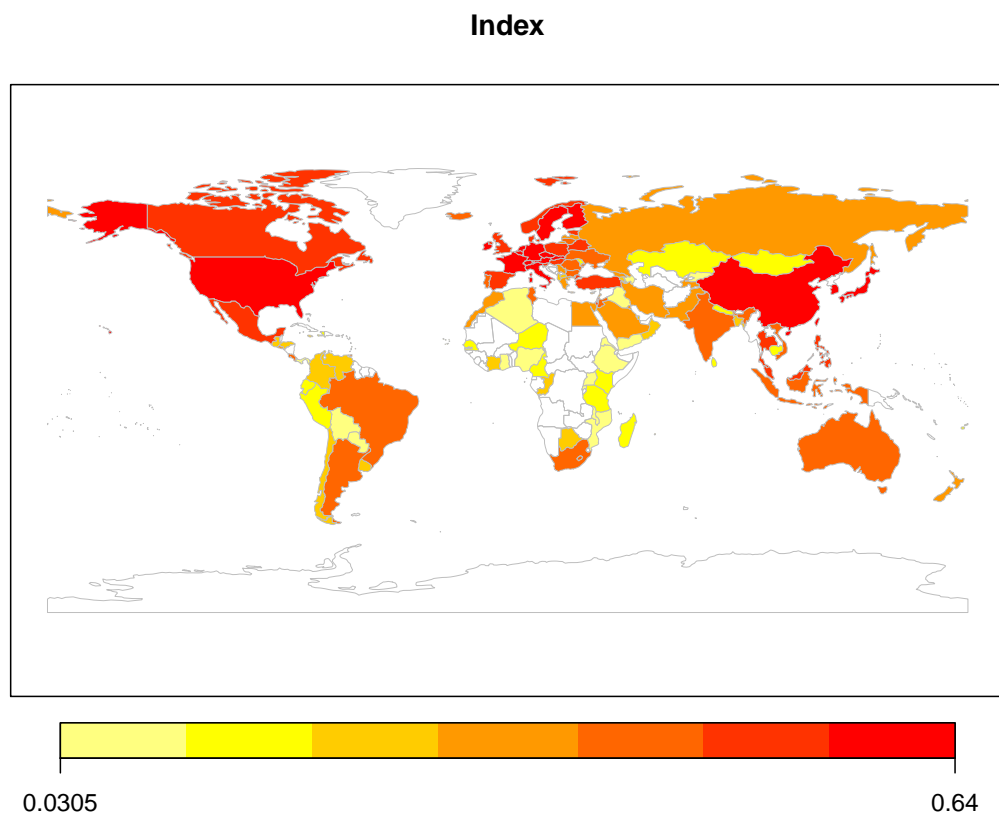


Figure 12: The CIP index on an world map: the CIP index is computed for only one year.

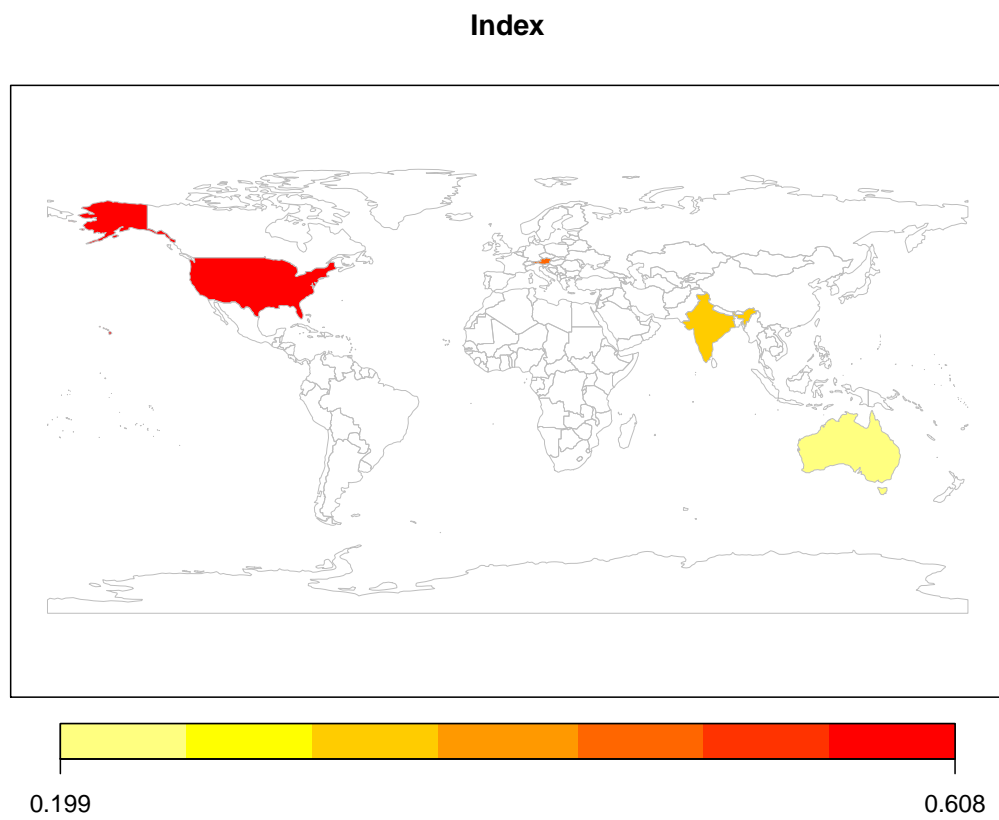


Figure 13: The CIP index on an world map: the CIP index is computed for only one year and several countries are selected.

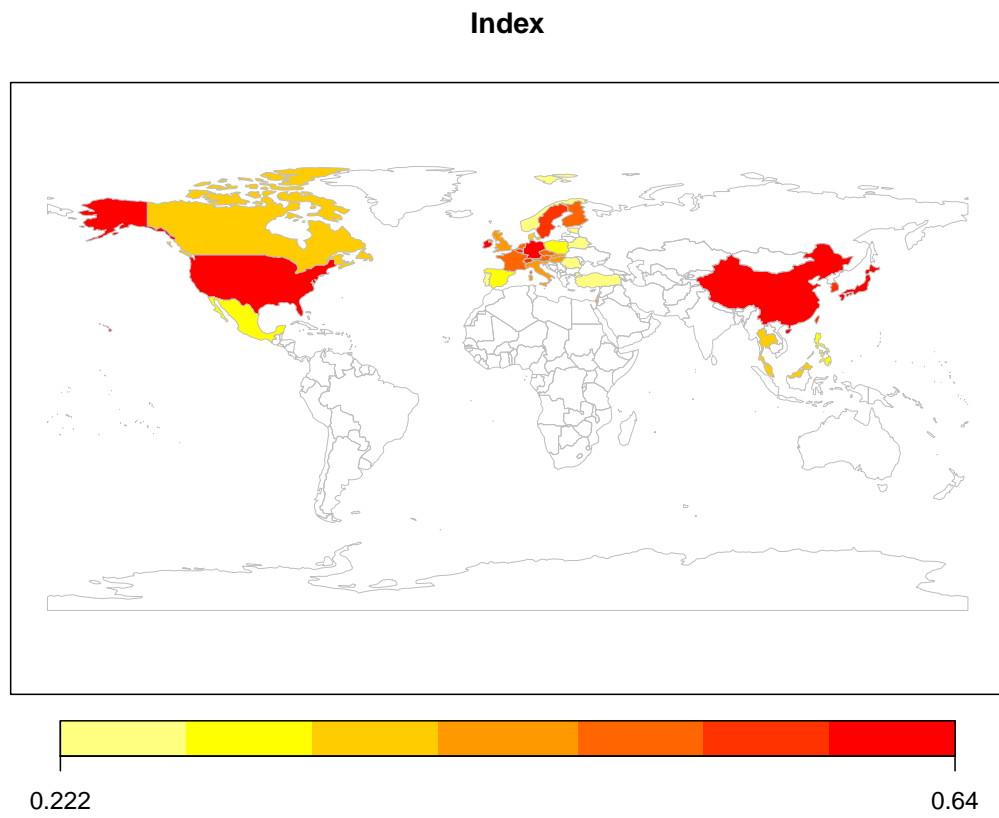


Figure 14: The CIP index on an world map: the CIP index is computed for only one year and the countries ranked as first 30 percent are selected.

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