Introduction to WDI, Part I

2023-10-18

Contents

Datascience for Macroeconomics using WDI

Introduction

Datascience

Datascience is an interdisciplinary academic field to extract or extrapolate knowledge and insights from noisy, structured, and unstructured data.

Why datascience? There are many reasons, but I believe it would promote evidence based, non-biased thinking.

Exploratory Data Analysis, EDA   EDA is an iterative cycle that helps you understand what your data says. When you do EDA, you:

1. Generate questions about your data

2. Search for answers by visualising, transforming, and/or modeling your data

3. Use what you learn to refine your questions and/or generate new questions

EDA is an important part of any data analysis. You can use EDA to make discoveries about the world; or you can use EDA to ensure the quality of your data, asking questions about whether the data meets your standards or not. (Posit Primers: EDA)

Macroeconomics

The study of the entire economy of a region, a country, or the entire world

World Development Indicators

World Development Indicators (WDI) is the World Bank's premier compilation of international statistics on global development. Drawing from officially recognized sources and including national, regional, and global estimates, the WDI provides access to approximately 1,600 indicators for 217 economies, with some time series extending back more than 50 years. The database helps users find information related to development,

both current and historical. The topics covered in the WDI range from poverty, health, and demographics to GDP, trade, and the environment.

The World Development Indicators website provides access to data as well as information about data coverage, curation, and methodologies, and allows users to discover what type of indicators are available, how they are collected, and how they can be visualized to analyze development trends. (Wikipedia: Link)

Open Data and Public Data

Datascience and Artificial Intelligence

- Computer Resources

- Data

  - Big Data

  - Open and Public Data

Q. Explain 'Open Data' and 'Public Data', and their differences.

A. AI Poe Assistant. (Poe.com)

"Open data" and "public data" are related concepts that refer to different aspects of data accessibility and usage.

Open Data: Open data refers to the idea that certain data should be freely available to the public, without restrictions on access, usage, or redistribution. Open data is typically released in a machine-readable format, such as CSV, JSON, or XML, and is accompanied by an open license that allows anyone to use, reuse, and distribute the data for any purpose. The goal of open data is to promote transparency, collaboration, and innovation by enabling individuals, organizations, and communities to analyze and build upon the data.

Open data often includes government data, scientific research data, public records, and other datasets that are deemed to be of public interest. Governments, international organizations, and various institutions actively promote the release of open data to foster accountability, drive economic growth, and empower citizens to make informed decisions.

Public Data: Public data, on the other hand, refers to any data that is accessible or available to the public. It is a broader term that encompasses both open data and other types of data that may have certain restrictions on access or usage. Public data can include information that is freely and openly available, as well as data that is accessible through specific channels, such as public libraries, government agencies, or subscription-based services.

Public data can include a wide range of information, such as government reports, census data, legal documents, financial statements, and more. While public data may be accessible to the public, it does not necessarily guarantee the same level of openness, usability, or freedom as open data. Public data may have limitations on its usage, copyright restrictions, or conditions imposed by the data provider.

In summary, open data specifically refers to data that is freely accessible, usable, and redistributable without restrictions, often accompanied by an open license. Public data, on the other hand, is a broader term that includes both open data and other data that may have varying degrees of accessibility and usage restrictions.

World Bank on Open Data for Open Government   Visit Open Government Data Toolkit.

R on RStudio

Install R and RStudio

- R: https://www.r-project.org
- RStudio: https://posit.co

Posit Cloud

- Posit.cloud: https://posit.cloud/
    - Posit Primers: interactive tutorials
    - Cheatsheets: RStudio IDE, Data Visualization, Data Transformation, Data Import, RMarkdown, etc.
- Shared Project: https://posit.cloud/content/5539763
- Create Your Copy and Download it.

Datascience Workflow
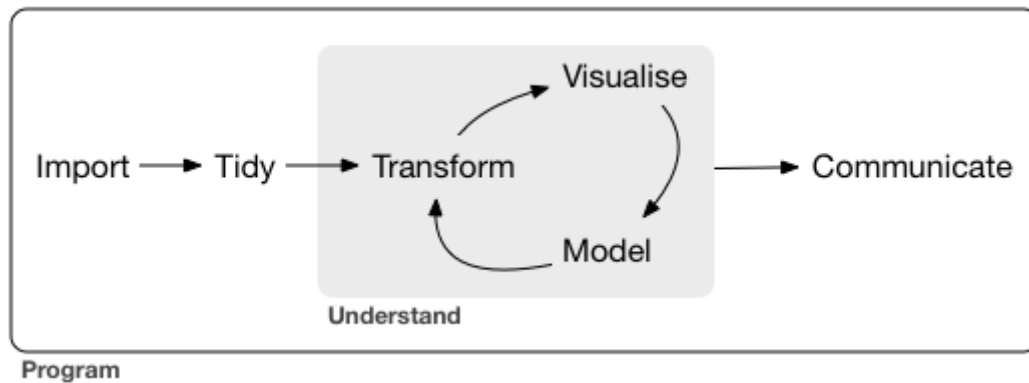
Figure 1: *The image above is from R4DS(2e) by Hadley Wickham, Mine Çetinkaya-Rundel and Garrett Grolemund*

First Datascience

We use two packages, `tidyverse` and `WDI`.

R packages are extensions to the R statistical programming language. R packages contain code, data, and documentation in a standardized collection format that can be installed by users of R, typically via a centralized software repository such as CRAN (the Comprehensive R Archive Network). [CRAN Link]

- **tidyverse**: The tidyverse is a collection of open source packages for the R programming language introduced by Hadley Wickham and his team that "share an underlying design philosophy, grammar, and data structures" of tidy data. Characteristic features of tidyverse packages include extensive use of non-standard evaluation and encouraging piping. [CRAN Link]

- **WDI**: Search and download data from over 40 databases hosted by the World Bank, including the World Development Indicators ('WDI'), International Debt Statistics, Doing Business, Human Capital Index, and Sub-national Poverty indicators. [CRAN Link]

Setup

Step 1. Install packages if necessary.

```r
install.packages("tidyverse")
install.packages("WDI")
```

Step 2. Load packages.

```r
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.3     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.3     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(WDI)
```

Step 3. Create a data directory for the first time.

```r
dir.create("data")
```

Step 4. Set 'System Language' to be English, recommended.

```r
Sys.setenv(LANG = "en")
```

Importing GDP Data

The following code chunk is to download GDP data with the following indicator code.

WDI indicator: NY.GDP.MKTP.PP.KD

```r
df_gdp <- WDI(indicator = "NY.GDP.MKTP.PP.KD")
```

N.B. There are many GDP related data in WDI, for example, "NY.GDP.MKTP.CD"

To avoid the internet traffic, save the data and reuse it.

CSV: comma separated values, a text format of a data.

```r
write_csv(df_gdp, "data/gdp.csv")
```

Run codes above only once to download and write the data into the data directory.

```r
df_gdp <- read_csv("data/gdp.csv")
```

```
## Rows: 16758 Columns: 5
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (3): country, iso2c, iso3c
## dbl (2): year, NY.GDP.MKTP.PP.KD
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

Viewing Data

First, look at the data by `head`, `str` ucture, and `summary`.

head: display the first 6 rows by default

```
head(df_gdp)
```

```
## # A tibble: 6 x 5
##   country                   iso2c iso3c  year NY.GDP.MKTP.PP.KD
##   <chr>                     <chr> <chr> <dbl>             <dbl>
## 1 Africa Eastern and Southern ZH    AFE    2022          2.56e12
## 2 Africa Eastern and Southern ZH    AFE    2021          2.47e12
## 3 Africa Eastern and Southern ZH    AFE    2020          2.37e12
## 4 Africa Eastern and Southern ZH    AFE    2019          2.43e12
## 5 Africa Eastern and Southern ZH    AFE    2018          2.38e12
## 6 Africa Eastern and Southern ZH    AFE    2017          2.32e12
```

2.561800e+12 is in scientific notation, i.e., $2.561800 \times 10^{12} = 2,562,800,000,000$.

str: display the structure of an object

```
str(df_gdp)
```

```
## spc_tbl_ [16,758 x 5] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ country          : chr [1:16758] "Africa Eastern and Southern" "Africa Eastern and Southern" "Afr
##  $ iso2c            : chr [1:16758] "ZH" "ZH" "ZH" "ZH" ...
##  $ iso3c            : chr [1:16758] "AFE" "AFE" "AFE" "AFE" ...
##  $ year             : num [1:16758] 2022 2021 2020 2019 2018 ...
##  $ NY.GDP.MKTP.PP.KD: num [1:16758] 2.56e+12 2.47e+12 2.37e+12 2.43e+12 2.38e+12 ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   country = col_character(),
##   ..   iso2c = col_character(),
##   ..   iso3c = col_character(),
##   ..   year = col_double(),
##   ..   NY.GDP.MKTP.PP.KD = col_double()
##   .. )
##  - attr(*, "problems")=<externalptr>
```

summary: display the summary of an object

```
summary(df_gdp)
```

```
##    country             iso2c              iso3c               year
##  Length:16758       Length:16758       Length:16758       Min.   :1960
##  Class :character   Class :character   Class :character   1st Qu.:1975
##  Mode  :character   Mode  :character   Mode  :character   Median :1991
##                                                           Mean   :1991
##                                                           3rd Qu.:2007
##                                                           Max.   :2022
##
##  NY.GDP.MKTP.PP.KD
##  Min.   :2.482e+07
##  1st Qu.:1.824e+10
##  Median :1.055e+11
##  Mean   :3.329e+12
##  3rd Qu.:1.083e+12
##  Max.   :1.390e+14
##  NA's   :9096
```

In RNotebook, the following also displays the first 1000 rows of the data in the paged format.

```
df_gdp
```

Transformation

|> , or %>%, is called a pipe operator and `df_gdp |> filter(country == COUNTRY)` is same as

`filter(df_gdp, country == COUNTRY)` .

`filter` : Keep rows that match a condition

```
COUNTRY <- "Japan"
df_gdp |> filter(country == COUNTRY)
```

```
## # A tibble: 63 x 5
##     country iso2c iso3c  year NY.GDP.MKTP.PP.KD
##     <chr>   <chr> <chr> <dbl>             <dbl>
##  1 Japan    JP    JPN    2022           5.21e12
##  2 Japan    JP    JPN    2021           5.16e12
##  3 Japan    JP    JPN    2020           5.05e12
##  4 Japan    JP    JPN    2019           5.27e12
##  5 Japan    JP    JPN    2018           5.30e12
##  6 Japan    JP    JPN    2017           5.26e12
##  7 Japan    JP    JPN    2016           5.18e12
##  8 Japan    JP    JPN    2015           5.14e12
##  9 Japan    JP    JPN    2014           5.06e12
## 10 Japan    JP    JPN    2013           5.04e12
## # i 53 more rows
```

Visualization

GDP of Japan `ggplot() + geom_line()`: A tidyverse function of draw a line graph

`aes(year, NY.GDP.MKTP.PP.KD)` : aesthetic mapping sending year to x-axis and `NY.GDP.MKTP.PP.KD` to y-axis

```
COUNTRY <- "Japan"
df_gdp |> filter(country == COUNTRY) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD)) + geom_line()
```

```
## Warning: Removed 30 rows containing missing values (`geom_line()`).
```
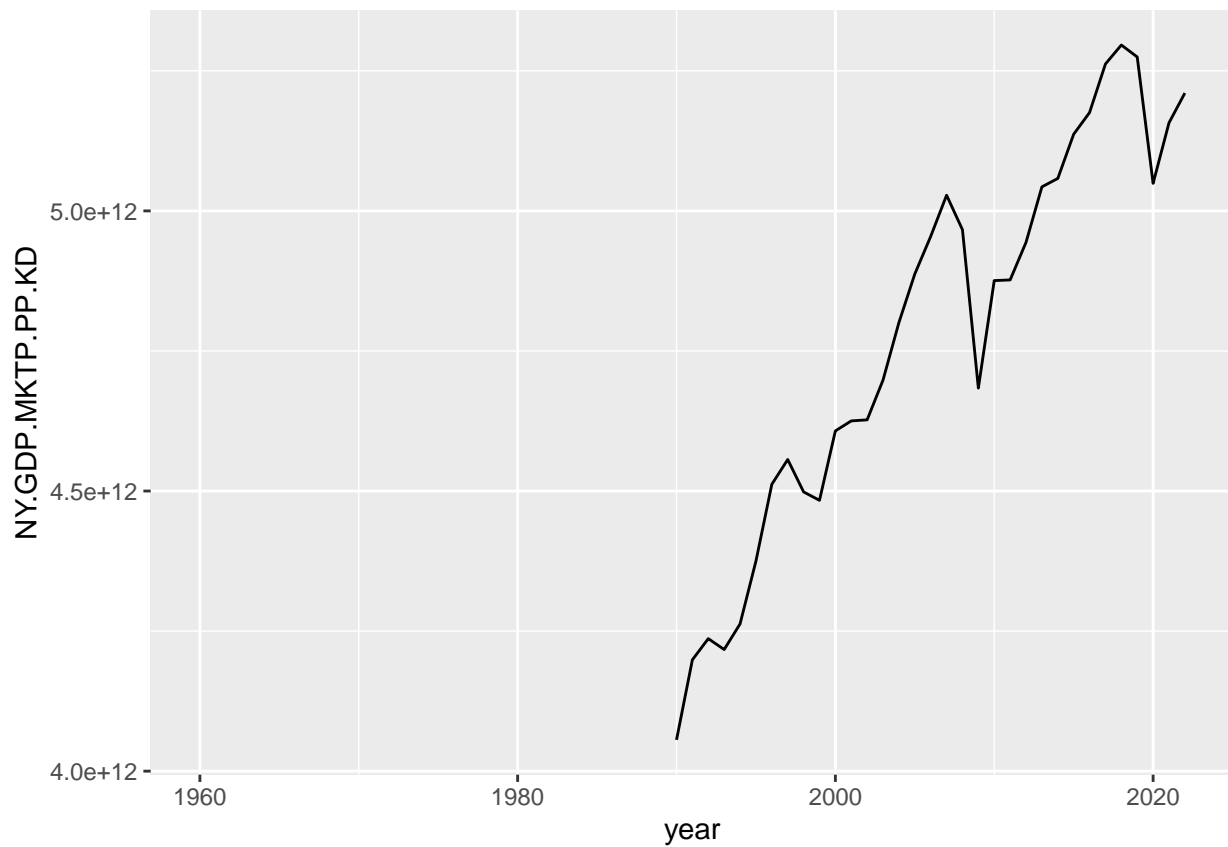
Let's delete the rows with missing values using `drop_na(NY.GDP.MKTP.PP.KD)`, a transformation.

```
COUNTRY <- "Japan"
df_gdp |> filter(country == COUNTRY) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD)) + geom_line()
```
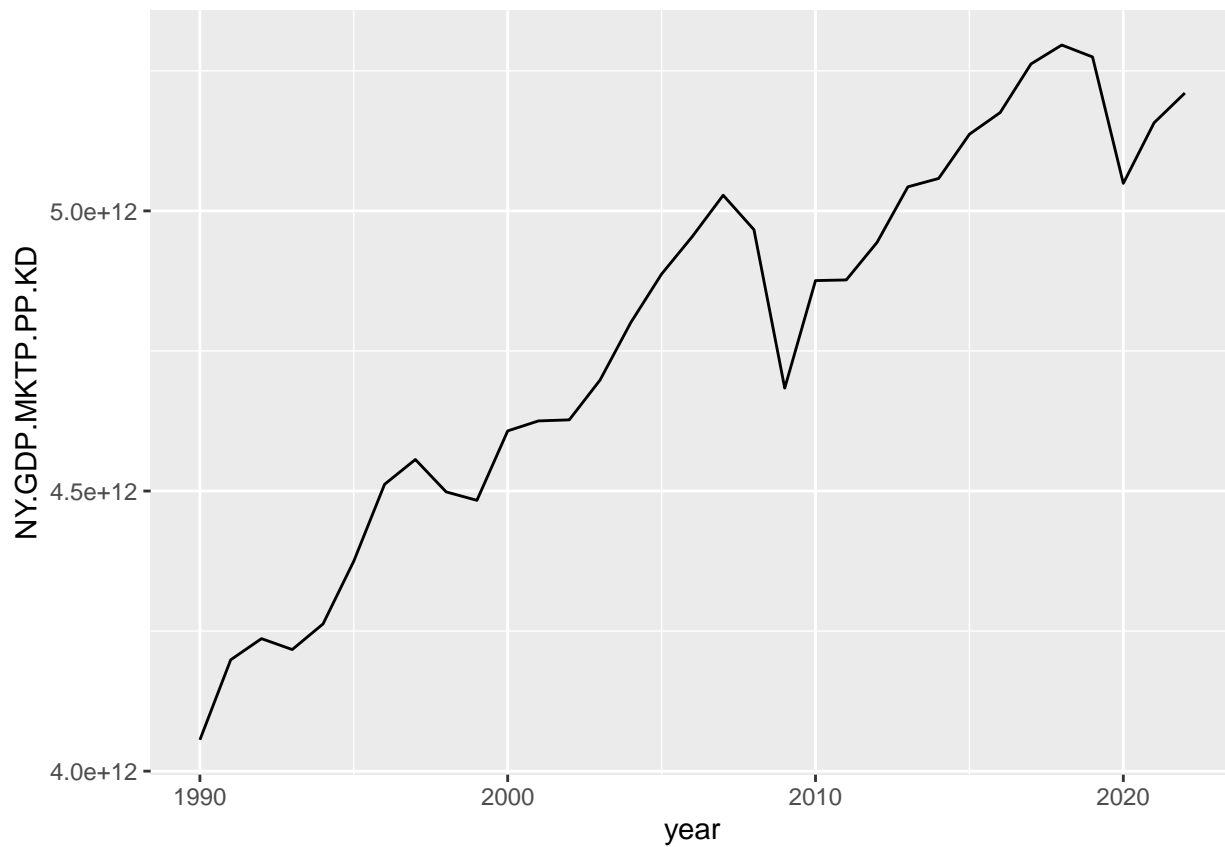
```
COUNTRY <- "World"
df_gdp |> filter(country == COUNTRY) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD)) + geom_line()
```

GDP of the World

```
## Warning: Removed 30 rows containing missing values (`geom_line()`).
```
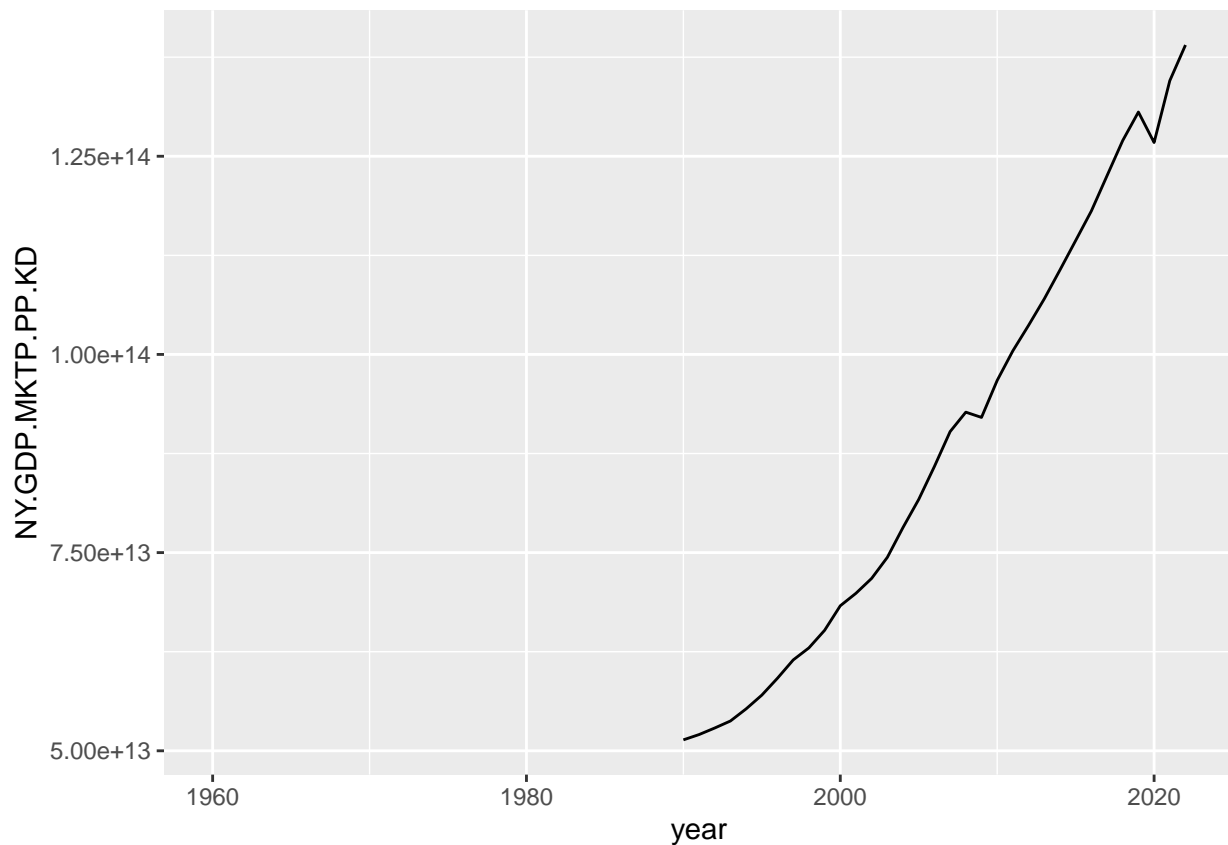
Exercise.

1. Delete the missing data of the GDP of the World by mimicking the one of Japan.
2. Write down your observations and questions.

```
COUNTRY <- "World"
df_gdp |> filter(country == COUNTRY) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD)) + geom_line()
```

Observations and Questions

- e.g. The GDP of the world is continuously increasing since 1990.

-

GDP of the countries   By country names

```
COUNTRIES <- c("Japan", "China", "India", "United Kingdom", "United States", "Germany", "France")
df_gdp |> filter(country %in% COUNTRIES) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD, color = country)) + geom_line()
```
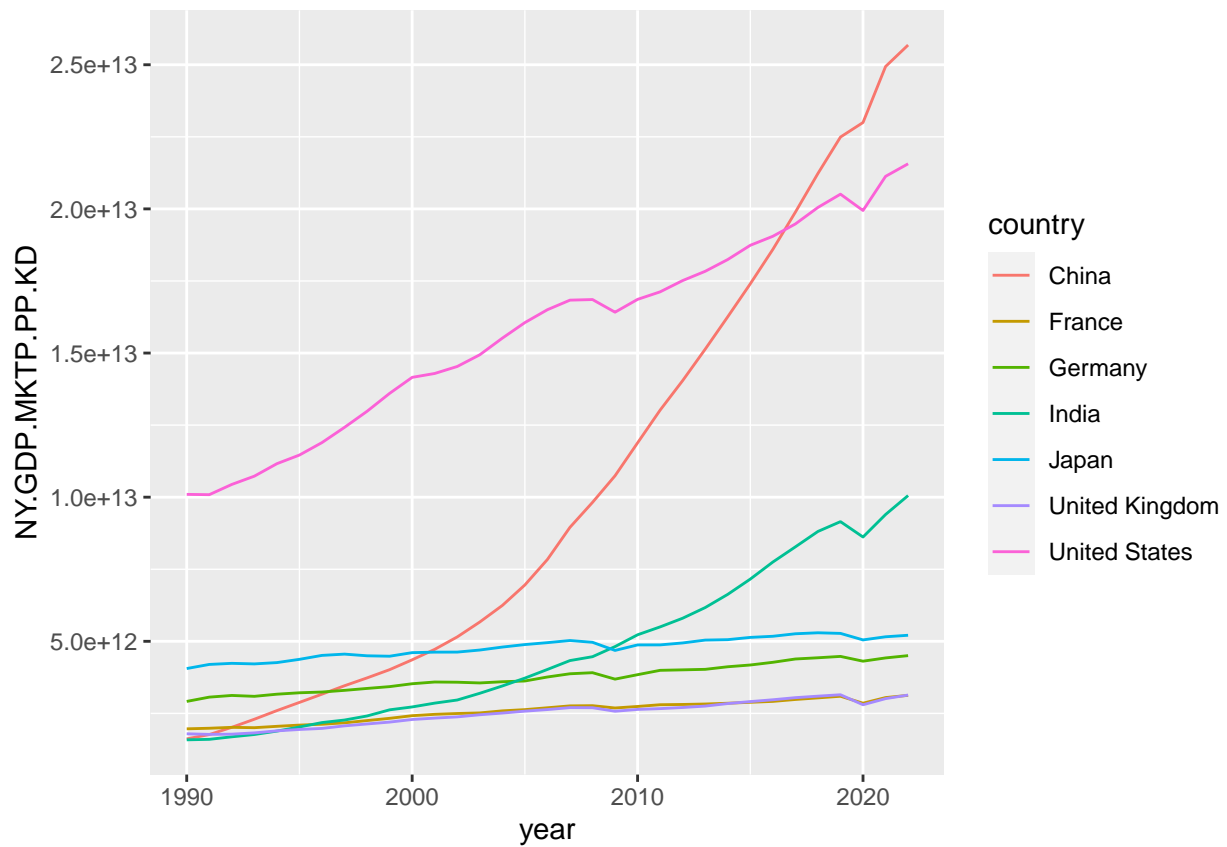
```
ISO2C <- c("JP", "CN", "ID", "UK", "US", "DE", "FR")
df_gdp |> filter(iso2c %in% ISO2C) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD, color = iso2c)) + geom_line()
```
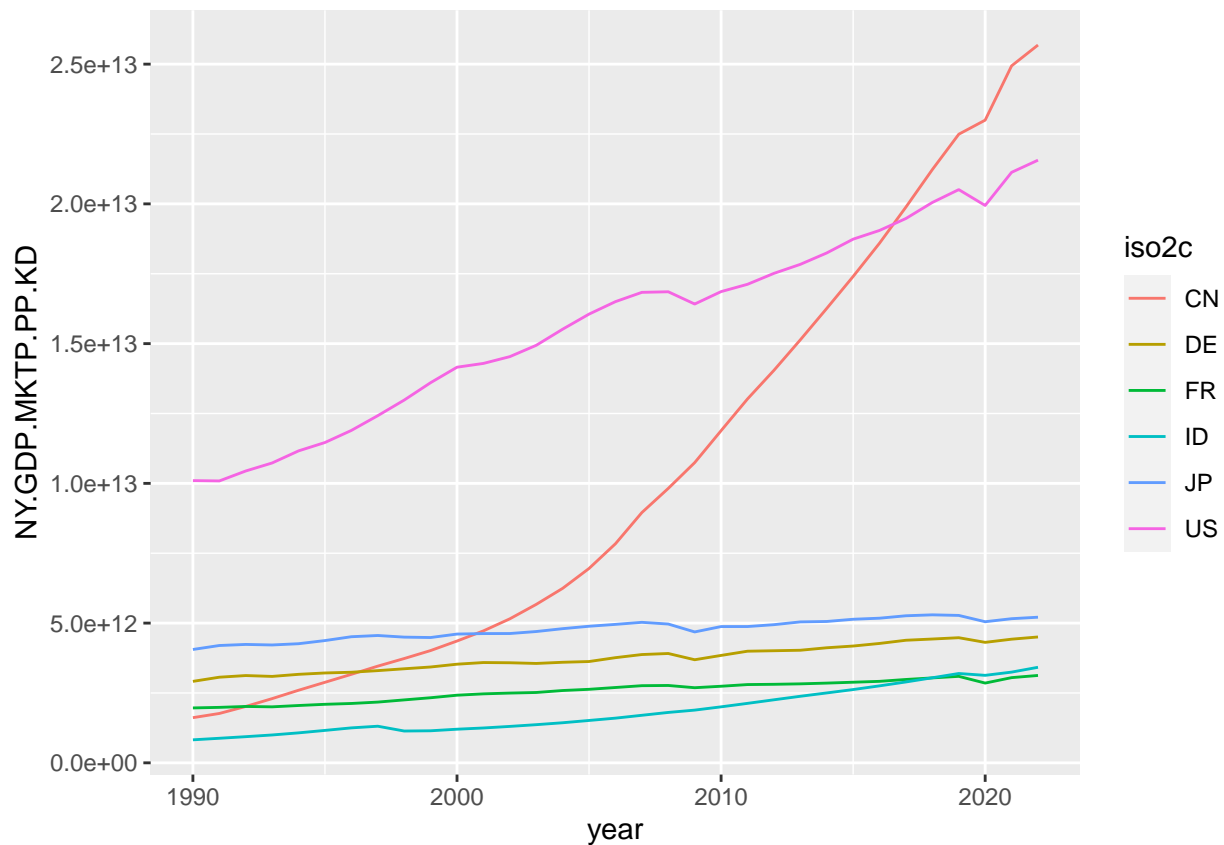
Exercise. What happens if you replace `color = iso2c` at the bottom of the code above with `colour = iso2c`, `color = country`, `col = country`?

```
ISO2C <- c("JP", "CN", "ID", "UK", "US", "DE", "FR")
df_gdp |> filter(iso2c %in% ISO2C) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD, color = iso2c)) + geom_line()
```

```
(df_codes <- df_gdp |> distinct(country, iso2c))
```

List of Countries and iso2c

```
## # A tibble: 266 x 2
##    country                                iso2c
##    <chr>                                  <chr>
##  1 Africa Eastern and Southern            ZH
##  2 Africa Western and Central             ZI
##  3 Arab World                             1A
##  4 Caribbean small states                 S3
##  5 Central Europe and the Baltics         B8
##  6 Early-demographic dividend             V2
##  7 East Asia & Pacific                    Z4
##  8 East Asia & Pacific (excluding high income) 4E
##  9 East Asia & Pacific (IDA & IBRD countries) T4
## 10 Euro area                              XC
## # i 256 more rows
```

Exercise. Set COUNTRIES and/or ISO2C to draw line graphs of GDP.

```
COUNTRIES <- c() # surround the country name with quotation marks, and use a comma as a separator
df_gdp |> filter(country %in% COUNTRIES) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD, color = country)) + geom_line()
```

```
ISO2C <- c() # surround the iso2c code with quotation marks, and use a comma as a separator
df_gdp |> filter(iso2c %in% ISO2C) |> drop_na(NY.GDP.MKTP.PP.KD) |>
  ggplot(aes(year, NY.GDP.MKTP.PP.KD, color = iso2c)) + geom_line()
```

World Development Indicators

Find Indicator Codes

1. World Bank Home Page

   - World Development Indicators: Link

   - World Bank Open Data: Link

   - WDI Statistical Tables: Link

2. Excel Files

   - Data Catalogues: Link Download Excel File

3. API Search

```
WDIsearch(string = "gdp", field = "name")
```

```
##                      indicator
## 712          5.51.01.10.gdp
## 714          6.0.GDP_current
## 715          6.0.GDP_growth
## 716              6.0.GDP_usd
## 717          6.0.GDPpc_constant
## 1557         BG.GSR.NFSV.GD.ZS
## 1558         BG.KAC.FNEI.GD.PP.ZS
## 1559         BG.KAC.FNEI.GD.ZS
## 1560         BG.KLT.DINV.GD.PP.ZS
## 1561         BG.KLT.DINV.GD.ZS
## 1752         BI.WAG.TOTL.GD.ZS
## 1772         BM.GSR.MRCH.ZS
## 1784         BM.KLT.DINV.GD.ZS
## 1785         BM.KLT.DINV.WD.GD.ZS
## 1798         BN.CAB.XOKA.GD.ZS
## 1799         BN.CAB.XOKA.GDP.ZS
## 1802         BN.CAB.XOTR.ZS
## 1805         BN.CUR.GDPM.ZS
## 1811         BN.GSR.FCTY.CD.ZS
## 1820         BN.KLT.DINV.CD.ZS
## 1822         BN.KLT.DINV.DRS.GDP.ZS
## 1828         BN.KLT.PRVT.GD.ZS
## 1839         BN.TRF.CURR.CD.ZS
## 1875         BX.GSR.MRCH.ZS
## 1887         BX.KLT.DINV.DT.GD.ZS
## 1889         BX.KLT.DINV.WD.GD.ZS
## 1898         BX.TRF.MGR.DT.GD.ZS
```

```
## 1904            BX.TRF.PWKR.DT.GD.ZS
## 1905              BX.TRF.PWKR.GD.ZS
## 2198               CC.ENTX.ENE.ZS
## 2270               CC.GHG.MEMG.EI
## 2271               CC.GHG.MEMG.GC
## 2293                CC.INCP.ALRS
## 2294                CC.INCP.KRGC
## 2295                CC.INCP.SPMC
## 2356              CC.RISK.AST.ZS
## 2357             CC.RISK.WELL.ZS
## 2364                 CC.SP.EXP.ZS
## 2401            CM.FIN.INTL.GD.ZS
## 2404            CM.MKT.LCAP.GD.ZS
## 2407            CM.MKT.TRAD.GD.ZS
## 2559         DP.DOD.DECD.CR.BC.Z1
## 2562         DP.DOD.DECD.CR.CG.Z1
## 2565         DP.DOD.DECD.CR.FC.Z1
## 2568         DP.DOD.DECD.CR.GG.Z1
## 2571         DP.DOD.DECD.CR.NF.Z1
## 2576         DP.DOD.DECF.CR.BC.Z1
## 2579         DP.DOD.DECF.CR.CG.Z1
## 2582         DP.DOD.DECF.CR.FC.Z1
## 2585         DP.DOD.DECF.CR.GG.Z1
## 2588         DP.DOD.DECF.CR.NF.Z1
## 2593         DP.DOD.DECN.CR.BC.Z1
## 2596         DP.DOD.DECN.CR.CG.Z1
## 2599         DP.DOD.DECN.CR.FC.Z1
## 2602         DP.DOD.DECN.CR.GG.Z1
## 2605         DP.DOD.DECN.CR.NF.Z1
## 2610         DP.DOD.DECT.CR.BC.Z1
## 2613         DP.DOD.DECT.CR.CG.Z1
## 2616         DP.DOD.DECT.CR.FC.Z1
## 2619         DP.DOD.DECT.CR.GG.Z1
## 2622         DP.DOD.DECT.CR.NF.Z1
## 2627         DP.DOD.DECX.CR.BC.Z1
## 2630         DP.DOD.DECX.CR.CG.Z1
## 2633         DP.DOD.DECX.CR.FC.Z1
## 2636         DP.DOD.DECX.CR.GG.Z1
## 2639         DP.DOD.DECX.CR.NF.Z1
## 2644         DP.DOD.DLCD.CR.BC.Z1
## 2647         DP.DOD.DLCD.CR.CG.Z1
## 2650         DP.DOD.DLCD.CR.FC.Z1
## 2653         DP.DOD.DLCD.CR.GG.Z1
## 2656      DP.DOD.DLCD.CR.L1.BC.Z1
## 2659      DP.DOD.DLCD.CR.L1.CG.Z1
## 2662      DP.DOD.DLCD.CR.L1.FC.Z1
## 2665      DP.DOD.DLCD.CR.L1.GG.Z1
## 2668      DP.DOD.DLCD.CR.L1.NF.Z1
## 2673      DP.DOD.DLCD.CR.M1.BC.Z1
## 2676      DP.DOD.DLCD.CR.M1.CG.Z1
## 2679      DP.DOD.DLCD.CR.M1.FC.Z1
## 2682      DP.DOD.DLCD.CR.M1.GG.Z1
## 2685      DP.DOD.DLCD.CR.M1.NF.Z1
## 2690         DP.DOD.DLCD.CR.NF.Z1
```

```
## 2694          DP.DOD.DLD1.CR.CG.Z1
## 2696          DP.DOD.DLD1.CR.GG.Z1
## 2698          DP.DOD.DLD2.CR.CG.Z1
## 2700          DP.DOD.DLD2.CR.GG.Z1
## 2702         DP.DOD.DLD2A.CR.CG.Z1
## 2704         DP.DOD.DLD2A.CR.GG.Z1
## 2706          DP.DOD.DLD3.CR.CG.Z1
## 2708          DP.DOD.DLD3.CR.GG.Z1
## 2710          DP.DOD.DLD4.CR.CG.Z1
## 2712          DP.DOD.DLD4.CR.GG.Z1
## 2715          DP.DOD.DLDS.CR.BC.Z1
## 2718          DP.DOD.DLDS.CR.CG.Z1
## 2721          DP.DOD.DLDS.CR.FC.Z1
## 2724          DP.DOD.DLDS.CR.GG.Z1
## 2727       DP.DOD.DLDS.CR.L1.BC.Z1
## 2730       DP.DOD.DLDS.CR.L1.CG.Z1
## 2733       DP.DOD.DLDS.CR.L1.FC.Z1
## 2736       DP.DOD.DLDS.CR.L1.GG.Z1
## 2739       DP.DOD.DLDS.CR.L1.NF.Z1
## 2744       DP.DOD.DLDS.CR.M1.BC.Z1
## 2747       DP.DOD.DLDS.CR.M1.CG.Z1
## 2750       DP.DOD.DLDS.CR.M1.FC.Z1
## 2753       DP.DOD.DLDS.CR.M1.GG.Z1
## 2756       DP.DOD.DLDS.CR.M1.NF.Z1
## 2761       DP.DOD.DLDS.CR.MV.BC.Z1
## 2764       DP.DOD.DLDS.CR.MV.CG.Z1
## 2767       DP.DOD.DLDS.CR.MV.FC.Z1
## 2770       DP.DOD.DLDS.CR.MV.GG.Z1
## 2773       DP.DOD.DLDS.CR.MV.NF.Z1
## 2778          DP.DOD.DLDS.CR.NF.Z1
## 2783          DP.DOD.DLIN.CR.BC.Z1
## 2786          DP.DOD.DLIN.CR.CG.Z1
## 2789          DP.DOD.DLIN.CR.FC.Z1
## 2792          DP.DOD.DLIN.CR.GG.Z1
## 2795       DP.DOD.DLIN.CR.L1.BC.Z1
## 2798       DP.DOD.DLIN.CR.L1.CG.Z1
## 2801       DP.DOD.DLIN.CR.L1.FC.Z1
## 2804       DP.DOD.DLIN.CR.L1.GG.Z1
## 2807       DP.DOD.DLIN.CR.L1.NF.Z1
## 2812       DP.DOD.DLIN.CR.M1.BC.Z1
## 2815       DP.DOD.DLIN.CR.M1.CG.Z1
## 2818       DP.DOD.DLIN.CR.M1.FC.Z1
## 2821       DP.DOD.DLIN.CR.M1.GG.Z1
## 2824       DP.DOD.DLIN.CR.M1.NF.Z1
## 2829          DP.DOD.DLIN.CR.NF.Z1
## 2834          DP.DOD.DLLO.CR.BC.Z1
## 2837          DP.DOD.DLLO.CR.CG.Z1
## 2840          DP.DOD.DLLO.CR.FC.Z1
## 2843          DP.DOD.DLLO.CR.GG.Z1
## 2846       DP.DOD.DLLO.CR.L1.BC.Z1
## 2849       DP.DOD.DLLO.CR.L1.CG.Z1
## 2852       DP.DOD.DLLO.CR.L1.FC.Z1
## 2855       DP.DOD.DLLO.CR.L1.GG.Z1
## 2858       DP.DOD.DLLO.CR.L1.NF.Z1
```

```
## 2863      DP.DOD.DLLO.CR.M1.BC.Z1
## 2866      DP.DOD.DLLO.CR.M1.CG.Z1
## 2869      DP.DOD.DLLO.CR.M1.FC.Z1
## 2872      DP.DOD.DLLO.CR.M1.GG.Z1
## 2875      DP.DOD.DLLO.CR.M1.NF.Z1
## 2880         DP.DOD.DLLO.CR.NF.Z1
## 2885         DP.DOD.DLOA.CR.BC.Z1
## 2888         DP.DOD.DLOA.CR.CG.Z1
## 2891         DP.DOD.DLOA.CR.FC.Z1
## 2894         DP.DOD.DLOA.CR.GG.Z1
## 2897      DP.DOD.DLOA.CR.L1.BC.Z1
## 2900      DP.DOD.DLOA.CR.L1.CG.Z1
## 2903      DP.DOD.DLOA.CR.L1.FC.Z1
## 2906      DP.DOD.DLOA.CR.L1.GG.Z1
## 2909      DP.DOD.DLOA.CR.L1.NF.Z1
## 2914      DP.DOD.DLOA.CR.M1.BC.Z1
## 2917      DP.DOD.DLOA.CR.M1.CG.Z1
## 2920      DP.DOD.DLOA.CR.M1.FC.Z1
## 2923      DP.DOD.DLOA.CR.M1.GG.Z1
## 2926      DP.DOD.DLOA.CR.M1.NF.Z1
## 2931         DP.DOD.DLOA.CR.NF.Z1
## 2936         DP.DOD.DLSD.CR.BC.Z1
## 2939         DP.DOD.DLSD.CR.CG.Z1
## 2942         DP.DOD.DLSD.CR.FC.Z1
## 2945         DP.DOD.DLSD.CR.GG.Z1
## 2948      DP.DOD.DLSD.CR.M1.BC.Z1
## 2951      DP.DOD.DLSD.CR.M1.CG.Z1
## 2954      DP.DOD.DLSD.CR.M1.FC.Z1
## 2957      DP.DOD.DLSD.CR.M1.GG.Z1
## 2960      DP.DOD.DLSD.CR.M1.NF.Z1
## 2965         DP.DOD.DLSD.CR.NF.Z1
## 2970         DP.DOD.DLTC.CR.BC.Z1
## 2973         DP.DOD.DLTC.CR.CG.Z1
## 2976         DP.DOD.DLTC.CR.FC.Z1
## 2979         DP.DOD.DLTC.CR.GG.Z1
## 2982      DP.DOD.DLTC.CR.L1.BC.Z1
## 2985      DP.DOD.DLTC.CR.L1.CG.Z1
## 2988      DP.DOD.DLTC.CR.L1.FC.Z1
## 2991      DP.DOD.DLTC.CR.L1.GG.Z1
## 2994      DP.DOD.DLTC.CR.L1.NF.Z1
## 2999      DP.DOD.DLTC.CR.M1.BC.Z1
## 3002      DP.DOD.DLTC.CR.M1.CG.Z1
## 3005      DP.DOD.DLTC.CR.M1.FC.Z1
## 3008      DP.DOD.DLTC.CR.M1.GG.Z1
## 3011      DP.DOD.DLTC.CR.M1.NF.Z1
## 3016         DP.DOD.DLTC.CR.NF.Z1
## 3022         DP.DOD.DSCD.CR.BC.Z1
## 3025         DP.DOD.DSCD.CR.CG.Z1
## 3028         DP.DOD.DSCD.CR.FC.Z1
## 3031         DP.DOD.DSCD.CR.GG.Z1
## 3034         DP.DOD.DSCD.CR.NF.Z1
## 3039         DP.DOD.DSDS.CR.BC.Z1
## 3042         DP.DOD.DSDS.CR.CG.Z1
## 3045         DP.DOD.DSDS.CR.FC.Z1
```

```
## 3048          DP.DOD.DSDS.CR.GG.Z1
## 3051          DP.DOD.DSDS.CR.NF.Z1
## 3056          DP.DOD.DSIN.CR.BC.Z1
## 3059          DP.DOD.DSIN.CR.CG.Z1
## 3062          DP.DOD.DSIN.CR.FC.Z1
## 3065          DP.DOD.DSIN.CR.GG.Z1
## 3068          DP.DOD.DSIN.CR.NF.Z1
## 3073          DP.DOD.DSLO.CR.BC.Z1
## 3076          DP.DOD.DSLO.CR.CG.Z1
## 3079          DP.DOD.DSLO.CR.FC.Z1
## 3082          DP.DOD.DSLO.CR.GG.Z1
## 3085          DP.DOD.DSLO.CR.NF.Z1
## 3090          DP.DOD.DSOA.CR.BC.Z1
## 3093          DP.DOD.DSOA.CR.CG.Z1
## 3096          DP.DOD.DSOA.CR.FC.Z1
## 3099          DP.DOD.DSOA.CR.GG.Z1
## 3102          DP.DOD.DSOA.CR.NF.Z1
## 3107          DP.DOD.DSTC.CR.BC.Z1
## 3110          DP.DOD.DSTC.CR.CG.Z1
## 3113          DP.DOD.DSTC.CR.FC.Z1
## 3116          DP.DOD.DSTC.CR.GG.Z1
## 3119          DP.DOD.DSTC.CR.NF.Z1
## 3615             DT.DOD.ALLC.ZSG
## 3618             DT.DOD.ALLN.ZSG
## 3773          DT.DOD.DECT.CD.ZSG
## 5376           DT.ODA.ALLD.GD.ZS
## 5447             DT.ODA.DACD.ZSG
## 5452             DT.ODA.MULT.ZSG
## 5460             DT.ODA.NDAC.ZSG
## 5466           DT.ODA.ODAT.GD.ZS
## 5616           DT.TDS.DECT.GD.ZS
## 5969           EG.EGY.PRIM.PP.KD
## 5993           EG.GDP.PUSE.KO.87
## 5994           EG.GDP.PUSE.KO.KD
## 5995           EG.GDP.PUSE.KO.PP
## 5996        EG.GDP.PUSE.KO.PP.KD
## 6004        EG.USE.COMM.GD.PP.KD
## 6023             EN.ATM.CO2E.GDP
## 6027        EN.ATM.CO2E.KD.87.GD
## 6028           EN.ATM.CO2E.KD.GD
## 6033           EN.ATM.CO2E.PP.GD
## 6034        EN.ATM.CO2E.PP.GD.KD
## 6164           ER.GDP.FWTL.M3.KD
## 6182             EU.EGY.USES.GDP
## 6236           FB.DPT.INSU.PC.ZS
## 6589           FD.AST.PRVT.GD.ZS
## 6595           FI.RES.TOTL.CD.ZS
## 7389           FM.AST.GOVT.CN.ZS
## 7398           FM.AST.PRVT.GD.ZS
## 7407           FM.LBL.BMNY.GD.ZS
## 7414           FM.LBL.MQMY.GD.ZS
## 7415          FM.LBL.MQMY.GDP.ZS
## 7417              FM.LBL.MQMY.XD
## 7422          FM.LBL.QMNY.GDP.ZS
```

```
## 7423            FM.LBL.SEIG.GDP.ZS
## 7462            FS.AST.CGOV.GD.ZS
## 7463            FS.AST.DOMO.GD.ZS
## 7464            FS.AST.DOMS.GD.ZS
## 7465               FS.AST.DTOT.ZS
## 7467            FS.AST.PRVT.GD.ZS
## 7468           FS.AST.PRVT.GDP.ZS
## 7469            FS.LBL.LIQU.GD.ZS
## 7470           FS.LBL.LIQU.GDP.ZS
## 7471            FS.LBL.QLIQ.GD.ZS
## 7530            GB.BAL.OVRL.GD.ZS
## 7531           GB.BAL.OVRL.GDP.ZS
## 7540            GB.DOD.TOTL.GD.ZS
## 7541           GB.DOD.TOTL.GDP.ZS
## 7545            GB.FIN.ABRD.GD.ZS
## 7546           GB.FIN.ABRD.GDP.ZS
## 7550            GB.FIN.DOMS.GD.ZS
## 7551           GB.FIN.DOMS.GDP.ZS
## 7561            GB.REV.CTOT.GD.ZS
## 7564           GB.REV.TOTL.GDP.ZS
## 7566            GB.REV.XAGT.CN.ZS
## 7569            GB.RVC.TOTL.GD.ZS
## 7571               GB.SOE.DECT.ZS
## 7573            GB.SOE.ECON.GD.ZS
## 7574           GB.SOE.ECON.GDP.ZS
## 7577            GB.SOE.NFLW.GD.ZS
## 7578           GB.SOE.NFLW.GDP.ZS
## 7579            GB.SOE.OVRL.GD.ZS
## 7605            GB.TAX.TOTL.GD.ZS
## 7606           GB.TAX.TOTL.GDP.ZS
## 7624           GB.XPD.DEFN.GDP.ZS
## 7627            GB.XPD.RSDV.GD.ZS
## 7630            GB.XPD.TOTL.GD.ZS
## 7631           GB.XPD.TOTL.GDP.ZS
## 7638            GC.AST.TOTL.GD.ZS
## 7641            GC.BAL.CASH.GD.ZS
## 7646            GC.DOD.TOTL.GD.ZS
## 7650            GC.FIN.DOMS.GD.ZS
## 7652            GC.FIN.FRGN.GD.ZS
## 7654            GC.LBL.TOTL.GD.ZS
## 7656            GC.NFN.TOTL.GD.ZS
## 7658            GC.NLD.TOTL.GD.ZS
## 7669            GC.REV.XGRT.GD.ZS
## 7684            GC.TAX.TOTL.GD.ZS
## 7701            GC.XPN.TOTL.GD.ZS
## 7792                   GFDD.DI.01
## 7793                   GFDD.DI.02
## 7794                   GFDD.DI.03
## 7796                   GFDD.DI.05
## 7797                   GFDD.DI.06
## 7798                   GFDD.DI.07
## 7799                   GFDD.DI.08
## 7800                   GFDD.DI.09
## 7801                   GFDD.DI.10
```

```
## 7802                   GFDD.DI.11
## 7803                   GFDD.DI.12
## 7804                   GFDD.DI.13
## 7805                   GFDD.DI.14
## 7806                   GFDD.DM.01
## 7807                   GFDD.DM.02
## 7808                   GFDD.DM.03
## 7809                   GFDD.DM.04
## 7810                   GFDD.DM.05
## 7811                   GFDD.DM.06
## 7812                   GFDD.DM.07
## 7813                   GFDD.DM.08
## 7814                   GFDD.DM.09
## 7815                   GFDD.DM.10
## 7816                   GFDD.DM.11
## 7817                   GFDD.DM.12
## 7818                   GFDD.DM.13
## 7821                   GFDD.DM.16
## 7822                   GFDD.DM.16
## 7830                   GFDD.EI.08
## 7837                   GFDD.OI.02
## 7843                   GFDD.OI.08
## 7844                   GFDD.OI.09
## 7848                   GFDD.OI.13
## 7849                   GFDD.OI.14
## 7854                   GFDD.OI.17
## 7855                   GFDD.OI.18
## 8686              IE.ICT.TOTL.GD.ZS
## 8959            IS.RRS.GOOD.KM.PP.ZS
## 8961            IS.RRS.PASG.K2.PP.ZS
## 9068              IT.TEL.REVN.GD.ZS
## 10943             MS.MIL.XPND.GD.ZS
## 10948     NA.GDP.ACC.FB.SNA08.CR
## 10949     NA.GDP.ACC.FB.SNA08.KR
## 10950               NA.GDP.AGR.CR
## 10951               NA.GDP.AGR.KR
## 10952         NA.GDP.AGR.SNA08.CR
## 10953         NA.GDP.AGR.SNA08.KR
## 10954         NA.GDP.BUSS.SNA08.CR
## 10955         NA.GDP.BUSS.SNA08.KR
## 10956              NA.GDP.CNST.CR
## 10957              NA.GDP.CNST.KR
## 10958         NA.GDP.CNST.SNA08.CR
## 10959         NA.GDP.CNST.SNA08.KR
## 10960         NA.GDP.EDUS.SNA08.CR
## 10961         NA.GDP.EDUS.SNA08.KR
## 10962    NA.GDP.ELEC.GAS.SNA08.CR
## 10963    NA.GDP.ELEC.GAS.SNA08.KR
## 10964             NA.GDP.EXC.OG.CR
## 10965             NA.GDP.EXC.OG.KR
## 10966              NA.GDP.FINS.CR
## 10967              NA.GDP.FINS.KR
## 10968         NA.GDP.FINS.SNA08.CR
## 10969         NA.GDP.FINS.SNA08.KR
```

```
## 10970       NA.GDP.HLTH.SOCW.SNA08.CR
## 10971       NA.GDP.HLTH.SOCW.SNA08.KR
## 10972                  NA.GDP.INC.OG.CR
## 10973                  NA.GDP.INC.OG.KR
## 10974          NA.GDP.INC.OG.SNA08.CR
## 10975          NA.GDP.INC.OG.SNA08.KR
## 10976       NA.GDP.INF.COMM.SNA08.CR
## 10977       NA.GDP.INF.COMM.SNA08.KR
## 10978                    NA.GDP.MINQ.CR
## 10979                    NA.GDP.MINQ.KR
## 10980            NA.GDP.MINQ.SNA08.CR
## 10981            NA.GDP.MINQ.SNA08.KR
## 10982                     NA.GDP.MNF.CR
## 10983                     NA.GDP.MNF.KR
## 10984             NA.GDP.MNF.SNA08.CR
## 10985             NA.GDP.MNF.SNA08.KR
## 10986       NA.GDP.PADM.DEF.SNA08.CR
## 10987       NA.GDP.PADM.DEF.SNA08.KR
## 10988           NA.GDP.REST.SNA08.CR
## 10989           NA.GDP.REST.SNA08.KR
## 10990            NA.GDP.SRV.OTHR.CR
## 10991            NA.GDP.SRV.OTHR.KR
## 10992       NA.GDP.SRV.OTHR.SNA08.CR
## 10993       NA.GDP.SRV.OTHR.SNA08.KR
## 10994            NA.GDP.TRAN.COMM.CR
## 10995            NA.GDP.TRAN.COMM.KR
## 10996   NA.GDP.TRAN.STOR.SNA08.CR
## 10997   NA.GDP.TRAN.STOR.SNA08.KR
## 10998              NA.GDP.TRD.HTL.CR
## 10999              NA.GDP.TRD.HTL.KR
## 11000            NA.GDP.TRD.SNA08.CR
## 11001            NA.GDP.TRD.SNA08.KR
## 11002                    NA.GDP.UTL.CR
## 11003                    NA.GDP.UTL.KR
## 11004       NA.GDP.WTR.WST.SNA08.CR
## 11005       NA.GDP.WTR.WST.SNA08.KR
## 11014                   NE.CON.GOVT.ZS
## 11025                   NE.CON.PETC.ZS
## 11042                   NE.CON.PRVT.ZS
## 11052                   NE.CON.TETC.ZS
## 11060                   NE.CON.TOTL.ZG
## 11061                   NE.CON.TOTL.ZS
## 11071                   NE.DAB.TOTL.ZS
## 11083                   NE.EXP.GNFS.ZS
## 11085             NE.GDI.CON.GOVT.CR
## 11086   NE.GDI.CON.GOVT.SNA08.CR
## 11087              NE.GDI.CON.NPI.CR
## 11088      NE.GDI.CON.NPI.SNA08.CR
## 11089            NE.GDI.CON.PRVT.CR
## 11090   NE.GDI.CON.PRVT.SNA08.CR
## 11091                 NE.GDI.EXPT.CR
## 11092         NE.GDI.EXPT.SNA08.CR
## 11117                   NE.GDI.FPRV.ZS
## 11122                   NE.GDI.FPUB.ZS
```

```
## 11125            NE.GDI.FTOT.CR
## 11132      NE.GDI.FTOT.SNA08.CR
## 11133            NE.GDI.FTOT.ZS
## 11134            NE.GDI.IMPT.CR
## 11135      NE.GDI.IMPT.SNA08.CR
## 11136      NE.GDI.INEX.SNA08.CR
## 11141            NE.GDI.STKB.CR
## 11145      NE.GDI.STKB.SNA08.CR
## 11154            NE.GDI.TOTL.CR
## 11161      NE.GDI.TOTL.SNA08.CR
## 11162            NE.GDI.TOTL.ZG
## 11163            NE.GDI.TOTL.ZS
## 11173            NE.IMP.GNFS.ZS
## 11174            NE.MRCH.GDP.ZS
## 11180            NE.RSB.GNFS.ZG
## 11181            NE.RSB.GNFS.ZS
## 11184            NE.TRD.GNFS.ZS
## 11191            NP.AGR.TOTL.ZG
## 11195            NP.IND.TOTL.ZG
## 11201            NP.SRV.TOTL.ZG
## 11209         NV.AGR.PCAP.KD.ZG
## 11219            NV.AGR.TOTL.ZG
## 11220            NV.AGR.TOTL.ZS
## 11240            NV.IND.MANF.ZS
## 11254            NV.IND.TOTL.ZG
## 11255            NV.IND.TOTL.ZS
## 11273            NV.SRV.DISC.CD
## 11274            NV.SRV.DISC.CN
## 11275            NV.SRV.DISC.KN
## 11292            NV.SRV.TETC.ZG
## 11293            NV.SRV.TETC.ZS
## 11299            NV.SRV.TOTL.ZS
## 11388         NY.AGR.SUBS.GD.ZS
## 11392         NY.GDP.COAL.RT.ZS
## 11393         NY.GDP.DEFL.87.ZG
## 11394         NY.GDP.DEFL.KD.ZG
## 11395      NY.GDP.DEFL.KD.ZG.AD
## 11396            NY.GDP.DEFL.ZS
## 11397         NY.GDP.DEFL.ZS.87
## 11398         NY.GDP.DEFL.ZS.AD
## 11399            NY.GDP.DISC.CD
## 11400            NY.GDP.DISC.CN
## 11401            NY.GDP.DISC.KN
## 11405         NY.GDP.FCST.KD.87
## 11407         NY.GDP.FCST.KN.87
## 11408         NY.GDP.FRST.RT.ZS
## 11409         NY.GDP.MINR.RT.ZS
## 11410            NY.GDP.MKTP.CD
## 11411         NY.GDP.MKTP.CD.XD
## 11412            NY.GDP.MKTP.CN
## 11413         NY.GDP.MKTP.CN.AD
## 11414         NY.GDP.MKTP.CN.XD
## 11415            NY.GDP.MKTP.IN
## 11416            NY.GDP.MKTP.KD
```

```
## 11417           NY.GDP.MKTP.KD.87
## 11418           NY.GDP.MKTP.KD.ZG
## 11419               NY.GDP.MKTP.KN
## 11420           NY.GDP.MKTP.KN.87
## 11421        NY.GDP.MKTP.KN.87.ZG
## 11422           NY.GDP.MKTP.PP.CD
## 11423           NY.GDP.MKTP.PP.KD
## 11424        NY.GDP.MKTP.PP.KD.87
## 11425               NY.GDP.MKTP.XD
## 11426              NY.GDP.MKTP.XU.E
## 11428            NY.GDP.NGAS.RT.ZS
## 11429               NY.GDP.PCAP.CD
## 11430               NY.GDP.PCAP.CN
## 11431               NY.GDP.PCAP.KD
## 11432            NY.GDP.PCAP.KD.ZG
## 11433               NY.GDP.PCAP.KN
## 11434           NY.GDP.PCAP.PP.CD
## 11435           NY.GDP.PCAP.PP.KD
## 11436        NY.GDP.PCAP.PP.KD.87
## 11437        NY.GDP.PCAP.PP.KD.ZG
## 11438            NY.GDP.PETR.RT.ZS
## 11439            NY.GDP.TOTL.RT.ZS
## 11452               NY.GDS.TOTL.ZS
## 11457            NY.GEN.AEDU.GD.ZS
## 11458            NY.GEN.DCO2.GD.ZS
## 11459            NY.GEN.DFOR.GD.ZS
## 11460            NY.GEN.DKAP.GD.ZS
## 11461            NY.GEN.DMIN.GD.ZS
## 11462            NY.GEN.DNGY.GD.ZS
## 11463            NY.GEN.NDOM.GD.ZS
## 11464            NY.GEN.SVNG.GD.ZS
## 11497               NY.GNS.ICTR.ZS
## 11535                  NYGDPMKTPKDZ
## 11536                NYGDPMKTPSACD
## 11537                NYGDPMKTPSACN
## 11538                NYGDPMKTPSAKD
## 11539                NYGDPMKTPSAKN
## 11564                   PA.NUS.PPP
## 11565                PA.NUS.PPP.05
## 11566               PA.NUS.PPPC.RF
## 15599               SE.PRM.SATT.2
## 15663               SE.PRM.TATT.1
## 15890               SE.XPD.EDUC.ZS
## 15895           SE.XPD.PRIM.GDP.ZS
## 15896            SE.XPD.PRIM.PC.ZS
## 15899           SE.XPD.SECO.GDP.ZS
## 15900            SE.XPD.SECO.PC.ZS
## 15904           SE.XPD.TERT.GDP.ZS
## 15905            SE.XPD.TERT.PC.ZS
## 15908            SE.XPD.TOTL.GD.ZS
## 15928            SF.TRN.RAIL.KM.ZS
## 16886            SH.XPD.CHEX.GD.ZS
## 16895            SH.XPD.GHED.GD.ZS
## 16899               SH.XPD.HLTH.ZS
```

```
## 16900          SH.XPD.KHEX.GD.ZS
## 16912           SH.XPD.PRIV.ZS
## 16915           SH.XPD.PUBL.ZS
## 16921           SH.XPD.TOTL.ZS
## 17073         SL.GDP.PCAP.EM.KD
## 17074      SL.GDP.PCAP.EM.KD.ZG
## 17075         SL.GDP.PCAP.EM.XD
## 17833       TG.VAL.TOTL.GD.PP.ZS
## 17834         TG.VAL.TOTL.GD.ZS
## 17835         TG.VAL.TOTL.GG.ZS
## 20066           UIS.XGDP.0.FSGOV
## 20067           UIS.XGDP.1.FSGOV
## 20068           UIS.XGDP.2.FSGOV
## 20069          UIS.XGDP.23.FSGOV
## 20070       UIS.XGDP.2T4.V.FSGOV
## 20071           UIS.XGDP.3.FSGOV
## 20072           UIS.XGDP.4.FSGOV
## 20073          UIS.XGDP.56.FSGOV
## 20123 UIS.XUNIT.GDPCAP.02.FSGOV
## 20124  UIS.XUNIT.GDPCAP.1.FSGOV
## 20125   UIS.XUNIT.GDPCAP.1.FSHH
## 20126  UIS.XUNIT.GDPCAP.2.FSGOV
## 20127 UIS.XUNIT.GDPCAP.23.FSGOV
## 20128  UIS.XUNIT.GDPCAP.23.FSHH
## 20129  UIS.XUNIT.GDPCAP.3.FSGOV
## 20130 UIS.XUNIT.GDPCAP.5T8.FSGOV
## 20131  UIS.XUNIT.GDPCAP.5T8.FSHH
##
## 712
## 714
## 715
## 716
## 717
## 1557
## 1558
## 1559
## 1560
## 1561
## 1752
## 1772
## 1784
## 1785
## 1798
## 1799
## 1802
## 1805
## 1811
## 1820
## 1822
## 1828
## 1839
## 1875
## 1887
## 1889
```

```
## 1898
## 1904
## 1905
## 2198
## 2270                                                             Macro drivers o
## 2271                                                                        Mac
## 2293                                                      Annual investment need
## 2294                                         Annual investment needs for coas
## 2295                                                    Annual investment need
## 2356
## 2357
## 2364
## 2401
## 2404
## 2407
## 2559                              Gross PSD, Budgetary Central Gov., Al
## 2562                                       Gross PSD, Central Gov., Al
## 2565                              Gross PSD, Financial Public Corp., Al
## 2568                                       Gross PSD, General Gov., Al
## 2571                           Gross PSD, Nonfinancial Public Corp., Al
## 2576                             Gross PSD, Budgetary Central Gov.,
## 2579                                        Gross PSD, Central Gov.,
## 2582                               Gross PSD, Financial Public Corp.,
## 2585                                         Gross PSD, General Gov.,
## 2588                            Gross PSD, Nonfinancial Public Corp.,
## 2593                             Gross PSD, Budgetary Central Gov., A
## 2596                                        Gross PSD, Central Gov., A
## 2599                               Gross PSD, Financial Public Corp., A
## 2602                                         Gross PSD, General Gov., A
## 2605                            Gross PSD, Nonfinancial Public Corp., A
## 2610                                            Gross PSD, Budge
## 2613                                                     Gross I
## 2616                                        Gross PSD, Finand
## 2619                                                     Gross I
## 2622                                    Gross PSD, Nonfinand
## 2627                              Gross PSD, Budgetary Central Gov., Al
## 2630                                       Gross PSD, Central Gov., Al
## 2633                              Gross PSD, Financial Public Corp., Al
## 2636                                       Gross PSD, General Gov., Al
## 2639                           Gross PSD, Nonfinancial Public Corp., Al
## 2644                                          Gross PSD, Budgetary Co
## 2647                                                   Gross PSD, Co
## 2650                                        Gross PSD, Financial Pu
## 2653                                                   Gross PSD, Ge
## 2656                Gross PSD, Budgetary Central Gov., Long-term, With payme
## 2659                         Gross PSD, Central Gov., Long-term, With payme
## 2662                Gross PSD, Financial Public Corp., Long-term, With payme
## 2665                         Gross PSD, General Gov., Long-term, With payme
## 2668              Gross PSD, Nonfinancial Public Corp., Long-term, With payme
## 2673                Gross PSD, Budgetary Central Gov., Long-term, With payment
## 2676                         Gross PSD, Central Gov., Long-term, With payment
## 2679                Gross PSD, Financial Public Corp., Long-term, With payment
## 2682                         Gross PSD, General Gov., Long-term, With payment
## 2685              Gross PSD, Nonfinancial Public Corp., Long-term, With payment
```

23

```
## 2690                                                                     Gross PSD, Nonfinancial Pu
## 2694                                                              Gross PSD, Central
## 2696                                                              Gross PSD, General
## 2698                                            Gross PSD, Central Gov.-D2
## 2700                                            Gross PSD, General Gov.-D2
## 2702                                                    Gross PSD, Central Gov
## 2704                                                    Gross PSD, General Gov
## 2706                                                         Gross PSD, Central (
## 2708                                                         Gross PSD, General (
## 2710                                 Gross PSD, Central Gov.-D4, All maturities, D3
## 2712                                 Gross PSD, General Gov.-D4, All maturities, D3
## 2715                                                         Gross PSD, Budge
## 2718                                                                  Gross
## 2721                                                         Gross PSD, Finan
## 2724                                                                  Gross
## 2727                    Gross PSD, Budgetary Central Gov., Long-term, Wit
## 2730                           Gross PSD, Central Gov., Long-term, Wit
## 2733                    Gross PSD, Financial Public Corp., Long-term, Wit
## 2736                           Gross PSD, General Gov., Long-term, Wit
## 2739                 Gross PSD, Nonfinancial Public Corp., Long-term, Wit
## 2744                    Gross PSD, Budgetary Central Gov., Long-term, With
## 2747                           Gross PSD, Central Gov., Long-term, With
## 2750                    Gross PSD, Financial Public Corp., Long-term, With
## 2753                           Gross PSD, General Gov., Long-term, With
## 2756                 Gross PSD, Nonfinancial Public Corp., Long-term, With
## 2761                                                         Gross PSD, Budge
## 2764                                                                 Gross
## 2767                                                         Gross PSD, Finan
## 2770                                                                 Gross
## 2773                                                     Gross PSD, Nonfinan
## 2778                                                     Gross PSD, Nonfinanc
## 2783                    Gross PSD, Budgetary Central Gov., All maturities, Insura
## 2786                           Gross PSD, Central Gov., All maturities, Insura
## 2789                    Gross PSD, Financial Public Corp., All maturities, Insura
## 2792                           Gross PSD, General Gov., All maturities, Insura
## 2795        Gross PSD, Budgetary Central Gov., Long-term, With payment due in one year or less, Insura
## 2798               Gross PSD, Central Gov., Long-term, With payment due in one year or less, Insura
## 2801        Gross PSD, Financial Public Corp., Long-term, With payment due in one year or less, Insura
## 2804               Gross PSD, General Gov., Long-term, With payment due in one year or less, Insura
## 2807     Gross PSD, Nonfinancial Public Corp., Long-term, With payment due in one year or less, Insura
## 2812      Gross PSD, Budgetary Central Gov., Long-term, With payment due in more than one year, Insura
## 2815               Gross PSD, Central Gov., Long-term, With payment due in more than one year, Insura
## 2818      Gross PSD, Financial Public Corp., Long-term, With payment due in more than one year, Insura
## 2821               Gross PSD, General Gov., Long-term, With payment due in more than one year, Insura
## 2824    Gross PSD, Nonfinancial Public Corp., Long-term, With payment due in more than one year, Insura
## 2829                             Gross PSD, Nonfinancial Public Corp., All maturities, Insura
## 2834                                                                  Gross
## 2837
## 2840                                                                  Gross
## 2843
## 2846                                       Gross PSD, Budgetary Central Gov., Long-
## 2849                                              Gross PSD, Central Gov., Long-
## 2852                                       Gross PSD, Financial Public Corp., Long-
## 2855                                              Gross PSD, General Gov., Long-
```

24

```
## 2858                                            Gross PSD, Nonfinancial Public Corp., Long-
## 2863                                              Gross PSD, Budgetary Central Gov., Long-to
## 2866                                                      Gross PSD, Central Gov., Long-to
## 2869                                            Gross PSD, Financial Public Corp., Long-to
## 2872                                                      Gross PSD, General Gov., Long-to
## 2875                                            Gross PSD, Nonfinancial Public Corp., Long-to
## 2880                                                                      Gross PSD
## 2885                                                      Gross PSD, Budgetary Cen
## 2888                                                              Gross PSD, Cen
## 2891                                                      Gross PSD, Financial Pul
## 2894                                                              Gross PSD, Gen
## 2897              Gross PSD, Budgetary Central Gov., Long-term, With paymen
## 2900                      Gross PSD, Central Gov., Long-term, With paymen
## 2903              Gross PSD, Financial Public Corp., Long-term, With paymen
## 2906                      Gross PSD, General Gov., Long-term, With paymen
## 2909           Gross PSD, Nonfinancial Public Corp., Long-term, With paymen
## 2914           Gross PSD, Budgetary Central Gov., Long-term, With payment
## 2917                      Gross PSD, Central Gov., Long-term, With payment
## 2920           Gross PSD, Financial Public Corp., Long-term, With payment
## 2923                      Gross PSD, General Gov., Long-term, With payment
## 2926           Gross PSD, Nonfinancial Public Corp., Long-term, With payment
## 2931                                            Gross PSD, Nonfinancial Pul
## 2936                                                      Gross PSD, Budgetary Cen
## 2939                                                              Gross PSD, Cen
## 2942                                                      Gross PSD, Financial Pul
## 2945                                                              Gross PSD, Gen
## 2948           Gross PSD, Budgetary Central Gov., Long-term, With payment
## 2951                      Gross PSD, Central Gov., Long-term, With payment
## 2954           Gross PSD, Financial Public Corp., Long-term, With payment
## 2957                      Gross PSD, General Gov., Long-term, With payment
## 2960           Gross PSD, Nonfinancial Public Corp., Long-term, With payment
## 2965                                            Gross PSD, Nonfinancial Pul
## 2970                                                      Gross PSD, I
## 2973                                                              G:
## 2976                                                      Gross PSD, I
## 2979                                                              G:
## 2982                      Gross PSD, Budgetary Central Gov., Long-term, Witl
## 2985                              Gross PSD, Central Gov., Long-term, Witl
## 2988                      Gross PSD, Financial Public Corp., Long-term, Witl
## 2991                              Gross PSD, General Gov., Long-term, Witl
## 2994           Gross PSD, Nonfinancial Public Corp., Long-term, Witl
## 2999              Gross PSD, Budgetary Central Gov., Long-term, With p
## 3002                      Gross PSD, Central Gov., Long-term, With p
## 3005              Gross PSD, Financial Public Corp., Long-term, With p
## 3008                      Gross PSD, General Gov., Long-term, With p
## 3011           Gross PSD, Nonfinancial Public Corp., Long-term, With p
## 3016                                            Gross PSD, Non
## 3022                                              Gross PSD, Budgetar
## 3025                                                      Gross PSI
## 3028                                              Gross PSD, Financia
## 3031                                                      Gross PSI
## 3034                                              Gross PSD, Nonfinancia
## 3039                                                      Gross PSD, Bu
## 3042                                                              Gro
```

```
## 3045                                                                                           Gross PSD, F
## 3048                                                                                                    Gr
## 3051                                                                                           Gross PSD, Nonf
## 3056                                     Gross PSD, Budgetary Central Gov., Short-term, Insura
## 3059                                              Gross PSD, Central Gov., Short-term, Insura
## 3062                                     Gross PSD, Financial Public Corp., Short-term, Insura
## 3065                                              Gross PSD, General Gov., Short-term, Insura
## 3068                                  Gross PSD, Nonfinancial Public Corp., Short-term, Insura
## 3073                                                                                                    Gr
## 3076
## 3079                                                                                                    Gr
## 3082
## 3085                                                                                           Gross
## 3090                                                                              Gross PSD, Budgetary
## 3093                                                                                       Gross PSD
## 3096                                                                              Gross PSD, Financial
## 3099                                                                                       Gross PSD
## 3102                                                                           Gross PSD, Nonfinancial
## 3107                                                                               Gross PSD, Bu
## 3110                                                                                        Gr
## 3113                                                                               Gross PSD, F
## 3116                                                                                        Gr
## 3119                                                                            Gross PSD, Nonf
## 3615
## 3618
## 3773
## 5376
## 5447
## 5452
## 5460
## 5466
## 5616
## 5969
## 5993
## 5994
## 5995
## 5996
## 6004
## 6023
## 6027
## 6028
## 6033
## 6034
## 6164                                                                         Water productivity, t
## 6182
## 6236
## 6589
## 6595
## 7389
## 7398
## 7407
## 7414
## 7415
## 7417
```

```
## 7422
## 7423
## 7462
## 7463
## 7464
## 7465
## 7467
## 7468
## 7469
## 7470
## 7471
## 7530
## 7531
## 7540
## 7541
## 7545
## 7546
## 7550
## 7551
## 7561
## 7564
## 7566
## 7569
## 7571
## 7573
## 7574
## 7577
## 7578
## 7579
## 7605
## 7606
## 7624
## 7627
## 7630
## 7631
## 7638
## 7641
## 7646
## 7650
## 7652
## 7654
## 7656
## 7658
## 7669
## 7684
## 7701
## 7792
## 7793
## 7794
## 7796
## 7797
## 7798
## 7799
## 7800
```

```
## 7801
## 7802
## 7803                                                                                    Private
## 7804
## 7805
## 7806
## 7807
## 7808
## 7809
## 7810
## 7811
## 7812
## 7813
## 7814
## 7815
## 7816
## 7817
## 7818
## 7821
## 7822
## 7830
## 7837
## 7843
## 7844
## 7848
## 7849
## 7854
## 7855
## 8686
## 8959
## 8961
## 9068
## 10943
## 10948                                              GDP on Accommodation
## 10949                                              GDP on Accommodation &
## 10950
## 10951
## 10952                                              GDP on Agricult
## 10953                                              GDP on Agricultu
## 10954
## 10955
## 10956
## 10957
## 10958
## 10959
## 10960
## 10961                                                              G
## 10962                                                      GDP on
## 10963                                                      GDP on
## 10964
## 10965
## 10966
## 10967
## 10968                                              GDP on Finan
```

28

```
## 10969                                                                                   GDP on Finan
## 10970                                                                               GDP on Human Heal
## 10971                                                                               GDP on Human Heal
## 10972
## 10973
## 10974
## 10975
## 10976                                                                                    GDP on In
## 10977                                                                                GDP on In
## 10978
## 10979
## 10980
## 10981                                                                                             (
## 10982
## 10983
## 10984                                                                                         GDP
## 10985                                                                                      GDP
## 10986                                      GDP on Public Administration, Defense & (
## 10987                                   GDP on Public Administration, Defense & Co
## 10988
## 10989
## 10990
## 10991
## 10992
## 10993
## 10994                                                                                    GDP on
## 10995                                                                                 GDP on Ti
## 10996                                                                                GDP on
## 10997                                                                             GDP on
## 10998
## 10999
## 11000                         GDP on Wholesales & Retail Trade, Repair of Mot
## 11001                        GDP on Wholesales & Retail Trade, Repair of Mot
## 11002
## 11003
## 11004                                   GDP on Water Supply, Sewerage, Wa
## 11005                                  GDP on Water Supply, Sewerage, Wast
## 11014
## 11025
## 11042
## 11052
## 11060
## 11061
## 11071
## 11083
## 11085
## 11086                                                                  GDP expenditure
## 11087                                                                              GDP
## 11088                                             GDP expenditure on non profi
## 11089
## 11090                                                                       GDP e
## 11091
## 11092
## 11117
```

29

```
## 11122
## 11125
## 11132                                                                          GDP expenditure
## 11133
## 11134
## 11135
## 11136                                                                     GDP expend
## 11141
## 11145                                                                GD
## 11154
## 11161
## 11162
## 11163
## 11173
## 11174
## 11180
## 11181
## 11184
## 11191
## 11195
## 11201
## 11209
## 11219
## 11220
## 11240
## 11254
## 11255
## 11273
## 11274
## 11275
## 11292
## 11293
## 11299
## 11388
## 11392
## 11393
## 11394
## 11395
## 11396
## 11397
## 11398
## 11399
## 11400
## 11401
## 11405
## 11407
## 11408
## 11409
## 11410
## 11411
## 11412
## 11413
## 11414
## 11415
```

```
## 11416
## 11417
## 11418
## 11419
## 11420
## 11421
## 11422
## 11423
## 11424
## 11425
## 11426
## 11428
## 11429
## 11430
## 11431
## 11432
## 11433
## 11434
## 11435
## 11436
## 11437
## 11438
## 11439
## 11452
## 11457
## 11458
## 11459
## 11460
## 11461
## 11462
## 11463
## 11464
## 11497
## 11535                                                            Annual percent
## 11536
## 11537
## 11538
## 11539
## 11564
## 11565
## 11566
## 15599
## 15663                                                            (De Jure)
## 15890
## 15895
## 15896
## 15899
## 15900
## 15904
## 15905
## 15908
## 15928
## 16886
## 16895
```

```
## 16899
## 16900
## 16912
## 16915
## 16921
## 17073
## 17074
## 17075
## 17833
## 17834
## 17835
## 20066
## 20067
## 20068                                                                    Gov
## 20069
## 20070                                      Government expenditure on sec
## 20071                                                                    Gove
## 20072                                                                    Gove
## 20073
## 20123                                                      Initial go
## 20124                                                         Initia
## 20125                                                           Init
## 20126                                             Initial gover
## 20127                                               Initial
## 20128                                                  Initial
## 20129                                          Initial govern
## 20130                                                   Initial
## 20131                                                  Initia
```

```r
WDIsearch(string = "NY.GDP.MKTP.PP.KD", field = "indicator", short = FALSE)
```

```
##                  indicator                                      name
## 11423     NY.GDP.MKTP.PP.KD GDP, PPP (constant 2017 international $)
## 11424 NY.GDP.MKTP.PP.KD.87 GDP, PPP (constant 1987 international $)
##
## 11423 PPP GDP is gross domestic product converted to international dollars using purchasing power par
## 11424
##                      sourceDatabase
## 11423 World Development Indicators
## 11424       WDI Database Archives
##
## 11423 International Comparison Program, World Bank | World Development Indicators database, World Ban
## 11424
```

Assignment

1. Find at least one WDI indicator with its name and its code.

2. Find at least one pair of WDI indicators with their names and their codes you want to study their relation.

GDP and GDP per Capita

1. GDP, PPP (constant 2017 international $): NY.GDP.MKTP.PP.KD

2. Population, total: SP.POP.TOTL
```

3. Calculate GDP per Capita

- GDP per capita, PPP (constant 2017 international $): NY.GDP.PCAP.PP.KD

- GDP, PPP (constant 2017 international $) PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP is the sum of gross value added by all resident producers in the country plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2017 international dollars. ID: NY.GDP.MKTP.PP.KD

- Population, total Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The values shown are midyear estimates. ID: SP.POP.TOTL

```
df_gdppcap <- WDI(indicator = c(gdp = "NY.GDP.MKTP.PP.KD", pop = "SP.POP.TOTL", gdppcap = "NY.GDP.PCAP.P
```

```
write_csv(df_gdppcap, "data/gdppcap.csv")
```

```
df_gdppcap <- read_csv("data/gdppcap.csv")
```

```
## Rows: 16758 Columns: 15
## -- Column specification -----------------------------------------------------
## Delimiter: ","
## chr  (7): country, iso2c, iso3c, region, capital, income, lending
## dbl  (6): year, gdp, pop, gdppcap, longitude, latitude
## lgl  (1): status
## date (1): lastupdated
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
str(df_gdppcap)
```

```
## spc_tbl_ [16,758 x 15] (S3: spec_tbl_df/tbl_df/tbl/data.frame)
##  $ country    : chr [1:16758] "Afghanistan" "Afghanistan" "Afghanistan" "Afghanistan" ...
##  $ iso2c      : chr [1:16758] "AF" "AF" "AF" "AF" ...
##  $ iso3c      : chr [1:16758] "AFG" "AFG" "AFG" "AFG" ...
##  $ year       : num [1:16758] 2014 2012 2009 2013 1971 ...
##  $ status     : logi [1:16758] NA NA NA NA NA NA ...
##  $ lastupdated: Date[1:16758], format: "2023-09-19" "2023-09-19" ...
##  $ gdp        : num [1:16758] 7.02e+10 6.47e+10 4.99e+10 6.83e+10 NA ...
##  $ pop        : num [1:16758] 32716210 30466479 27385307 31541209 11015857 ...
##  $ gdppcap    : num [1:16758] 2144 2123 1824 2165 NA ...
##  $ region     : chr [1:16758] "South Asia" "South Asia" "South Asia" "South Asia" ...
##  $ capital    : chr [1:16758] "Kabul" "Kabul" "Kabul" "Kabul" ...
##  $ longitude  : num [1:16758] 69.2 69.2 69.2 69.2 69.2 ...
##  $ latitude   : num [1:16758] 34.5 34.5 34.5 34.5 34.5 ...
##  $ income     : chr [1:16758] "Low income" "Low income" "Low income" "Low income" ...
##  $ lending    : chr [1:16758] "IDA" "IDA" "IDA" "IDA" ...
##  - attr(*, "spec")=
##   .. cols(
##   ..   country = col_character(),
##   ..   iso2c = col_character(),
##   ..   iso3c = col_character(),
##   ..   year = col_double(),
```

```
##    ..    status = col_logical(),
##    ..    lastupdated = col_date(format = ""),
##    ..    gdp = col_double(),
##    ..    pop = col_double(),
##    ..    gdppcap = col_double(),
##    ..    region = col_character(),
##    ..    capital = col_character(),
##    ..    longitude = col_double(),
##    ..    latitude = col_double(),
##    ..    income = col_character(),
##    ..    lending = col_character()
##    .. )
##  - attr(*, "problems")=<externalptr>
```

```r
df_gdppcap |> select(region, income, lending) |> lapply(unique)
```

```
## $region
## [1] "South Asia"              "Aggregates"
## [3] "Europe & Central Asia"   "Middle East & North Africa"
## [5] "East Asia & Pacific"     "Sub-Saharan Africa"
## [7] "Latin America & Caribbean"  "North America"
## [9] NA
##
## $income
## [1] "Low income"          "Aggregates"          "Upper middle income"
## [4] "Lower middle income" "High income"         NA
## [7] "Not classified"
##
## $lending
## [1] "IDA"           "Aggregates"     "IBRD"          "Not classified"
## [5] "Blend"         NA
```

```r
COUNTRY <- "World"
df_gdppcap |> filter(country == COUNTRY) |>
  ggplot(aes(year, gdppcap)) + geom_line()
```

```
## Warning: Removed 30 rows containing missing values (`geom_line()`).
```
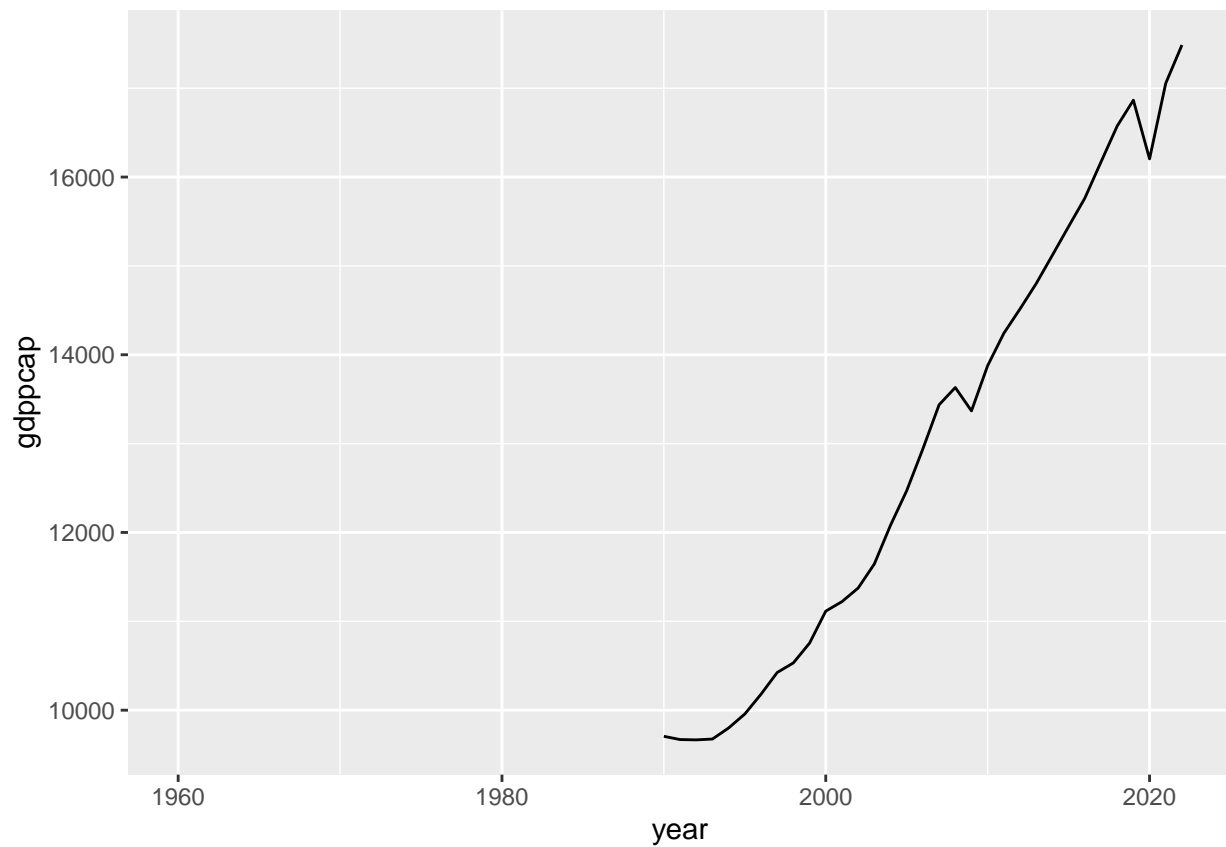
```
COUNTRY <- "World"
df_gdppcap |> filter(country == COUNTRY) |>
  ggplot(aes(year, pop)) + geom_line()
```
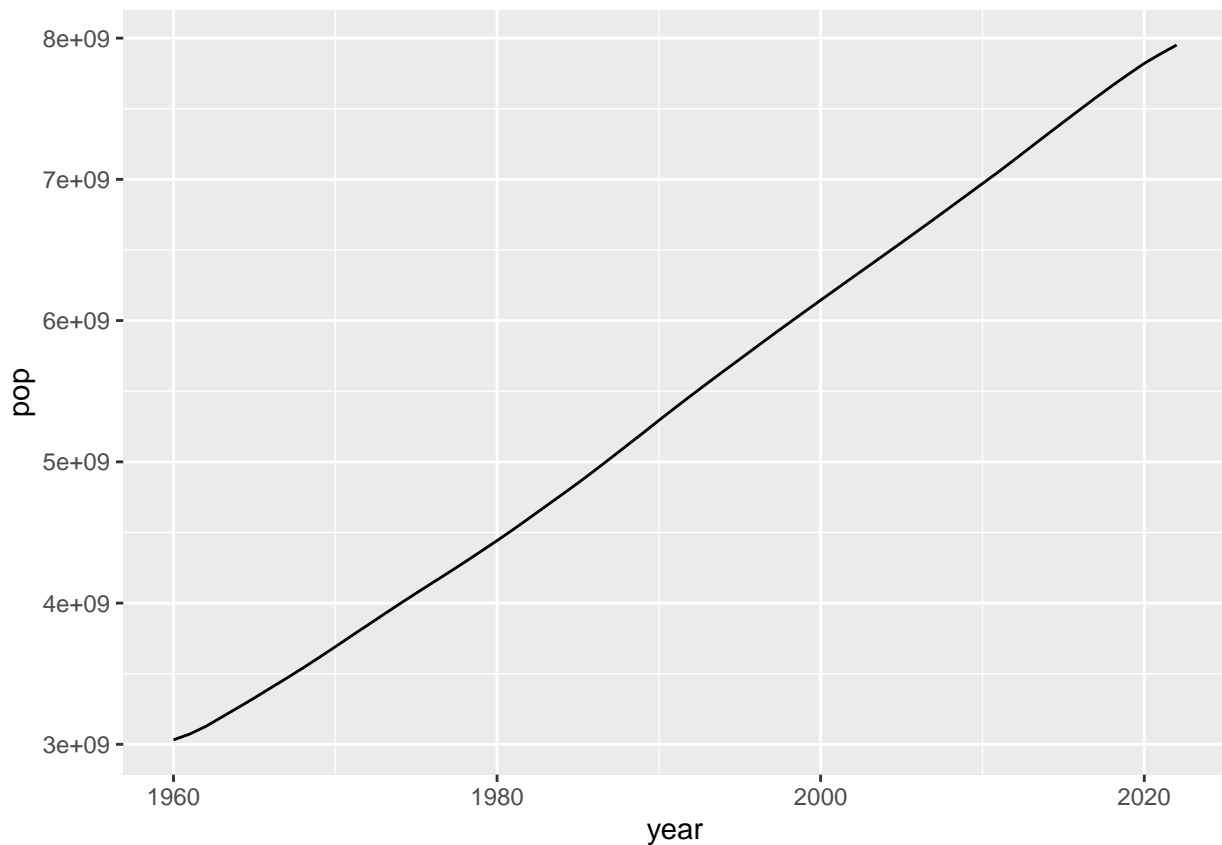
Exercise. Write your observations and questions.

GDP Per Capita

```
df_gdppcap2 <- df_gdppcap |> drop_na(pop) |>
  mutate(PCAP = gdp/pop, .after = gdppcap)
```

```
df_gdppcap2
```

```
## # A tibble: 16,665 x 16
##    country    iso2c iso3c  year status lastupdated      gdp     pop gdppcap  PCAP
##    <chr>      <chr> <chr> <dbl> <lgl>  <date>         <dbl>   <dbl>   <dbl> <dbl>
##  1 Afghanist~ AF    AFG    2014 NA     2023-09-19  7.02e10 3.27e7    2144. 2144.
##  2 Afghanist~ AF    AFG    2012 NA     2023-09-19  6.47e10 3.05e7    2123. 2123.
##  3 Afghanist~ AF    AFG    2009 NA     2023-09-19  4.99e10 2.74e7    1824. 1824.
##  4 Afghanist~ AF    AFG    2013 NA     2023-09-19  6.83e10 3.15e7    2165. 2165.
##  5 Afghanist~ AF    AFG    1971 NA     2023-09-19  NA      1.10e7      NA    NA
##  6 Afghanist~ AF    AFG    2015 NA     2023-09-19  7.12e10 3.38e7    2109. 2109.
##  7 Afghanist~ AF    AFG    1969 NA     2023-09-19  NA      1.05e7      NA    NA
##  8 Afghanist~ AF    AFG    2010 NA     2023-09-19  5.71e10 2.82e7    2026. 2026.
##  9 Afghanist~ AF    AFG    2011 NA     2023-09-19  5.74e10 2.92e7    1961. 1961.
## 10 Afghanist~ AF    AFG    2008 NA     2023-09-19  4.11e10 2.64e7    1557. 1557.
## # i 16,655 more rows
## # i 6 more variables: region <chr>, capital <chr>, longitude <dbl>,
## #   latitude <dbl>, income <chr>, lending <chr>
```

36

```r
df_gdppcap2 |> drop_na(gdppcap, PCAP) |> mutate(near = near(gdppcap, PCAP)) |>
  summarize(numberofdata = n(), sum(near))
```

```r
df_gdppcap2 |> filter(!near(gdppcap, PCAP))
```

Check against GDP per capita, PPP

```
## # A tibble: 198 x 16
##    country iso2c iso3c  year status lastupdated       gdp     pop gdppcap    PCAP
##    <chr>   <chr> <chr> <dbl> <lgl>  <date>          <dbl>   <dbl>   <dbl>   <dbl>
##  1 Cyprus  CY    CYP    2009 NA     2023-09-19    3.11e10 1.11e6  38536.  28028.
##  2 Cyprus  CY    CYP    2010 NA     2023-09-19    3.18e10 1.13e6  38399.  28193.
##  3 Cyprus  CY    CYP    2005 NA     2023-09-19    2.79e10 1.04e6  37723.  26865.
##  4 Cyprus  CY    CYP    2006 NA     2023-09-19    2.92e10 1.06e6  38848.  27641.
##  5 Cyprus  CY    CYP    2007 NA     2023-09-19    3.07e10 1.07e6  39968.  28552.
##  6 Cyprus  CY    CYP    2008 NA     2023-09-19    3.18e10 1.09e6  40399.  29091.
##  7 Cyprus  CY    CYP    2004 NA     2023-09-19    2.66e10 1.02e6  36499.  26083.
##  8 Cyprus  CY    CYP    1991 NA     2023-09-19    1.47e10 7.99e5  24770.  18447.
##  9 Cyprus  CY    CYP    1992 NA     2023-09-19    1.61e10 8.10e5  26387.  19898.
## 10 Cyprus  CY    CYP    1993 NA     2023-09-19    1.62e10 8.26e5  25937.  19660.
## # i 188 more rows
## # i 6 more variables: region <chr>, capital <chr>, longitude <dbl>,
## #   latitude <dbl>, income <chr>, lending <chr>
```

Exercise. Write your observations and questions.

Visualization

Two useful questions.

1. What type of **variation** occurs **within** my variables?

2. What type of **covariation** occurs **between** my variables?

See Link.

Ranks. `arrange(desc(gdp))` is to reorder in descending order of `gdp`, `arrange(gdp)` in ascending order.

```r
df_gdppcap |> filter(year == 2022, region != "Aggregates") |>
  drop_na(gdp) |> arrange(desc(gdp))
```

```
## # A tibble: 183 x 15
##    country    iso2c iso3c  year status lastupdated      gdp     pop gdppcap region
##    <chr>      <chr> <chr> <dbl> <lgl>  <date>         <dbl>   <dbl>   <dbl> <chr>
##  1 China      CN    CHN    2022 NA     2023-09-19   2.57e13 1.41e9  18188. East ~
##  2 United St~ US    USA    2022 NA     2023-09-19   2.16e13 3.33e8  64703. North~
##  3 India      IN    IND    2022 NA     2023-09-19   1.01e13 1.42e9   7096. South~
##  4 Japan      JP    JPN    2022 NA     2023-09-19   5.21e12 1.25e8  41641. East ~
##  5 Germany    DE    DEU    2022 NA     2023-09-19   4.50e12 8.41e7  53560. Europ~
##  6 Russian F~ RU    RUS    2022 NA     2023-09-19   4.03e12 1.44e8  27584. Europ~
##  7 Indonesia  ID    IDN    2022 NA     2023-09-19   3.42e12 2.76e8  12410. East ~
##  8 Brazil     BR    BRA    2022 NA     2023-09-19   3.25e12 2.15e8  15093. Latin~
##  9 United Ki~ GB    GBR    2022 NA     2023-09-19   3.14e12 6.70e7  46831. Europ~
## 10 France     FR    FRA    2022 NA     2023-09-19   3.13e12 6.79e7  46020. Europ~
## # i 173 more rows
```

```
## # i 5 more variables: capital <chr>, longitude <dbl>, latitude <dbl>,
## #   income <chr>, lending <chr>
```

Exercises.

1. Find the top 10 of the countries with the highest GDP per capita.

2. Find the top 10 of the countries with the lowest GDP per capita.

3. Find the top 10 of the countries with the largest population.

4. Find the top 10 of the countries with the smallest population.

Scatter Plot   What type of **covariation** occurs **between** my variables?

```
df_gdppcap2 |> filter(year == 2022, region !="Aggregates") |>
  drop_na(gdp, pop) |>
  ggplot(aes(pop, gdp)) + geom_point()
```



```
df_gdppcap2 |> filter(year == 2022, region !="Aggregates") |>
  drop_na(gdp, pop) |>
  ggplot(aes(pop, gdp)) + geom_point() +
  scale_x_log10() + scale_y_log10()
```
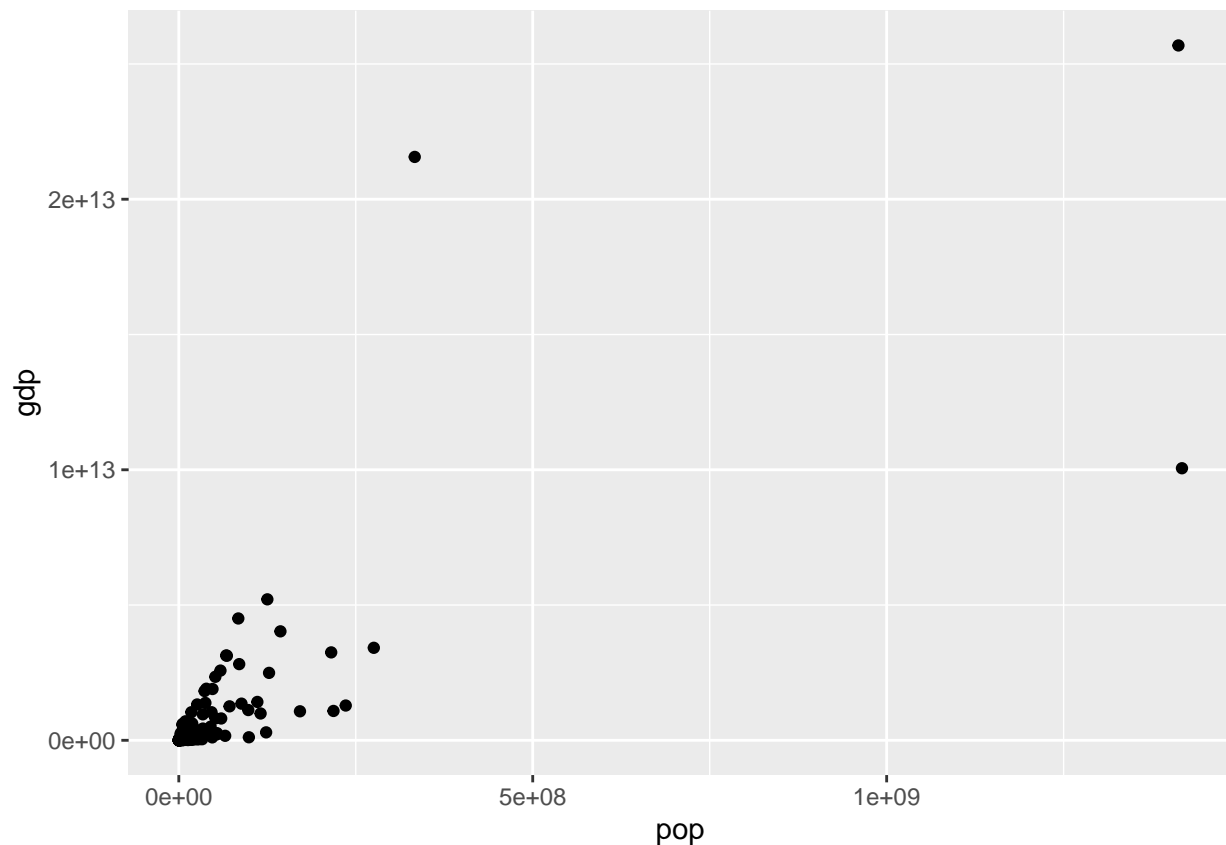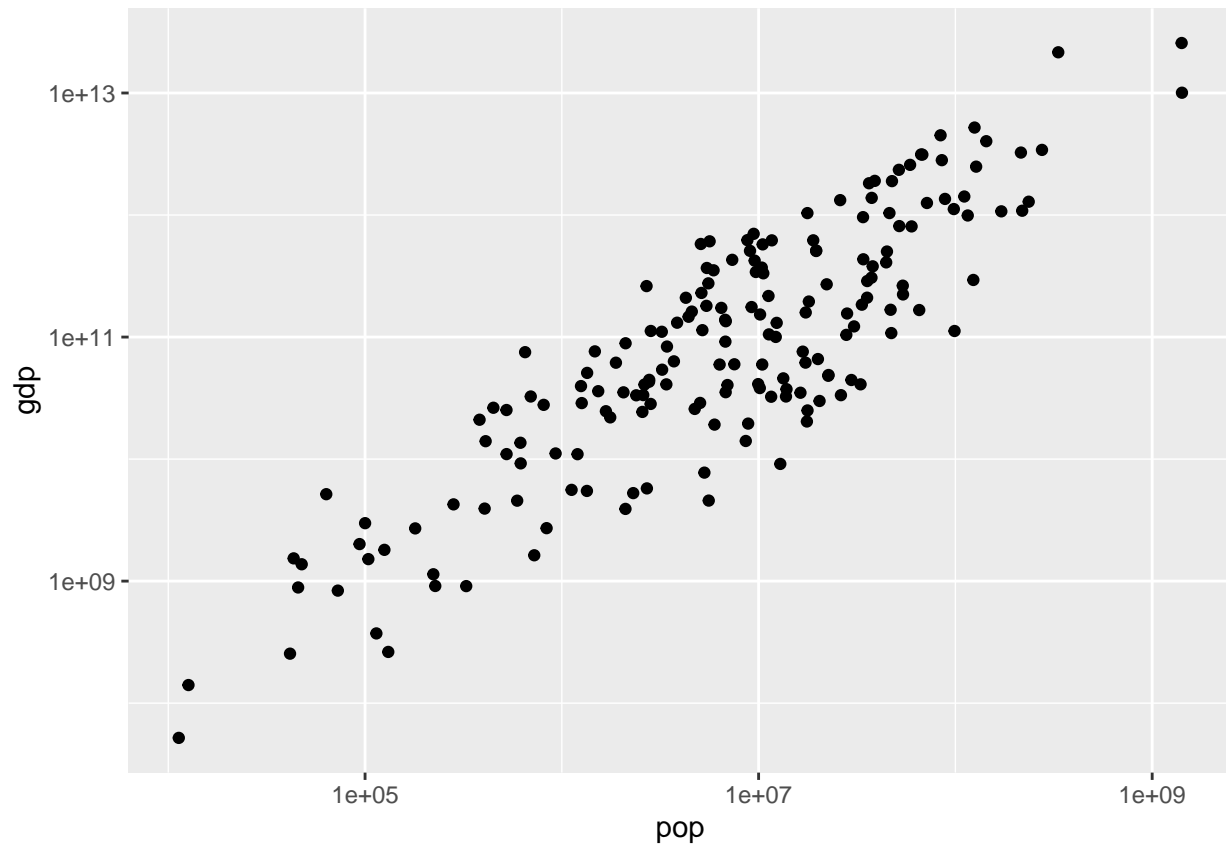
```
df_gdppcap2 |> filter(year == 2022, region !="Aggregates") |>
  drop_na(gdp, pop) |>
  ggplot(aes(pop, gdp)) + geom_point() +
  geom_smooth(method = "lm", se = FALSE) +
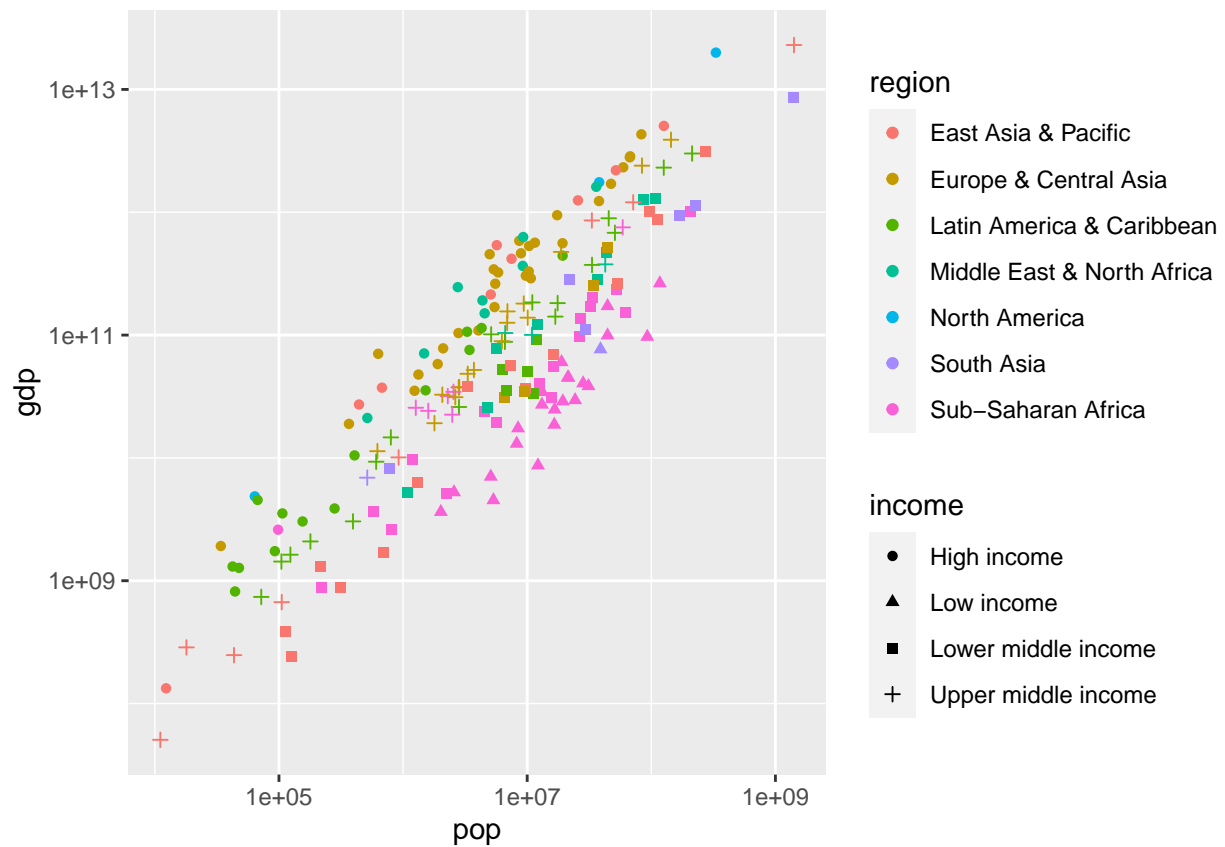  scale_x_log10() + scale_y_log10()
```

```
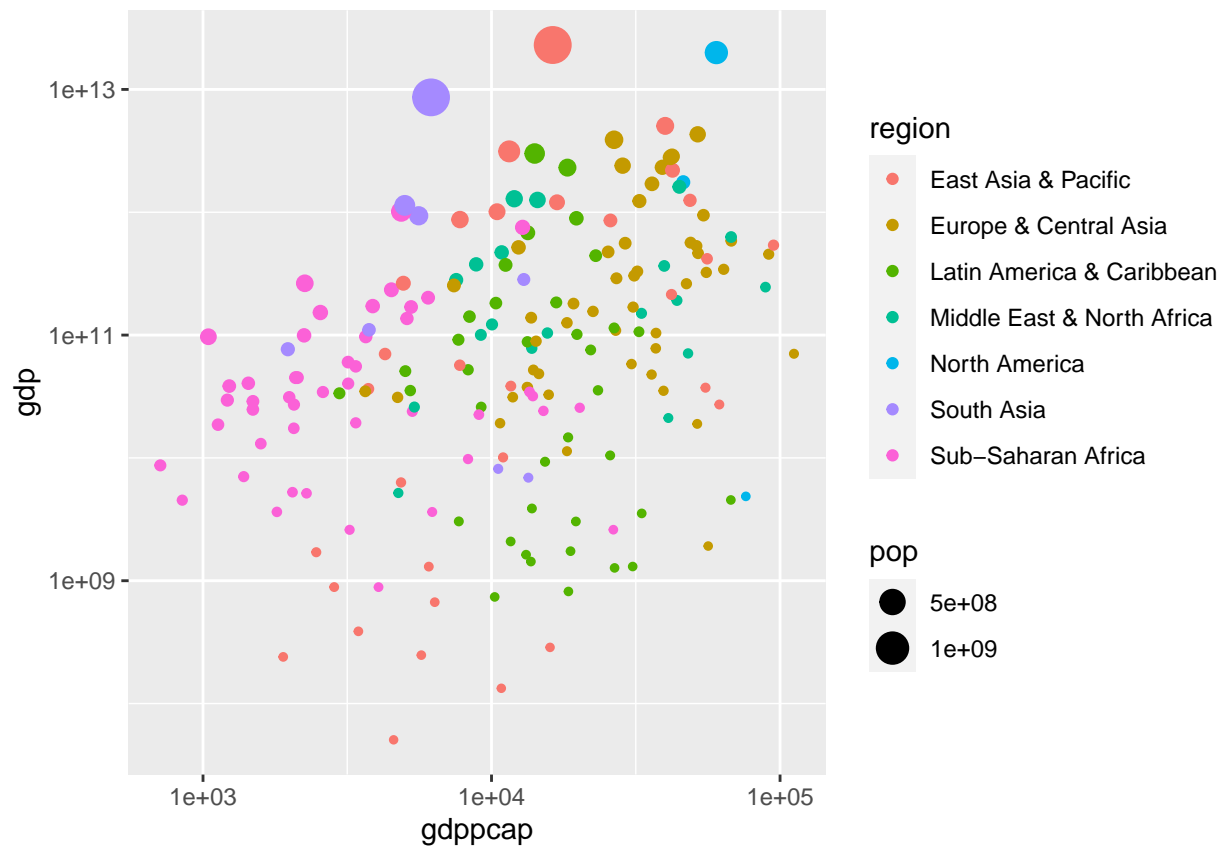## `geom_smooth()` using formula = 'y ~ x'
```
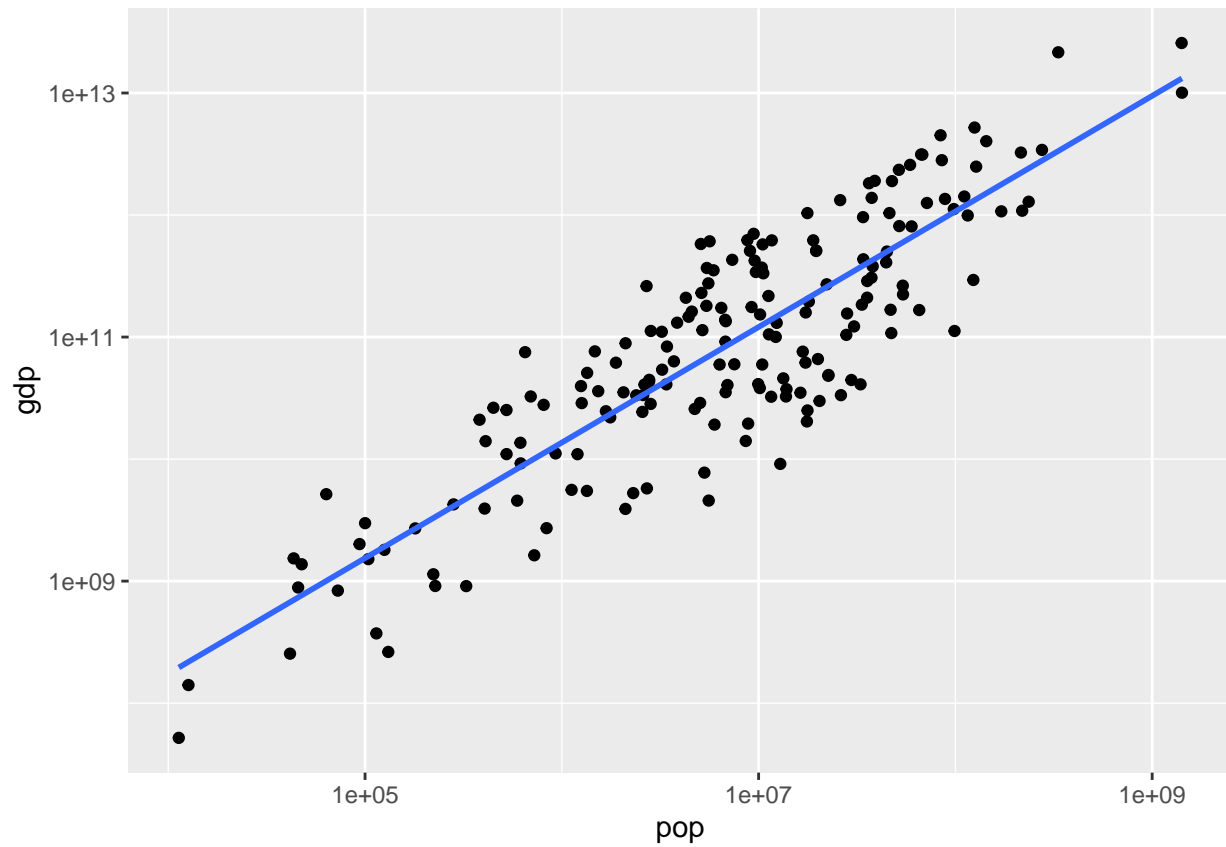
```
df_gdppcap2 |> filter(year == 2020, region !="Aggregates") |> drop_na(gdp, pop) |>
  ggplot(aes(pop, gdp, color = region)) + geom_point() +
  scale_x_log10() + scale_y_log10()
```
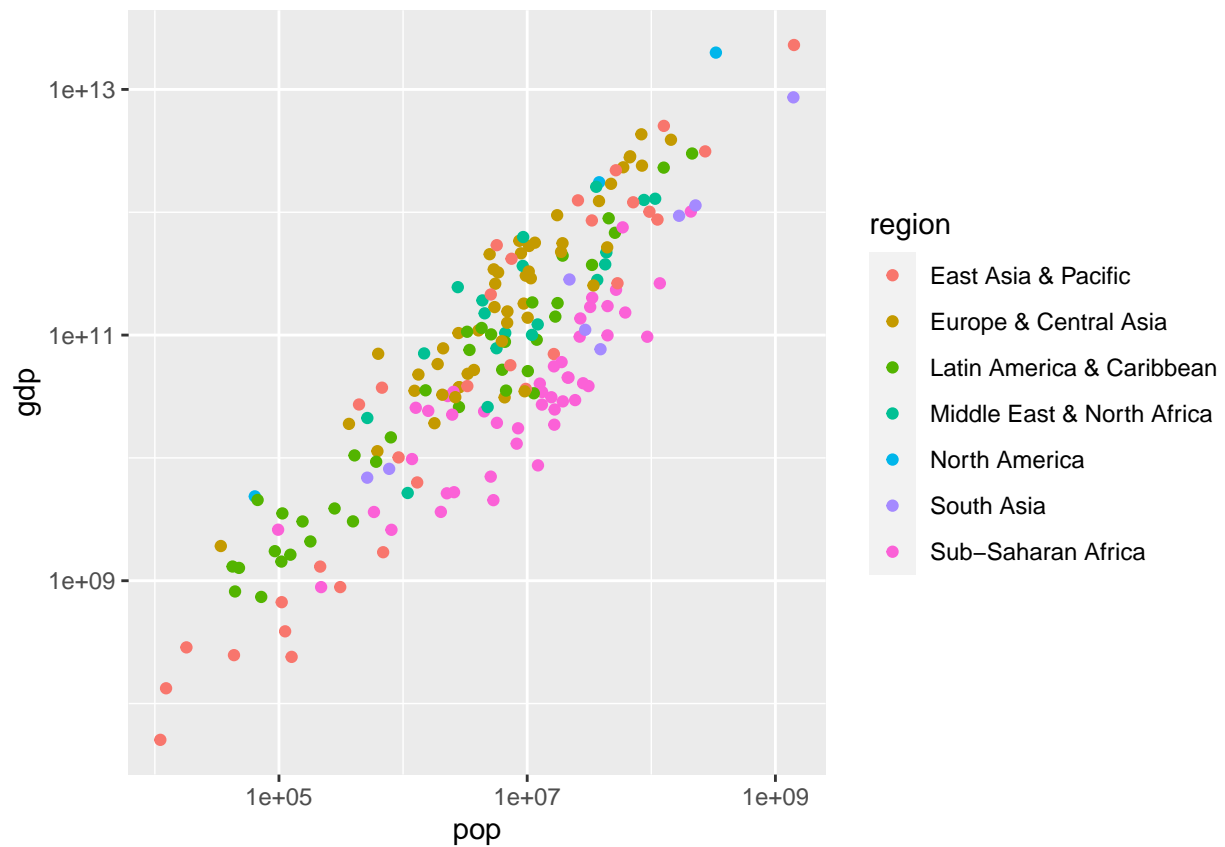
```
df_gdppcap2 |> filter(year == 2020, region !="Aggregates") |>
  drop_na(gdp, pop) |>
  ggplot(aes(pop, gdp, color = region, shape = income)) + geom_point() +
  scale_x_log10() + scale_y_log10()
```

```
df_gdppcap2 |> filter(year == 2020, region !="Aggregates") |>
  drop_na(gdp, gdppcap, pop) |>
  ggplot(aes(gdppcap, gdp, color = region, size = pop)) + geom_point() +
  scale_x_log10() + scale_y_log10()
```

```r
install.packages("plotly")
```

```r
library(plotly)
test <- df_gdppcap2 |> filter(year == 2020, region !="Aggregates") |> drop_na(gdp, pop) |>
  ggplot(aes(color = country, shape = region, pop, gdp)) + geom_point() +
  scale_x_log10() + scale_y_log10() + theme(legend.position = "none")
test |> ggplotly()
```